
PROCURING COMPLEX PRODUCTS AND SERVICES: AN ASSESSMENT OF ACQUISITION
LIFECYCLE STRATEGIES AND PRACTICES

by

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DECLARATION:

I hereby certify that this dissertation constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions or writings of another. I declare that the dissertation describes original work that has not previously been presented for the award of any other degree of any institution.

Abstract

This research examined the processes that define the acquisition lifecycles of organisations procuring major assets in complex environments. The research used a multiple case study approach within an abductive research design in order to explore the approaches taken towards solving the problem of effectively procuring within these complex contexts. High-profile, public and private organisations operating in the Defence, Nuclear, Local Government, Health, Manufacturing and Technology sectors are analysed over a four year period. The research utilised a novel means of cross-case examination based on the Zachman enterprise mapping technique in order to derive a comprehensive understanding of processes embedded in complex organisations' acquisition lifecycles.

The requirement for complex contracting for an increasingly diverse range of products and services continues to grow, particularly in the public sector where organisations heavily focus on their core competencies and procure a significant proportion of their requirements from the private sector. Thus this work seeks to address increasing calls for actionable insights from major UK institutions and the academic literature. Current work into the area has been described as 'provider-active'. This work seeks to redress this by focusing on generating insights from the procurer's perspective.

The research identified 18 categories of potential process difference amongst the cases of complex procurers. The research suggests that differences within these 18 categories explain the majority of functional differences emerging from the body of cases, and thus can act as a means by which organisations could benchmark against other organisations operating within a PCP (Procuring Complex Performance) domain. By considering differences in these categories the work highlights three major types of complex procurer: partially-enabled reactors, moderately-enabled conformers and fully-enabled architects. These three categories vary in their capacity to manage complex performance, the complexity of their environments as well as the perceived effectiveness of their current acquisition lifecycle practices. This classification forms a major theoretical contribution of the thesis.

The research has articulated the strategic positions taken toward procuring complex products and services within each case by identifying and analysing the processes embedded along the entirety of the acquisition lifecycle that are classified in the aforementioned categories. In doing so, the research provides both theoretical knowledge to the current academic literature, most notably PCP, as well as having provided actionable insights of benefit to procurement practitioners and policy makers.

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1 CHAPTER 1: INTRODUCTION

1.1 Introduction to the research

This research explores the acquisition lifecycle practice of procurers of complex products and services. The research approach is novel and utilises an abductive research design (*Dubois & Gadde 2001*) in the form of a qualitative multiple-case study investigation. Specifically, the research explores the processes along the acquisition lifecycle of six procurers of complex products and services in order to derive a thematic architecture for understanding the ‘what’ and ‘how’ of complex acquisition practice. The case set is compared and contrasted in order to derive a hierarchical thematic architecture that articulates ‘how’ organisations are addressing the challenges of procuring within long-term, relationally complex (*Hartmann et al, 2014*), often oligopolistic environments (*Caldwell & Howard 2014*). The case data is used to build theoretical insights into the varying composition of acquisition lifecycle practice and strategy within procurers of complex products and services. Institutional theory and agency theory are adopted in tandem and used as a means by which to interpret the motivations for the emergent differences and similarities between the cases (*Eisenhardt, 1989*).

The following research question and associated objectives were developed and drove the research summarised above:

Research Question: “How are organisations addressing the challenges of managing acquisition lifecycles in the context of procuring complex products and services?”

The challenges pertinent to the context of procuring complex products and services are described in detail within the literature review but concern the management of relationally complex organisations and supply chains with a context of high uncertainty, and long-term project and oligopolistic market pressures. Acquisition lifecycles refer to the sequence of processes beginning at project conception through to the ‘in-use’ after sales phase, through to the eventual contract termination.

Objectives:

- O1: “To propose a method for comprehending the strategic activities undertaken in an acquisition lifecycle.”

The research required the development of a method that would allow a broad consideration of processes along the acquisition lifecycle of each other organisations and a means of effectively discriminating between those processes, thus reducing the number of processes being considered. The capability to discriminate between meaningful and non-meaningful processes allows the research to compare relevant ‘strategically pertinent’ case characteristics during the cross-case analysis. Strategically pertinent processes are defined as those that align with a-priori areas of importance defined within the literature, and those processes that are divergent amongst the case set.

- O2: “To identify strategically significant acquisition lifecycles characteristics of organisations operating within the PCP domain.”

Through a process of thematic reduction the cross-case analysis is required to produce a set of themes that are able to describe the ‘what’ and ‘how’ of organisations procuring complex products and services. The purpose of this is to create a set of descriptors that can be applied to understand acquisition lifecycle practice across the set of cases.

- O3: “To identify the substantive differences in how case organisations approach complex procurement, so as to propose theory regarding the significant process patterns in complex procurement.”

The final objective is to apply the thematic framework derived in achieving the second objective in order to produce a classification of complex procurers from the case set. Demonstrating similarities and differences amongst the case set allows the researcher to theorise as to the reasons, and ultimately suggest a pathway to improve performance.

1.2 Contextualising the research

The realities of procurement in a contemporary context have, and continue to, change toward more interactive, longer-term arrangements exhibiting higher infrastructural and performance complexity with increased emphasis on servitized lifecycle components, particularly within areas of high complexity such as COPS (*Complex*

Product Systems) (Oliva & Kallenberg, 2003, Ren & Yeo, 2006; Lewis & Roehrich, 2009; Roehrich & Caldwell, 2014). This trend would seem to be correlated with the increasing reliance on outsourcing arrangements generally (Bowman, 2015), a trend particularly pertinent to large public bodies seeking to procure complex capabilities and services (Gash et al, 2013). These concurrent trends have led to bodies operating within this space to make calls to academia and research organisations to develop knowledge assets in order to address the challenges emerging from managing large scale, performance-influencing and infrastructural complex (Lewis & Roerich, 2009) procurement organisations (Grey, 2009, NHS, 2013).

The Literature review identified the area of Procuring Complex Performance (PCP) as a core domain of academic literature relevant to this work (Lewis and Roehrich 2009). The original research question was centred on the Ministry of Defence (MOD), and their acquisition lifecycle and thus, as has been the case with previous work into PCP, the defence case naturally led the researcher to exploring the PCP domain (Roehrich et al, 2014; Caldwell & Howard, 2014). In following Spring & Araujo (2014) this work softens the typical PCP assumptions about the empirical setting and extends the area of concern beyond the focused view of “high value capital goods” (Davies and Hobday, 2005, p. 4). The reason for this is to broaden the variety of practice that can be viewed in the empirical world. In using a broader definition of what a procurer of complex performance is, the work avoids the potential pitfall of expending energies reassuring a narrowly defined grouping of organisations that have already established a set of common, and well researched isomorphisms (Eisenhardt, 1989). Whilst a narrow definition of PCP is to be avoided, the chosen cases must still contain a high degree of infrastructural complexity and procurement complexity (Lewis and Roehrich 2009). This respects the position taken by Spring and Araujo (2014) that PCP organisations are defined by “*greater and radically altered dispersal of activities among supply network actors*” (Spring & Araujo 2014, p. 06). As well as the view of Howard and Caldwell (2010) whom observe that the established means of managing traditional procurement is not transferable into the context of managing the acquisition of complex products and services.

1.3 Research background

This PhD research was sponsored by the UK Ministry of Defence (MOD) under the control of ACDS LOGOPS (Assistant Chief of the Defence Staff – Logistics and

Operations) based at DE&S (Defence Equipment and Support Organisation) located at AbbeyWood Bristol. The wider stream of research, under which this PhD was a component, was undertaken in partnership with DSTL (Defence, Science and Technology laboratory and QinetiQ, a long-term private contractor to defence. The wider body of commissioned work sought to understand and work towards excellence within complex acquisition practice. A broad remit for the conditions of sponsorship was provided, with the researcher having been given the freedom to explore and enhance knowledge within the domain of complex products and service acquisition over a four year period. This thesis is accompanied by a summary industry-facing report that has been provided to MOD to address the sponsorship conditions.

1.4 Thesis Structure

The thesis structure is outlined below in Figure 1, along with a brief description of each of the chapters.

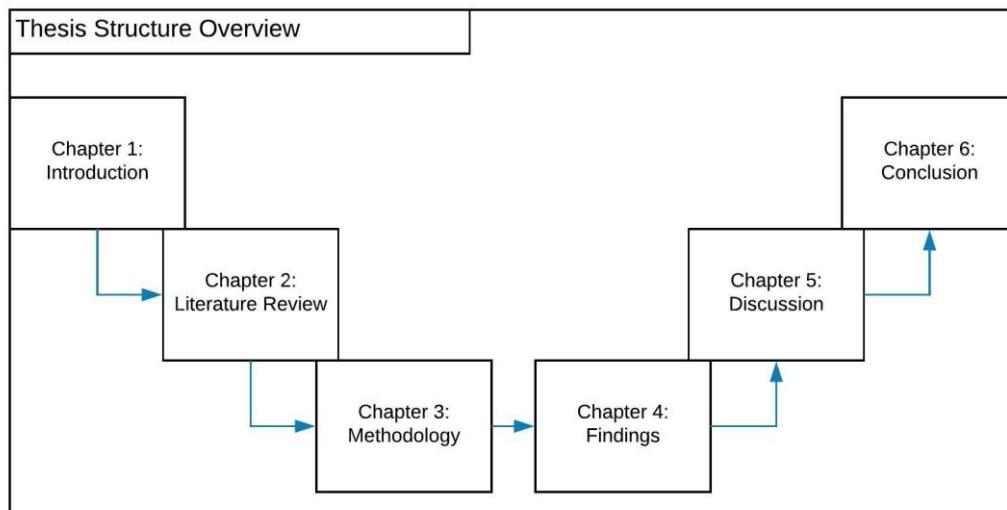


Figure 1-Thesis Structure Overview

1.4.1 Chapter One Introduction Overview

This chapter has laid out the research question and associated objectives, contextualised the research by providing a brief background detailing its origins and lastly providing an overview of the thesis structure.

1.4.2 Chapter Two: Literature Review Overview

The literature review is divided into two main sections. Firstly, a systematic review was undertaken in order to derive key thematic areas of interest pertinent to addressing the research question. This synthesis acutely articulates those authors and research topics, which were then used in order to carry out a detailed, narrative review in the second half of the literature review chapter. This latter half articulated the research gap, discussed each of the key areas in turn and concludes with relevant a-priori areas to be considered when understanding and assessing the procurement of complex products and services.

1.4.3 Chapter 3: Methodology Overview

The methodology chapter outlines the research strategy, justifying each of the key elements in sequence and discusses the underlying research philosophy. The chapter also outlines and justifies the use of an abductive research design, provides justification for the use of agency and institutional theory as the theoretical lenses for use in interpreting the results.

1.4.4 Chapter 4: Findings Overview

The findings chapter provides a comprehensive overview of the research's expansive data collection phase and then discusses each case in turn. The cases are introduced, data collection is revisited, the composition of the acquisition lifecycle is provided and the acquisition lifecycle maps are provided. Lastly, the characteristics emergent from the case are presented and described in detail.

1.4.5 Chapter 5: Cross-case Analysis and Discussion Overview

The discussion chapter firstly presented the cross-case analysis process in detail, showing how each of the emergent themes have been reduced from the set of case characteristics. The second half of the chapter discusses each of the key emergent themes, the implications of those themes and applies instructional and agency theory in interrogating the emergent results. Lastly, the core literature identified in chapter two is revisited, and the implications of those results to this body of literature is discussed in detail.

1.4.6 Chapter 6: Conclusion

The conclusion chapter follows on from the deductions presented in the discussion chapter. The research question and objectives are discussed in terms of how they have

been addressed, and what contribution the research has made in addressing these. Reflection on the research limitations and possibilities for future research are also provided

1.5 Chapter Summary

This chapter has introduced the research and the thesis contents by presenting the research question and objectives, by contextualising the research within the body of literature and by providing an overview of the research background. Lastly the chapter has provided an overview of the thesis structure. The following chapter discusses the two distinct stages of the literature review undertaken within this thesis.

2 CHAPTER 2: LITERATURE REVIEW

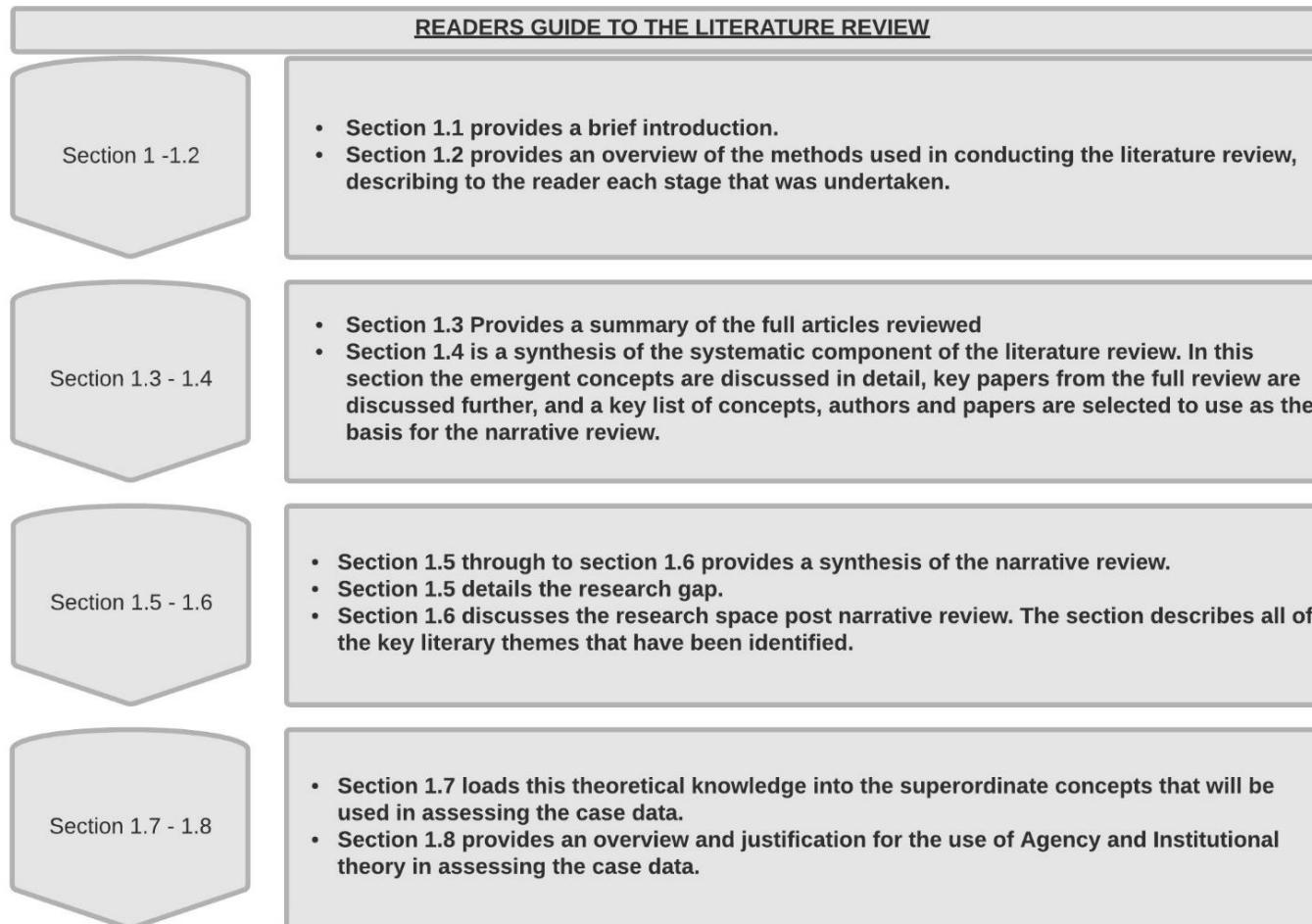


Figure 2 - Readers Guide to Literature Review

2.1 Chapter Introduction

The chapter takes a two-stage approach towards conducting the literature review. Firstly, a systematic literature review is undertaken based upon the approach used by Golicchia and Strozzi (2012). The purpose of this review is to generate a coherent understanding of literary areas that are pertinent to the research context. This allows the researcher to identify relevant gaps in knowledge, and define the context and boundaries of the research areas.

Secondly, an in-depth narrative review was conducted into those key areas and articles that have been identified from the systematic literature review in part one. The purpose of this section is to generate expert and contemporary knowledge in those areas most pertinent in addressing the research question. With the key areas, themes, authors, and concepts identified as a result of the systematic literature review, the author can then assess the relevant contemporary literature in greater detail, utilising a ‘snowballing technique’.

2.2 Literature Review Method

This thesis draws on the approach to systematic literature review used by Golicchia and Strozzi (2012) who in turn draws on the works of Denyer and Tranfield (2009) for their creation of a multi-stage literature review method that utilises a systematic component. In departure from Golicchia and Strozzi (2012), this research combines the systematic review segment in phase one with an in-depth narrative review of the resulting key conceptual areas in phase two. Figure 2 depicts the processes the researcher has undertaken within each phase.

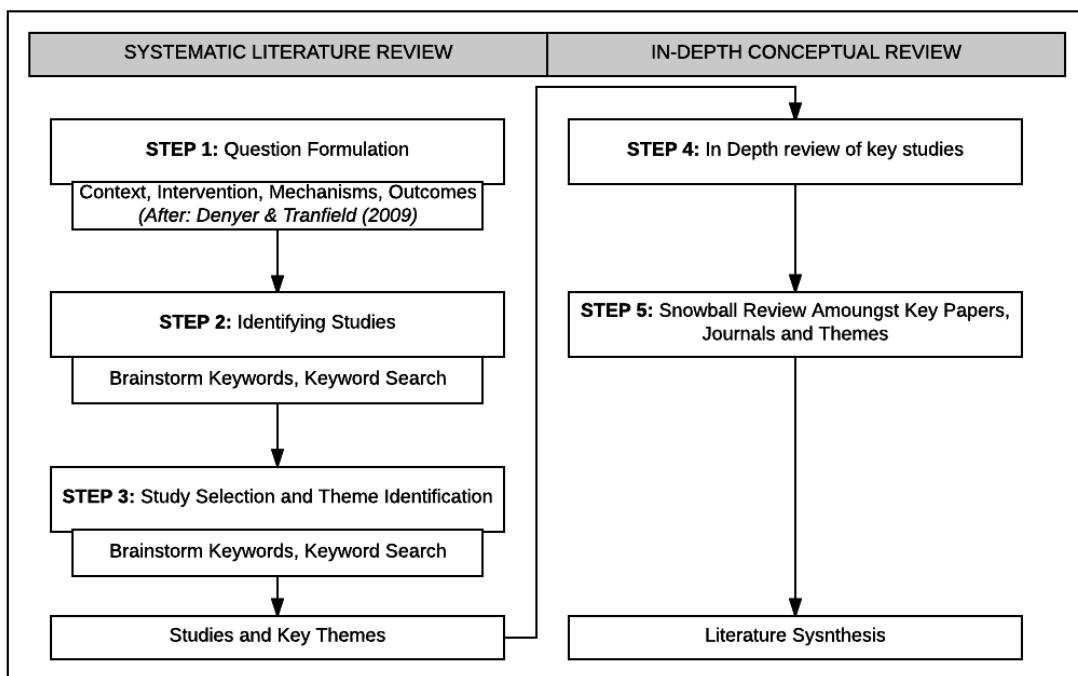


Figure 3- Literature Review Method

2.2.1 Step One - Question Formation

The question formation stage follows the acronym CIMO (Context, Intervention, Mechanisms, and Outcomes) that was originally used by Denyer and Tranfield (2009) and operationalised within a systematic literature review by Golicchia and Strozzi (2012). The four phases are used to critically reflect upon the domain so as to identify a suitable breadth of research topics eventually narrowing upon the key areas of interest that are utilised within the research. The key areas of reflection are:

Context: The context defines the question of what is under study in terms of individuals, organisations, and systems being studied.

Intervention: The intervention question prompts the researcher to question what relevant action is being undertaken within the given context.

Mechanisms: The mechanisms define the variables mediating the relationship between any given intervention identified and the outcomes of said intervention.

Outcomes: Lastly, the outcomes are the tangible outputs of a given intervention.

In addressing each of these questions, the researcher is able to create a working model to be utilised in the creation of keyword searches. To address these questions, the researcher identifies the following: Organisations acquiring products, service or product service systems within complex contracts and the context (C). The act of procuring and/or outsourcing as the intervention (I). The normative processes embedded within the acquisition process as the mechanisms relevant (M). Lastly, the overall effectiveness and capabilities of the procurement initiative is defined as the outcomes (O).

2.2.2 Step Two Identifying Studies:

Within this segment, keywords have been identified that adequately summarise the phenomena under investigation from each of the perspectives described in the CIMO approach. These keywords are derived through a process of brainstorming and critical reflection by the researcher. The keywords were then operationalised into search strings to cover the full range of literary perspectives that describe contemporary acquisition practice in complex environments. Thus the primary keywords derived from each of the four key areas of interest are as follows:

- **Context:** Defence, Products, Services, Product Service Systems, Complex,
- **Interventions:** Procurement, Outsourcing, Contracting, Acquisition

- **Mechanisms:** Process, System, Lifecycle
- **Outcomes:** Capabilities, Effectiveness

In order to perform a systematic review of the relevant literature, the key concepts identified through the process of brainstorming are then operationalised into Boolean search strings. The purpose of these search strings is to create a balance between adequate relevance and suitable breadth of the literature identified.

2.2.2.1 Boolean logic

Boolean logic allows for the functional behaviour of database search technology to be explicitly dictated by the researcher. The basic operators and their functionalities are listed below

Term	Function
OR	The ‘or’ function allows flexible inclusion of additional terms and typically expands the search results
AND	The ‘and’ function specifies that both terms, prior to and after the ‘and’ are required and thus typically limits the search results.
NOT	The ‘not’ function in reducing the search results by excluding those that have a particular term present. This is useful for omitted non relevant articles that share a core nomenclature.
ASTERISK *	The * used after a term expands the search term to include all variants of that root word. For example “admin*” will return administrator, administration etc.
PARENTHESIS ()	The parenthesis bounds a set of statements to ensure they function independently of any other statement that proceed or follow a set of related search terms.
QUOTATION MARKS “”	The quotation marks function ensures that the exact set of terms included in the quotation are searched and not each word individually e.g. “Supply chain management” instead of supply, chain and management.

Using these above terms, the search strings were created to be applied in search of the DISCOVER database. Discover is a meta-database with access to over 483 databases, that

include all major publications in operations management and wider management and thus provides the requisite breadth of coverage. After an initial period of core reading amongst the outsourcing literature, the research was broken down into key concepts which were eventually operationalised into search strings. These concepts were refined through brainstorming until a reasonable list of search terms were derived. Inclusion criteria and exclusion criteria were created. These search strings were then executed in order of increased specificity until there was a sensible number of papers defined. This gave the greatest breadth of reading, whilst retaining a reasonable level of relevance to the core concepts identified. The search strings are defined in the table below, and the process of searching is recorded within Table 2.

2.2.2.2 Creation of search strings

	N	CONCEPTS	CATEGORY	BOOLEAN SEARCH STRING
CONTEXT	1	Products Services Product Service Systems Servitization	Primary search construct to be included in string	("product service systems" OR "PSS" OR "product*" OR "service*" OR "servitization" OR "servitized" OR "servitize")
	2	Complex Environments,	Primary search construct to be include in string	("complex" OR "complicated" OR "sophisticated")
	5	Operations management, supply chain management fields	Inclusion criteria (primary focus areas)	("Operations Management" OR "Operations" OR "Supply Chain Management")
	6	Written in English, embedded within the operations and supply chain management literature. Contemporary – As defined since 2009	Exclusion criteria	N/A
INTERVENTION	3	Procurement, Outsourcing	Primary search construct to be included in string	("procurement" OR "procure*" OR "acquisition" OR "acquire*" "acquirement" "purchase" "buy*" "outsource*")
MECHANISMS	4	Process, System, Lifecycle	Primary search construct to be included in string	("process**" OR "system**" OR "lifecycle**")
OUTCOMES	N/ A	Capabilities & Effectiveness	Inclusion Criteria	N/A

Table 1- Creation of Search Strings

2.2.2.3 Operationalising Search Process

COMBINATIO N	OPERATION	BOOLEAN SEARCH STRING	OUTCOME
A	1, 3	(“product service systems” OR “PSS” OR “product*” OR “service*” OR “servitization” OR “servitization” OR “servertize”) AND (“procurement” OR “procure*” OR “acquisition” OR “acquire*” “acquirement” “purchase” “buy*” “outsource*”)	<p>Results: 455,877</p> <p>Too broad a search for systematic review additional terms required. Further refinement of search criteria required in order to generate a suitable number of results for abstract analysis.</p>
B	1,3,2	(“product service systems” OR “PSS” OR “product*” OR “service*” OR “servitization” OR “servitization” OR “servertize”) AND (“procurement” OR “procure*” OR “acquisition” OR “acquire*” “acquirement” “purchase” “buy*” “outsource*”) AND (“complex” OR “complicated” OR “sophisticated”)	<p>Results : 19,554</p> <p>The refinement of the search include the complexity construct narrowed the results but further refinement is required in order to perform abstract analysis.</p>

C	1,3,2,4	(“product service systems” OR “PSS” OR “product*” OR “service*” OR “servitization” OR “servitization” OR “servertize”) AND (“procurement” OR “procure*” OR “acquisition” OR “acquire*” “acuirement” “purchase” “buy*” “outsource*”) AND (“complex” OR “complicated” OR “sophisticated”) AND (“process*” OR “system*” OR “lifecycle*”)	Results: 12,884 The results now encapsulate the full range of terms derived in the initial brainstorming process, but still require the additional parameters to reduce the volume of results being returned.
D	1,3,2,4,5	(“product service systems” OR “PSS” OR “product*” OR “service*” OR “servitization” OR “servitization” OR “servertize”) AND (“procurement” OR “procure*” OR “acquisition” OR “acquire*” “acuirement” “purchase” “buy*” “outsource*”) AND (“complex” OR “complicated” OR “sophisticated”) AND (“process*” OR “system*” OR “lifecycle*”) AND (“Operations Management” OR “Operations” OR “Supply Chain Management”) AND (“Operations Management” OR “Operations” OR “Supply Chain Management”)	Results: 1,388 The inclusion of articles that pertain to the operations or supply chain management fields significantly reduced the available results.

		(“product service systems” OR “PSS” OR “product*” OR “service*” OR “servitization” OR “servitization” OR “servertize”) AND (“procurement” OR “procure*” OR “acquisition” OR “acquire*” “acuirement” “purchase” “buy*” “outsource*”) AND (“complex” OR “complicated” OR “sophisticated”) AND (“process*” OR “system*” OR “lifecycle*”) AND (“Operations Management” OR “Operations” OR “Supply Chain Management”) AND (“Operations Management” OR “Operations” OR “Supply Chain Management”) NOT (“energy” OR “security”)	Results: 164 At this stage additional exclusion criteria were applied to remove entries pertained to Energy or Security as that is a common sub-area of interest that lies outside the scope of the study. Additionally, only articles written in English and published in reputable academic journals since 2009 were included through DISCOVER’s native interface. Leading to a final short list of 184 papers for review.
E	1,3,2,4,5,6		

Table 2-Operationalising Search Process

2.2.3 Step Three - Study Selection & Theme Identification

The list of 164 articles that were identified in the systematic literature search were then carried forward into a full abstract review. The purpose of the abstract review is to discern the relevance of the articles in assessing the overall research question in greater detail than can be codified into a search string. The abstracts of the articles are read in detail and the decision is made to exclude the articles or include and perform a full review. The purpose of the systematic literature review is to provide a breadth of understanding within the areas deemed relevant to the research question, as such articles that are deemed relevant will be included within section 2.3 and assessed in terms of their key themes, concepts, approaches and contexts. The purpose of this is to establish the key authors, papers, journals and topics that are of the most relevance to the research. These areas can then be explored in greater depth. Articles deemed non-relevant at abstract review are included in Appendix 1 along with the reason for their rejection.

2.2.4 Inclusion / Exclusion Criteria

- The paper's use of the key search terms is employing any of the key words in the manner that they were intended at conception of the work. E.g. 'Complexity' pertained to the complexity of the product-service system or procurement initiative and not some other form of complexity.
- There are numerous relevant concepts that are discussed within the paper and not simply any single one of the concepts.
- The article is from a relevant discipline. E.g. management, operations, supply chain management.
- The central focus of the article pertains to a directly relevant concept. E.g. there are relevant concepts discussed but if they are not key themes within the study then the study will be excluded. An example here is that complexity and product-service-systems may be discussed from a 'green supply chain' perspective.

2.2.5 Article Review

Figure 5 below depicts the stages that the research went through in order to identify the key articles to undergo full review. After the removal of repetitions, incompletes and abstract review there were 31 articles that were carried forward. Those articles are summarised and examined within section 2.3

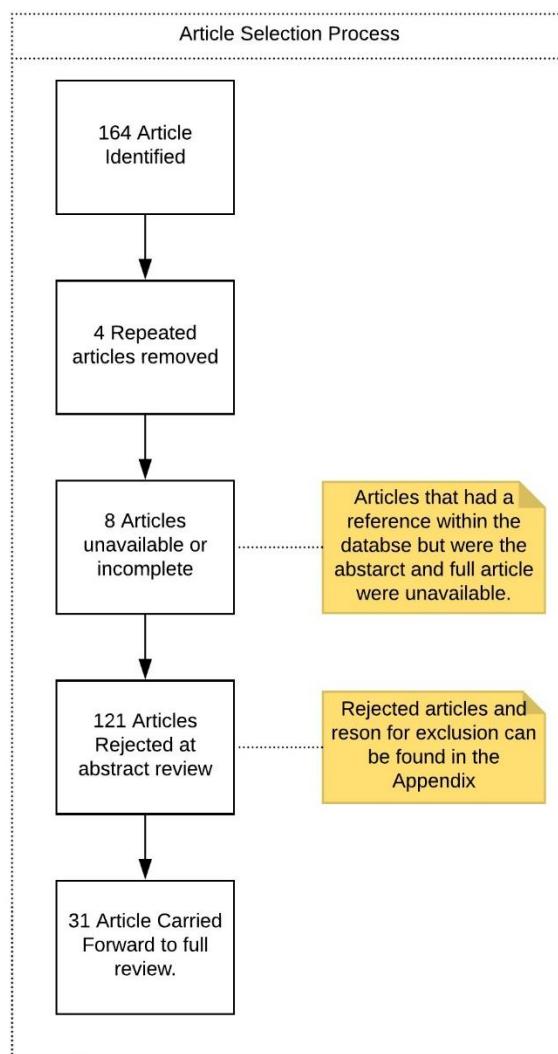


Figure 5-Review Process

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2.3 Step Four - In Depth Review Summary table

			FINAL ARTICLE SELECTION														
			Rodríguez et al (2016)	Mahapatra et al (2017)	Datta et al (2013)	Blome et al (2013)	Parthiban et al (2013)	Sivapornpunlerd & Setamannit (2014)	Mishra & Chan (2012)	Lebreton et al., (2010)	Zeuschner et al., (2015)	Datta et al., (2010)	Spring & Araujo (2014)	Caldwell & Howard (2010)	Dixit et al., (2014)	Inderfurth & Kleber, (2013)	Şen et al., (2010)
GENERAL CHARACTERISTICS	TYPE	Explanatory	X				X				X						
		Exploratory				X					X	X	X	X			
		Model Development	X	X			X	X		X		X	X		X	X	X
		Simulation			X				X								
ARTICLE AREAS	SPECIFIC LITERATURE FOCUS	Case Study	X				X	X			X	X		X	X		
		Survey				X											
		Theoretical Paper											X			X	X
		Knowledge Management	X			X				X	X			X			
EMERGENT AREAS		Supply Chain integration / Logistics	X			X				X	X	X			X		
		Risk Management		X							X			X			
		Outsourcing contract effectiveness		X	X						X	X	X	X	X		
		Supplier Selection / Evaluation					X	X			X		X	X		X	X
		Application of technology	X							X	X						

		Operations Strategy										X	X	X	X	X	X
PROCUREMENT FOCUS	Non Complex Product / Service Acquisition	X	X			X	X	X	X							X	X
	Complex Product / service Acquisitions			X								X	X	X	X		
	PSS & Servitization business models			X							X	X	X	X			
	Supply Management independent of type				X												
SECTOR FOCUS	Non-Specific		X		X	X		X				X				X	X
	Public Sector Interest			X							X	X	X	X			
	Private sector interests	X					X		X								
RELATIONAL FOCUS	Procurer focused insights					X	X				X	X			X	X	
	Supplier/Vendor focused insights																
	Non-directional	X	X		X			X	X	X			X	X			
NEWLY EMEGEN CONCEPTS	Product Service Logic			X							X	X					
	Industrial Product Service Systems			X								X					
	Procuring Complex Performance (PCP)											X	X				
	Indirect/Direct Capabilities											X					
	Co-Creation of value											X					

			Complex Product Systems (CoPS)												X			
			Performance & Infrastructural complexity															
			Through Life Management (TLM)															

Table 3-In Depth Review Summary Table

			FINAL ARTICLE SELECTION (2)															
			Hartmann et al., (2014)	Gobbi, Hsuan, (2015)	Roehrich & Lewis (2014)	Rai & Hornya k, (2013)	Chen & Carrillo (2010)	Baker (2012)	Gaudenz & Christopher, (2016)	Nollet et al. (2017)	Wong et al., (2015)	Tate et al (2012)	Tansaka nen (2014)	Brady et al (2012)	Johnsen (2009)	Inderfur th et al (2011)	Mahna m et al., (2008)	
ARTICLE CHARACTERISTICS	GENERAL CHARACTERISTICS	TYPE	Explanatory										X			X		
			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		Model Development																
		Simulation														X	X	
	METHOD	Case Study	X	X	X	X	X	X	X	X	X	X	X	X	X			
		Survey				X					X							
		Theoretical												X		X	X	
ARTICLE AREAS	SPECIFIC LITERATURE FOCUS	Knowledge Management		X	X							X						
		Supply Chain integration / Logistics	X				X		X	X	X		X			X	X	
		Risk Management		X	X		X							X				
		Outsourcing contract effectiveness	X	X	X		X	X					X	X				
		Supplier Selection / Evaluation	X			X												
		Application of technology		X	X													
		Operations Strategy							X			X		X		X	X	

		PROCUREMENT FOCUS	Non Complex Product / Service Acquisition						X	X	X	X			X	X	
			Complex Product / service Acquisitions	X	X	X									X		
			PSS & Servitization business models	X		X											
			Supply Management independent of type				X	X	X					X			
	SECTOR FOCUS	Non-Specific			X	X	X			X				X	X	X	X
		Public Sector Interest	X					X								X	
		Private sector interests							X			X					
	RELATIONAL FOCUS	Procurer focused insights		X						X		X				X	
		Supplier/Vendor focused insights					X										
		Non-directional				X		X	X		X		X			X	X
	NEWLY EMEGEN CONCEPTS	Product Service Logic	X		X			X									
		Industrial Product Service Systems															
		Procuring Complex Performance (PCP)	X		X												
		Indirect/Direct Capabilities and capabilities development	X														
		Co-Creation of value	X		X							X	X				
		Complex Product Systems (CoPS)	X	X	X												

			Performance & Infrastructural complexity	X		X								X		X		
			Through Life Management (TLF)			X										X		

Table 4-In Depth Review Summary Table 2

2.3.1 Summary descriptions of key articles

The following presents a brief overview of each of the papers included in the full review inclusive of key contributing points towards the study.

PAPERS	OVERVIEW
Baker et, al (2012)	The authors discuss a related set of core phenomena that are under investigation within this research. Specifically, the increased focus on core competencies and outsourcing particularly by public firms that are dependent on the expertise and capabilities of the private sector. Baker (2012) describe the Strategic Service Partnerships (SSP) as a more developed and integrated form of a public private partnerships, describing them as a ‘co-equity’ partnership that is formalised in a joint venture organisation with a management structure seeded from both the originating private and public organisations. The SSP codifies a particular incarnation of a long term capital good procurement structure among organisations in the public to private context. The authors acknowledge the significant absence of research undertaken into these relationships, noting a specific absence of details to have these work correctly.
Blome et, al (2013)	Acknowledges and investigates the increasing interdependence of supply chain elements and the increased role of complexity in contractual relationships between supply chain echelons.
Brady et, al (2012)	This article reinvestigates Klein and Mecklings (1958) historical article entitled “Application of operations research to development decisions” in the context of the contemporary phenomena of complex development projects. The article posits that the Klein and Meckling (1958) approach towards dealing with high uncertainty markets was largely ignored due to the focus of the last few decades on highly structured and tightly controlled management perspectives. The central argument of Klein and Meckling was that complex development projects that

	<p>are characterised with high uncertainty require repeated experimental testing of the various project sub-systems to acquire empirical knowledge to counter the uncertainty. The principle being that an optimal outlook is juxtaposed with a sceptical outlook and empirical testing reveals the most suitable view under a set of given conditions within the context of a particular project. Brady et al. (2012) state that the newly emergent field of COPS can benefit from the initial insights posed by Klein and Meckling as the newly emergent complexity and increasing uncertainty of system in the field renders the application of logical, tightly controlled management structures as ineffective within this context.</p>
Caldwell & Howard (2014)	KEY PAPER - Detailed review presented in section 2.5.2
Cheng & Carrillo (2010)	The paper explores partnering in the context of complex manufacturing projects. The authors used a case study approach to test hypotheses on the effect of having formed a partnership within the domain of complex manufacturing, focusing entirely on the supplier perspective. The research concludes with partnership having the potential to increase operational efficiency, although with the requirement for a performance focused set of mechanisms applied to the agent in the principal-agent relationship.
Datta et al, (2010)	KEY PAPER - Detailed review presented in section 2.5.2
Datta et, al (2013)	Focuses on the availability contract as a variant of the performance based contract that is replacing typical service procurement practice due to the rise of product service systems. The paper explores how this has been used in the context of fast jet aircraft maintenance.

Dixit et al, (2014)	The article investigates materials procurement within the areas of complex supply chains. Specifically the paper develops a procurement scheduling model for operating in uncertain environments with a complex BOM (Bill of Materials) spread over complex interdependencies of supply chain arrangements. The article points to the difficulties in adequately and correctly budgeting in these instances, and provides a mathematical model that describes the relative importance of budgetary decisions at various points in the allocation of resources. These works contribute towards understanding part of the picture in these complex environments, however it is the environment itself that is still poorly bounded in terms of relevant academic disciplines and themes, as well as having a coherently articulated problem space.
Gaubenz & Christopher, (2016)	Describes the need for lean and agile supply chains in response to the growing complexity of marketplaces and supply chains. The paper adopts a single case study design of a global telecommunications company in order to assess and demonstrate the effectiveness of an agile project management style. A key contributing factor of the paper is the idea that increasingly complex supply chains, operating within a globalised environment with increased customer-specific solutions and increased product variety are more akin to large-scale projects than to traditional supply chains. The paper does however focus upon complex supply chains of fast throughput items and not the procurement of complex items through a supply chain.
Gobbi, Hsuan, (2015)	This paper reviews the acquisition of complex medical equipment in the Danish healthcare sector. Specifically the paper focuses on collaborative purchasing efforts of the buyer embedded within a purchasing group. The relevance of the paper is clear as it is operating in a product-service system environment in acquiring both complex medical assets and the service

	associated with the assets. The paper is a sharp example as to the inconsistent nomenclature amongst the complex acquisitions literature, as the paper describes complex procurement without reference to the specific term PCP (Procuring complex performance), omitting capabilities development in favour of using the term alignment, and makes only minimal reference to servitization as a concept, despite clear cross-over with each of these concepts. The paper draws attention to the benefits of best practice transfer and best in class copying in the field of complex assets acquisition and emphasises the beneficial role of novel acquisition practice within this field.
Hartmann et al, (2014)	KEY PAPER - Detailed review presented in section 2.5.2
Inderfurth & Kleber, (2013)	The article is only partially relevant as it centrally concentrated on fast throughput items as opposed to complex product service systems. However, the paper does specifically attend to the procurement of after-sales support goods such as spare parts, and concentrated the context around aerospace and defence. The article mathematically models optimum order points and times when dealing with highly uncertain environments and contributed to a rounded understanding of the field.
Inderfurth et al (2011)	Inderfurth et al. (2011) in their paper address a similar question to a number of the papers that were included in the full systematic review but rejected at the abstract review stage. The paper uses a mathematical simulation to identify optimum stock in fast throughput supply chains.
Johnsen et, al (2009)	KEY PAPER - Detailed review presented in section 2.5.2
Lebreton et al, (2010)	Whilst not directly relevant to the exact areas of acquisition lifecycle planning. This paper holds relevance in attempt to ascertain a model of effective communication within a complex

	supply chain. The paper takes an approach of mathematical modelling towards trying to comprehend facets such as asset utilization, and highlight the shortcomings of ERP (enterprise resource planning) in being able to orchestrate this in such a complex environment
Mahapatra et, al (2017)	Considers the relative effectiveness of various combinations of sourcing models by combining ‘market’ or ‘contract’ sourcing alternatives. The paper mathematically simulated the alternatives in the context of a standardised product.
Mahnam et al, (2008)	The paper by Mahnam et al. (2008) is another example of a paper that attempts to optimise fast throughput supply chains through simulations. The paper attempts to address supply chain uncertainty but takes a view of uncertainty as it pertains to fast throughput specific problems such as stock out. The paper explores number of the key themes that are pertinent to the research, however the context of fast throughput supply chains gives a fundamentally different character to the processes of risk management, addressing uncertainty and optimal forms of interaction between supply chains.
Mishra & Chan (2012)	Operationalises a range of supply chain management techniques such as postponement, vendor managed inventory and test the effectiveness of these techniques in a simulation. This applicability is again through the fast throughput-logistics facing market and does not directly contribute to the area of complex systems.
Nollet et al (2017)	The paper uses a case study approach to investigate the effects of performance management on group dynamics within purchasing groups based in the healthcare sector. Purchasing groups are an emergent phenomena used to effect savings in a number of contexts, and are also used within the context of procuring complex product service systems. The researchers acknowledge the need for further research in the area.

Oechmen et al, (2009)	The paper explores supply chain risk management in the context of the highly developed field of risk management within fast moving supply chain industries. The paper makes contributions to providing a structural approach within these environment and shows the effectiveness of tightly controlled systematic modelling of supply chain risk as it is applicable to the fast moving supply chain context but does not touch on the larger more complex assets acquisition practice under discussion within this research.
Parthiban et, al (2013)	The paper models a fuzzy logic SWOT approach towards improving the vender selection process in the context of fast throughput non-complex products.
Rai & Hornyak, (2013)	The work by Rai and Hornyak (2013) focuses upon the use of Sourcing Enterprise Systems (SES) as a means of navigating complexity within complex acquisition environments. Of the papers reviewed previously there is significant discussion on the role that IT has to play in operating effectively within complex domains. However, within those papers selected from the 165 featured in the systematic literature review this was the only paper to specifically identify those procurement enabling IT systems as SES. This is again highly suggestive of the fractured nature of the condition of research within this topic area. Rai and Hornyak (2013) conclude on the key importance of SES in dealing with complex sourcing arrangements but identifies that when work process interdependence was high that SES use was correlated with a negative perception. Then the opposite being true when work process interdependence was low SES was seen positively. Work process interdependence is defined as the reliance on other actors and agents in order to execute a procurement task. This is extremely likely in complex environments, thus the higher the complexity, the higher the interdependence and the lower the perceived usefulness of SES.

	<p>This interesting finding shows that to simply adopt procurement specific knowledge management capabilities is inadequate, and further highlights the need to explore which SES elements and practices are being used well within the empirical environment so as to move towards a theory of effective adoption of knowledge management systems in complex procurement initiatives.</p>
Rodríguez et, al (2016)	Proposes an information system to account for knowledge management in supply chains. Simple knowledge organization systems for supply chain management (SKOSSCM) – applies semantic web technologies to create a model that attempts to solve the issue of effective knowledge management exchange between interacting supply chain echelons.
Roehrich & Lewis (2014)	KEY PAPER - Detailed review presented in section 2.5.2
Şen et al, (2010)	This paper adds to those that attempt to model the supplier selection problem for procurers. The paper focuses on a fast-throughput supply chain and therefore has only partial relevance in addressing the research question.
Sivapornpunlerd & Setamanit (2014)	The paper builds a model towards effectively evaluating suppliers' performance, it is based within the context of fast-throughput acquisition. The specific focus is on logistics and the delivery of non-complex goods.
Spring & Araujo, (2014)	KEY PAPER Detailed review presented in section 2.5.2
Tanskanen (2015)	The paper uses a multiple case study design to investigate and explore complex buyer supplier relationships in view of examining asymmetries that emerge in non-contractually bound exchanges. The paper makes the contribution that primacy, power balancing mechanisms and an awareness of the

	relationships attractiveness had the most effect on explaining the asymmetry exchanges.
Tate et al (2012)	This paper investigates the outsourcing and offshoring of call centre service. This is a slight divergence from the complex domain of product service systems in that the paper is focused upon relatively non-complex service supply management. However, the paper does offer valuable insights into the complex structures that emerge in response to having to manage a multitude of supply chain partners operating services across a geographical basis, pointing to trends of centralisation of control and team based structures as emergent properties of managing complex service systems.
Wong et al, (2015)	The research surveyed 101 wholesale firms in order to establish an understanding of the relationship between supply chain information integration and increased operational performance. Again, this is another example of fast throughput supply chains. The authors found an inverse relationship between the complexity of a product being ordered and the overall effectiveness of supply chain information integration on operational performance, which gives credit to the view that a project management style structure may be the more effective means of organising supply chain activity as supply chain complexity increases and that the lessons learnt in fast-moving supply chains are non-transferable.
Zeuschner et al, (2015)	KEY PAPER – Detailed review presented in section 2.5.2

Table 5-Summary Descriptions of Key Articles

2.4 Synthesis of full paper review

The systematic literature review returned 164 academic journal papers after inputting the initial search string. Of these articles, four were removed as they were featured twice within the results, 8 additional articles were removed due to them being unavailable or incomplete after attempting to access the articles through alternative search engines. Of the remaining 152 articles 121 were rejected at abstract analysis. Each of the abstracts were read in detail and the rationale for each article's exclusion is presented within appendix 1.

Of the remaining articles 31 were reviewed in full, and each of these were categorised in terms of both their general characteristics, methodology, private or public sector focus, procurement or supply focus, relationship focus, goods/service categorisation as well as in terms of the key themes or areas of study that are discussed within the papers. The summary table is shown in section 2.3. This information has been summarised so as to provide an overview of the state of knowledge within the relevant areas under study within this PhD research. The purpose of doing this is twofold:

- To provide an overview of the key themes, concepts and methods used within the relevant research that can inform the research questions, design and methods used within this study.
- To provide a comparative assessment of the papers so as to better identify a gap in knowledge within this research domain.

2.5 General Characteristics

Of the 31 papers that were investigated, the majority were empirical investigations exploring an aspect of the goods or services procurement process, with some notable exceptions. Typically the focus of the conceptual studies were directed toward theorising a set of constructs for use in understanding and examining the emergent area of complex acquisitions and procurement. For example, Spring and Araujo (2014) focus on theorising of relevant capabilities required for efficient procurement options, Brady et al., (2012) re-apply an early imagining of project management practice towards the newly emergent challenges posed by complex product service systems management, with other conceptual research mathematically modelling some aspect of the procurement process such as supplier selection (*Inderfurth & Kleber, 2013*) or procurement model selection (*Sen, 2010*). There is a divergence in the A-theoretical

papers between those applying a mathematical model or simulation and those qualitatively characterising some aspect of the acquisition or contracting process. The modelling papers are typically applied to the fast moving, low value supply chain contexts while the qualitative papers tend towards high value, longer term, and complex acquisitions.

Of those empirical papers included in the final review, the majority used an exploratory or explanatory case study approach (*i.e. Caldwell & Howard, 2010; Datta et al., 2010; Zeuschner et al., 2015*). Case studies were the predominant method captured by this review, as it is a suitable approach for building theory in the contextually rich and newly emergent research domain of complex acquisitions (*Hartman et al., 2014*). In other cases, authors were attempting to develop models in order to conceptualise the problem space of issues within B2B complex acquisitions or procurement generally. Examples include models of knowledge management (*Rodriguez, 2016*), sourcing selection models (*Mahapater, 2017, Parthiba et al., 2013*), supplier performance evaluation (*Sivapornpunlerd & Setamanit (2014)*) with other featured articles attempting to create working conceptual models of complex contracting and its required capability and general characteristics (*Datta, 2010; Spring & Araujo, 2014*).

In the case of both the empirical and conceptual papers surveyed the general characteristics of the papers suggest two key points:

- There is an apparent dichotomy in the full papers reviewed between two distinct types of research. Firstly, there are those papers that focus on fast-throughput, procedural and mathematically comprehensible supply contexts and those papers that are concerned with high value, low volume, complex, lower throughput acquisitions. The latter have a far more nebulous contextual boundary and employ terms such as complex product systems, procuring complex performance and industrial product service systems to describe the difficulties in complex contracting arrangements within non-typical contexts like ‘defence’.
- There is clear distinction into the maturity of these two distinct types of article made apparent based on the methods used. The papers concerned with fast throughput supply chain methods utilise an established nomenclature, use well

defined constructs and variables. Whereas the second type of paper is often still establishing a common nomenclature, utilising a myriad of terms to describe the same or similar phenomena.

2.5.1 Emergent Areas

In order to create an understanding of the state of knowledge surrounding this research topic, the 31 full review articles were categorised in terms of themes featured within these papers. The purpose thereof was to both build up an understanding as to what is being explored to develop the relevant problem space for the research, but also as a means of identifying which papers were of the most relevance to the research. Whilst some of the featured articles focused on one core literary theme that was deemed relevant to the research, others discussed numerous relevant areas and thus were deemed to be of greater utility in framing the research question and core constructs. These areas were not preconceived, but rather derived from the papers themselves as they were reviewed. After consideration there were 7 main literary themes identified from the full paper: knowledge management, supply chain integration and logistics, risk management, outsourcing contract effectiveness, supplier selection and evaluation, application of technology and operations strategy. These emergent factors are listed in no particular order and having not been ranked in terms of significance.

Knowledge Management - A recurrent and pivotal theme, knowledge management refers to the storage, assessment, transfer and usage of information within and between supply chain partners towards a better realisation of mutual goals. Within the context of complex procurement and complex contractual arrangements the question of how and best to interact in between supply chain echelons is of critical importance. Articles featured have focused upon generic models for adopting knowledge management systems (*Rodriguez et al., 2016*), understanding relationships between effective knowledge management and performance characteristics of procurement functions (*Blome et al., 2013*), and in specifying specific technological solutions that are better able to enable effective knowledge management practices between supply chains echelons or partnered organisations (*Lebreton et al., 2010*). Within those studies that more directly focused on the problem space of complex, servitized, high value, acquisitions (such as in the defence sector) there was a consensus as to the increased importance and increased difficulty of implementing effective knowledge management practices, although no consensus as to best approach, which is indicative

of this newly forming and underdeveloped field (*Roehrich & Lewis, 2014; Zeuschner et al., 2015; Caldwell & Howard, 2010; Spring & Araujo, 2010*).

Supply Chain Integration / Logistics – In addition to the often digital integration of knowledge management, a number of the studies reviewed were specifically focused on the traditional questions of supply chain integration and the exchange of physical products. Within the review, those papers that were addressing the issue of the integration of physical goods often were modelling the supply chain in a procedural fashion (*Inderfurt et al., 2011; Mahnam, 2008, Mishra & Chan, 2012*) and the context was overwhelmingly in the non-complex product domain. Equally, of those papers rejected at abstract review a significant number were rejected because the focus was singularly on the supply chain integration of physical goods in the fast moving context. Of those papers concerned with the more complex acquisitions, the logistics and supply function tends to be discussed in terms of how the resupply (usually of spare parts and services) is undertaken. An example of this being a ‘contracting for availability’ approach. The difference in management approach and maturity between the lower value products and complex product service systems seems once again apparent here.

Risk Management – Risk management was a prominent topic explored within the literature taken forward to final review. A number of the articles considered risk from the perspective of the buyer in managing this risk, and how risk averse behaviour may be non-optimal (*Mahapatra et al., 2017*), while other articles emphasised the importance of risk sharing mechanisms as a means of creating effective working strategies between organisations in both a fast moving and highly complex environments (*Zeuschner et al., 2015; Caldwell & Howard, 2010; Gobbi & Hsuan, 2015; Roehrich & Lewis 2014; Chen & Carillo, 2010, Brady et al., 2012*). Amongst those articles that did not explicitly mention an approach to the management of risk it was often featured as a consideration. It seems evident that risk management is an integral aspect to consider across all variant of procurement and B2B contracting.

Outsourcing Contractor Effectiveness – Another prominent theme amongst the literature reviewed is the effectiveness of contractors and suppliers. A common way in which contractor effectiveness is discussed is through the consideration of various performance based contract approaches (*Datta, 2013; Datta 2010*) or through consideration as to how to align suppliers’ interests with that of the complex procurer

(*Caldwell & Howard, 2010; Spring & Araujo, 2014*). In the case of those articles that pertain to fast throughput supply chains the variable pertaining to making a determination of supplier effectiveness is far better developed and often explored thought finite quantitative assessment such as delivery time, downtime etc. (*Dixit et al., 2014*). There is a clear division between the two categories of highly complex, long-term partnerships whereby effectiveness is defined on a much broader scale and fast throughput areas where effectiveness is defined acutely and only in terms of typical key performance indicators. Nonetheless, the theme is a prominent feature within the relevant literature.

Supplier Selection / Evaluation – Amongst the papers surveyed, the importance of supplier selection and bidding was featured prominently. Some of the articles reviewed attempt to quantify the criteria for effective sourcing strategies (*Parthiban et al., 2013*) while others focus on the evaluation of suppliers (*Sivapornpunlerd & Setamanit, 2014*). This process of supplier selection is less applicable to those oligopolistic markets where the availability of first-tier suppliers makes competitive selection an impossibility (*Datta, 2010; Caldwell & Howard 2010; Hartmann et al., 2014*). Within these areas, the focus is upon evaluation of current suppliers, and modelling how to mitigate risks inherent in a long-term, mutually-dependent relationship. In any case the consideration of supplier selection and evaluation as a coherent theme is clear from having reviewed the body of papers identified from the systematic literature review. The theme has cross-over with the outsourcing contractor effectiveness theme, as organisations that collect a wide variety of performance based metrics may be empowered to apply previous data to the selection of suppliers.

Application of Technology – Literature exploring complex procurement frequently include the application of technology at multiple points in the procurement lifecycle as a means of coping with the inherent complexity of the in-use or after sales aspect of any complex product service-system (*Caldwell & Howard 2010, Hartmann et al., 2014*). More commonly, technology is discussed in its role as a necessary component in the tendering process and to exchange information in fast moving supply chains. There is thus significant cross-over between the application of technology and knowledge management (*Rodriguez et al., 2016; Lebreton et al., 2010*). This relationship is clear. As a general rule: The more sophisticated the approach to knowledge management the greater the sophistication of the information systems

installed within the organisation in order to capture, assess and disseminate this knowledge to the relevant parties.

Operations Strategy – Operations strategy refers to the tools, technologies and approaches governing effective and efficient operations with a given area. The theme is somewhat ubiquitous, but a clear and apparent strand of focus within the areas of complex procurement. Datta et al., (2010) specifically discuss the need to build up a coherent conceptual view of what effective operations strategy looks like within a product service system such as those featured in defence and highly complex environments. Articles such as Spring and Araujo (2014), Caldwell and Howard (2010) go on to further nest the concept of procurement and in-use contract methods under effective operations strategy as critical elements to it. Broadly speaking, operations strategy is a relevant prevalent theme as the literature suggests that effective operations strategy within a complex context is intimately related with the procurement and acquisition lifecycle.

Concluding remarks

The above synthesis provides grounding for the research by summarising the literary trends and current tensions existing within the relevant academic research. Thus, the categories of literary interest featured above have been created by following a two part rule: (1) is the trend apparent in many of the papers that have been selected for final review and (2) is the trend relevant in addressing the research question?

Identifying the research gap (Part 1) - There is a clear and ostensible difference between the maturity of research undertaken between high-volume procurement and purchasing and procurement of long-term, complex product-service systems. The former tends towards mathematically comprehensible solutions to a wide range of often physical supply issues or decision making, while the latter often cites the need for the creation of a new conceptual model to address the unique challenges apparent in the acquisition of long-term complex asset acquisition and service support. Therefore, the review has identified the prevalent thematic areas of interest common across the final paper section, and has highlighted the aforementioned dichotomy. Consequentially, this forms the first set of major insights towards generating a comprehensive articulation of the research gap.

2.5.1.1 Procurement, sector & relational focus of papers reviewed

The following section provides a synthesis of how and what type of procurement is being discussed within the literature. Specifically, papers have been compared on the basis of three elements: firstly, the focus of the procurement in terms of whether it applied to non-complex products or services, complex products or services, servitized business models generally or address procurement and supply management independent of type. This category was deemed of critical relevance in exploration of a research gap as there was a clear dichotomy identified between complex and non-complex product and service acquisition that emerged from reviewing the articles. Secondly, whether the article pertains to the public sector, private sector or does not fit into one of those categories. Lastly, the perspective the articles takes in the procurement-acquisition dyad in terms of either procurer-focused articles, supplier-focused articles or articles that do not allude to a specific direction.

As has been described above, there is a clear dichotomy between two distinct types of papers in terms of the themes explored, and methods used and the body of research consulted with. This dichotomy aligned clearly with whether these papers are or are not addressing complex product or service acquisition. Of those papers that do not address a complex product or service context, a significant number also do not give procurer or supplier-focused insights. These papers typically develop a model or simulate a problem that pertains to logistics and supply management generically (*Rodriguez et al., 2016; Mahapatra et al., 2017; Mishra & Chan, 2012; Levreton et al., 2010*). These papers also vary in terms of whether they are directed towards public or private sector interest, often without a particular sector being stated or implied. Although some of the articles pertaining to non-complex acquisitions do investigate an implicit public or private sector context through investigation of specific industry such as healthcare (*Nollet et al., 2017; Tate et al., 2012*).

It should be noted that a significant proportion of the papers that were rejected at abstract review pertained directly to the traditional supply chain perspective and were non-complex. While there are a number of papers that deal with non-complex acquisition included, these papers involved some other element of relevance at abstract review such as servitization or complexity. Additionally, a full review of some of the

more relevant non-complex papers was necessary to provide essential contrast to the key papers that best encapsulate the area under investigation.

In regard to those papers that do address complex product service systems acquisition, this is where the insight is either focused directly towards addressing the procurer perspective (*Datta et al., 2010; Datta et al., 2011; Caldwell & Howard, 2010; Gobbi & Hsuan, 2015*) or is attempting to address more general questions that create a knowledgebase of utility to a procuring organisation (*Roehrich & Lewis, 2014; Hartman et al., 2014; Brady 2012*).

Identifying the research gap (Part 2) - The reason that the complex product service systems' papers are predominantly aligned with the perspective of the procurer is that the empirical reality appears to be driving necessity for comprehension of how to procure in complex environments. Most notable of these appears to be the defence and the aerospace industries (*Caldwell & Howard, 2010; Datta 2010; Datta, 2013; Spring & Araujo, 2014*). In taking a synthesis from these articles it is apparent that some combination of a reduced in-house capability to manage complex assets, an increase in technological sophistication of procured assets, increased budgetary constraints and increased market specialisation amongst organisations has led to increasingly complex servitized outsourcing models. These newly emergent models and their pre-requisite condition affect defence and aerospace more acutely as those industries represent two of the largest procurers of technologically sophisticated assets that require an ongoing contracted service form the supplier.

2.5.1.2 Newly Emergent Concepts

The relevant concepts and terminology have been identified, in order to conceptualise the conceptual landscape that are pertinent to this research. In a similar fashion to the literary trends, concepts were included on the basis of two rules: Firstly, that the concept is relevant to the area of procuring complex products and services. Secondly, that the term is featured across multiple papers. This allows the review to build up a working taxonomy of relevant concepts that can be operationalised in the creation of the methodology and ultimately in addressing the research question.

Product-Service logic & Industrial product service systems – Industrial product-service systems refers to large scale servitization models of operating B2B between a procurer of a major asset and the provider of a major asset. Product service logic

generally and industrial product service systems were observed in Datta's articles (2010, 2013) who describes the proliferation of performance-based contract and availability based contracting within the defence and aerospace industries as a response to increased technical complexity, budgetary requirements and a loss of internal capability. Performance based contracting models are widely adopted in major industrial product service systems and are described as being a more cost effective means of organising the supply chain. Zeuschner et al., (2015) acknowledges the unique set of skills required to operate in a servitized product service systems environment, and how these skills do not overlay with the traditional project management approach found in non-complex, non-servitized environments.

Procuring Complex Performance (PCP) – The concept refers to the unique challenges and capabilities required when purchasing one-off or rare, complex items. The concept of procuring complex performance was first observed within Spring and Araujo (2014) and Caldwell and Howard (2010). This concept sits central to what is being explored within this research. The articles centrally focused at addressing PCP also align a majority of characteristics shown in Table 5-Summary Descriptions of Key Articles that are relevant to this work. In their paper, centred on procurement in oligopolistic markets, Caldwell and Howard (2010) touch on the relevant topics of knowledge management, supply chain integration, risk management, outsourcing contractor effectiveness, supplier selection and evaluation, and operations strategy in contrast to the non-PCP articles that other papers the only typically feature two or three of the themes that have been identified as relevant. Additionally, those articles concerned with PCP again tend to feature more of the newly emergent concepts that were identified in the literature review. For example, Hartman et al., (2014) and Roehrich and Lewis (2014) whose articles both heavily feature PCP also discuss product service logic, indirect and direct capabilities development, co-creation of value, Complex Product Systems (COPS) and Performance and Industrial complexity with Roehrich & Lewis (2014) also discussing the usefulness of the through life management concept in complex environments. Again this is in direct contrast to those papers not pertaining to PCP which only discuss one or two of the emergent themes identified in the review.

It therefore seems readily apparent that PCP's inclusion within a paper suggest a far greater relevance to this research, therefore, identifying it as a unifying field of research within which this work can be appropriately situated.

Co-Creation of Value – Value co-creation refers to the process of adding commercial value to a product or asset by two or more organisations aligned in a partnership or supply chain. The concept functions as a way of viewing relationships between partnering organisations. Four of the articles carried through to final review discussed the concept of value co-creation. Hartman et al., (2014) describe the idea of value co-creation in relation to capabilities generation, making a strong case for the particularly acute requirement to co-create capabilities within complex domains, as a single organisation is poorly suited to provide the range of technical and infrastructural requirements in product service systems. Whilst less explicitly, Roehrich and Lewis (2014) also highlight the demands of capability placed on jointly operating partners operating within a COPS (Complex Product System) environment. Tate (2012) and Tansakanen (2014) discuss the importance of value creation in regards to effective make or buy relationships and from a social exchange theory perspective respectively. The consensus surrounding the concept is that the co-creation of value is a valid and an important one to be considered within supply chain partner relationships generally, however its criticality is accentuated within the context of complex product systems.

COPS – Complex product systems are a recurrent theme within the literature which correlates strongly with PCP in terms of the papers in which the concepts are discussed. COPS has overlap with Industrial Product Systems and described highly technical, expensive one-off or infrequent project, often visible in defence and aerospace procurement (*Caldwell & Howard, 2010; Hartman et al., 2014, Gobbi Hsuan, 2015; Roehrich & Lewis, 2014*). The literature discussing the term makes two salient points that solidify COPS inclusion within this research as a core concept. Firstly, that the term describes highly complex assets often purchased under complex contract agreements. Secondly, as with PCP, the domain requires a unique set of competencies and capabilities in order to operate within effectively. In synthesis of the papers above it is clear that while PCP can be conceived of as the umbrella term that describes the solutions to complex contracting, COPS can be conceived of as the umbrella term that described the problem domain and its characteristics.

Performance & Infrastructural Complexity – The concept of performance and infrastructural complexity are terms original conceived by Lewis and Roehrich (2009) and discussed by Heartman et al., (2014) within the systematic literature review. The terms are useful in distinguishing between classifications of procurement. Infrastructural complexity is described as the number and inter-relatedness of physical assets within a system whereas performance complexity refers to the number and inter-relatedness of knowledge activities required within a system. In their argument, Heartman et al., (2014) discuss that a procurement that is complex in both of these types is likely to be susceptible to the principles of PCP and thus an operationalisation of these concepts is critical within this PhD research as inclusion and exclusion criteria.

Through Life Management – Through life management (TLM) refers to an organisation taking an active role in the management of an asset outside of the traditional remit. Within the context of this research the concept is often used to explain the role of suppliers to managing the repair and maintenance of their asset ‘through-life’. Of the papers reviewed, only Johnsen (2009), address the concept directly, and at length, with Roehrich and Lewis (2014) touching on the concept in the generic. Despite the low frequency with which TLM has occurred in the systematic review, the concept has been deemed pertinent to the research. Johnsen et al., (2009) describe TLM as pertaining directly to the MOD’s CADMID cycle. While other articles may use overlapping terms to describe some of the same features of TLM such as ‘servitization’ or ‘product service systems’ the inclusion of TLM is deemed necessary to build up an expansive working nomenclature for use in investigating the relevant area.

2.5.2 Review of Key Papers

Of the papers reviewed there was a subset of papers that have been heavily referenced in defining the key concepts and relevant literary focuses that are most applicable to the research. A significant proportion of those papers relate to the concept of Procuring Complex Performance which has proven to be an umbrella term that encompasses the spectrum of contexts and concepts of the newly emergent challenge of complex contracting outsourcing for high-value, product-service systems. In order to build the review towards a well-defined research gap this most relevant subsection of key papers is reviewed in greater detail:

Datta et al., (2010) -

The article uses the classification of industrial product service systems with reference to the complex product service systems observed within areas such as defence and aerospace. In accounting for these complex markets recent usage of performance-based contracting the authors investigate a variant of the performance based contract, namely the ‘availability contract’ within the context of two defence case studies. The article makes valuable contributions towards defining contextual and environmental factors that are pertinent to the discussion of how complex contracting in these environment can or should be undertaken to maximise operational performance. This article is core to this research in providing a contextual insight into the logic, strategies and motivations that underpin performance-based contracts that are so widely adopted within complex contexts.

Spring and Araujo (2014) -

In their article, Spring and Araujo directly address many of the key concepts that are relevant to answering the research questions posed within this research. The authors use the concept of indirect capabilities to examine an organisation strategy within a PCP context. The article is embedded within a network of key articles that centre on the concept of Procuring Complex Performance. In terms of contribution to the problem space, the authors invoke the concept of indirect capability and direct capabilities in explaining the variance in organisations’ abilities to operate effectively within a PCP domain. The authors define indirect capabilities as those intellectual and knowledge assets that allow the organisation to effectively extract value from the direct capabilities (tangible assets, workforce). Thus an example of indirect capabilities would be the organisation’s knowledge management practice that allow them to better learn how to exploit a tangible asset such as a factor. The authors operationalise these indirect capabilities into a mode for use within successfully executing PCP systems that consists of Interface artefacts, Contracting, Boundary Management Practices and IT infrastructure thus providing a number of critical components for use in understanding the problem space.

Caldwell and Howard (2014) -

Caldwell and Howards (2014) provide one of the major contributing works in establishing an understanding of the problem domain. The article introduces and

discusses a significant range of concepts relevant to the enquiry. The authors investigate the large scale procurement programmes of two defence cases as a means of assessing the effectiveness of a newly emergent set of contractual arrangements such as ‘contracting for availability’. These contract model types have seen significant update in complex contractual areas such as defence within recent years. The authors examine this domain in order to assess the strategic differences in PCP areas on oligopolistic markets, and test a number of propositions, generated from an extensive literature review about the characteristics of PCP marketplaces. In regard to pertinent contributions that inform this research the article contributes the following:

- (1) The authors conclude that the infrequent demand pattern is having an effect on the overall capability of the marketplace, and procurers’ ability to effectively contract for a given capability using traditional methods of managing projects and supply chains.
- (2) The oligopolistic pressures and complex natures of the contract in a defence context means that there is often a bundling of what could otherwise be separate contractual items. This leads to a calibration problem in contractual incentivisation models, as the mechanisms governing the overarching monolithic contract may not be the most appropriate for each sub-stream of work and thus as Caldwell and Howard (2014) discuss there was no obvious incentivisation for contracts to report that a task has been executed under time and budget.
- (3) The authors showed that within the context of complex contracting, the motivation for bundling numerous procurement lines was due to the need to create a marketplace where one did not exist previously. Therefore the initial manufacturer is contracted with the ancillary services and additional work streams. An example given is that new technological developments are bundled along with the traditional more routinized offerings.
- (4) Contracting for availability was seen to be an appropriate contractual model in the oligopolistic PCP domains.
- (5) Another key contribution emphasised is the necessity of one or more of the contracting parties to act as a systems integrator in order to effectively leverage the co-creation of value.
- (6) The creation and implementation of adequately calibrated incentivisation mechanisms poses significant challenges. The authors also point towards there being

a political dimension to the difficulties faced in these domains with an extended list of stakeholders that importantly include the prime contractor, defence procurer and public treasury (referred to as the golden triangle). Lastly, this article is critical to this research in making the important link between CoPS literature and PCP as interrelated concepts.

Zeuschner et al., 2015 -

These authors span the range of topics that pertain directly to the research question such as product-service systems, servitization offerings and complex environments. Importantly, of those papers reviewed, Zeuschner's work positions the Product Service System (PSS) as the following: "Product Service Systems (PSS) are a new business concept that aims to integrate all phases of the lifecycle of a complex engineering product from acquisition to sustainment" (*Zeuschner et al., 2015: p126*). The important placement definition links the concept of servitization to lifecycle assessment. Two key points that are seldom discussed together but form the justification for investigation of this research gap.

Hartmann et al., (2014) -

The paper by Hartmann et al., (2014) was of critical importance in positioning the research question into its relevant body of knowledge as the concepts and industrial context represented within the paper are directly aligned with the research question. The paper makes several meaningful contributions to the domain of PCP research and in conceptualising the research domain. Notably, the authors provide a comprehensive overview of the conceptual background of the PCP domain and discuss the theoretical concepts that contribute to, or, are embedded within the area of PCP, these being; product service systems and the delivery of PSSs (*Spring & Araujo, 2009*), complex outsourcing arrangements, performance complexity, infrastructural complexity, servitization, integrated solutions, value co-creation and capability development. The authors use a longitudinal approach towards the formation of PCP relationships and conclude that the reasons for adopting complex outsourcing arrangements vary significantly between sectors. Public sector initiatives tend to be driven by the public sector procurer who is engaging industry due to an absence of state finance and inability to deliver increasingly technologically complex capabilities in-house. In contrast, the private sector procurers are driven predominantly through supplier-based

initiatives to supplement product offerings with the additional and ongoing value streams of maintenance and delivery of ancillary services. This points to a slight conceptual alignment issue, where despite servitization and product service systems appearing to derive the same phenomena of bundles, products and services, the word servitization tends to have a skew towards supplier-focused insights, and PSS tends to derive from public sector interests and emphasises the role of the buyer or procurer. Importantly, Hartmann et al., (2014) discuss the overemphasis on the generation of supplier-focused insights within the literature and point to the neglected perspective of the procurer - a perspective which was supported by the systematic literature review as a majority of articles were excluded in part due to the narrow focus on the supplier perspective.

Roehrich and Lewis (2014) -

Roehrich and Lewis have been shown from the Systematic Literature Review (SLR) to be major contributing influences to the current body of knowledge existing within the area of complex service system acquisition and toward the emergent domain that capsulated these themes of PCP. In their 2014 paper, they make the fundamental contribution of linking system complexity of the procurement domain with an increasing relational governance complexity. In a sense this paper acts a direct precursor to the research being explored within this PhD research. Given that relational governance complexity increases as systemic complexity of the procurement domain increased, this research seeks to understand what mechanisms and practice can be embedded within the acquisition lifecycle so as to effectively manage these systemically complex domains.

Johnsen et al., (2009) -

The authors investigate the UK defence sector as a singular cohesive case and focus their exploratory enquiry on deriving key characteristics of supply relationships embedded within this case. As this research centres initially on the defence case, the areas deemed relevant in Johnsen et al., (2009) are of immediate relevance to the project. The paper uses an exploratory qualitative technique to identify themes that describe the way in which the defence supply chain is changing through the CADMID model which was adopted in 2006. In their conclusions, the authors identify four key

themes that summarise the ways in which change is required in order to function effectively in an increasingly outsourced and complex environment:

- (1) A renegotiation of Strategic Boundaries – The authors describe the need to change the boundaries of where one organisation stops and another begins in order to form stronger more integrated relationships with an increasingly smaller list of suppliers that are providing large and more complex contracts. The shift in strategic boundaries is expressed as a shift from a “Fixed Contract” towards a “Dynamic Boundary” with shared and interconnected organisational processes, cultures and ways of working.
- (2) Movement toward integrated through-life support and servitization models: this theme describes the move from one-off monolithic procurement of complex products towards what is known within defence as “contracting for capability”. Under this approach the contract details that the supplier has responsibilities in ensuring that defence has the capability to undertake a certain set of tasks specified in the contractual arrangement, thus the supplier retains the responsibility for providing both maintenance and upgrades through in-service support to ensure the capability remains present. The authors point out that the defence suppliers recognise that through-life in service supports accounts for an equal proportion of their business as new build business, mimicking the wider pattern of servitization. This requirement demands an integrated approach over a transactional one.
- (3) Transparency and openness – Johnson et al., (2009) cite a number of key MoD white papers that highlight the issue of ‘trust’ that is derived through poor coordination of information and a perception of competing stakeholder interests between the procurer (MOD) and the supply chain partners. The authors describe an effective flow of information between the organisations as a means of combating the absence of trust and fostering a culture of openness. The role of technology features heavily as a means of collaborating tightly across inter-organisational boundaries and increasing the sense of mutual investment in a partnership over the transactional relationship between separate organisation entities.
- (4) Risk and benefit sharing – In order to move towards a more integrated partnering approach the ways in which each organisation perceives its role in managing risk receiving the benefit of successfully avoiding the realisation that is highlighted by the authors. Traditionally, the tendency is to transfer as much risk as possible onto the

partnering organisation while retaining as a majority of the benefit. New models of risk and benefit sharing allow the overall competitiveness of the supply chain to be higher thus increasing the overall efficiency through a collaborative rather than competitive means. This theme is strongly associated with the transparency and openness theme as a sharing of risk and benefits often necessitate a certain degree of openness and information transparency.

2.5.3 Step Five – ‘Snowball’ review of key themes, authors and studies.

As stated previously, the literature review is a two-stage approach linking a systematic literature review upfront in order to achieve a breadth of coverage of related topics and concepts Golicchia and Strozzi (2012). The second section then uses these relevant concepts, topics and authors to move into a snowballing narrative review so as to build an accessible and nuanced understanding of the subject matter. Taken largely from the key papers, the key authors, themes and concepts are detailed below in Table 6.

Key Authors	Key Relevant Themes	Key Concepts
Datta – Roy	Knowledge Management	Product Service Logic
Spring – Araujo	Supply Chain integration / Logistics	Industrial Product Service Systems
Caldwell	Risk Management	Procuring Complex Performance (PCP)
Howard	Outsourcing contract effectiveness	Indirect/Direct Capabilities and capabilities development
Hartmann	Supplier Selection / Evaluation	Co-Creation of value
Roehrich – Lewis	Application of technology	Complex Product Systems (CoPS)

Johnsen – Miemczyk	Operations Strategy	Performance Infrastructural complexity	&
		Through Management (TLF)	Life

Table 6 - Key Authors, Themes & Concepts Summary

Identifying the research gap (Part 2): As has been discussed in the preceding sections, there is a prominent dichotomy in the papers returned by the systematic literature review. Taken from these papers has been a smaller sub-section of critical papers that describe a range of relevant issues in detail. The author used this sub-section of papers in order to generate a list of key authors, concepts and themes. These elements were used in an extensive narrative review in order to understand the full degree to which these areas have currently been explored, and ways in which further knowledge generation could be of benefit.

The following narrative review provides the conclusion of this snowballing process, outlining and understanding of the problem space, identifying the key concepts, discussing the applications of theory and providing an investigative framework for use within the methodology.

2.6 The problem space and Research Gap

Contracting for products and services accounts for a significant and growing proportion of public sector spending, and is being applied toward an increasingly diverse range of applications (*Bel et al., 2010; Radin, 2012*). The shift from in-house to outsourced arrangements has been described as ‘remarkable’ in terms of their scope and pace (*Bowman, 2015*) with estimates being of around £1 in every £3 of government spend being directly contracted to private sector providers (*Gash et al., 2013*).

A narrowing of what can be viewed as a firm’s ‘core competency’ and a greater requirement for public engagement with activities exhibiting high technological complexity (*Oliva & Kallenber, 2003*) have led to more complex contracting arrangements emerging which is especially true of the public sector (*Brady, 2005*).

Attempts within the academic community to classify this expanding area has resulted in a myriad of terms being used to describe the different facets of complex contracting (*Rayners, 2013*). A notable definition is that of a Public Private Partnership (PPP hereafter), a concept that has attracted some considerable confusion as to its exact meaning (*Weihe, 2008*). The concept of a PPP has considerable overlap with the emergent complex contracting phenomenon despite its focus upon the public sector. Hodge (*2010*) describes five variants of the PPP; Institutional cooperation, long term infrastructure contract, public policy network, civil society and community development, and urban renewal. Alternative variants of the PPP are discussed by Rayners (*2013*) as: Long term infrastructure contracts or design-build-finance-maintain operate (DBFMO) contracts, whilst these are not entirely interchangeable with PPP definitions of Hodge (*2010*) they each explain the emergent phenomena of complex servitized contract procurement from distinct perspectives. Baker (*2012*) discusses the concept of the strategic service partnership as a more developed and integrated form of a public private partnership, describing it as a ‘co-equity’ partnership that is formalised in a joint venture organisation with a management structure seeded from both the originating private and public organisations.

In order to account for the myriad of overlapping and conceptually similar terms this work borrows from the wider operations management research in order to simplify this heterogeneous group of terms. This is done by positioning the research into PCP (procuring complex performance), within the wider domain of CoPS, as a unifying concept that can be used to address the emergent challenges of complex contracting.

The challenge of increasing dependence on outsourcing is well understood within public sector procurers of CoPS, with many critical UK institutions citing their waning acquisition programmes, and affirming the requirement to better understand the current outsourcing landscape through industry and academic engagement. The Ministry of Defence (MOD) is a significant contributor to the growing interest in acquisition within complex domains owing to their increasing reliance on the provision of complex contracting, an area in which MOD is currently underperforming by its own admission (*MOD, 2016*). The current inefficiency within the areas of complex acquisition is palpable within the defence context. In the latest Review of Acquisition for the Secretary of State for Defence it was stated that:

“The average programme overruns by 80% or c.5 years from the time specified at initial approval through to in service dates” (Gray, 2009; p7)

“The average increase in cost of these programmes is 40% or c.£300m. This study also estimates that the “frictional costs” to the Department of this systematic delay are in the range £900m - £2.2bn pa.” (Gray, 2009; p7).

In the context of the defence sector, the inefficiencies within the acquisition system are set to increase as the dependence on outsourcing is set to expand with the total ten year projection for equipment alone being at £178bn from 2016 to 2026 (MOD, 2016). The current procurement practices have been described as lacking in terms of both the agility of acquisition practice to meet changing demand, and the overall capability of service provision (Prins & Salisbury, 2008). A significant proportion of the research into addressing the emergent challenges of complex contracting and acquisitions in previous research has emanated from the defence context (Caldwell & Howard, 2014; Datta et al., 2010).

There have been similar inefficiencies observed within other monolithic public service sectors such as public health. Within the NHS, there has been significant acknowledgement of the shortcoming of the current acquisition lifecycle practices, and their requirement to improve this through understanding best practice and academic engagement:

“Very few senior stakeholders, executives, clinical and operational leaders know what best practice looks like and many often experience inconsistent performance and variable outcomes from their procurement teams” (NHS England, 2013)”

“The production, publication and sharing of procurement best practice and related case studies across the NHS is negligible. It is almost impossible to identify publications of relevant best practice (NHS England, 2013).”

“Health was once recognised across government for driving thought and leadership in procurement and supply chains, particularly research into global and international healthcare markets in conjunction with academia and in engaging healthcare industries to encourage supplier innovation. These strategic, centre-led activities no longer exist (NHS England, 2013)”

As derived from the above extracts and the systematic literature review, these large procuring organisations recognise that the issues associated with the efficiency of acquisition practices amongst procurers of complex contracting requirements are intricate and multifaceted. However, both internal organisational level assessment of these practices (*MOD, 2017*) and the wider literature both point to a loss of expertise and in-house capability as a key theme in understanding organisations' increasing inability to effectively specify and orchestrate the process of complex outsourcing (*Davies & Brady, 2000*). The increased complexity of contemporary large-scale procurements has led to an increased requirement for inter-organisational capabilities, specifically with the competencies of contract management, relationship management and project management featuring as a set of increasingly important disciplines (*Davies and Hobday, 2005; Johnsen 2009*). This change in focus, toward a narrowing set of core competencies and the loss of industry specific knowledge had resulted in a situation where procurers of complex requirements are systemically disadvantaged by both the architecture of the marketplace and focus of research leading to a position whereby procurers 'know rather less than they buy' (*Flowers, 2007*). In contrast to this pronounced scholarly and practitioner shortfall of knowledge, much of operations and supply chain management research focusing on procurement has been directed toward knowledge creation within fast moving, high turnover and often consumer facing markets (*Moncza et al., 2010*) as was observed first hand in the systematic component of this review.

2.6.1 Research Gap

The realities of procurement in a contemporary context are changing toward more interactive, longer-term arrangements with increased efficiencies offered through technological innovation (*Howard and Caldwell, 2010*). In the domain of contemporary complex contracting, these new innovations in procurement are still not sufficiently aligned with the challenges raised by the field in complex, long-term acquisitions (*Lonsdale, 2005*). There is an increasing amount of capital flowing through the procurement systems designed to procure complex product systems. This is due to both an increase in the requirement for specific measurable outputs from contractors (a pronounced problem within the public sector), and the bundling of often proprietary technologies with associated services in servitized business models (*Howard and Caldwell, 2010*). These changes lead to an alignment problem between

the focus of the research that is being undertaken and the tangible requirements of industry.

From the industry perspective; the relative infancy of such complex outsourcing arrangements is driving a lack of coherence within the literature and is prompting calls from practitioners to understand how to achieve success within complex contracting (MOD, 2005). Previous research has described the existing knowledge body as ‘provider-active’ in addressing the understanding of complex outsourcing relationships (*Roehrich & Caldwell, 2014*) and had a tendency to cognitively segregate the capabilities to support service acquisition from the capabilities required to effectively support product acquisition, when the trend has long been moving toward the bundling of product service systems in a variety of domains (*Oliva & Kallenberg, 2003, Cusumano, 2008*).

This trend towards integrated product-service systems has realigned the core capability profile of large outsourcing organisations to focus upon the delivery of service flexibility, and through-life management of ongoing maintenance, repair and replacement services (*Davis & Hobday, 2005; Oliva & Kallenberg, 2003; Araujo & Spring, 2006*).

These trends, in combination with the discontinuity between research and industry focus, has begun to be addressed over the last few years through the emergence of PCP as a research concept. PCP acknowledges the unique constraints and capabilities required in order to solve the challenges of complex contracting of product-service systems within increasingly outsourcing dependent environments like Defence.

This research seeks to contribute to the growing body of work surrounding the concept of PCP which is currently only being championed by a small number of scholars and institutions, despite the prevalent requests from industry. This research seeks to contribute to the domain in the following ways:

- By further addressing the gap in ‘procurer active’ knowledge that was apparent within the systematic component of this review, contributing to the generation of insights that are of utility to procurers operating within a PCP domain (*Baker et al., 2012, Caldwell & Howard 2014*)
- By further contributing to the empirical body of knowledge surrounding PCP especially by observing and analysing the processes being undertaken across a

range of case organisations thus building up a working understanding of what models, strategies, tools and techniques are being brought to bear to address the problems present within a PCP domain.

- By creating a method of facilitating best practice transfer amongst PCP-orientated firms. This is currently a difficulty as PCP firms are inherently unique in more ways than their fast-moving supply chain counterparts. The observations that complex procurers can benefit from benchmarking is widely cited (*Gobbi & Hsuan, 2015*).
- Lastly, to create a working conceptual model of what capabilities are of importance when attempting to address the problem space of PCP, building on previous working in defining the problem space (*Caldwell & Howard, 2010*).

2.7 Prevailing concepts in operations management research

The systematic literature review has provided the author with an overview of the prevailing concepts that are relevant to the research area. In order to build on this grounding, the second stage of this review focuses upon fully exploring those concepts as well as the linkages between them by performing a ‘snowball’ review of the key papers, concepts and authors.

PCP has been identified within the systematic component of this literature review to be a potential unifying concept that aligns all other relevant concepts within the correct context. As a result of this, the paper organises the snowball review of concepts around PCP, discussing each of the other concepts in terms of their relevance to PCP.

2.7.1 Procuring Complex Performance (PCP)

PCP was first observed within the paper by Lewis and Roehrich (2009) and characterised as “inter-organisational arrangements that are characterized by significant levels of performance complexity and infrastructural complexity”. Firstly, the notion of performance complexity in this context can be thought of as the interrelatedness of knowledge intensive activities required to ensure an effective outcome to both parties (*Hartman et al., 2016*). This definition keeps PCP aligned with the classification of CoPS put forth by Ren and Yeo (2006) which is a closely related concept that is discussed in this snowball review. The second of the complexities which features in Lewis and Roerich’s original definition is that of infrastructural complexity. Infrastructural complexity refers to the systemic

complexity in the tools, process, infrastructure, and technologies required to execute any particular action (Brady *et al.*, 2005). The general purpose of the literature that surrounds the still emergent area of PCP is to identify and understand the full range of phenomena that impact upon procurements that exhibit high levels of both of these forms of complexity. Due to this being a relatively broad remit, the PCP perspective has overlaps across numerous other academic areas of study. The PCP perspective is therefore taken as the central concept that links all relevant concepts that are pertinent in defining and executing this study. As such, the review will take the form of explaining the state of knowledge regarding PCP upfront, and then follow with an exploration of all the interrelated concepts that apply..

One clear conceptual relationship is between PCP, the domain of COPS (complex product systems) and the older concept of servitized business models. Procuring complex performance in a servitized environment is a concept that straddles the traditional view of both procurement and outsourcing, and can be described from either perspective. A more specific understanding of PCP can be created with reference to the domain of COPS, given that PCP is principally the procurement of goods and services within the domain of CoPS (figure 4). COPS typically deals with the more integrated and complex asset and service acquisitions. This broad characterisation of these concepts and their relationships to each other is depicted below in Figure 6:

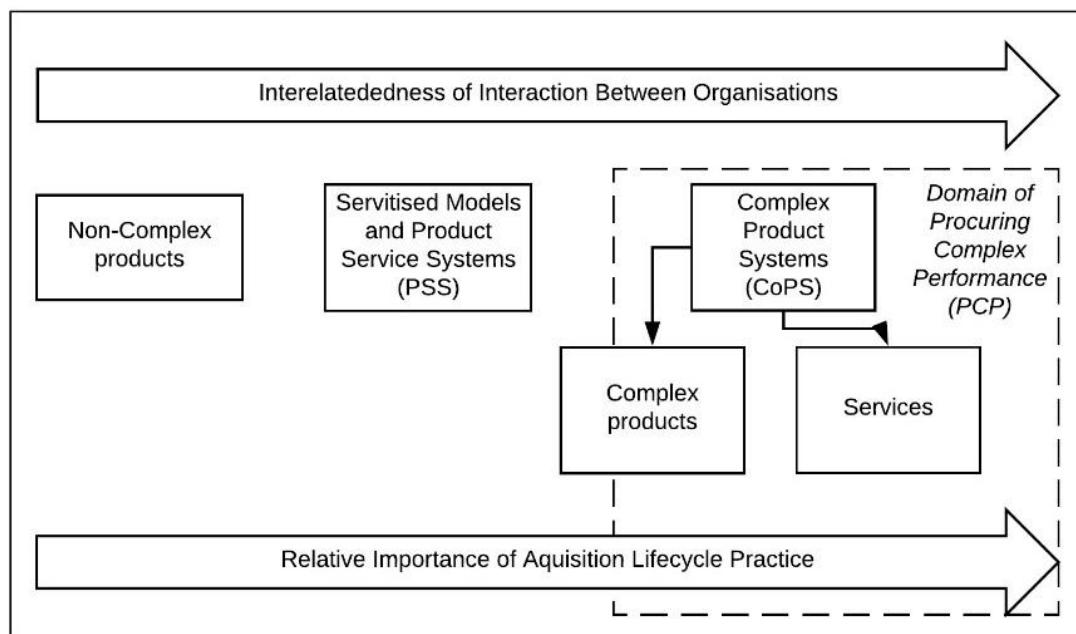


Figure 6 - Understanding CoPS vs PCP

The technical complexity and longitudinal nature of these endeavours necessitates that the procurement initiative requires competencies more closely aligned to strategic outsourcing than to high throughput purchasing and procurement competencies. Indeed, traditional procurement best practice and tools such as Kraljic's matrix (*Kraljic, 1983*) are described by Howard and Caldwell (*2010*) as failing to transfer into the context of complex product systems as effective strategies. The reasons for this are that traditional procurements fail to take into account both the infrastructural and performance based dimensions of complexity (*Lewis & Roehrich 2009*) whilst also forwards ideas of continuous and uniform demand that are not implicit in the CoPS or PCP context.

Equally, the traditional view of strategic procurement is also not entirely transferrable into the context of PCP. From the perspective of a traditional strategic outsourcing decision Quinn & Hilmer (*1994*) delineate four central motivations for outsourcing:

- the maximisation of internal resources through an increased focus on core competencies;
- form barriers against new market entries through well-established core competencies;
- full utilisation of external organisations investments in innovation that would prove difficult to replicate internally;
- decreased risk and increased responsiveness through shared responsibility for innovation.

These four principles broadly hold true today, but as applied to a contemporary context of PCP they are arguably better viewed as reasons why in-housing is non-viable as opposed to outsourcing is desirable, as these factors are essentially qualifying criteria for effective operations and not strategic motivations to achieve competitive advantage. Additionally, in Quinn and Hilmers (*1994*) the central motivations are centrally concerned with profitability and market strategy. Such concerns are less relevant to the public sector organisations that constitute a significant number of those organisations that are engaged in PCP. The PCP domain is further differentiated from the 1990s context of strategic outsourcing theory in a number of important ways that position the research stream as 'unique' but whilst retaining numerous shared concepts

with purchasing, supply and strategic outsourcing. Whilst informed by a number of the traditional strategic outsourcing characteristics the domain of PCP operates at the intersection of a number of research themes, concepts, industries and contexts. In order to illustrate and bound the areas of PCP the research explores these intersecting areas.

The key contributing areas relevant to defining the PCP space are:

- Servitization (Olivia & Kallenburg, 2003)
- Increased procurement complexity (*Lewis & Roehrich, 2009; Araujo & Spring, 2010*)
- CoPS – Complex Product Systems (Davies et al., 2007, Ren & Yeo, 2006)
- Oligopolistic Markets (*Roehrich et al, 2014*)
- Highly integrated organisational relationships and the need to achieve Co-Creation of value.

2.7.2 Servitization

Of the most prevalent prerequisite conditions to permit a shift towards a PCP environment is the bundling of services into product offerings from supplier to procurers, the model is referred to as servitization. The historically prevalent separation between product and service has been increasingly eroded over the last few decades, with scholars pointing to these factors being viewed as clustered commercial offerings, instead of the traditional view that considered these items as opposite ends of a spectrum (*Oliva and Kallenberg, 2003, Araujo & Spring, 2006*). The new paradigm privileges service-based flexibility in the trough life management of ancillary contractor service such as ongoing maintenance, and intermittent upgrades to correct for changes in the outside market or keep up to date with the latest technical developments (*ibid.*).

The coalescing of product and services are driven by a combination of factors. Firstly, from the suppliers' perspective, the supplier is incentivised to develop a secondary revenue stream that continues beyond conclusion of the procurement of the initial purchase. This perspective is hardly novel, in the late 1980's Vandermerwe and Rada (1988) posited three central reasons for manufacturing firms to servitize: To 'lock-in' customers, to exclude competitors or new market entrants and to diversify the organisation's revenue stream. Secondly, Wise and Baumgarntner (1999) posited the idea of high initial asset investment to establish the manufacturing capabilities

furthering the ‘lock-in’ effect upon a prospective customer, e.g. a manufacturing plant. This effect is particularly pronounced in areas relating to CoPS and PCP as there is often such a high initial investment.

From the procurers’ perspective, organisations are incentivised to contract for servitized offerings because of the wider phenomena of added-value shifting away from the contractors’ labour and more towards the provider’s intellectual expertise (information & knowledge) (*Correa et al.*, 2007). The added value of a supplying organisation’s (often proprietary) intellectual knowledge-sets often leads to a self-selecting monopoly for ancillary services relating to assets known intimately by only one provider thus causing the bundling of physical properties with heterogeneous service properties as the supplier of the asset is often the only organisation capable of effectively undertaking the maintenance (*Correa et al.*, 2007). The lock-in risk between particular procurers and suppliers is having a detrimental effect on market competitiveness, however this process does create a stability in the capabilities within the market that can result in reduced risk as there is one stable and dedicated oligopoly of suppliers (*Slack*, 2005). Again, this is more applicable in those areas with highly-complex, long-term contractual initiatives.

These pressures are the central cause of organisations like the MOD shifting towards a ‘contracting for capability’ model that places additional emphasis on its major supplier base such as British Aerospace Engineering and Rolls Royce (MOD, 2005). Indeed, owing to the effectiveness of this servitized models, Rolls Royce has now for some time acquired around 50% of its total overall revenue from services (*Baines & Lightfoot*, 2013). Additionally, the drive towards alternative contracting models and the move towards servitization contractual operations has been exacerbated by wider trends in general economic activity (*Howard & Caldwell*, 2010). The boundaries that previously prohibited this action from the perspective of the procurer are eroded as trends such as globalisation, and communications technologies are creating an increasingly interconnected world which blurs organisational boundaries with seamless connectivity of intra-organisational processes, thus removing a traditional motivation to provide an ancillary service in house (*Oliva & Kallenberg*, 2000). This is especially true of information and communication technologies that ease the friction of frequent and intensive communications between separate organisational entities. Whereas previously the difficulties in communicating with a supplier would have

required that the organisations undertook a particular process in-house, there is now the option for this exchange to be hosted virtually, removing some of these natural barriers (*Slack, 2005*).

In addition to the advantages offered through the exchange of general communications, specialist technologies can aid in the introduction of supplier operations within a procurer's domain such as remote monitors systems for procurer owned but supplier monitors assets such as vehicles, or large machinery (*Neely, 2008*). With the relatively recent introduction of RFID-enabled tracking systems (*Barrat & Choi, 2009*) the boundaries for jointly conducted operational practice are only set to continue to diminish.

Servitization is therefore a growing trend that is set to intensify as these natural barriers continue to be eroded thought technological and procedural innovation. This effect is exacerbated in PCP and COPS environments where the increased knowledge requirements in these areas cause natural monopolies of capability. Thus the need to understand why and how firms are opting for servitization business model is of ever increasing importance (*Baines & Lightfoot, 2013*). A seminal article into the motivations to engage in servitized or collaborative contracting models are described and organised by Oliva and Kallenberg (*2003*), where the authors delineate three major categories of motivation:

- **Economic pressure:** Deriving revenue from the services in addition to the original products gives an additional source of revenue to the supplier. Typically there is a higher margin for services than for products, compounding the economic incentive. This only takes the form of an incentive from the perspective of the supplying organisation.
- **Lean market pressures:** The pressure to concentrate on core competencies and specialise in an increasingly narrow field of operations has been a prevalent trend globally. This trend pushes non-core activities upstream to suppliers (e.g. product maintenance, spare parts management) and horizontally to expert organisations (E.g. I.C.T, HR) within the value chain.
- **Competitive pressures:** Specialisation of a particular service provision offers a source of competitive advantage for the supplying firm. This effect is

exacerbated in highly technical areas, or those typified with significant levels of intellectual property.

Oliva & Kallenberg (2003) proposed a matrix summarising the variety of outsourcing relationships which can be used to consider the spectrum of servitized business models.

	Product- orientated services	End-user's process- orientated services
Transaction- based services	(A) Basic Installation services	(B) Professional services
Relationship- based services	(C) Maintenance services	(D) Operational services

Source: Oliva & Kallenberg (2003)

The degree of complexity and co-dependence in the relationship increases as the relationship moves from top to bottom, and from left to right with operational services being the most highly complex and co-dependent relationship type. In summary,

- (A) **Basic installation services** are discrete activities undertaken in order to transition the product into a useable condition within the purchasing organisation's enterprise. E.g. Transportation, installation, refurbishment, recycling.
- (B) **Professional services** are discrete activities not-directly related to the operation of the product. E.g. R&D, consultancy, training, stress testing.
- (C) **Maintenance Services** continuous (within the contract term) activities directly related to the product's operations. E.g. Full maintenance contracts, spare part management etc.
- (D) **Operational services** represent the most integrated approach, where the service provider assumes partial or complete operational control of the product. E.g., managed maintenance function, management of operations.

Within the context of non-capital goods procurement, the distinction between outsourcing and procurement has been eroded but is still broadly true. Goods can either be procured on a one-off transactional basis, or as part of a PSS (*Baines et al., 2007*). These PSS's can vary in the relative contribution of the service component that

is associated with the product as demonstrated in the Oliva & Kallenberg classification. A ‘basic installation service’ offered by the supplier would be classified as a PSS, albeit one that is strongly weighted toward the product. However, in the event that a supplier overtakes significant control of the product, then the weighting of any servitized arrangement shifts strongly toward the service component of the PSS (Operational Services). In this second example, the product has become the delivery mechanism for the more substantive and economically significant service bundling within a service-dominant logic (*Vargo & Lusch, 2004; Ford, 2011*).

It is these heavily servitized operational elements (described in D items) that are common-place within the complex contracting domain of organisations like MOD and those typically featured within the PCP literature. The procurement of complex contract activities typically occurs within the context of longstanding sophisticated extra-organisational relationships beset by complex governance issues (*Caldwell & Howard, 2014*). The additional complexity posed by a complex product systems domain has caused the area to be regarded as distinct and characteristically separate to an ‘ordinary’ servitized PSS. This demonstrable, characteristic difference is demonstrated by Meier et al (2010) who describes the area as an ‘Industrial Product Service System’ which is “*...characterised by the integrated and mutually determined planning, development, provision and use of products and service shares including its imminent software components in Business-to-Business applications and represents a knowledge intensive socio-technical system*” (p608). Baines et al (2013) describe the highly complex forms of servitization B2B interactions as advanced services that constitute a ‘special case’ within the wider servitization models. The special case described is akin to the ‘D’ category items that are identified by Oliva and Kallenberg (2003), as well as the Industrial Product Service Systems that are discussed by Meier et, al (2010). Whilst not direct equivalents these partially overlapping concepts all discuss the still emerging form of servitization models of organisational interactions that govern B2B interactions in the most complex of areas. Owing to the unique challenges presented within these complex domains, the skills set for establishing and managing B2B interactions is distinct from the capabilities governing lower complexity traditional B2B arrangements (*Datta & Roy, 2010; Baines et, al, 2013*). As a result of this, the field of Procuring Complex Performance (PCP) has emerged to explore the challenges faced in these complex areas from the perspective of the

procurers. The environment of requires the generation of a diverse and prominently unique set capability and competencies on the part of both supplier and procurer in comparison with low-complexity servitized business models.

2.7.3 Increased procurement complexity:

Arguably the most definitive characteristic of PCP is the dimension of complexity, in that the domain explores the acquisition of good and services that are typified by a high level of aggregate complexity. In considering complexity within the context of procurement, Lewis & Roehrich (2009) delineate the phenomena into two subordinate constructs of complexity: Performance complexity (*Danaher & Mattsson, 1998*) and infrastructural complexity (*Brady et al., 2005*), a classification that is widely employed within the PCP literature (*Howard & Caldwell, 2010*). The former is an expression of the multiplicity of characteristics required (by an individual, organisation or value chain) to effectively undertake a given task (procurement in this context). A typical example being the requirement for a professional to hold both tangible knowledge requirements (medical degree) and interpersonal skills (bedside manner). At the organisational or value chain level the plurality of necessary characteristics is markedly more numerous and diverse (*Araujo & Spring, 2010*). In the case of a complex procurement the performance complexity varies according to each case but is generally manifest in elements such as knowledge management, technical expertise, project management, risk management etc. The latter construct of infrastructural complexity is described as the infrastructure through which performance is enacted (*Lewis & Roehrich, 2009*) and accounts for the multiplicity of actors, hardware and software elements required to effectively undertake a given task. These two dimensions as applied to procurement and outsourcing can be presented in a matrix in order to classify the aggregate complexity of any particular procurement initiative (Figure 7).

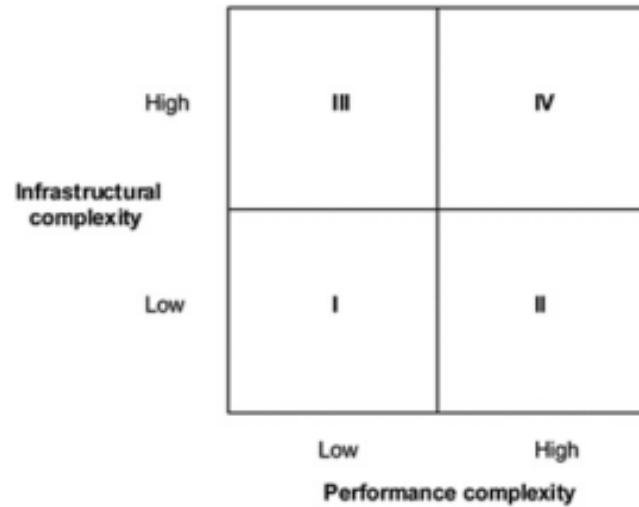


Figure 7 - Complexity Matrix (After: Lewis & Roerich, 2009)

The total aggregate complexity deriving from performative and infrastructural complexity causes differences in emergent practice when compared with those practices observed in traditional procurement. Most notable of these is the move away from discrete separation of capital good and ancillary services in contractual terms, and a move towards monolithic contracts that employ numerous metrics to guide the project outcomes through-life (*Araujo & Spring, 2010*). PCP is characterised most notably by these types of complex contracting requirements. With reference to Figure 7 , PCP projects would most typically occupy quadrant IV, displaying the highest levels of aggregate complexity. While this and other such typologies are useful in conceiving the role of PCP, Lewis & Roerich (2009) in their operationalisation of these constructs point to the need for further work in deriving the precise differences of procurement activity in terms of overall complexity.

2.7.4 CoPS

The formation of much of the PCP research has referenced the work on complex product systems, as a defining characteristic of any PCP acquisition is the complexity of the product or service that is being acquired (*Howard & Caldwell, 2010*).

CoPS represent a growing area within operations research, and is often considered to be strongly associated with the capital goods market (*Davies et al., 2007; Fischer et al., 2012*). CoPS are described as product service systems that: “*have a long product life cycle, including pre-production bidding, conceptual and detailed design, fabrication, delivery and installation, post-production innovation, maintenance,*

servicing and sometimes, decommissioning; “and that “involve a certain degree of technological novelty and innovation” Ren and Yeo (2006, p522)

As a result of these characteristics, CoPS are also strongly associated with a number of distinct and emergent research streams including the aforementioned Servitization and PSSs, which can be viewed as predecessors to CoPS research (Baines et al, 2013; Raddats et al., 2016). The characteristics that differentiate a PSS from a traditional procurement are often the same as those that differentiate a CoPS to a PSS (Raddats et al., 2016, Smith et al., 2014) although they do so to a greater degree. Thus a categorisation between these phenomena can be conceived as a linear progression; the higher the complexity, duration and integrative nature of a servitization procurement the more closely it aligns with the definition of CoPS (Caldwell & Howard, 2011).

CoPS research poses a set of novel acquisition considerations that are not found within the mass production and consumer goods literature (Ren & Yeo, 2006). As such, CoPS represents a distinct stream of academic undertaking, the significance of which is only set to increase, as, owing to a broad cross-industry adoption of automation, intelligent systems and generally more advanced technologies, the trend for organisations to focus narrowly on their core competencies and outsource is expected to continue (*ibid*). This places a greater impetus on the need to understand the key success factors associated with inter-organisational relationships such as in the domain of PSSs and CoPS.

More specifically, continuing outsourcing trends are emphasising the need to understand the procurement of CoPS between the whole ranges of stakeholders. Research to date has discussed numerous contexts inclusive of the motivations underpinning servitization (Raddats et al., 2016), supplier capabilities in the provision of CoPS (David & Brady, 2000; Brady et al., 2005) and product to service transitioning (Smith et al., 2014). Numerous other prevalent works on CoPS research focus on the comprehension of complex product-services and their effects on inter-organisational collaborations (Brady et al., 2005; Davies et al., 2007; Hobday 1998; Miller et al., 1995).

The procurement of CoPS poses numerous difficulties over and above the traditional ‘fast throughput’ view of procurement (Davis and Hobday, 2005; van Marrewijk et al., 2008) which has occupied the majority of the research effort into ‘best-practice’

procurement in recent decades (*Womack et al., 2007; Van Weele, 2005; Moncza et al., 2010*). Caldwell and Howard (2014) point out one such significant difference is that the prime contract often governs servitized elements of maintenance and repair, but that the core procurement item (such as an aircraft carrier) often acts as a platform operational over a significant time period, the life of which far outstrips the life of both the parts supporting the carrier, as well as the technologies and processes used to support it. Thus the contractual and organisational complexities required to support the initiative are required to be dynamic over time and forward thinking in the setting of their initial conditions.

Amongst the seminal works discussed, there is a prevailing absence of procurer-focused knowledge. In order to address this, a number of contemporary research efforts have discussed the other side of the principal–agent relationship within CoPS domain, which is what defines the relationship between CoPS and PCP where CoPS is the domain and PCP is the knowledge that can be brought to bear in being able to procure effectively within this domain (*Roehrich et al., 2014*).

2.7.5 Oligopolistic Markets:

One of the central components of PCPs unique positioning within the domain of procurement, supply and strategic outsourcing has been the range of market options that are available for PCP acquisitions specifically, PCP markets are often limited, highly skilled, niche oligopolistic environments (*Caldwell & Howard, 2014*). The required capabilities for acquisitions to be successful in these environments are numerous and have been largely under researched (*David & Hobday, 2005; Van Marrewijk et al., 2008*), in comparison with the relative abundance of attention applied to deriving best practice and competencies amongst fast moving, highly competitive marketplaces (*Womack et al., 1990; Van Weele, 2005; Moncza et al., 2010*). The cost overruns that are seen within the public sector procurers of complex product systems in a PCP environment where the procurers are interacting on what is often a one-to-one basis, are shown not to have benefitted from the capabilities required to achieve cost efficiencies in competitive highly vibrant market places (*Grey, 2009; Heynes, 2012; Caldwell & Howard. 2014*). As such there is a need to derive a set of competencies that offset the negative impact of this capability-scarce operational environment.

Oligopolistic markets, lacking in competitive pressures are shown to lead to low levels of cost efficiency in the general case (*Appelbaum, 1982; Sherer & Ross, 1990*). In the case of PCP type acquisitions of CoPS there is a tendency for suppliers to be in oligopolistic market as a consequence of the highly technical, specialised or expansive requirement placed upon the supplier in order to provide CoPS. These complexities create an exceptionally high barrier to entry that deters a redundancy of capable suppliers from existing within the marketplace as in overwhelmingly the case with defence and long-term infrastructure projects (*Caldwell & Howard, 2014*). Hence within the PCP-CoPS environment the capability requirements change, and realign away from the ‘efficiency’ of the procurement effort that extract the most from the market and towards co-operation and co-creation of value (*Lavie, 2006*) that allows co-dependent organisations to minimise operating costs.

2.7.6 Co-Creation of Value

For the reasons described in the above section, the PCP environment is typified by the need to orchestrate the effective co-creation of value between the two allied organisations of ‘procurer’ and ‘supplier’.

Value in the traditional meaning is the addition of worth to a product or item through the application of labour and expertise (*Dyer & Singh, 1998*). In the previous two decades the concept of competing organisations was reimagined as competing value chains where numerous organisations were logically bound in a linear progression of value addition to a product, each adding their own unique value to a product so as to outdo there competing rival value chains (*Ramirez, 1999*). In contrast, the contemporary setting sees that capabilities that make-up an organisation’s value proposition are far more diverse than simply to enhance or produce a product efficiently (*ibid.*). More recent research has raised and discussed the value on focusing on an organisation’s capability to extracting value from the B2B relationships between organisations. (*Kickul et al., 2011*).

Henneberg et al., (2009) make the distinction between two types of value creation ‘internal value’ and ‘relational value’. Internal value can be described as the effectiveness of capabilities of the organisations to create or add value to a product or service. Relational value is the organisation’s capability to extract value through the B2B relationships and transfer this to the aggregate value of the final product/service

offering. Significant research has been undertaken in exploring the mechanisms and inter-organisational models used to exploit this relational value (*Cheung et al., 2010; Lindgreen & Wynstra, 2005; Vargo & Lusch, 2004*) although very little into the mechanisms for building up these relational value capabilities in the domain of PCP specifically (*Hartmann et al., 2014*).

2.7.6.1 Capabilities creation

So far within this review, it has been demonstrated the consensus surrounding PCP is that there are unique sets of capability required within PCP in comparison with traditional procurement or strategic outsourcing (*Howard & Caldwell, 2010*). Furthermore that benchmarking is a necessary and powerful tool in establishing and transferring emergent forms of value-adding capabilities between PCP organisations (*Gobbi & Hsuan, 2015*). As such the process by which value-adding knowledge, and new capabilities can be added to a procurement process is at the centre of this research.

Capability creation is the process of embedding best practice and value adding knowledge within the organisation's structures, normative routines, explicit policy and practice (*Zollo & Winter, 2002*). The means through which capabilities are generated is through the transformation of newly introduced novel processes into established and well-rehearsed processes through practical repetition (*Brady & Davies, 2005*). This view in combination with Gobbi and Hsuan (2015) gives a basic model for the transfer and adoption of new capabilities. That being: value adding capabilities can be observed in other organisations, adopted within the host organisation and then customised to fit the receiving organisations over time.

Capabilities can be conceptually divided into operational capabilities and dynamic capabilities. The former can be loosely be thought of as the efficiency with which organisations execute their routinised behaviours, encompassing the degree to which these behaviours are fit-for-purpose (*Zollo & Winter, 2002*). An important distinction generated throughout an examination of the literature pertaining to PCP is that the practical and academic consensus of best or effective practice established in the 'provide-active' manufacturing viewpoints do not carry into the PCP and CoPS domain (*Grey, 2009; Heynes, 2012; Caldwell & Howard, 2014*). When discussing the case of operational capability, it is therefore of relevance to point explicitly to the fact that poor or inappropriate organisational capabilities can be adopted and

operationalised effectively. Thus an organisation can become highly competent at the execution of an undesirable or at least non-ideal process. The latter capabilities type is dynamic capabilities, which is an expression of an organisation's ability to reform the organisational structures, normative routines, explicit policy and practice into more effective or appropriate variants based on a change in the operating environment of the organisation (*Teece et al., 1997*). Both of these concepts are key in comparing the capabilities of each of the case organisations investigated as part of the multiple case study undertaken within this research.

Heartman et al., (2014) further delineate two manifestations of these capabilities that are most centrally pertinent in the domain of PCP. These being contractual capabilities and relational capabilities. The contractual capabilities are the practices surrounding the formation and execution of the formalised contractual relationship in the procurement, e.g. the contracting mechanism. The contractual mechanisms are where current established best practice principles are explicitly stated in order to derive the most out of the joint venture (*Vanneste & Puranam, 2010*).

Relational capabilities are those seen in the inter-organisational mechanisms that govern inter-firm communication. The effectiveness of these practices play a role in organisations establishing trust, building capable systems that capture and exploit joint organisational learning (co-creation of value). The contractual capabilities are often explicit whereas relationship capabilities are less tangible soft skills that govern the socially complex routines engaged in by supply chain partners. The concept of relational capabilities has significant conceptual overlap with Cohen and Levinthal's (1990) definition of absorptive capacity. Both concepts describe the effectiveness of the organisation's functional learning apparatus as applied to making use of externally sourced inputs. Davis & Hobday (2005) make this comparison and draw from the work into absorptive capacity to conclude on the essentiality of defining clear pathways for accumulation of knowledge over time within complex systems. Thus this argument stresses the case for models of iterative refinement in transforming the suitability of internal process to extract maximum value from the external inputs.

Both capabilities are required to support the creation of effective aggregate capabilities throughout the procurement process whereby the tangible mechanisms such as electronic procurement systems and shared assets are supplemented by a mutually trusting and collaborative environment (*Mahapatraa et al., 2010*).

2.7.6.2 The need for capabilities

It has been discussed that research has traditionally neglected the challenges in developing organisational capabilities to support procurement capabilities (*Lam, 2005*), specifically those ‘dynamic capabilities’ are arguably of the most importance in the rapidly changing technically sophisticated areas such as COPS and PCP. It is a long established principle that the introduction of new operational capabilities in the form of technologies requires a significant readjustment of organisational structure, skills and relational capabilities within the organisation (*Fichman & Kemerer, 1997*). In contrast to the known requirement for significant readjustment in the face of dynamic capability adjustment in highly technological firms, there has been little to no attention paid to the investigation of this phenomena within procurement and PCP (*Hartmann et al., 2010*). This research is therefore attempting to address this by focusing upon those core capabilities that create effective procurement within the PCP domain. While there has been significant research into the relationships that govern inter-organisational value building, there is a pronounced absence of research within the area of tangible operational capabilities that apply to PCP. Relational capabilities may benefit from being someone ubiquitous across sectors, however the operational capabilities to effectively support the co-creation of value within PCP are distinct and non-transferrable (*Ethiraj, et al., 2005*).

2.7.7 Specifying the research inquiry (Part 1)

PCP differentiates itself by focusing on the challenges of developing and maintaining organisations’ structures and procurement strategies that can extract value whilst operating within the multi-faceted area of CoPS. PCP shifts the focus away from the supplier by giving precedence to the inter-organisational relationship governing the complex outsourcing initiative (*Roehrich et al., 2014*).

While a focus on governance of inter-firm relationships is pivotal, this research seeks to make an original contribution amongst the still emergent PCP literature by taking a holistic view of acquisition lifecycle practice from the perspective of the procurer, and not on the relationship or governing contract. Specifically, instead of a focus on governance generally, the thesis proposes that the acquisition lifecycle practice of the procuring organisation is the central means through which a principal (procurer) seeks to control the self-interested behaviour of the agent (supplier). Furthermore, the

acquisition lifecycle is a vehicle within which the procurer has embedded newly required capabilities as described by Heartman et al. (2014). Therefore, a holistic exploration of these acquisition lifecycle practices can offer a plausible unifying view of acquisition activity, acting as a pillar of reference from which industry-wide accepted process (isomorphisms) may be derived in any respective emergent discipline.

2.7.8 TLM and Acquisition Lifecycle Practice

In order to further establish the relevance of taking the aforementioned approach toward the inquiry, it is necessary to make a further conceptual link between concepts specifically, between TLM practices and the decision to investigate the acquisition lifecycle practice of organisations as the driving force between capabilities' development and execution.

Fundamentally, the pressures to servitize and the emergence of PCP are both phenomena that stem from the increased economic pressures placed upon organisations in both private and public sector to extract greater value from core competencies (*Borins, 2002, Betts & Holden, 2003*). This is done through increased specialisation of roles along the value chain, leading to a higher outsourcing requirement for each individual firm, as each of the organisations is now more dependent on a wider network of firms to provide a more optimized but narrowly focused range of services (*Davis & Hobday, 2005; Davis et al, 2007*). The servitized grouping of complex product and services then derives as a logical consequence of this increased specialization (*Davis & Hobday, 2005; Lewis & Roehrich, 2009*) as the organisation with the technical proficiency to provide the product is often best placed to repair, replace or augment the product offering. This is especially true in those instances where the barrier to market entry for the supplying firm is high, as if often the case with the typical offerings that could be classified as CoPS (*Ren & Yeo, 2006*).

The outcome of this growing outsourcing requirement within complex areas has caused the emergence of a new core competency – the management of long complex outsourcing contracts & relationships. Thus, the areas of research under PCP are now primarily concerned with investigating those competencies that support the through-life management process of conceiving, planning, executing, managing and re-commissioning long term projects. This is why this research seeks to explore the key

characteristics of these domains by selecting the normative (as designed) ‘acquisition lifecycle practice’ as the key unit of analysis.

Howard and Caldwell (2010) acknowledge the differentiating factor of PCP is in the strategic inclusion of the procurement function into the wider organisational apparatus that support organisations’ broader through-life acquisition process. This broader view encapsulated the outsourcing requirement, purchasing of the product or service, and supporting the product or service through-life. Previous research into PSM (purchasing and supply management) focuses upon those areas pertaining to the processes surrounding the discrete procurement function only (Day & Barksdale 2003; Ellram *et al*, 2007). Valk and Wynstra (2010) discuss how traditionally the mechanism that supports longstanding complex relationships had received relatively little scholarly attention in spite of long standing literary calls for research into the area (Araujo & Spring, 2006; Selviaridis and Spring, 2007) thus justifying the adoption of a through life management view of normative acquisition lifecycle practice as the central unit of analysis in contributing to the current knowledge within the still emergent area.

A consensus on the importance of normative processes across the entirety of a lifecycle, connecting previously separate disciplines (procurement, project management, operations management) has been building over the past ten years. The view of an integrated procurement function had led researchers to discuss this set of extended procurement capabilities within PCP as a Through-Life-Management approach as early as 2009 (Johnsen *et al.*, 2009) – a definition which derives largely from the MOD’s internal view of acquisition lifecycle practice (MOD, 2005) although little scholarly attention has been paid to furthering this conceptual view.

2.7.9 Specifying the research inquiry (Part 2)

Howard and Calwell (2010), in their important special issue refer to the same fundamental conception of an integrated procurement function as the ‘extended lifecycle’ which the authors use to situate the application of PCP (Figure 8), and stress that effective practice within the PCP domain cannot be determined by examining the procurement function alone, and a comprehensive understanding of all process before and after the technical procurement of the asset need to be assessed as they are major contributors to the overall success of PCP activities.

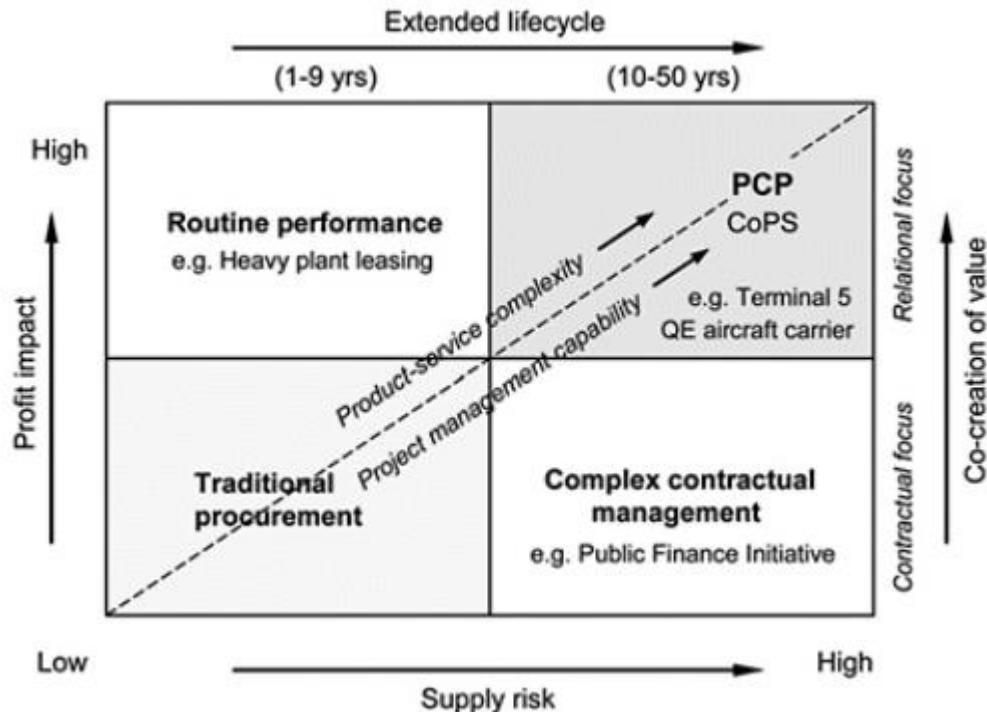


Figure 8 - Extended Lifecycle (After: Howard & Caldwell 2010)

In order to further the process of capability creation and execution along this extended lifecycle the research proposes to investigate each major activity across a range of comparable case studies. In defining these activities, the research can identify convergent and divergent usage of process in compatible contexts, in order to build a coherent overview of the state of knowledge within the extended lifecycle of complex procurers.

Given this research seeks to understand the how practice manifests in PCP domains the research takes a broader view of PCP practice than the traditional application of aircraft carrier and airport runways. This is done in order to provide a comparison of how organisation capabilities change as relational and infrastructural complexity increase. However, the research focuses upon cases that can be considered either directly within or close to the PCP domain.

2.8 Theoretical Loading

The researcher sought to build a profile of thematic groupings of concepts that explain the majority of difference in acquisition lifecycle practice.

- In the first instance, a systematic literature review was undertaken that identified key concepts, articles and areas that are pertinent in better framing and addressing the research question.

- In the second instance, a narrative review was undertaken of the PCP literature and associated concepts so as to load into the research process all meaningful concepts to be used in investigating effective capability within a PCP domain and identify a specific gap to be used in the investigation.

From these two actions, a set of factors to be used A-priori was created in exploring the data. These factors are used as a guide to what it considered a ‘meaningful process’ when seeking convergent and divergent processes within the case data. Over the course of the research, these factors were interrogated through a systematic combining approach, and ordered into hierarchical groupings (*Dubois & Gadde, 2002*). This process resulted in deriving the following superordinate themes that are used as criteria for deciding the relevance of a process when exploring the acquisition lifecycle of the various cases.

2.8.1 Organisational Alignment

‘Organisational structure’ was selected as an A-priori factor deemed relevant in the examination of acquisition lifecycle practice and later refined through empirics into ‘Organisation Alignment’ to include extra organisational and collaborative structures. The phenomenon is well researched from an agency and institutional theory perspective. Eisenhardt (1988) noted that organisational practice, and critically, ‘organisational structure’, become isomorphic over time. In this sense, the normative pressure to professionalise the acquisition process derives practices that are legitimate but not necessarily efficient (*Tolbert & Zucker, 1983*). Equally, the organisational practices inherent in the supply chain partners may cause a coercive effect on the behaviour of the organisation. In order to meet these emergent expectations structural changes may occur internally. ‘Organisational Alignment’ represented an amalgam of these two phenomena necessary for the interrogation of structural choices within the hierarchical, procedural and geographical arrangements within an acquisition lifecycle. Organisational alignment also acts as a proxy for infrastructural complexity discussed by Lewis and Roehrich (2009) and Heartman et al. (2014). In observing the processes that relate to how organisations and their supply chain partners are organised, the research is also generating insight into what infrastructural assets are utilised by each organisation, and how they are interacting with it. Thus, a recording

of how organisations are arranged gives insight into how each case organisation is managing this complexity.

The PCP and COPs literature make the case that PCP capability not only requires consideration of the practices surrounding the contracting process but of the ‘relational mechanisms and continuing interactions that work alongside these traditional mechanisms’ (*Valk & Wystra, 2010*) and a focus upon the multiple structural levels or mechanisms across the supply chain network, and indeed across all phases of the acquisition lifecycle (*Howard & Miemczyk, 2010*). The organisational structures to support PCP acquisitions’ capability are seen largely to be non-transferable, with structural profiles that support high-volume acquisition or traditional through life management being ineffectual in the pursuit of effective PCP acquisition practice PCP (*Zheng et al., 2008*).

The adoption of appropriate organisational structure and practices has numerous effects within the PCP domain, including: the enhancement of organisational capability to learn from experience and accumulate knowledge over time (*Brady & Davies, 2005; Bresnen & Marshall, 2000*) and to develop and exploit relationship specific assets, both tangible and intangible (*Dyer & Singh, 1998*). Whilst tangible joint assets to exploit a complex product are unavoidable in numerous instances, the intangible are arguably more important as they propagate a common normative context through which organisations can enhance the efficiency of the collaborative undertaking (*Vincent-Jones et al., 1997*). Numerous papers point to the importance of coordination efforts through structural choice in hierarchical arrangements (*Tanskanen, 2015; Tate & Ellram, 2012; Johnsen et al., 2009*).

Importantly, appropriate organisational alignment of processes facilitates the capability to contract for specific outcomes rather than manage the procurement of capital goods and the manage in-use ancillary services as separate organisational undertakings (*Araujo & Spring, 2010*). Of those key issues considered in the formation of this research, organisational alignment becomes a key feature that distinguishes a PCP procurement arrangement from the traditional, thus an exploration as to the difference between case organisations gives significant opportunity to build up a view of effective procurement strategy within PCP. The relevance of this is described well by Johnsen et al (2009) in the exploration of the defence sector. Johnsen et al describe complex contracts as moving towards a system characterised by “dynamic

boundaries” whereby arrangement and rules for these boundaries have a profound impact on the overall capability and operational effectiveness of the PCP organisation.

2.8.2 Risk Management

Previous research has often invoked both agency theory and institutional theory in the exploration of uncertainty and risk in inter-organisational relationships (*Kauppi, 2008; Eisenhardt, 1989*) as it features as one of the central tenets of both of these theories and thus it is a theoretically compatible factor with this type of inquiry. This experience is borne out in consultation with the empirical world, causing risk management selection as a superordinate theme after abductive refinement of risk and uncertainty.

Within the existing PCP literature the prevalence of risk management is pronounced as a key feature of the initial problem space in the PCP research effort (*Howard & Caldwell, 2010*). Within CoPS environments it is noted that the economic and organisational burden of sharing and managing risk requires the organisation to employ techniques beyond the mechanistic procedures embedded in the outsourcing contract (*Mayer & Argyres, 2004*). The ability of alliance partners to garner trust, generate effective information sharing mechanisms, and a mutual sense of accountability are of importance in mitigating issues previously governed by explicit contract terms (*Dyer & Singh, 1998*). The inclusion of risk management strategies is of paramount importance in calibrating a fit between various risk sharing, management techniques such as incentivisation mechanisms (*Gruneber et al., 2007*). Uncertainty and risk are deemed critical in the examination of process along the entirety of the acquisition lifecycle, borrowing concepts from Through-Life-Management as the length and complexity of operation or instillation services increase, as does the unpredictability of the asset or service (*Howard & Caldwell, 2010*). There is little contention that the management of risk is of critical importance to the successful execution of large scale projects, and complex procurements with a significant preponderance of key PCP papers specifically highlighting the importance of risk (*Mahapatra et al 2017; Zeuschner et al., 2015; Spring & Araujo 2014; Caldwell & Howard, 2010; Gobbi & Hsuan, 2015; Roehrich & Lewis 2014; Chen & Carrillo, 2010; Brad et al., 2012; Johnsen et al, 2009*).

2.8.3 Technology management

The mechanism of exchanging information and systems integration have long been regarded as a core capability for the execution of successful complex projects (*Hobday, 1998*). The case is made that technological and systems integration is the means through which organisations can effectively manage temporary structures of many firms perusing a common objective (*Johnsen et al, 2009*). Of particular interest to the research was not only the technological capability itself but also how it is embedded within the extended organisation, specifically with regard to the placement of responsibility for management within the system. Hagel and Brown (2005) conceived of the notion of process orchestrators within extended supply chains to describe those organisations which account for the majority of the organisational effort. Typically, this role is fulfilled by the primary contractors, and the appointment of a literally or practically acting process orchestrator. This has been shown to lead to better use of incremental learning and leveraging of innovative technological solutions (*Geyer and Davies, 2000*). Thus the research explores the spread of technically enabled control within both the procurer and wider supply chains as an-priori construct within the research. Furthermore there is a particular focus upon those systems encouraging learning from experience within the organisation as this is often cited within the literature as a key component of competitive advantage, leading to what Davies and Brady (2000) have called ‘economies of repetition’ in undertaking complex acquisitions.

The inclusion of technology management as an A-priori superordinate theme investigation is also compatible with previous works that have adopted an institutional and agency theoretic perspective. Given the prevalence of ICT within organisational processes, the coercive, normative and memetic pressures to adopt systems through ‘legitimacy’ and not ‘efficiency’ seeking behaviours (*Eisenhardt, 1988*) strongly impacts the adoption of technology. Consequently previous works often employ institutional theory in explaining the adoption of technologies relevant to the acquisition lifecycle process e.g. SCM technologies (*Liu et al., 2009*) e-commerce (*Huang et al., 2010*) and auto-tagging technologies (*Barrat & Choi, 2007*). Agency theory also has an impact in the selection of technology management as a superordinate theme. Agency theory positions information asymmetries existing

between the principal and the agent as a core consideration in defining a contract (*Eisenhardt, 1989*).

The review highlighted without ambiguity the importance in various forms of technology management in the execution of effective PCP practice (*Rodríguez et al 2016; Lebreton et al., 2010; Zeuschner et al 2015*) with some highlighting the importance of particular sub-categories such as knowledge management (*Gobbi, Hsuan, 2015; Roehrich & Lewis 2014*). Thus the inclusion of technology management as an a-priori construct to be applied in the review of convergent and divergent process amongst the case body is apparent. After confrontation with the empirical world (*Dubois & Gadde, 2002*), it became evident that the use of technology acted a proxy for interrogating information flow and thus these grouping of factors were consolidated into technology management

2.8.4 Contract & Performance Management

Contract and performance management are amongst the most commonly used metrics in taking an agency theoretic perspective in the assessment of outsourcing relationships (*Eisenhardt, 1988*). Contracting and performance management are also featured strongly within the initial PCP problem space put forward by Howard & Caldwell (2010). The point is made therein that the problem faced within oligopolistic markets are not interchangeable with those seen in those markets with an abundance of supplier options. The argument is made for oligopolistic PCP markets to create dynamic and iterative performance measurements embedded within an adaptable contracting framework, thus aligning outputs and requirements over generating simple compliance to contract (*Caldwell et al., 2015; Howard & Caldwell, 2010*). Further research discussed the importance of appropriate metrics applied to contracting frameworks within the context of the unique public sector PCP domain (*Raynaers, 2014; Brown, et al., 2015*). The contract and the various mechanisms embedded within the contract are the central means through which the procurer enacts the desired strategy. Thus differences in creation, execution and model of direct relevance in addressing the research question.

A-PRIORI FACTOR	DESCRIPTION	LOADING SOURCES	GUIDING CONTRIBUTION
Risk Management	The sharing, transferring, termination or treatment of risk between principal and agent.	Howard & Caldwell, (2010)	Howard & Caldwell in their seminal book on PCP define appropriate risk management strategies to be a foundational piece of the risk management problem area, and of critical importance particularly with the through life management of products.
		Mayer & Argyres (2004)	On describing the nature of complex projects, describe the inadequacy of contacts ability to absorb uncertainty, and thus alluding to the relevance of a broader risk management strategy.
		Dyer & Singh, (1998)	Similarly, Dyer and Singh point a contacts inability to compensate for a board holistic system wide approach to risk management. Thus stressing the importance of risk management strategies across the whole of the acquisition lifecycle.
		Gruneberg et al. (2007)	In an investigation of the UK Construction sector Grunebe et al., describe the industrial context sensitivity of calibrating incentivization and disincentivization as appropriate risk mitigation strategies.

Technology management	The use of e-tendering, knowledge management and other enterprise systems tools	Hobday (1998)	Hobday's 1988 works was an early proponent in suggesting the link between technological infusion (Embedded systems) and CoPS. Including embedded systems as a defining characteristic of CoPS, Hobday describes the necessity of large scale management systems in the CoPS activity as a key stumbling block in these large projects. Thus justifying the inclusion of this criteria a-priori.
		Hagel & Brown (2005)	Describes the applications of governing technological systems in complex supply chains. Advocating process orchestrates to act as the information organisers in the supply chain. Thus loading in a consideration of where systems capability is managed from, and questions about the supply chain wide composition of technological systems.
Contract & Performance Management	The formation and management of the contractual relationship between principal and agent.	Raynaers (2014)	Reynaers, not an operations or operations management research describes the case of how public sector has unique requirements, in the case of public-private-partnerships, looking specifically at Long term infrastructure contracts (LTIC) and Design-Build-Finance-Maintain-Operate (DBFMO) contracts. The material bring novel considerations to operations research, seeking to understand unique responsibility of public organisations in procuring CoPS or their conceptual equivalents.
		Brown et al. (2015)	Discusses key affecting principals in arranging at effective strategies for public contracting as a consideration of public values, institutional norms and market characteristics. These stress the importance of contacting type for the public procurer, thus justifying it's inclusion as an A-priori theme, but also ascribe key factors to consider as guiding categories of interest as the research engaged with the empirical world.

		Caldwell et al. (2015)	<p>Taking to CoPS based case studies, this paper draws attention to the various formal & Informal control mechanisms used within these cases. This was a critical study in provoking this a-priori categorisations to appreciate performance affecting acquisition practice from both the formalised incentivisations contract mechanisms and non-formalised methods applied throughout the acquisition lifecycle.</p>
Organisational Alignment	The hierarchical and geographical arrangement of functions servicing the acquisition lifecycle.	Van der Valk & Wynstra (2010)	<p>Emphasises the 'nature' and 'pattern' of buyer supplier interaction across the whole of the acquisition lifecycle. Thus the research loads in an understanding of procurement team, composition across enterprise, stage of involvement & the nature of ongoing interaction.</p>
		Howard & Miemczyk (2010)	<p>The work focuses on PCP in the case of a large scale Naval procurement, and describes numerous key issues relation to the organisational makeup of a procurement function such as task-partitioning, and the coordination of formal contracts and relational governance.</p>
		Davies & Brady (2000)	<p>David and Brady in their early work on CoPS make the crucial point of organisational structures capable of continuous improvement. This 'economies of repetition' describes the organisations absorptive capacity to learn from experience through an implementation of appropriate internal acquisition practices.</p>
		Brady et al (2005)	<p>In this paper Brady and Davis make a fundamental contribution to the formation of the research, discussing the inclusion of pre-bid and post implementation into the traditional lifecycle when</p>

		dealing with CoPS based integrated solutions. Thus an introspection as to the organisational structures that underpin when, how, where and why this extended lifecycle is realised becomes of critical importance in the research effort.
	Bresnen et al. (2000)	Discusses the collaborative imperative the case of the UK construction industry, placing further emphasis on the organisational structures capability to support collaborative actions.
	Dyer and Singh (1998)	Discusses the exchange of inter-organisational cooperation and how this is effectively realised. Specifically discusses the mutual investment in idiosyncratic assets as a key driver of capability synergies.

Table 7- A priori contributing factors summary

2.9 Theoretical lens: Interpreting the results

In order to guide how the data under each thematic category was understood and interpreted this research draws on variables from both institutional and agency theory. The reason for this is not to test the validity of these approaches against each other but to utilise the complementary nature of the theories to derive a more robust examination of the phenomena. The validity for this has been widely cited (*Allison, 1971; Feyerabend, 1981; Kuhn, 1970*), with further literature having employed both agency theory and institutional theories concurrently (*Eisenhardt, 1988*). In a departure from Eisenhardt (1988), the purpose of invoking the two theories is not to generate hypotheses from the two viewpoints. Instead, both viewpoints are used as a means to derive a more comprehensive set of interrogatable constructs that codify meaningful strategic practice within procurer – supplier engagements. This codification process is inclusive of both directly contributing practice, and supporting practices, examining all meaningful divergent and convergent practices across the acquisition lifecycle of each of the multiple case organisations from both agency and institutional theoretical perspectives.

2.9.1 Agency Theory

Agency theory is concerned with agency relationships whereby one party (the principal) delegates work to another party (the agent). The theory is a versatile tool for comprehending the empirical world, it has been applied across a wide range of disciplines in pursuit of a broad range of goals. Notably, it has been evoked as a seminal theory in economics (*Spence & Zackhauser, 1971*), marketing (*Basu et. al, 1985*), management (*Pepper & Gore, 2015*), organisational behaviour (*Eisenhardt, 1989, Eisenhardt, 1988*), sociology (*Eccles, 1985*), information technology (*Mahaney and Lederer, 2003*) and supply chain management (*Ketchen and Hult, 2007*). Stock (1997) points to the pre-eminent works of Ross (1973, 1979), Mitnick (1973, 1975), Jensen and Meckling (1976) and Eisenhardt (1989) as having established the academic communities' interest in the theory from the perspective of economics. At its most basic, agency theory rests on a number of fundamental assumptions:

- Each party acts with self-interest;
- There exists an informational asymmetry between the principal and the agent;
- There exists a conflict of goals between the principal and the agent;

- The preferences for managing self-interested behaviours do not conform between principal and agent (*Eisenhardt, 1989, Eisenhardt, 1988*).

Agency theory is often employed in determining the optimal form of contract between a principal and an agent. Based on the explanation of these fundamental concepts listed above: degree of information asymmetry, the contradictions in governance preferences between parties, agency theory seeks principally to identify whether a behaviour-based contract, or one that is at least partially outcome-based would be the more effective in any given context. This research is concerned with the exploratory investigation of a process that could potentially add value, and is not attempting to determine an optimum between these two fundamental types, raising questions as to the exclusive suitability of agency theory.

Agency theory explores the exchange between a principal (buyer) and the agent (supplier) often employing the contract as the unit of analysis under investigation. As summarised by Zsidisin (2003); various research has adopted ‘coordination efforts (*Celly and Frazier, 1996*), “control” (*Anderson and Oliver 1987*), and “management” (*McMillan, 1990*) to be subsets of the basic ‘contract’ unit. There are numerous factors shown to have a mediating effect on the contractual relationship between the principal and the agent, such as contract management systems, environmental complexity and uncertainty, risk management and the inherent environmental risk, nature and makeup of the principal-agent relationship (*Eisenhardt, 1989*). In this research the unit under investigation was the processes used along the entirety of the acquisition lifecycle, inclusive of but not exclusive to, the formation and execution of a contract governing supply from the perspective of the principal. So whilst agency theory holds significant explanatory power over the factors directly impacting the contractual relationship between supplier and provider, it is an inadequate mechanism through which to interpret those processes along an acquisition lifecycle which do not relate directly to this. Often the processes within the acquisition lifecycles investigated are demonstrably motivated by non-rational choice making, and pertain to satisfying stakeholders whom do not have direct involvement in the buyer-supplier relationship. As such, alternative theoretical positions are necessarily invoked in order to understand processes along the entirety of the acquisition lifecycle.

At the onset of the research, engagement with the empirical world made clear that some of the processes featured along an organisation’s acquisition lifecycle fell out of the remit

of agency theory for two primary reasons: Firstly, agency theoretic assumptions cover contractual relationships between independent economic entities. As such these assumptions cannot be employed at all stages of an acquisition lifecycle. For example, the processes embedded at the beginning of an acquisition lifecycle are utilised to satisfy internal stakeholders' needs and are not within the agents' visibility, nor are they intended to mediate the principal-agent relationship. This is stated in the literature review section of the research because this established the need to employ another theoretical perspective that holds explanatory power over those processes and behaviours that sit as acquisition lifecycle practice but are not directly related to the creation or assessment of a contract.

Secondly, the presumption of rational actors was contradicted directly by empirical evidence. Within these UK institutions the motivations underlying a process were cited to be as a result of previous behaviour embedded within the organisations, and that actors were adhering to expected internal norms regardless of the impact on the governance of the contract.

2.9.1.1 Previous relevant applications of Agency Theory

In order to ascertain an overview as to the suitability of agency theory within the context of this research, the author draws on the systematic literature review undertaken by Fayezi et al. (2012). The purpose is not to provide an exhaustive exploration of each and every application of agency theory within the wider domain, but to make a sensible selection of relevant, comparable applications to determine the general suitability of agency theory. As such, papers were selected from the literature review that pertained to the core areas of interest investigated in the wider research, and the majority employed a case study methodology to ensure compatibility of application with the application being posited within this research.

Zsidisin and Ellram (2003) – Within this seminal example of the application of agency theory, the authors investigate the use of agency theory to explore methods of reducing supply risk. The specific application of the theory concerns itself with the behaviour of the supplier and their impact upon risk. The work confirms the basic premises of agency theory. Importantly the research concludes that the greater the degree of complexity the greater the tendency for the principal to implement behaviour moderating controls upon the agent.

Zsidisin et al. (2005) - In this expansion of the topic pursued in Zsidsin & Ellram (2003) the authors employ a single case study methodology to examine the relationship between early supplier involvement and risk management within a supply chain. They conclude that agency theory is an effective tool to investigate this phenomena and build theory within the newly emergent field.

Zsidisin, et al. (2006) - Within this research a case study methodology is employed to explore value adding techniques that can contribute to the reduction of risk within purchasing and supply. The research builds upon earlier works to provide an overview of factors effecting risk from the agency theoretic perspective.

Halldórsson et al., (2006) – In this single case study method the authors examine the emergence of relationship governance by employing the perspectives of both agency theory and transaction cost economics. A key insight from the research is that over time the two parties involved in the case focused upon exploitation of contract terms instead of pursuing a trajectory for a ‘win-win’ outcome. The application of agency theory is again proved within the setting of traditional fast moving supply chains to be an effective descriptor of the empirical reality of contracting and goal divergence.

Norrman (2008) – The research uses an agency theoretic perspective in exploring two case studies adopting risk-sharing contracts. The conclusions generally centre around the more in depth-controlling contracts replete with balancing mechanisms are of most benefit to the organisations observed. In the author’s application of agency theory in the usage of risk-sharing agreements between the parties identifying which approach to contracting best mitigates the goal divergence of the principal-agent problem.

Tate et al. (2009) – Of those papers highlighted in the exploration of the usage of agency theory Tate et al. has the most direct applicability to the subject matter described within the research. The paper explores acquisition of services, and specifically complex business services. The paper, as with one of the central propositions of this research, recognises that the skills applicable in the acquisition of non-complex items do not transfer directly into the acquisition of complex items. In this paper, the authors applied the fundamental assumptions underpinning agency theory toward an expanded base of actors that includes the marketing service providers as well as the supplier management problem that agency theory is directly concerned with.

The application of agency theory amongst the selected examples varies significantly, however the theory is rarely applied beyond an explanation of the contractual arrangement between one given principal and one given supplier. The relationship remains the core focus. The range of usage indicated that whilst agency theory is adopted and accepted as a valid mechanism for understanding the factors affecting this contractual relationship, it is rarely applied to the internal mechanics of an organisation. A key component of the positioning of this research is that the internal mechanics and processes observed within an acquisition lifecycle are not only contextual factors that influence the contractual relationship, but are indeed part of one inseparable cohesive system. Thus the fundamental assumptions of agency theory described by Eisenhardt (1989) of self-interest, bounded rationality, risk aversion, information exchange, utility of information and goal conflict are effective in describing activity in only part of the acquisition lifecycle. As such, agency theory alone lacks the breadth to offer insights into those processes which are not reasonably related to the contracting formation and execution. Additionally, after the empirical work began, evidence quickly amassed that some of the assumptions embedded within agency theory did not hold true in some of the broader contexts. Whilst agency theory still offers a useful perspective it became evident that use of an additional theoretical perspective was required to better uncover a deep understanding of the phenomena.

2.9.2 Institutional theory

Institutional theory views the structures, strategies and processes through the lens of institutional isomorphisms (*Deephouse & Suchman, 2008*). An isomorphism is a coherence of practice within a given institution. Forces within the firm and surrounding context prompt organisational actors to seek legitimacy through the adoption of process that conform to the institutionally normative process (*Zsidisin, 2005*). There exist two primary variants of institutional theory, the sociological variant (*Dimaggio & Powell, 1983*) and the economic variant (*Tate et al., 2010*). Within this research, the author is seeking to understand the motivations for practice adoption within highly complex contexts, as such, the situational uncertainty is high. It therefore becomes difficult to draw a causal link between process adopted and the outcome produced. In the context of such uncertainty the economic perspective loses explanatory power, as the causal link to profit cannot be made. In these contexts the social comparison is the more effective means through which process adoption can be understood (*Haunschild & Miner, 1997*). For the

reasons of increased complexity and increased uncertainty that characterises the field of PCP, the sociological variant will be the key focus of this section of the literature review.

A key principle of the explanatory power of institutional theory of the sociological variant is that organisational legitimacy increases as adherence to industry isomorphisms (*Deephouse & Suchman, 2008*). This legitimacy is viewed as being desirable as there is an innate presumption that processes and behaviours that are frequently observed in similar contexts are in place for rational reasons that link to performative outcomes (*Gopal & Gao, 2009*). While this may be the case it is not necessarily true and therefore an examination as to the potential motivations for process adoption offers the capability to determine the degree to which a conformity to isomorphism is beneficial or appropriate.

In their original paper that describe the methods of institutional conformity Dimaggio & Powell (1983) delineate three categories of motivations for conforming to isomorphism, namely. Mimetic, Coercive and Normative.

2.9.2.1 The coercive pressure

A coercive pressure to adopt an isomorphism is in many ways the most direct application of institutional pressure. Within this category of applied pressure an organisation is coerced into the adoption of a given process by an extra organisation or governmental body. An often stated example is that of legislative pressure applied by a governmental organisation (*Dimaggio & Powell, 1983*). Within the context of this research, the Official Journal of the European Union (OJEU) is a frequent source of process conformity acting as a set of rules that all EU organisations must comply with when undertaking a procurement. Other less direct coercive pressure can derive from social consensus regarding environment and social practices in the organisation, whereby organisations are coerced to adopt a particular environmental or social practice through the application of normative practice. Other direct coercive pressures are applied by a supply chain partner in a stronger negotiating position that forced the adoption of a process or set of processes that are native to that organisation (*Liu et al., 2010*). Whilst there exists substantive variation within the positive effect on performative outcomes of coercive adoption, there is considerable reason to consider that these factors may not be the ‘most’ effective practices to be adopted in any specific context, particularly complex areas such as defence (*Miemczyk et al., 2007*).

2.9.2.2 The Mimetic pressure

The mimetic pressure is the adherence to an isomorphism in response to a lack of clear cause and effect reasoning available within contexts that display a high level of uncertainty. In this case, the higher the degree of uncertainty in the link between any potential process and performative outcomes, the greater the mimetic pressure to adhere to isomorphisms that are visible and deemed effective within a comparable context (*DiMaggio & Powell, 1983; Zsidisin et al., 2005*). It is proposed that the motivation here is an innate risk aversion, whereby organisations do not want to fail outright or perform unduly worse, they seek out processes that have already been adopted instead of opting for the riskier strategy that could potentially create a source of competitive advantage (*Miemczyk, 2008*). Moreover, owing to the differences in context of each of the organisations the perceived safety of adopting established process may be erroneous as the processes are non-compatible between these varying circumstances (*Sousa & Voss, 2008*).

2.9.2.3 The Normative Pressure

The third of the pressures is that of normative pressure. John et al. (2001) defines this as the creation of homogeneity in process and behaviour within a given profession or discipline. In seeking legitimacy amongst peer groups or within wider organisations of professional networks, actors seeks to conform to the established patterns of thought and consensus so as to join a professionalised group (*DiMaggio & Powell, 1983*). This drive towards professionalization of the role gives a homogeneity of methods and practice within a given discipline (*Gopal & Gao, 2009*). The normative pressure is distinct from the mimetic pressure in that the normative pressure is a search for the accepted practices within a discipline and the mimetic pressure is a search for acceptable practice, often when the normative pressure is underdeveloped or not apparent such as the case within highly uncertain areas like Complex Product Systems procurement.

2.9.2.4 Previous relevant application Institutional Theory

In order to assess the validity of institutional theory as a suitable lens for exploring and comparing the acquisition lifecycle practice of complex procurers the research draws on the literature review performed by Kauppi (2013) published in the International Journal of Operations and Production Management (IJOPM). This journal is a key publisher of works pertaining to CoPS and PCP and the literature review by Kauppi specifically

investigates the range of applications of Institutional Theory from IJOPM and seven other similar quality journals, and so is in a position to be a relevant overview of the theory's application. Journals within this review were selected based on the following criteria: the research uses a case study based methodology; the study has a broad applicability to the area being investigated within this research.

Barratt and Choi (2009) – The paper seeks to investigate the institutional pressures to adopt RFID (radio frequency identification) technology. The paper specifically investigates the coercive institutional pressure mandated by the Department of Defence (United States). In this example, the researchers use institutional theory as a lens through which to understand the range of reactions suppliers have to the coercive pressure to adopt RFID placed upon them by the DoD. A key factor in the usage of institutional theory is that the research compares the reactions to a common coercive pressure between different organisations, thus taking the organisation as the unit of analysis.

Howard et al. (2007) - In this paper the authors apply the institutional school of thought to understand the establishment of a supplier park as a result of coercive pressures applied from an engine plant in the UK. This research invoked the institutional lens though the notion of a 'bandwagon' effect in this instance resulting in the suppliers opting en masse to not conform to the coercive pressure applied by the case organisation under study.

Rogers et al. (2006) - This study investigates the adoptions and usage patterns of a supplier development program by a North American automobile manufacturer. The focus of the research is how the suppliers reconcile the coercive institutional demand of adoption of the developmental practice being imposed by the manufacturer with the internal operational efficiency needs of the adopting supplier organisation. The study is again therefore exploring the difference between case organisations in response to coercive institutional pressure.

Tate et al. (2009) - The paper utilises nine in-depth case studies to investigate offshore service outsourcing. Importantly, this research does not utilise institutional theory exclusively, and instead adopts numerous theoretical paradigms in tandem to provide broader explanatory power to the phenomena under investigation. In addition, the managerial implications that pertain specifically to effectiveness of the offshore outsourcing decision, the paper also contributes to the theory in the combination of these research paradigms. In this regard, the implications find that the theories offer unique

insights in different areas of the complex multifaceted phenomena of offshoring adoption and execution.

Wong and Boon (2008) - The research uses a multiple case study approach to validate a typical institutional theory model whereby institutional norms moderate the reaction towards environmental uncertainty (supplier uncertainty, customer uncertainty, technological uncertainty). Again this research uses a multiple case study approach, taking the organisation as the unit of analysis.

Zsidisin et al. (2005) - This study investigates the institutional pressures that govern the adoption of risk management practice. The context of this research is based upon contingency planning within the context of fast moving supply chains such as those that have adopted lean supply chain principles. In this example, the approaches towards risk management are deemed to derive from regulatory, validatory and habitualising forces from the industrial theory perspective. This is an important finding to be considered for this research generally as it supports the idea that there is potentially an erroneous adoption of isomorphisms within acquisition lifecycles.

In the selected examples, each utilised institutional theory within a case study based method. Each of the examples is also aligned to one of more areas that are explored within this research (outsourcing, purchasing and supply, risk management & uncertainty). In each example institutional theory is employed in the same basic formulaic model: adoption and usage of processes are examined within organisations to understand and explain similarities and differences within a wider group of case organisations. This formula is very similar to the manner in which the theory is intended to be applied within this research and thus gives credit to the approach. However, all but one of these examples applied institutional theory exclusively, without the involvement of any additional theories. In their paper Tate et al. (2009) are an exception to this as they use institutional theory in conjunction with the Resource Based View and Transaction Cost Economics.

2.9.3 Application of theory

This research uses variables from both institutional and agency theory in order to address the research question. The reason for this is not to test the validity of these approaches against each other but to utilise the complementary nature of the theories to derive a more robust examination of the phenomena. The validity for this has been widely cited (*Allison, 1971; Feyerabend, 1981; Kuhn, 1970*), with further literature having employed both

agency theory and institutional theories concurrently (*Eisenhardt, 1988*). In a departure from Eisenhardt (1988), the purpose of invoking the two theories is not to generate hypotheses from the two viewpoints. Instead, both viewpoints are used in order to derive a more comprehensive set of interrogatable constructs that codify meaningful strategic practice within procurer – supplier engagements. This codification process is inclusive of both directly contributing practice, and supporting practices, so as to examine all meaningful divergent and convergent practices across the acquisition lifecycle of each of the multiple case organisations, from both agency and institutional theoretical perspectives.

2.9.4 Summary of the integration and application of theories

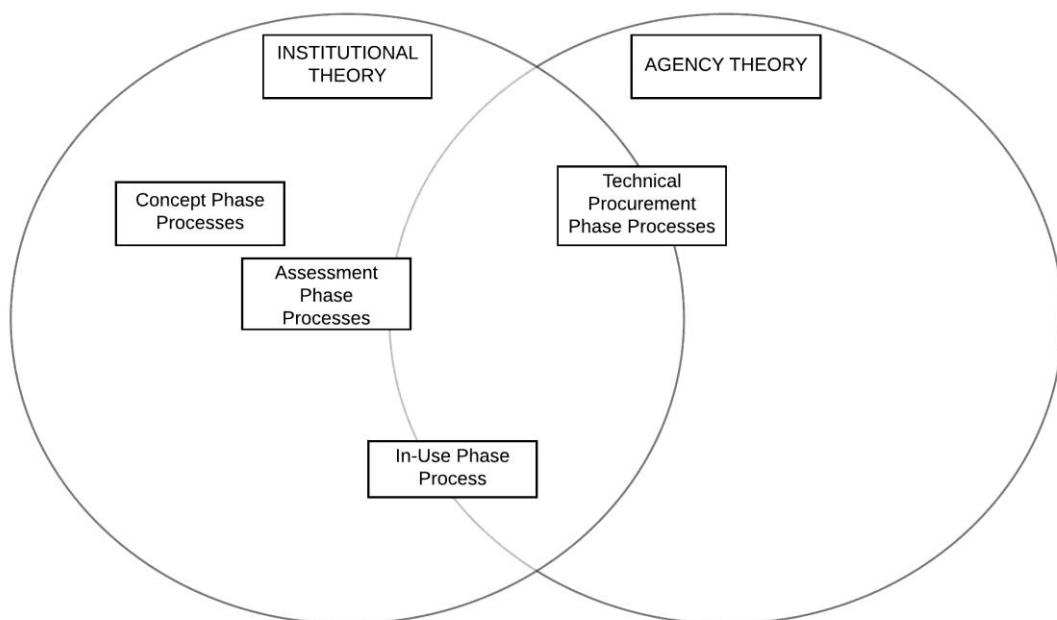
In summary, the research seeks to use agency and intuition theory to understand and explore the differences and convergences of processes within the acquisition lifecycle of organisations procuring complex products or services. In this sense, the research is attempting to generate new knowledge into which processes are being used, and insights as to why organisations have adopted these through a comparison of the organisations included in the case study research. As cited earlier there is a precedent in the inclusion of multiple theories in exploratory research (*Allison, 1971; Feyerabend, 1981; Kuhn, 1970*), with others having explicitly utilised agency and institutional theory in tandem (*Eisenhardt, 1988*).

Agency theory attempts to ascertain the ideal contract between a procurer and supplier via a consideration of the cost of informational exchange, the relative risk exposure of both parties, and outcome uncertainty. In doing so, agency theory prescribes ideal contractual conditions that are either based on behaviour, or outcome. In order to achieve a comprehensive and valid interrogative framework the research also loads variables from institutional theory. This initially was to account for those behaviours present in an acquisition lifecycle that are not directly related to the principal-agent problem. In the case of institutional theory, a consideration as to the potential motivations for practice adoption (normative, mimetic & coercive) allows for consideration of key practices affecting the acquisition lifecycle that lay outside of the domain of agency theory. Specifically, the methodology considered each of the divergent and convergent processes that are identified within the research and attempts to understand each of these through the lens of both agency theory and institutional theory. In line with this Institutional theory offers broad explanatory power over the process investigated within the research, whereas

agency theory coverage of the phenomena was only applicable to those areas pertaining directly to the selection, formation, and maintenance of the contract with the suppliers.

In using a lifecycle analysis, the research identified four distinct phases of an acquisition lifecycle that were applicable across the entire case range. The phases of concept, assessment, technical procurement and in-use contain functionally-different processes from one another, and the applicability of each of the theories differs from phase to phase. Thus the combination of the two theories is required in order to offer a comprehensive explanation of the entire lifecycle.

This is demonstrated in Figure 9.



This figure demonstrated a comparison of relative suitability of each theory as explanatory frameworks for the processes observed within each lifecycle. It does not imply exclusivity however. Table X below presents an explanation of how each theory can be applied to the unique circumstances of each phase.

PHASE OF LIFECYCLE	AGENCY THEORY APPLICATION	INSTITUTIONAL THEORY APPLICATION
CONCEPT	<p>- <i>Consideration of requirements and potential procurement routes.</i></p> <p>Agency theory has most traditionally been applied in the context of procurement with the procurer being cast as the principal, and the supplier as the agent. Given activities undertaken at the concept stage are largely internal, agency theory only remains relevant if the roles of principal and agent are recast to internal stakeholders, an approach holding far less academic precedent.</p>	<p>Institutional theory seeks to understand the normative, coercive and mimetic pressures that have caused the emergence of the processes and strategies involved in the concept stage. A number of contextual factors make this theory a powerfully explanatory tool here namely: Concept procedures are largely internal but affected by the wider context. Processes emerge as a result of numerous pressures from both stakeholders and the wider professional standard</p>
ASSESSMENT	<p>- <i>Assessment of acquisition strategy, pre-market agreement, make/buy decision etc.</i></p> <p>The assessment phase typically includes the initial elements of market engagement thus the initial interactions between the principal and the agent. The strategies employed within this phase have a bearing on the informational asymmetry, self-interested behaviour and risk aversion of both parties when a contract is eventually signed.</p>	<p>Whilst there are some interactions between principal and agent at this stage, the processes are largely designed towards satisfying internal requirements primarily. As a result, understanding the assessment phase process through agency theory alone is inadequate and institutional theory offers the more comprehensive set of explanations for processes being as they are in the empirical cases.</p>

TECHNICAL PROCUREMENT <ul style="list-style-type: none"> - <i>Activities involved in the procurement of products or product/service contracts.</i> 	<p>The technical procurement phase encapsulated primary negotiations and the formal processes associated with agent engagement e.g. invitation to tender, request for quotation, etc. Agency theory is directly applicable here as the principal agent relationship is the central focus of this stage.</p>	<p>Whilst agency theory offers greater explanatory power over the elements of the buyer-supplier relationship in this stage, there is a wider scope of process engagement here. There are a wider range of internally focused processes over which agency theory offers little explanatory power. Thus, institutional theory is able to be used as the mechanism through which these processes and strategies can be interpreted independent of inter-organisational relational dynamics.</p>
IN-USE PHASE <ul style="list-style-type: none"> - <i>Activities post-contract award, including manufacture, construction and development.</i> 	<p>The post contractual servitised elements involve numerous interactions between the principal and agent, and are impacted strongly by agency theoretic factors such as information asymmetry.</p>	<p>Factors native to the institutional theory framework are conspicuous in the data collected regarding the in-use phases of this PhD. There was evidence of conformity to wider normative, coercive and mimetic isomorphism. In numerous organisations there was adoption of supplier practices, as well as government standards in managing supplier engagement.</p>

Figure 9 - Institutional & Agency Theory

Where possible, interpreting those processes observed through both an institutional theoretical perspective and an agency theory perspective offers a different subjective interpretation and thus provides a different set of implications for the findings.

Using both theories in this manner is completely congruent with the broader critical realist research paradigm that this research is undertaken within (*Guba and Lincoln, 1994*). Given that the paradigm presumes that the research pertaining to a real phenomenon that exists independent of its observation, this allows multiple interpretations to be juxtaposed so as to triangulate a more comprehensive understanding of the phenomena. This

approach would be non-viable in a constructive paradigm, as the theoretical lens itself plays a role in defining the empirical result, thus the outcomes could be entirely divergent. Within this research the hope is to capture realistic images of the same phenomena but from different angles.

2.10 Chapter Summary

The literature review has provided the following two main contributions. Firstly, a systematic review was undertaken in order to identify key concepts and authors. These were then used to drive a focused narrative review into the core areas. An exploration of these core areas has allowed the researcher to outline the research inquiry, specify the research gap and identify key areas of a-priori importance for use in the investigation of complex procurer of products and services. The next chapter is the methodology and will details the research design, as well as provide justification for each element of the research strategy in turn.

3 CHAPTER 3: METHODOLOGY

3.1 Introduction

The purpose of this chapter is to justify and describe the research methodology research. This includes a discussion of underlying research philosophy, research design and methods employed in this research. Within this, the guiding rationale is presented. Following this, the chapter delineates the practicalities of the study; how the cases were selected, the data collected, the processes mapped and the analysis performed.

3.1.1 Research Question

General Aim: To generate an understanding of acquisition lifecycle practice of organisations that procure within complex domains. This understanding should develop theory that provides useful and actionable insights to the field.

Research Question: “How are organisations addressing the challenges of managing acquisition lifecycles in the context of procuring complex products and services?”

Objectives:

- O1: “To propose a method for comprehending the strategic activities undertaken in an acquisition lifecycle.”
- O2: “To identify strategically significant acquisition lifecycles characteristics of organisations operating within the PCP domain.”
- O3: “To identify the substantive differences in how case organisations approach complex procurement, so as to propose theory regarding the significant process patterns in complex procurement.”

3.1.2 Methodology Overview

This research is an abductive series of qualitative case studies into procurement practice within complex contexts. The specific complex contexts under investigation are those major contract arrangements that cause significant relationships to form over extended time periods between procurers and suppliers of both goods and associated services. The literature review has shown the academic disciplines that best describe these areas are CoPS and PCP.

Owing to the relative scarcity of research into acquisition lifecycle practices operating within a PCP context, the author adopts an exploratory approach, using the case study

methodology to allow the abductive creation of theory (*Yin, 2009, Eisenhardt 1989*). The methodological approach featured within this thesis is influenced by the works of Dubois & Gadde (2002) and their rational for iterative reengagement with the empirical world. Generally the research takes an abductive logic approach to understanding complex phenomena within their inseparable complex contexts. The logic of abductive reasoning is an alternative method of discourse to the more traditional inductive and deductive variants, and is distinctly characterised by an iterative consultation between theory and the empirical world throughout the research process. This process can thus be best defined in its opposition to the deductive and inductive approaches; a deductive approach starts with theory and seeks to confirm this view with the empirical world. Conversely an inductive approach observes the empirical world and postulates theory that fits that these observations.

The abductive approach offers a means through which formally tacit approaches of inductive theory generating works are made explicit (Dubois & Gadde 2002), and operationalised into an actionable research design. In this model the theoretical underpinnings are challenged with the empirical world and conversely the empirical observations are used to prompt further engagement with theory as a continuous, mechanised process of correction and recalculation. The abductive method articulated by Dubois & Gadde (2002) can be used as scaffold to position the key components of the research methodology, and understand the purpose of these components. This ‘scaffold’ is depicted below (Figure 10).

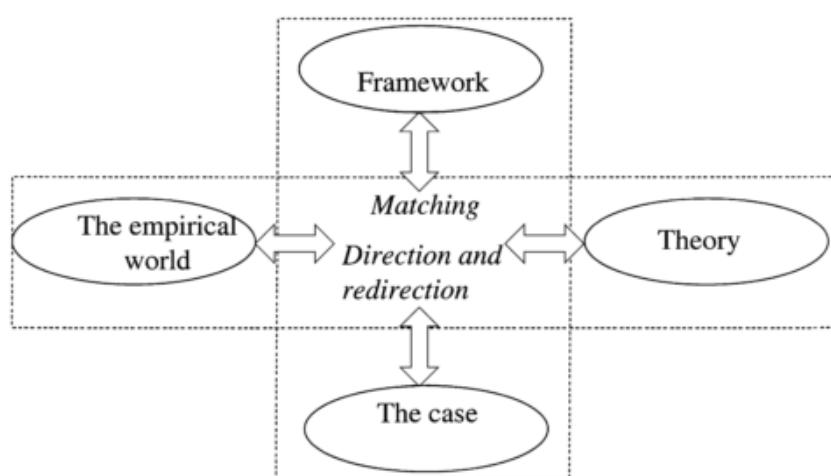


Figure 10 - Abductive Approach (After: Dubois & Gadde, 2002)

The Framework component is defined as follows: “*The preliminary analytical framework consists of articulated preconceptions*”, Dubois & Gadde (2002, P555). The analytical framework exists as the theoretical lens through which this research is understood.

Theory details what is a relevant element to be explored though this lens (contract management, technology management, etc.).

The empirical world is used to challenge the relevance of this analytical framework and the theory with which has already been consulted. In course the theory is then amended and subsequently affects what is viewed or interrogated in the empirical world. Each of these elements is intertwined in an iterative and reflexive attempt to best discover a representative view of the given phenomenon (Acquisition lifecycles).

The Case is the outcome of this process as viewed through the established theory, interrogated through the framework and shaped by the empirical world.

Operationalising this process results in the following: As data is recovered from the empirical world, theory is consulted again and any emergent or modified understandings are used to reconsider the framework which subsequently affects what is viewed or interrogated in the empirical world. The empirical world is used to challenge this emergent framework again until a point of adequate fit, ultimately resulting in the completed case study. Each of these elements is intertwined in an iterative and reflexive research design that attempts to best discover a representative view of the given phenomenon (Acquisition lifecycle practice).

The visualisation of this process as it applied to this research resulted in the following interrogative framework (Figure 11

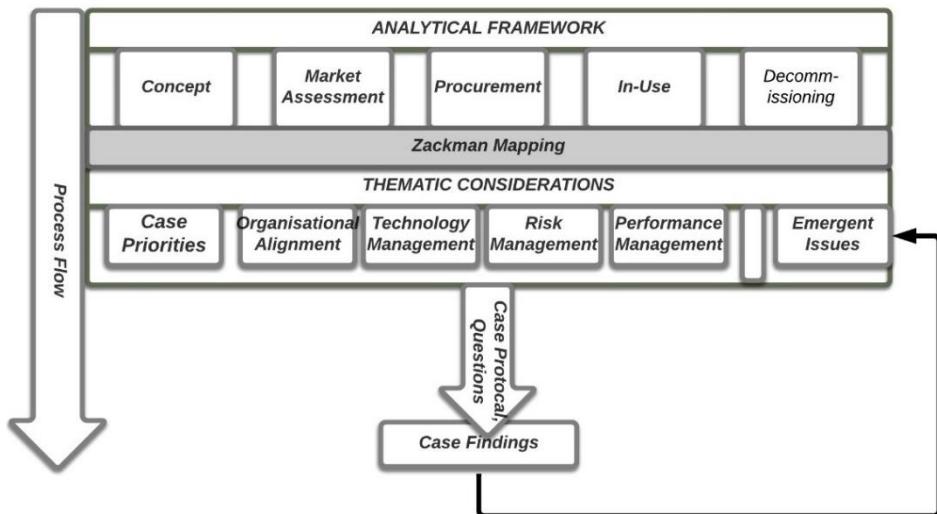


Figure 11 - Interrogative Framework

The interrogative framework consists of two primary elements:

- The analytical framework, is arrived at abductively (creation, amendment, recreation), in an attempt to categorise the sets of activities undertaken from the perspective of the procurer in the complex procurement relationship. The analytical framework isolates variance within the acquisition procedure by categorising the process into comparable and universally cogent segments.
- The thematic focus the researcher's attention on the variances highlighted in the analytical framework. The theoretical elements are initially those key lifecycle practices lifted from literature but are revised in consort with theory, as the research progresses through.

The abductive logic has been used here as an accessible framework through which the other methodological components can be best comprehended. Other elements of key importance are discussed in turn.

Firstly, section 3.2 is a presentation of the key component choice that form the basis of the enquiry, namely: The research paradigm, qualitative & quantitative approaches, exploratory approach, the case study method, and the abductive and theory generation approach.

Secondly, within section 2.9, the theoretical position is considered, invoking agency and institutional theory, along with a description of how they are applied methodologically within this study.

Thirdly, in section 3.3, the specifics of the research design, informed by the previous elements, are considered in detail. The research design is described through a chronological structure of where each of these process occurs in the carrying out of the research, namely, initial framework creation, case selection, case study profiling, data collection, process mapping, model refinement, secondary data collection, case analysis and cross-case analysis.

Lastly, section 3.4 attends to ensuring rigour is designed into the aforementioned approach.

3.2 Research Strategy

The research strategy section of this methodology is a sequential narrative describing each of the key components that make up ‘how’ this research was designed, and ‘why’ these choices were made.

3.2.1 Research Paradigms

This section draws on Guba and Lincoln (1994), who delineate the four competing paradigms within qualitative research, namely Positivism, Post-positivism, Critical Theory, and Constructivism/Subjectivism. These paradigms are a congruent arrangement of ontology, epistemology and methodology. Thus, definitions for the three are required:

Ontology: Defines what is thought of as the “form or nature” of reality (*Ibid*). Typical ontologies include realism (an objective, independent reality), critical realism (an imperfectly comprehensible yet independent reality) or relativism (reality is non-universal and dependent on a knower) (*Ibid.*).

Epistemology: Defines the relationship between the holder of the knowledge and the reality about which the holder knows. Typical epistemologies include objectivist (true), modified objectivism (probably true) and subjectivism (dependent).

Methodology: Defines how a prospective knower best discovers what there is available to know. Methodologies used are wide ranging and not suitable for exploration in this overview.

When a logical compatibility between these elements occurs the result is often a paradigm under which academic study can operate without contradiction. Over time, particular ‘schools of thought’ have formed around these paradigms. The four key paradigms outlines by Guba and Lincoln (1994) are understood to be the following:

Positivism takes an ontologically ‘realist’ view of reality and an epistemologically ‘objectivist’ view of knowledge. That is to say that in the positivist research paradigm there is assumed to be a reality that exists independent of any observers. Therefore the interpretation of that reality can be objective, in that it can be perfectly appreciable regardless of context. The positivist paradigm most typically fits with hard sciences that are most often explored with methods used in the quantitative tradition.

Post-Positivism is a successor to positivism that brings into question absolute objectivity of knowledge. Post-positivism takes an ontological stance of ‘critical realism’ and an

epistemological stance of ‘modified objectivism’. That is to say that within a post-positivist research paradigm there is assumed to be a reality that exists independent of any observer, but that the interpretation of that reality cannot be entirely objective, in that it cannot be perfectly comprehended (*Cook and Campbell, 1979*). The post-positivist paradigm conceives of a hypothetical objective reality as a ‘guiding principle’ for inquiry rather than pursuing an entirely knowable reality (*Guba and Lincoln, 1994*). Therefore the focus of inquiry under this paradigm focus on identify means of uncovering this imperfectly comprehensible reality, assuming it is neither perfectly knowable nor entirely socially constructed (*Easton, 1998*).

Critical Theory, not to be confused with the ontological stance of critical realism is a departure from the ontologically realist paradigms previous mentioned. Critical theory posits that a reality is conceivable only though the historical, political, economic and contextual factors that surround both the knower and the knowledge. Typically findings are stated as provisional within certain circumstances, and the methods of exploration are subjectivist (*Guba and Lincoln 1994*).

Constructivism also takes an ontological relativist perspective similarly to critical theory but without the dedicated focus of a particular lens though which to interpret any results. These results are viewed as provisionally true in certain circumstances and the methods are subjectivist (*Guba and Lincoln 1994*). The researcher exploring the phenomena within this paradigm is presumed to be an integral part of the construction of any finding, with the interplay of the researchers own dispositions and bias forming the findings as observed.

These paradigms define the basic makeup of the methodological approach and are critical considerations in deriving a coherent research design. This research takes a post-positivist view of the inquiry for the following reasons:

- The unit of analysis being investigated are ‘processes undertaken along acquisition lifecycles’. These processes exist independently of the researcher or theorists and thus a critical theorist or constructivist perspective that presumes a constructed reality is immediately constrained.
- Despite the existence of the process independently of the researcher’s observation, the purpose and usefulness of the process is subject to interpretation and thus subjective. There is therefore an objective reality that is imperfectly

knowable, leading to a compatibility between this research and the post-positivist paradigm.

3.2.2 Quantitative or Qualitative

Research may be conceptually categorised into quantitative and qualitative traditions. In applying these terms to the architecture of research paradigms described above, the quantitative tradition most closely aligns to the positivist paradigm and to a lesser extent the post-positivist paradigm. While this is not true in each and every instance it is the typical patterns that are observed (*Denzin & Lincoln, 2011*). The quantitative method attempts to explain the relationships between variables in answer to questions such as ‘what’ and ‘when’, thus aligning more directly with the epistemological objectivist principles of the positivist paradigm, in that the relationship exists in reality and can be objectively represented (*ibid*). In this regard, the quantitative tradition is attempting to either create generalizable findings or make predictions using current models depending on the deductive or inductive nature of the work (*Golafshani, 2003*).

In contrast, qualitative research tends towards focusing on answering questions of ‘how’ and ‘why’ and is more directly applicable to the critical theory or constructivist paradigm (*Guba & Lincoln, 1994*). A substantive difference between the two traditions is in that quantitative theory has natural applicability towards breadth, while the qualitative inquiry lends itself more directly towards achieving an in-depth of understanding of the phenomena of interest (*Adamides et al., 2012*). While the qualitative tradition has more direct applicability within the constructivist paradigm (*Guba & Lincoln, 1994*) there is a long traditional of employing qualitative methods within the post-positivist paradigm. This is especially true in the case of operations management-focused research that often focuses on objective phenomena that exists independently of the observer’s interpretation (*Adamides et al., 2012*). Approaches such as grounded theory (*i.e. Glaser & Strauss, 1967*) that are firmly embedded within a qualitative tradition also featured under a paradigm of post-positivism, however the research question requires that a number of elements are considered a-priori and are thus not suitable to such heavily inductive qualitative methodologies (*Guba & Lincoln, 1994*). In the case of this research, the exploration of processes within complex acquisition lifecycles required that the complex context be examined in tandem. Thus the phenomena, its surrounding context, and the interaction between the two require the in-depth capabilities of a qualitative study in order

to successfully comprehend the nuance of the landscape and build theory from this research (*ibid.*).

3.2.3 Exploratory Case Studies (Building theory)

A central component of this research is that it attempts to make a contribution to the existing body of knowledge through the generation of new theoretical insights. Handfield and Melnyk (1988) described three fundamental ways in which research projects can contribute to the theory of knowledge. Firstly, research can create a new theory for use in understanding an empirical reality. Secondly, the research can take an existing theory and either extend the bounds of this theory or test its applicability within a different context. Lastly, existing theory can be challenged, through disproving or modifying some element of the theory. In this project the research seeks to build theory that provides a coherent overview to the processes embedded within complex acquisition lifecycles.

The reasons for choosing an exploratory approach is related to the state of knowledge within the field. The research identified Procuring Complex Performance (PCP) as the theoretical domain that best encapsulates the concepts and contexts that are relevant to the research question. In considering the relative appropriateness of an exploratory theory building approach within the research, the author makes three central points.

- Firstly, the concept of PCP is a relatively new concept, first defined by Lewis and Roehrich (2009, P4) as “*inter-organisational arrangements that are characterised by significant levels of performance complexity and infrastructural complexity*”. In the years since the subsequent articles pertaining to PCP have been derived from a limited number of authors and the empirical insight whilst critical are still relatively limited.
- Of these authors that have investigated the phenomena and have arrived at a consensus that the field requires further development and is still not well defined (Hartmann et al., 2014; Caldwell and Howard, 2014; Spring & Araujo, 2014; Datta, 2010)
- Lastly, the literature features a number of competing terms and concepts that significantly overlap in their attempt to describe similar phenomena. This lack of a consistent nomenclature is indicative of a field still in development as a consistent concept of the relevant phenomena is yet to form. Thus generating

new theoretical insights is useful in moving towards a consensus regarding fundamental properties of the phenomena.

Within developing fields of knowledge such as PCP where there are no prominent a-priori theories to be tested or rejected it follows that further inquiry is likely to take the character of an exploratory study (*Choi and Hong, 2002; Yin, 2009*).

3.2.4 Case Study Justification

In order to explore the phenomena of acquisition lifecycle processes the research employs a multiple case study design. Case studies are a suitable method to employ in both qualitative and exploratory studies, and of particular applicability when attempting to understand in-depth questions of ‘why’ and ‘how’ (*Yin, 1994*). While this research does attempt to ascertain ‘what’ processes are being undertaken in each of the case study organisations the central focus remains on the ‘how’ and the ‘why’. With strategic processes being the unit of analysis within this study the ‘what’ and the ‘how’ have some overlap. This is because ‘how’ a particular task is performed does define what that process is, and how it differs from any comparable process within the other body of cases. Thus the case study method provides the necessary depth to understand ‘how’ a case organisation is executing its strategic acquisition.

The phenomena under investigation within this research requires that it be investigated in its real world context, which *Yin (1994)* describes as a key strength of the case study approach. As each of the processes observed along an acquisition lifecycle is specifically calibrated to operate alongside the surrounding processes and market/industrial context of the organisation. The phenomenon under investigation is therefore highly complex and cannot be separated from its surrounding context, thus requiring a naturalistic method of enquiry like that case study. Using the case study method retains the link between context and phenomena as well as allows the researcher to build empirical insights from a range of data sources within that context. Therefore enabling the research to adequately capture the complexity of the phenomena (*Welch 2011*).

The issues and limitations of case study research are numerous. A frequently cited criticism is the lack of generalisability of the findings identified within a case study, as they are only applicable to the context in which they were observed. Within the context of exploratory research embedded within a post-positivist paradigm this is less of an issue. As the objective of the research is to understand what is being done in acquisitions within

complex context so as to theorise as to why this is being done within these particular contexts. These results can then be used as the empirical basis to theorise about the implications without assuming ubiquity across all contexts. Thus the state of knowledge is furthered without the need to establish generalisability to an entire population of organisations, as Yin states: “*Case studies are generalizable to theoretical proposition and not to populations*” (Yin, 2009; p15). This sentiment is echoed by Welch (2011), who concurs that while the results are not generalisable to the population that this does not compromise the case study method’s capability to provide explanatory power over a context-sensitive phenomenon.

A further argument against the requirement for generalisability is put forth by Lincoln & Guba (1985) who state that what is lost in the ability to generalise between contexts is somewhat recuperated though the ability to be able to provide contextually rich descriptions essential to understanding. This is a particularly acute requirement when attempting to understand complex phenomena embedded within a complex system, as is the case within this research.

Lastly, a key strength of a case study is the in-depth engagement with case data, which makes the methodological approach particularly suitable to research employing an abductive design (Dubois & Gadde, 2002). Abductive research benefits from this depth, as there needs to be a means of re-questioning the empirical reality based on numerous iterations of analysis, across a range of data sources. Thus the proximity of the researcher to this empirical reality makes this eminently more actionable, as the development of personal relationships increased the likelihood of repeated engagement by practitioners embedded in the empirical setting (Hayward & Cassell, 2017).

The reason for combining case research with this abductive approach is that the academic area of PCP still has room to develop and the purpose of the research is partially to further explore the domain. As such, there was a requirement not to have a rigid and exhaustive set of constructs defined in advance as would be the case in a purely deductive inquiry. Equally, purely inductive work would not permit the necessary A-priori components. These A-priori areas of interest are required given the size and scale of the phenomenon under investigation. Therefore, a purely inductive approach could result in potential scope creep. Instead an abductive approach was used to allow the empirical reality to partially define the bounds of the research whilst still permitting A-priori loading to bound the research. This suitability of case research is highlighted as a key benefit by Eisenhardt

(1989) who describes exploratory cases as being particularly suitable when initial constructs are renegotiable and not certain to be a feature of final results.

3.2.4.1 Multiple Case vs Single Case Study Design

Yin (2009) describes a number of instances where the use of the case studies is appropriate. One of these such instances is when the phenomenon under investigation is exceedingly rare or unique so as to test the applicability of theory in the confines of a unique case. However, within this research, the acquisition lifecycle practice of procurers of complex performance is not a unique phenomenon, it is certainly a rare phenomenon. In rare, but non-unique, contexts the multiple case study approach is cited to be the more appropriate to establish new theory (*Benbasat et al., 1987*).

The selection of multiple case studies over the single case study does partially compromise the depth of the study in favour of breadth. When attempting to add to build theory in a field, there is a need for a breadth of the phenomena as the comparison between the case studies is where context independent rules can be revealed and separated from the contextual sensitive aspects of the phenomena. A single case study would reveal depth of the phenomena unique to that particular context, while a multiple case study approach has a greater possibility to achieve findings that are applicable to procurers of complex products and services more generally, and not exclusively apply to a particular case (*Miles & Huberman, 1994*).

3.2.5 Inductive, Deductive & Abductive.

Inductive and deductive reasoning in research often describes the relationship between the empirical world (the data) and the theory (the knowledge). Where in the inductive school empirical data is taken as a starting position, and theory is extracted from that, in the deductive school, theory acts as the starting point and empirical data is then consulted to test the validity of the initial theory. Eisenhardt (2007) describes these approaches as mirrors of each other with the inductive generating new theory and then the deductive augmenting or providing proof towards that theory.

Case study research is particularly suitable to the generation of theory through inductive reasoning. Eisenhardt (2007) makes the point that the strength of a case study is that it is embedded within rich-empirical, context-sensitive data that increases the likelihood the theory generated will be accurate, useful and testable thus making the inductive case study a logical antecedent to further deductive reasoning-based work.

In this instance, the state of knowledge is sufficiently immature that an exploratory, inductive, ‘empirical data first approach’ is more appropriate. However, as the research seeks to understand complex processes embedded within complex acquisition lifecycles certain bounding preconceptions are required. A purely inductive approach like grounded theory would fail to limit the study in scope, and there is sufficient existing theory to load in pre-conceived ideas of where the greatest impact of processes to the wider acquisition lifecycle may be felt. Thus given the constraints of time and space, and the immaturity of the field it seems that neither an inductive nor deductive approach is the most appropriate to make an inquiry into this field. Thus, an abductive logic approach that focuses on the iterative engagement and re-engagement with the empirical world has been selected as the mode of most suitable inquiry within this research.

3.2.6 The Abductive Approach – Systematic combining

The abductive methodological approach featured within this research is heavily influenced by the works of Dubois and Gadde (2002). Generally the research takes an abductive approach to understanding complex phenomena within their inseparable complex contexts. The logic of abductive reasoning is that there is a back and forth consultation between theory and the empirical world throughout the research process. The process is best defined in its opposition to the deductive and inductive approaches.

The abductive approach offers a means through which formally tacit approaches are made explicit (Dubois & Gadde, 2002), and operationalised into an actionable research design. Whereas in the use of the deductive and particularly in the use of inductive approaches, there is inevitably some iterative redesign of the approach after the empirical world is engaged. Within an abductive systematic combining approach iterative redesign is a critical and prominent component of the research design. Each iteration between analysis and the further inquiry brings the thematic architecture further in line with the empirical reality.

Within a systematic combining approach the theoretical underpinnings are challenged with the empirical world and conversely the empirical observations are used to prompt further engagement with theory as a continuous process of correction and recalculation. This process allows the empirical world to inform the research design and areas of focus and is thus not reliant on having a coherent descriptor of acquisition lifecycle practice loaded into the design a-priori. Thus the approach retains some of the benefit of an

inductive study. Also, the approach allows for the inclusion of some a-priori theory that can be reworked over time, thus bounding the areas of most relevance and retaining some of the benefit of the deductive study. This latter characteristic addresses a key weakness of the case study method as described by Weick (1979; p.38) who describes observation cases as being “*Bent on describing everything, and as a result describe nothing*”. The address of both of these strengths is what Dubois and Gadde (2001) cite as motivation for utilising a hybrid of the approach in the form of abductive systematic combining for case research.

3.2.6.1 Operationalising the Abductive Approach

The abductive method articulated by Dubois and Gadde (2001) can be used as a scaffold to position the key components of the research methodology as shown below (Figure 12), and discussed in the overview section of this methodology chapter.

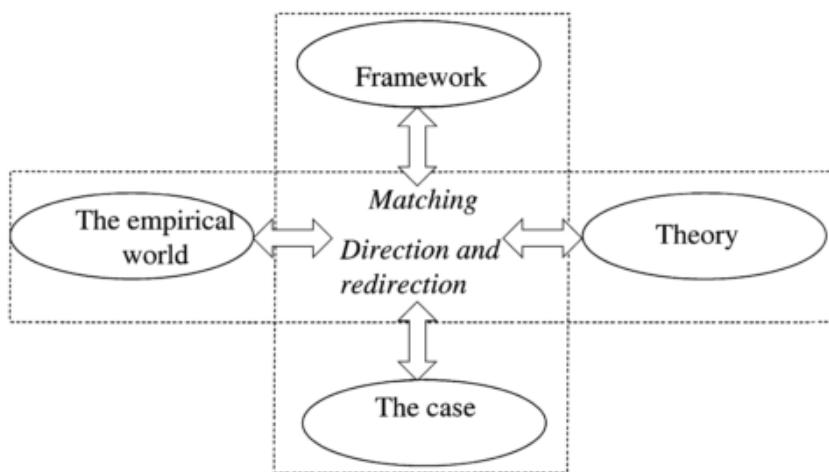


Figure 12 - Abductive Approach 2 (After: Dubois & Gadde, 2002)

The key purpose of Figure 12 is to illustrate the key components that play a role in a systematic combining approach to case research. Of these elements ‘the empirical world’ remains stable, ‘the case’ is in a sense the output of the research and ‘the framework’ and ‘theory’ are those elements that are initially present but re-understood throughout the process after their initial conditions have been confronted with the empirical world.

With regards to the framework: “*The preliminary analytical framework consists of articulated ‘preconceptions’*”, Dubois and Gadde (2002, p555). The framework (conceptual) exists as the theoretical lens through which this research is understood, dictating what concepts are relevant as well as their general relationship to one another.

'Theory' is used to construct the framework, and details why and how these conceptual elements featured within it are relevant to the research initiative, and how they are to be understood. Therefore, as data is recovered from the empirical world, theory is consulted again and any emergent or modified understandings are used to reconsider the framework which subsequently affects what is viewed or interrogated in the empirical world. The empirical world is used to challenge this emergent framework again until a point of adequate fit, ultimately resulting in the completed case study. Each of these elements is intertwined in an iterative and reflexive attempt to best discover a representative view of the given phenomenon (Acquisition lifecycles).

3.2.6.2 Matching Process

The matching processes embedded within the abductive logic approach to qualitative research described by Dubois & Gadde (2002) and is based on the principle of iterative recombination of theoretical concepts with the empirical reality over time. With each iteration the concepts are created, eradicated, amended, combined or adjusted based on the contradiction provided by the empirical reality. This formalised methodological approach seeks to fit the framework, data sources and analysis. Practically speaking, this involves codifying elements from a 'within case' analysis, matching and combining these categories until a normative set of descriptors is derived for that case. Secondly, each of these codified themes from the individual cases are compared, matched and combined to create a normative set of descriptors that hold validity across the set of cases. Both the ability or inability to make sensible matches at the cross-case level generates new insights. A failure of combination identifies a meaningful divergence and therefore a prompt to further inquiry to arrive at an understanding of why and how. Also, a successful matching demonstrated a normative pattern cross-case and help build a theoretical framework effective in perceiving the nature of complex acquisition lifecycles.

The matching process is an attempt to directly leverage a characteristic of effective theory building within qualitative case research discussed by Eisenhardt (1989). Eisenhardt makes the point that theory building is achieved through :

"frequent overlap of data analysis with data collection". (p.538)

Secondly, Eisenhardt (1989) makes the claim that empirical interaction, realignment then re-interaction is a key characteristic of theory development. Furthermore Eisenhardt (*ibid.*) makes the following statement

“Creative insights often arise from the juxtaposition of contradictory or paradoxical evidence....The process of reconciling these contradictions forced individuals to reframe perceptions into a new gestalt.” (p.546)

These two statements inform the main rationale for selecting the matching process within this research. The first statement emphasises the importance of the abductive back-and-fourth exchange between the empirical world and theory in order to generate useful new theory. The second quotation is being used as partial justification for the methodological approach used within this project. Amongst the case studies employed, the work seeks out convergence and divergence processes amongst similar complex organisations. The explanation as to how and why these processes differ or are convergent is the principal driving force behind the generation of theory within this study.

Within this research, therefore, initial theoretical conditions were identified along with their associated assumptions (Risk management, Technology Management, Organisational Alignment, Contract Management were the final categories). These categories are used to explain the majority of performative and strategic difference observed with acquisition lifecycles in complex environments. The initial list of categories that were derived from theory were significantly larger, over time the matching process removed, combined and amended the list in order to finally arrive into these five top-layer categories which are shown in Figure 13. Each of these categories consist of numerous other subordinate themes that are discussed later.

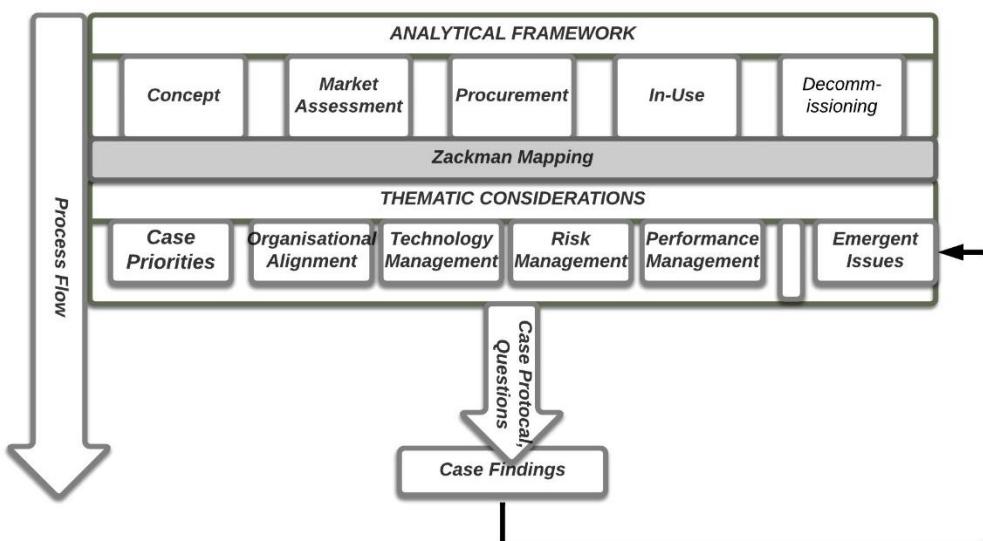


Figure 13 - Interrogative Framework 2

3.3 Research Design

The research design is shown as a chronological process depicted below in Figure 14. Given the nature of abductive research, specifically it's intermixing of analysis and data collections stages, the following sections will be organised in accordance with the broadly linear design featured in Figure 14.

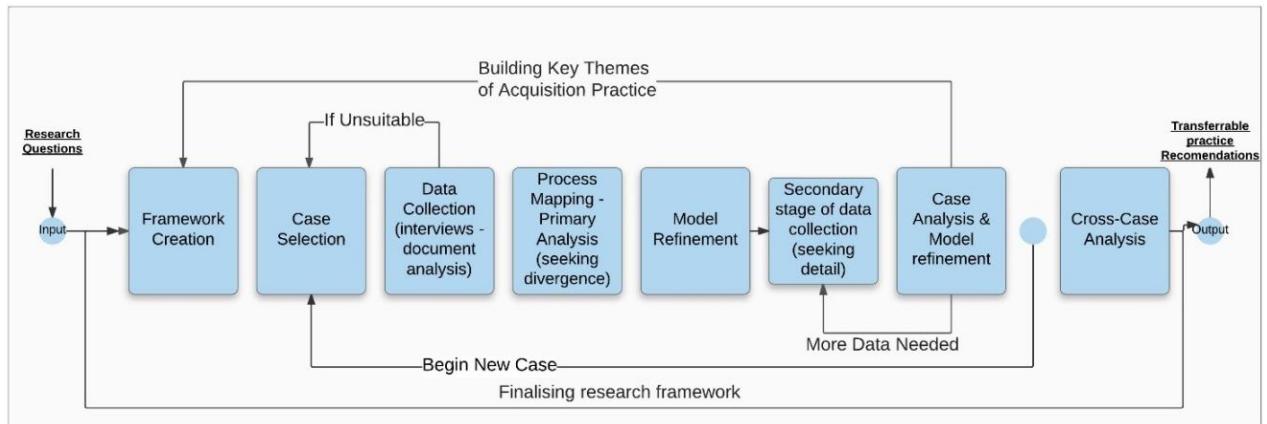


Figure 14 - Research Process

3.3.1 Framework Creation

The initial interrogative framework consisted largely of theoretical components, with some initial guiding insights taken from a-prior areas featured within the literature review as well as insights taken from preliminary meetings held with the first case organisation. The framework consisted of articulated preconceptions regarding what themes of strategic and procedural difference contribute towards overall operational effectiveness of the acquisition lifecycle. These themes were subcategorised over time and finally reduced into the thematic architecture, they sat under the main themes of interest shown in the interrogative framework in Figure 13

An important characteristic of the framework used to assess the data from each case is the refinement of the analytical mapping used to capture the data in the first instance. This is described in the process mapping section (3.3.6)

Therefore, the interrogative framework used to assess the case data consists of two components. Firstly, the analytical framework used to create a common contextual reference for analysing and understanding data, and secondly the thematic considerations that define what processes are relevant. The analytical framework is developed entirely

inductively from case data. Whereas the thematic considerations are initially generated from the literature and refined with case data over time as shown in Figure 13.

3.3.2 Case Selection

Case selection involves making a number of critical decisions regarding the research, namely, the number of cases that are going to be explored, and the decision making process of selecting each of the cases. With regard to the number of cases explored Yin (2009) suggests using between four and ten cases for an exploratory study examining a non-unique phenomena. Taking this as a guiding principle the final number of cases examined in this research was six. This number was decided upon based on two factors:

Firstly, when a level of theoretical saturation had been reached in that the examination of additional case materials were not producing significant additional divergences in process that fit into the categories of interest. Thus the research had reached a point of diminishing returns whereby the case data no longer caused significant re-evaluation of the themes. From an abductive systematic combining approach this is the point at which the empirical reality matches the theory.

Secondly, given that the phenomenon being investigated is acquisition lifecycle practice in complex environments, the number of cases available to select from are limited as they are restricted to large organisations, operating in complex environments. Of this diminished pool of potentially suitable organisations the resource and time constraints on the research meant that only six organisations fitting the criteria could be successfully contacted and explored. Numerous other organisations were considered with contact failing due to either the case being deemed not suitable or the organisation being unwilling to participate in the work. Of these rejects, several organisations from the oil and gas industry, as well as the banking sector were amongst those considered.

3.3.2.1 Case inclusion criteria

The research aimed to undertake case studies in different organisations from a range of industries to reflect the diversity of practice that is used in the acquisition of complex products and services against a variety of lifecycles. As stated earlier, the research identified CoPS as an area of relevance, but more directly identified PCP as the principal area that this work applied to. In following Spring & Araujo (2014) this work softens the typical narrow PCP assumptions about the empirical settings and extends the area of concern beyond the focused view of “high value capital goods” (*Davies and Hobday,*

2005, p. 4). With this having been said, there is still a requirement to ensure a reasonable level of adherence to the PCP domain. The objective is to ensure that broadly relevant areas are explored, without narrowly focusing on narrowly focused, and well explored industries.

Therefore the selection of a case required the author to make sensible ex-ante judgements around the relative complexity of the product/service offering. To ensure the best suit of case organisations ex-ante: The study borrows from the Ren & Yeos (2006) definition of complex product systems in identifying case study selection criteria (Table 8) and compares the selected case context against the definitions.

CoPS Definition – Case	Defence	Health	Nuclear	Government	Encirc	IBM
<i>“CoPS are business to business capital goods used to produce mainly consumer goods and provide services”</i>						
<i>“They have significant economic and political value for both CoPS suppliers and users;”</i>	X	X	X	X		X
<i>“CoPS have elaborate architecture; consist of many interconnected control units, subsystems and components;”</i>	X	X	X	X	X	X
<i>“CoPS is a complex system that can perform multiple and important functions;”</i>	X	X	X	X	X	X
<i>“They are produced in one-off projects or small batches;”</i>	X		X		X	
<i>“They involve a certain degree of technological novelty and innovation;”</i>	X		X		X	X
<i>“They are customized for specific customers”</i>	X	X	X	X	X	X

<i>"They involve a high level of coordination and collaboration during design and implementation, including user/customer and supplier involvement, and sometimes, government and regulator involvement"</i>	X	X	X	X	X	X	X
<i>"They involve a wide breadth of knowledge and skills;"</i>	X	X	X	X	X	X	X
<i>"They usually have a certain degree of embedded software"</i>	X	X	X		X	X	X
<i>"They have a long product life cycle, including pre-production bidding, conceptual and detailed design, fabrication, delivery and installation, post-production innovation, maintenance, servicing and sometimes, decommissioning"</i>	X	X	X	X	X	X	X

Table 8 - Case Selection

The case study profile was arrived at by seeking cases that broadly fit into this classification, whilst not mechanistically dismissing contexts that did not perfectly ascribe to all areas. Also, there was a requirement to ensure that the body of cases covered the range of issues that were pertinent to the research question, and did not focus heavily on any particular type of activity.

As such ‘categories of key importance’ derived through discussion with practitioners operating in the defence case (first case). Categories were used to provide a broad profile of characteristics: sector type, technological sophistication, focus of lifecycle practice, and degree of product/service in contracts (Table 9).

These criteria were used before commencing a case to ensure the case was suitably relevant to both the literary themes discussed in PCP and the areas of concern applicable to the areas highlighted in the earlier cases. This is level of empirical assurance made possible by the abductive research design, allowing the classification to evolve as each

case was undertaken. This provided the most likely fit and suitability of further cases. The criteria are detailed below:

- The organisation engages in long-term contractual arrangements for acquisition and procurement;
- There was a significant portfolio of contractual arrangements;
- The procurement centred on a complex, capital intensive product/service.

3.3.3 Case Study Profile

All cases were tested to ensure they conformed to the basic eligibility criteria highlighted above and then the degree to which the cases exist within ‘categories of key importance’ is assessed to ensure a breadth of coverage. Each new subsequent cases were selected in reference to what type of case had already been explored in order to provide a comprehensive profile.

	Sector		Tech-use	Lifecycle Focus				Servitization	
Case	Public	Private	High	Concept	Assessment	Procurement	In-Use	Service	Product
MOD	H		M	M	M	M	H	H	H
Sellafield		M	M	M	M	H	H	H	H
NHS	H		L	M	L	H	L	H	M
Encirc		H	L	L	L	H	L	L	H
Local Gov	H		L	M	M	M		H	M
IBM		H	H	H	H	H	H	H	M
Alternative Cases Approached									
BP			H	H	H	H		M	H

Table 9 - Case Study Profile

Key: (H) High Relevance, (M) Medium Relevance, (L) Low Relevance (-) N/A

Preliminary conversations occurred with a number of other potential case organisations but were discontinued because of implementation constraints, namely the time scale of the project, the willingness of the organisations to participate and the availability of participants to support the studies. BP was also considered, and preliminary research on the organisation was conducted and initial contact was undertaken but no contact was available within the study timeframes.

3.3.4 Data collection methods

The data collection featured within this research primarily involved semi-structured interviews and document analysis. As is typical within the abductive approach there were multiple points of data collection used throughout the research. While there was a minimum of two points of data collection used within the research design, in reality there was often a significant number of back and forth between data collection and analysis in formalised stages. Moreover, given that data collection often involved significant security requirements there was several semi-structured interviewed used over multiple days on site at a given case. This allowed more ad-hoc alignment of the empirical reality being explored and theory already generated. In each formalised phase there was both semi-structured interviews and document analysis used.

3.3.4.1 Semi-Structured Interviews

Interviews are widely regarded as one of the key data collection tools used within case study research (*Eisenhardt & Grabner, 2007; Yin, 2009*). The semi-structured interview is the interview method most compatible with the abductive approach, and the reasons for this are akin to the selection of an abductive approach in the first instance (*Duboi & Gadde, 2002*). The semi-structured interview approach offers some of the flexibility of being able to change the case study protocol based on the empirical reality whilst also providing a means through which to target specific A-priori areas of interest. An unstructured approach would fail to focus on the areas critical to addressing the research questions that were highlighted a-priori in the literature review. Equally, an entirely structured questionnaire would run counter to the purpose of the abductive approach in that it would not permit the realignment of questions based on observations in the empirical reality (*Yin, 2009; Duboi & Gadde, 2002*).

In regard to the specific procedure undertaken at interview: A practical problem with a fixed interview guide was that the relevant knowledge was not distributed uniformly across the various cases. In some of the smaller organisations the bulk of relevant knowledge was distributed amongst a small number of individuals, often based at the same geographical location. In the largest of the organisations this same fundamental knowledge was spread across multiple departments, and multiple geographical locations. As such a rigid interview guide was entirely untenable. Instead the abductive approach informed the interview guide. Typically interviews started with an exploration of the

participants' specific position in the acquisition process by asking what processes they are directly involved in. As these processes are uncovered, they are sketched in the initial iteration of the Zachman mapping tool and then these processes are investigated in terms of the six key interrogatives (what, why, how, when, who, where). Processes that relate to thematic categories of interest are given particular focus. Subsequently to this the participant was asked to identify processes adjacent to those that they are directly involved in, and the primary interrogatives are then again pursued with these processes. This process continues until the participants' boundaries of knowledge were reached.

After the production and analysis of transcripts a formal iteration of the Zachman process map is produced. This is then used to identify gaps in knowledge. At this point a suitable participant or department to fulfil these gaps is identified and targeted if this cannot be done by document analysis. The process is then repeated with these new participants until there is a comprehensive overview of process along with acquisition lifecycle.

3.3.4.2 Document Analysis

The other main component of data collection used in this study was document analysis. Yin (2009) provides a wide range of examples of documentation that would typically be consulted in case-based research involving diaries, official documentation, memos etc. The documents made available were wide ranging, but all fell under the category of official documentation across all cases. The availability of documentation varied significantly, with some cases having dedicated repositories of data that could be readily accessed, though to small quantities of printed documentation held in storage.

The document analysis was undertaken in a manner similar to the interviews. Document analysis typically followed an initial interview and was used to assist with filling in gaps in knowledge identified on the Zachman process maps, any subsequent gaps after assessment of the relevant documentation would then be included within the next interview guide.

3.3.5 Data collection process

The systematic combining approach featured within this research requires repeated re-engagement to collect new primary data. As such the research design required free access to the case organisations as the number of interviews, documents or site visits required could not be known in advance. This is because the Zachman process mapping technique used within this research prompts the research to investigate areas that were previously missed at interview during the analysis phase, and causes a re-engagement in line with the wider abductive approach. The sequencing of data collection stages that were used within this research can be seen in the findings chapter.

3.3.6 Process Mapping

The process mapping featured within this study takes inspiration from the Zachman Enterprise mapping toolkit (*Zachman, 2018*), amended to be commensurate with the time and resource requirements of qualitative PhD research.

Within the Zachman enterprise mapping model, the organisation is taken as the unit of analysis. The model arranges two basic criteria in opposition in a matrix arrangement. The first of these criteria are what the framework considers to be the six primary interrogatives (what, why, when, where, who, how). The second of these criteria are perspectives from different hierarchical and functional levels within the organisations such as (executive, business management, architect, engineer, technician, and enterprise). These two sets of criteria are arranged within a matrix, and the explanation of each of these questions, from each perspective is given within the cell. An example of this can be seen below in Figure 15.

	What	How	Where	Who	When	Why	
Planner							Scope
Owner							Concepts
Designer							Logic
Builder							Physics
Implementer							Technology
Operator	THE ENTERPRISE						Product

Figure 15 - Zachman example

Numerous versions of the framework offer suggestions as to how to best model an answer to a given question, when asked from a given perspective. For example when applying the Zachman framework to a software developer the most appropriate diagrams and tools to model what is happening from the planners perspective differ when compared with a construction company. Equally the perspective embedded in the model will also change when mapping different organisations and different industries.

The proprietors of the model are sure to stress that the Zachman model is an ontology as opposed to a cohesive methodology (Zachman, 2018). The purpose of the framework is to offer a scaffold around which an overview can be provided of a given phenomenon, and not a prescriptive set of instructions to be followed in order to reveal the phenomena.

3.3.6.1 Application within this research

This research has taken the principals of the Zachman enterprise mapping approach towards providing a cohesive overview of acquisition lifecycle practice. In doing so the research retains the key interrogatives on one side of the matrix (What, why, when, where, who and how). However, the perspective on the opposing side of matrix are replaced by the process themselves, as detailed by the ‘what’ interrogative. This change can be thought of in two ways. Firstly, it could be considered a single perspective from the Zachman framework as the process is concerned entirely with procurement and acquisition of complex assets. Alternatively, it can be seen as each process undertaken

within the acquisition lifecycle has within it an embedded perspective, thus taking the ‘processes’ as the opposing side of the matrix, the framework explores each perspective by reference to the process that are undertaken from that perspective. For example if a process in the acquisition lifecycle is to release a RFQ (request for quotation) then the perspective of the procurement officer is embedded within that process, as it is the procurement officer who undertakes it. If there is a strategic review, then the perspective of the management team is embedded within the process, as it is the management team that undertaken the strategic review. In applying the framework towards the acquisition lifecycle practice alone then the perspective are limited to those perspective that have direct involvement within the acquisition lifecycle.

The other substantive emergent difference in applying the Zachman ontology towards an acquisition lifecycle instead of an enterprise is the chronological nature of the lifecycle. When applying the Zachman framework to an enterprise the overview is of those perspectives as they exist in that fixed point in time. In the case of the acquisition lifecycle, processes within an acquisition lifecycle are arranged chronologically, in a largely linear fashion. Certain process cannot be undertaken before others have completed. As a result the diagrams used within this study have a linear nature moving left-to-right and explaining the details of each process as they go along.

3.3.6.2 Benefit of Process modelling in this way

Given that this research is a comparative case study, the use of a linear Zachman framework allows a number of benefits when compared with a traditional qualitative investigation.

Abductive Prompting: Requiring that each process be explained in terms of its key interrogatives (What, why, when, where, who and how) results in the framework operating as more than simply a recording instrument. It prompts the researcher to direct question as to where there is an omission of knowledge gathered regarding a particular process. This is a critical element to ensure that there is a comprehensive overview of acquisition lifecycle practice within each case.

Normalised Comparisons: Summarising data in the Zachman framework provides a normative structure across each of the cases. This provides the basis from which the researcher can make comparisons regarding the cases and use these to feed into follow up questions within this and other cases. An example: If previous organisations each had

a pre-qualification stage before the release of a request for quotation stage then this would signify a thematic pattern. If when a new case is explored, there stages are omitted or contain a previous unseen process between them, then this divergence from the pattern would be cause to further interrogate both why the process is in place within the new case, but also to ask why there is an omission of this process from the previous case.

While having proved an extremely effective tool for generating pertinent questions throughout the research this tool can only be used effectively in wider abductive research. As new process emerge in other cases this can cause questions to be asked of any and all previous cases conducted, as such free access to primary data is critical and has been a time consuming element of this PhD.

3.3.6.3 Example of Zachman Mapping

After numerous iterations, the Zachman mapping was eventually broken down into four key stages that were universal to the series of case organisations that were being explored within this research.

The individual process are not interchangeable with each other and there were vastly different groupings of similar process amongst the cases. In spite of this however it was observed that there were four broad categories that could sensibly describe every process grouping. These categories were Concept, Assessment, Procurement and In-use. The composition of the case stages of an acquisition lifecycle varied in a number of ways. Some organisations would have manufacturing or decommissioning stages, others had extensive installation stages. Despite these difference each of these could be viewed conceptually as part of the top four categories of activity as defined as follows:

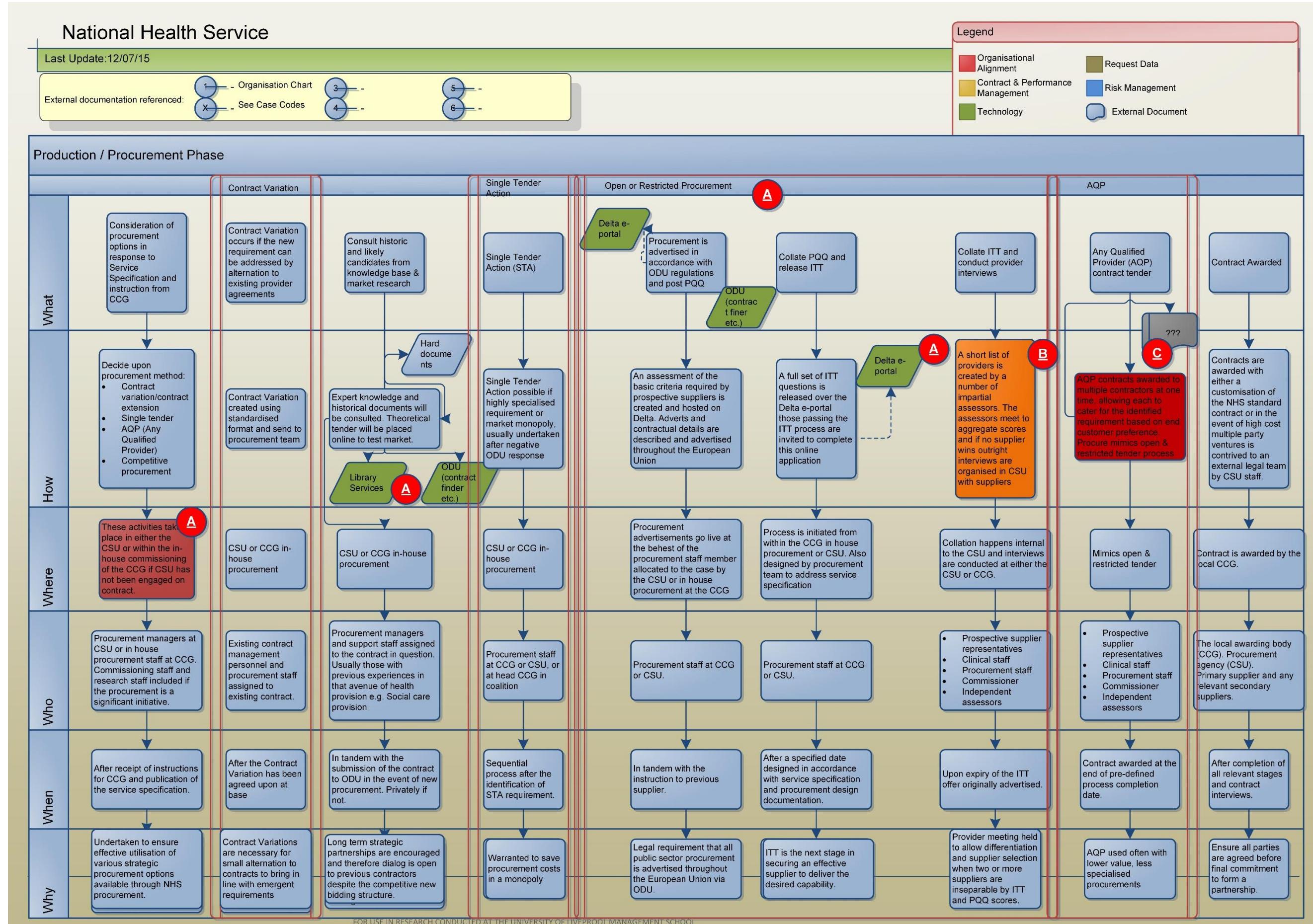
- **Concept Stage:** Consideration of requirements and potential procurement routes.
- **Assessment Stage:** Assessment of acquisition strategy, pre-market agreement, make/buy decision.
- **Procurement Stage:** Activities involved in the procurement of products or product/service contracts.
- **In-Use Stage:** All activities post-contract award, including manufacture, construction and development.

Thus, for each of the cases explored there were a minimum of four diagrams drawn, depicting these stages. Each of the processes were described in accordance to the following six primary interrogatives:

- **What:** A description of what the process is, referencing practically is being undertaken.
- **How:** An overview of the specific action undertaken in order to execute this process.
- **Where:** In reference to the organisations structure, both physically and hierarchically, where does is the process undertaken. Inclusive of the extended enterprise in some cases whereby third party contractors are used.
- **Who:** In reference to the organisations hieratical structure, what person(s) are responsible for carrying out this process.
- **When:** With reference to the other processes feature in the acquisition lifecycle, when is this process carried out. What are the processes dependent on it, and what process is it dependent of.
- **Why:** What organisational function does this process support, what value is added or what value adding process is supported by this process.

Once sufficient data has been collected to complete the first iteration of the framework for each stage of a case organisation preliminary analysis is concluded. This analysis included the highlighting of relevant items (A on Figure 16), highlighting points of divergence with other cases (B on Figure 16) and tagging of potentially relevant omissions (C on Figure 16).

Figure 16 - Zachman Map (example)



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Figure 16 is an example of the framework for the Procurement/ Production stage of the NHS case study. As can be seen within the figure, each interrogative is explained for each process observed within this phase, within this case study. These items are then tagged in the following ways:

- **(A) Highlighting relevant items:** These items are colour coded to the relevant superordinate theme. As can be seen in the legend at the top right: Red corresponded with a point demonstrating data points that can be thematically coded under organisational alignment, green to technology, orange to contract & performance management. Initially each element that can be potentially coded thematically under these classifications are highlighted, then non relevant but thematically pertinent points are discounted over time in the analysis stage.
- **(B) Notable divergences:** Whilst not exclusively, the notable divergences are highlighted when the process in question is both pertinent to the thematic classification and divergent from processes observed in other cases. The notable divergences are critical points to follow-up on in the next stage of data collection as these divergences are what drive theory generation within defining a schema for operations within complex acquisition lifecycles.
- **(C) Potentially relevant omissions:** Omissions are flagged when the data collected is inadequate to fully or partially answer one of the primary interrogatives. Thus prompting the researcher to fill the gaps in knowledge that remain after the initial data collection.

It is important to note that the above example is close to final, and the intermediate stages often include far more unknown elements highlighted.

3.3.7 Analysis Model Refinement

Model refinement refers to the thematic coding that is being applied to case data. With each iteration themes are added, deleted, amended or merged. This kind of codification is widespread through academic and whilst variants in precise methodological process exists (*i.e. King, 2004*) the approach generally falls under the rubric of thematic analysis (*Voss et al, 2002; Miles & Huberman, 1994*). Whereas traditional thematic analysis involved creation and re-creation of themes from case data, the abductive research requires re-engagement with primary data sources during this analysis process (*Duboi & Gadde, 2002*).

In each case the boarder purpose remains the same: to generating insights pertinent in address of the research question. The data analysis can be divided into two key elements, the case analysis and the cross case analysis. The purpose of the case analysis is create a detailed understanding of the case organisation in the form of a case report (*Eisenhardt, 1989*) whereas the cross case analysis focuses on generating comparative insights from each of these reports (*Voss et al, 2002*).

The first component is referred to by (*Eisenhardt, 1988*) as the ‘within-case’ analysis. The central component of this is to acquaint the researcher with the case organisations as a single and separate case so as to allow the distinctive properties of that case to emerge. Within the abductive framework employed here this takes on a different character, as the boundaries of the data collection for each case is informed by the previous cases conducted in the study. However, the purpose of the abductive component is not to diminish the distinctiveness of each case, but rather to ensure that all relevant categories of difference have been explored and understood within each of the organisations. It also does not make any substantive difference to the central purpose of the ‘within-case’ analysis. That being to generate insights about the unique properties of the case (*Barat et al, 2011*).

3.3.7.1 Analysis output

The thematic analysis describes and classifies processes along the acquisition lifecycle within the case. Given that ‘process’ is the unit of analysis in this research it is required that there be a way of discriminating between meaningful and non-meaningful processes undertaken by an organisation in their acquisition lifecycle. Processes were deemed relevant based on the following criteria:

- The process falls under the categories of interest established as a-prior areas of relevance in the literature.
- The process is divergent from those processes observed in other cases
- The process is of any potential significance to the performative character of the acquisition lifecycle.

Emergent themes from each case are added to the interrogative framework in order to ensure that similar processes are identified in the subsequent cases. The Zachman framework is then consulted and previous cases are re-explored with the new ‘interrogative framework’.

Once this set of themes have been created for each of the ‘within case’ studies these thematic classification are then contrasted and combined with those from the wider case population. This produces the final classification of the thematic framework after cross case analysis.

3.3.8 Secondary Data collection stage

As the data analysis occurred simultaneous with the data collection in multiple instances. The secondary data collection stage can be thought of as either a mandatory data collection stage in the normative process outlined in this research or as a final data collection stage before completion of the case. The abductive logic and specifically the systematic combining approach does not advocate restricting data collection to a two stage process, however it is a requirement that there be more than one instance of engagement after the initial process had been mapped. It therefore seems prudent to represent this process within the diagram detailing the normative process used.

3.3.9 Case Analysis and Model Refinement

The final stage of analysis occurs for a given case when theoretical saturation has been reached, and all unknowns highlighted on the Zackman process maps have been satisfied, thus indicating that further data collection is unnecessary.

3.3.10 Cross-Case Analysis

The second phase of the case analysis as defined by Eisenhardt (1989) is the cross-case analysis. The purpose of the cross case analysis is to compare and contrast the individual insights of cases across the body of cases so to derive further insights applicable to the group (*Ketokivi & Choi, 2014*). There are a number of ways that this cross case analysis can be undertaken, typically this involves a thematic comparison across the body of cases and thematic reduction into a set of themes that apply to the whole set (*Miles & Huberman, 1994*). This process has been made explicit within this research, as the categories of interest were first posited a-priori and then amended iteratively with the inclusion of additional case data. Within this research the superordinate categories were loaded partially a-priori and verified over time after numerous iterations. Within these key areas there are also subordinate themes arranged hierarchically which change, multiply and reduce as new data

is collected. The final hierachal thematic architecture is deduced from the case characteristics across the set of cases and presented in the cross case analysis section of the discussion chapter.

3.3.10.1 Cross-Cutting Themes

In assessing the relative differences amongst these areas, two additional cross-cutting themes were encoded in order to make assessments as to how each of the key themes are manifesting within each case. The cross-cutting themes were prevalence and perceived effectiveness. These themes were encoded relative to the other themes identified at interview.

An example: When analysing case data, if a quotation from the transcript is encoded under the ‘technology management’ superordinate theme and another sub theme then the surrounding text will be examined and any indication as to the positivity or negativity of the phenomena being described will be encoded under ‘perceived effectiveness’. Once data collection has fully identified areas of interest then the question as to how effective a particular case characteristic is perceived to be will be added to the case protocol and asked at a follow up interview or via e-mail correspondence. The second of the cross cutting themes ‘Prevalence’ is derived through a meta-analysis of the entirety of in case coding that fits under the subordinate and superordinate characteristics defined during the cross-case analysis. Prevalence as a category is not intended to mean that amount featured within the interview data, but instead the amount of organisational activity that has been shown to fit under these headings. Therefore if the defence case study has a high prevalence of a “Quality management and KPIs” theme, then this is to say that they undertake a significant labour within these process relative to the other cases, and does not mean simply that it was discussed heavily at interview.

Encoding these characteristics allows the researcher to leverage expert knowledge of the interview participants into a form whereby comparisons can be made cross-case. This aids in the creation of theory that applies to the entire case body, without losing the nuance and in depth-explanation associated with theory building, case based qualitative research.

3.4 Designing for Rigor in the research

3.4.1 Construct Validity

Construct validity is achieved by having the design of a research study accurately measure or understand what it claims to be measuring or understanding. In the case of this study, the study is purporting to understand what the significant characteristics of acquisition systems within complex environments are, and what strategies are being used effectively within these characteristic categories. In understanding these characteristics the research seeks to inform our knowledge base regarding what process and strategies can be utilised to execute an acquisition function effectively within complex environments.

Therefore in order to assure construct validity there is a need to confirm that the characteristic categories are factors that make a substantive difference to the operation of acquisition lifecycles. There are three primary ways in which the research achieves this: Firstly, the literature was consulted in order to consider what categories are known to be of significance in complex acquisition practice, ensuring that the questions asked map onto these relevant literary themes (*Voss et al, 2002*). Secondly, these characteristics are co-created in consultation with the empirical work thought the systematic combining approach. These two points ensure that the characteristics are measuring the most relevant categories of interest. This ensures that the categories are relevant, and thus that differences amongst these categories in process are potentially relevant differentiators in performance.

3.4.2 Content Validity

Whilst construct validity is a mark of whether the research measures what it is intending to measure, content validity is a mark of whether the research measures the entirety of the phenomena. In the statistical sense this can mean that a set of variables adequately depict a given phenomenon, in the case of this qualitative study content validity is achieved by ensuring the range of process undertaken under a given thematic category have been adequately captured and mapped within a given case.

For this the research uses the Zachman mapping approach. As described above in section 3.3.6 the Zachman approach used in this research allowed the researcher to be prompted in real time as to where there is a gap in the data collected. This helps to ensure that all key process are observed, and thus that each of the relevant categories has been fully explored within each case. After the initial collection there is then an abductive-style comparison

between the new data, the evolving theory, and original literature. The categories and sub categories are therefore adjusted, rejected or added as is appropriate to bring the theory in line with the empirical observations.

Expertise in considering the theoretical relevance is stated by Flynn et al, (1990) to be one of the key drivers of increasing content validity. There are three levels of expertise working towards increasing content validity within this study. Firstly, there is the expertise of the authors of previous work into PCP and complex acquisitions who identify critical components of complex acquisitions which are used as the a-prior superordinate categories. Secondly there is the expertise of the researcher and supervisor as they consider empirical evidence and theory once data has been collect. Thirdly and finally there is the expertise of the interview participants who are consulted and re-consulted after a rotation of theory and asked about the perceived relevance of current classifications.

3.5 Chapter Summary

This chapter has outline the philosophical and methodological approach undertaken within this thesis. The chapter has made the case for the selection of the qualitative, multiple, case study methodology as well as using the Abductive approach in address of the research question. The specifics of the research design have also been outlined in detail, describing how cases were selected, data was collected, data was analysed as well as having provided an explanation of the Zachman process mapping approach. The following chapter now summarises the findings from each of the six cases, describing the ‘within case’ for each, as well as the findings and cross-case analysis.

4 CHAPTER 4: FINDINGS

4.1 Introduction to chapter.

This chapter is used to describe these acquisition of lifecycles of each of the case organisations and highlight the relevant process used within each of these cases. As described within the methodology, processes are identified and discussed based upon the following criteria:

- The process falls under the categories of interest established as a-priori areas of relevance in the literature.
- The process is divergent from those processes observed in other cases (so as to avoid a focusing on non-significant processes)
- The process is of any potential significance to the performative character of the acquisition lifecycle.

The purpose of highlighting these processes is twofold: Firstly this allows the researcher to build on the interrogative framework after new cases and processes are identified and understood. The end result is an interrogative framework that makes a theoretical contribution to the field. This interrogative framework is a set of thematic considerations that allows researchers to classify the important strategic components along a PCP acquisition lifecycle.

Secondly, having these items classified across each of the organisations allows cases to be compared on the basis of these thematic areas of interest within the cross-case analysis. In order to aid with this comparison, two further cross-cutting themes were codified at interview; ‘prevalence’ and ‘perceived effectiveness’. These themes are codified relative to the highlighted processes and thus the researcher is able to articulate direct comparison on the amount of particular process themes being undertaken, along with a sentiment as to how effective this strategy is view to be by research participants.

4.1.1 Data Collection Narrative

The systematic combining approach featured within this research requires repeated re-engagement with the empirical world, as opposed to discrete data collection phases seen within alternative forms of qualitative research. As such the research design featured within this research required free access to the case organisations as the number of interviews, documents or site visits required could not be known in advance. In order to illustrate the complexity and nature of this approach a narrative explanation of the key points of data collection have been

described below in Table 10, along with an overview of the process in Figure 17. It should be noted that while this diagram represents the requirements for actively re-engaging with the organisations, it does not show each iteration back-and-forth between data already collected and the analysis.

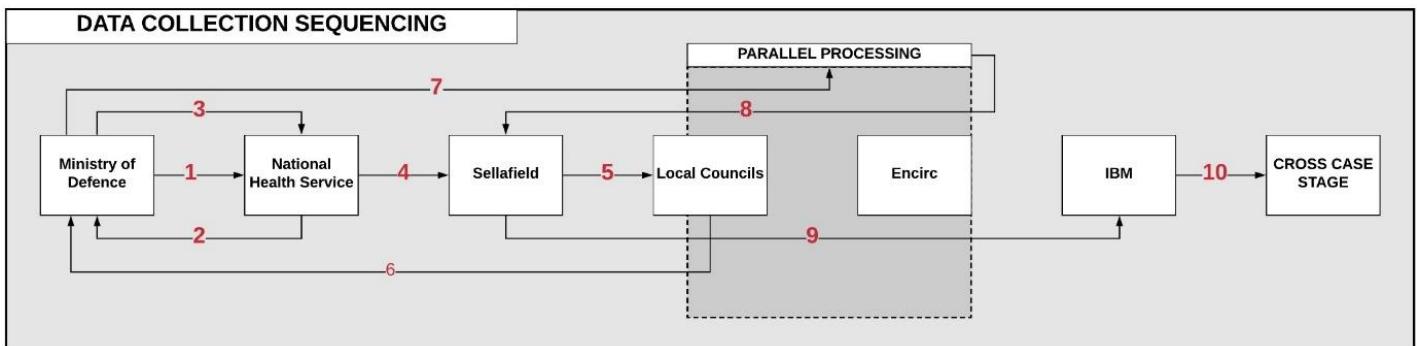


Figure 17 - Data Collection Sequencing

STEP NARRATIVE OF DATA COLLECTION SEQUENCINGS

- | STEP | NARRATIVE OF DATA COLLECTION SEQUENCINGS |
|------|--|
| 1 | <p>In the first instance, initial interviews were conducted at MOD. These interviews were the first test of the a-priori concepts and themes identified in the literature against the empirical reality. At the same time preliminary documentation to the acquisition cycle was provided by key contacts in the DE&S (Defence Equipment and Support Organisations) after a series of initial discussions and start-up meetings. Also, MOD granted access to the “Defence Gateway” which allowed instant access to a significant repository of strategic documentation pertaining to the acquisition lifecycle practice.</p> <p>Considerable time was spent on this original case aligning the theory with the strategic documentation and that overview that was presented within the initial interviews.</p> |
| 2 | <p>After the interrogative framework had been adapted to capture themes observed within the MOD case study, the NHS data collection was undertaken. A procurement officer working at a CCG acted as a key contact person for the study and three interviews were conducted with this person to build up a coherent overview of the key acquisition stages. At this time, strategic acquisition documentation was provided for the NHS sourcing strategies of large contracts. After the initial inclusion of this</p> |

empirical evidence into the evolving thematic considerations driving the enquiry the MOD was re-engaged.

The purpose of re-engaging with the MOD was to collect further data in an attempt to create a normalised overview of how procurement was structured across these two case studies, having a standardised way of conceptualising acquisition lifecycle practice allows for the practical ability to make comparisons between the cases.

Having established an overview of the NHS procurement structure, this prompted the generation of further questions, and lines of inquiry that were then reapplied to MOD. This was a process of extensive iteration between the data collected in each case, the theory being generated in explanation of it, the interrogative framework used to ensure comprehension, and the Zachman process mapping technique being applied to assure a comprehensive investigation cross-case.

- 3** With the latest iteration of the model realigned with further data collected from the initial case, there was a further two interviews conducted with the primary contact person at the NHS to ensure that the representation of their process within the Zachman framework had validity in the empirical setting.

Once the Zachman framework was agreed to be representative of the NHS's process there were further interviews undertaken with a wide range of NHS personnel including, head of contracting at the CCG (Clinical Commissioning Group) two ICT specialists and a head of procurement at the CCG. These interviews served to populate those areas of the Zachman framework that were missing or incomplete to build a full overview of the relevant processes undertaken.
- 4** With having established a Zachman framework that was able to present congruent data across the two different cases data collection form the third case was undertaken.

Initial contact with a high ranking procurement practitioner had already been initiated and a preliminary meeting was undertaken to assess security and data sensitivity concerns. Following the successful completion of related legal work, full interviews were then conducted.

The primary data collection mechanism in this case was three major interviews with high ranking personnel followed by an extensive exchange of strategic procurement documentation. The entire overview of the normative procurement process was provided along with I.C.T system demonstration, risk management documentation and contract selection methodologies.

The content of this data was analysed after collection at the local councils.

- 5 The data collection of the local government case was especially iterative as whilst being treated as a single case from a research perspective data was collected from a composite-case of three local authorities. The authorities in question where Liverpool City Council, Blackburn City Council and Manchester City Council (being embedded within a procurement hub).

The reason for treating these multiple organisations as a single case is for the following two reasons: Firstly, the processes were both relatively simple in comparison to other organisations included in the case study and thus theoretical saturation was reached quickly with each casees. Secondly, the processes were relatively common across the organisations and could pragmatically be included into one overarching Zachman framework.

The only case to be explored at points five was the Liverpool City Council, consisting of one major interview with the head of procurement. Interviews at the other councils were also arranged at this time.

- 6 After data collection had begun at the local council's case study the analysis from Sellafield was completed and the preliminary results from the local government had been incorporated into the interrogative framework. This required a final round of interviews within MOD as the range of themes being explored had developed as each of the cases had been

explored. The findings at Sellafield were particularly critical in prompting the need to re-engage with MOD.

The NHS did not require an additional round of interviews to address the gaps, however there were points clarified via a series of phone calls.

- 7 Data from the government and Encirc was then completed at this stage. The local council's data collection consisted of interviews with the heads of procurement for each of the authorities, as well as a head of procurement for the Manchester based procurement group AGMA who procure on behalf of a number of local authorities in Manchester. In addition to this each council provided documentation pertaining to their acquisition strategy. This was the final iteration of data collection for the local councils. Due to the geographical separation of each authority interviews were carried out over a number of months. This allowed the researcher time to synthesise findings into theory, and pose clarifying question at the next interview without having to re-arrange for a second round.

Encirc data was collected alongside the councils. The data from the Encirc case consisted of two primary interviews, followed by two further interviews with the operations manager responsible for overseeing their largest procurement project. In addition to this, the entire company archive of official reports was made available to the researcher resulting in a demanding but comprehensive document analysis segment.

- 8 Areas raised in the previous collection and analysis phases at the local councils and Encirc cases prompted further inquiry to clarify details at Sellafield.

The final round of data collection at Sellafield consisted of specific questions being forwarded via e-mail, and then a face-to-face interview with a senior manager who had pre-prepared responses and examples to discuss. The sensitive nature of the meeting meant that recordings could not be undertaken.

- 9** Data collection at IBM consisted of three major telephone interviews with procurement professionals operating in the United States. After the initial interview was analysed, e-mails relating to various documentation were exchanged. Analysis of this documentation was in turn used to inform questions undertaken at the latter two interviews.
- The IBM case did not cause a re-ordering of any of thematic structured embedded within the hierarchical framework. This is because theoretical saturation had been reached at this level of analysis. Exploring additional levels of detail would have likely resulted in the work continuing well beyond its current scope, as is the case the inclusion of more cases.
- 10** At this stage the research moved into a cross-case analysis. While there was some re-engagement with the empirical world to clarify increasingly small details, this point represented the end of the major data collection stages.

Table 10- Narrative of Data Collection Sequencings

4.2 Ministry of Defence Case

4.2.1 Case Background

The Ministry of Defence has been a critical case for the investigation of PCP amongst the wider body of literature (*Roehrich et al, 2014; Caldwell & Howard, 2014*). It is clear from consultation with the relevant literature that the defence case has in part helped to form the current conception of PCP, as it is a primary example of a context that displayed the characteristics MOD associated with PCP. As stated in Howard & Caldwell (2010) the PCP landscape is typified by: Complexity (lifecycle management, through life management, temporal dynamics and complex products and services), Managing Markets (performance measurement, supply management, risk, public-private governance), Procurement (alliances, outsourcing, relationships, contracts, and Innovation management (discontinuity, product-service innovation, knowledge and learning and sustainability). While broad categories each of these factors plays a disproportionately larger role in the defence domains as compared with many others.

The procurement and PCP practice occurs largely within a sub group of MOD referred to as DE&S (Defence Equipment and Support Organisation). This sub-unit has around 12,000 employees made up predominantly of a mix of civil servants and serving military personnel. Of those military personnel deployed at DE&S their posts rotate on a two year cycle and thus a majority of the positions within the DE&S hierarchy have an artificially rapid staff turnover. These staff are based overseas and around the UK but the vast majority are employed at the Bristol Abbey Wood site.

The purpose of the DE&S is to procure the majority of MOD's requirements from long term complex assets such as aircraft, vehicles, weapons etc. through to general amenities, food clothing etc. The former category is the primary focus of this research. In the procurement of these goods the DE&S follows a structured normative procurement process referred to as CADMID (Concept, assessment, design, manufacture, in-use and decommissioning) or CADMIT for services (concepts, assessment, design, mitigation, in-use and termination). In following these cycles integrated project teams are assigned to particular projects and often consult with numerous centralised hubs of expertise based within DE&S commercial dept., systems experts etc. Primary data collection was focused around these Integrated Project teams (IPT's) and the centralised units still within DE&S.

4.2.1 Data Collection Overview

In line with the iterative abductive methodology employed in collecting the data throughout this process, there were several stages of data collection required. Owing to MOD being the first case in the sequence, as well as conceptually dense it required the most iterative stages of data collection amongst the body of cases.

In the first instance seven major interviews were undertaken with a range of participants across DE&S. A number of these interviews were conducted with project team heads of major projects operating within different domains (Land, Air and Sea). Three interviews were also conducted with the heads of three different centralised sub-units of organisational expertise, namely IMOC (Inventory Management Operating Centre), the head of the commercial unit and the information systems centre. Lastly, there was a further interview conducted with a senior member who had multiple decades of experience operating project teams and groups of project teams. After this initial period of data collection there was a substantial engagement with documentation, access through the defence gateway (a central repository of strategic level documentation) and provided directly by interview participants and key contact people.

Secondly, after the second case at the NHS was undertaken MOD was reengaged with in an additional three interviews, two of which were repeat interviews with the previous participants.

A final round of interviews then took place with a range of senior stakeholders after there had been considerable development on the Zachman framework for MOD. These interviews focused on discussing the emerging results with the participants so as to allow final amendments to the developing analysis. These interviews were conducted with extremely senior personnel, at the 1-star general level and above.

4.2.2 Composition of Acquisition Lifecycle

Figure 18 shows the way in which the acquisition lifecycle at MOD maps onto the four generic categories. MOD has a number of alternative procurement lifecycles, however the prominent two and two used as the primary subject of this research are the CADMID and CADMIT cycles discussed earlier. As the most prominent example under investigation the CADMID cycle has been featured here. Given that the research takes the approach of a comparative case study, and the decommissioning (Post-in-use) phase is a unique set of considerations not explicitly addressed amongst the other cases this phase has been omitted.

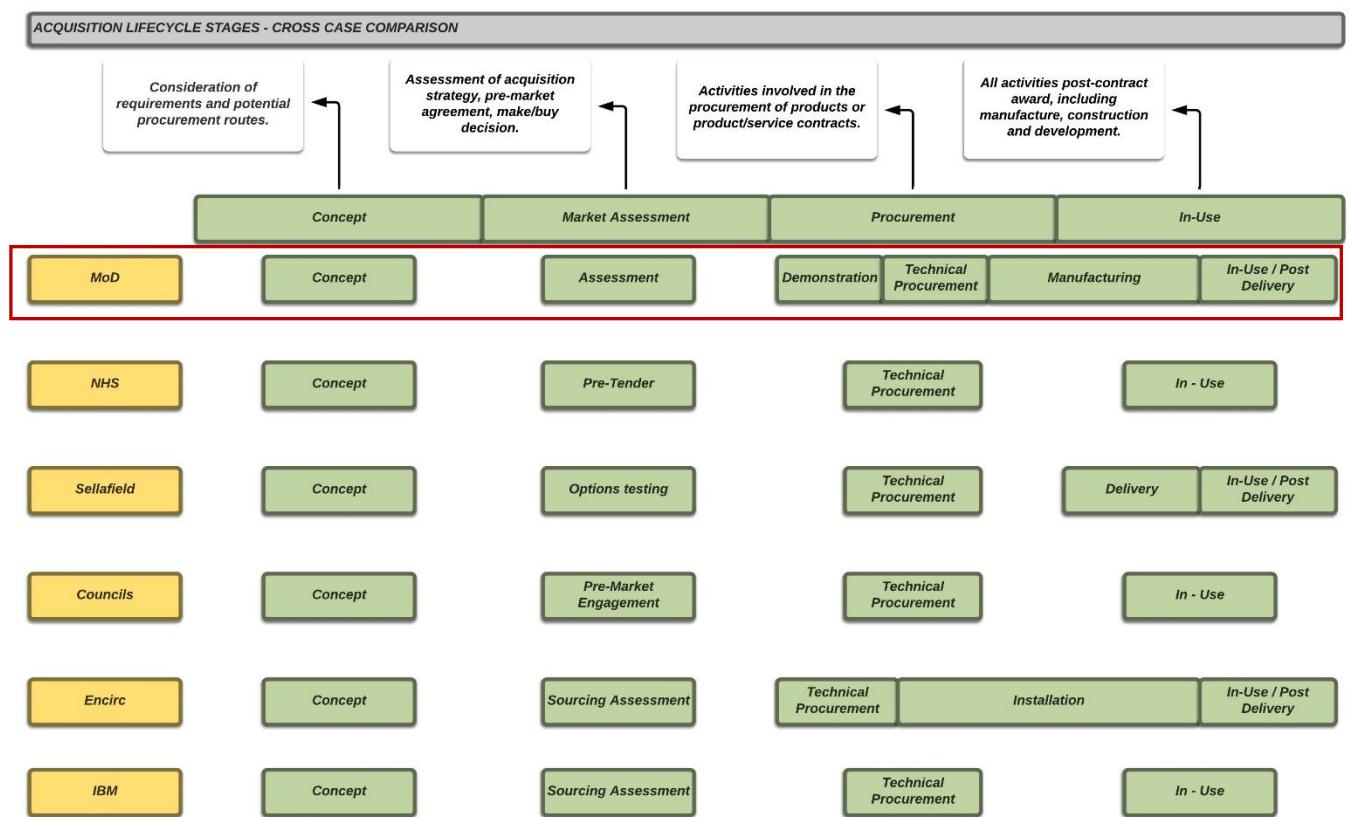


Figure 18 - Composition of Acquisition Lifecycle Stages

4.2.3 Summary of case study characteristics (MOD)

The following table depicts the stages of the acquisition lifecycle that the emergent case study characteristics were identified in. As with each of the cases, the Acquisition lifecycle is plotted chronologically and areas of thematic areas of interest are highlighted on the maps. The highlighted process then derive into the case study characteristics that are explored through further inquiry via the abductive method.

Phase	Thematic Area of Interest	Case study characteristics	Code on acquisition map
CONCEPT	Organisational Alignment, Performance Management, Technology Management	Mechanisms for creating holistic control and process consistency	A
	Organisational Alignment,	Organisational Coherence	B
	Performance Management, Risk Management	Learning from Experience	C
	Organisational alignment, Performance Management	Oligopolistic pressures and prime contractor dependence	D
ASSESSMENT, PROCUREMENT & INSTALLATION (INTEGRATED)	Organisational alignment, Performance management	Hybrid devolved/centralised control Organisational Alignment	E

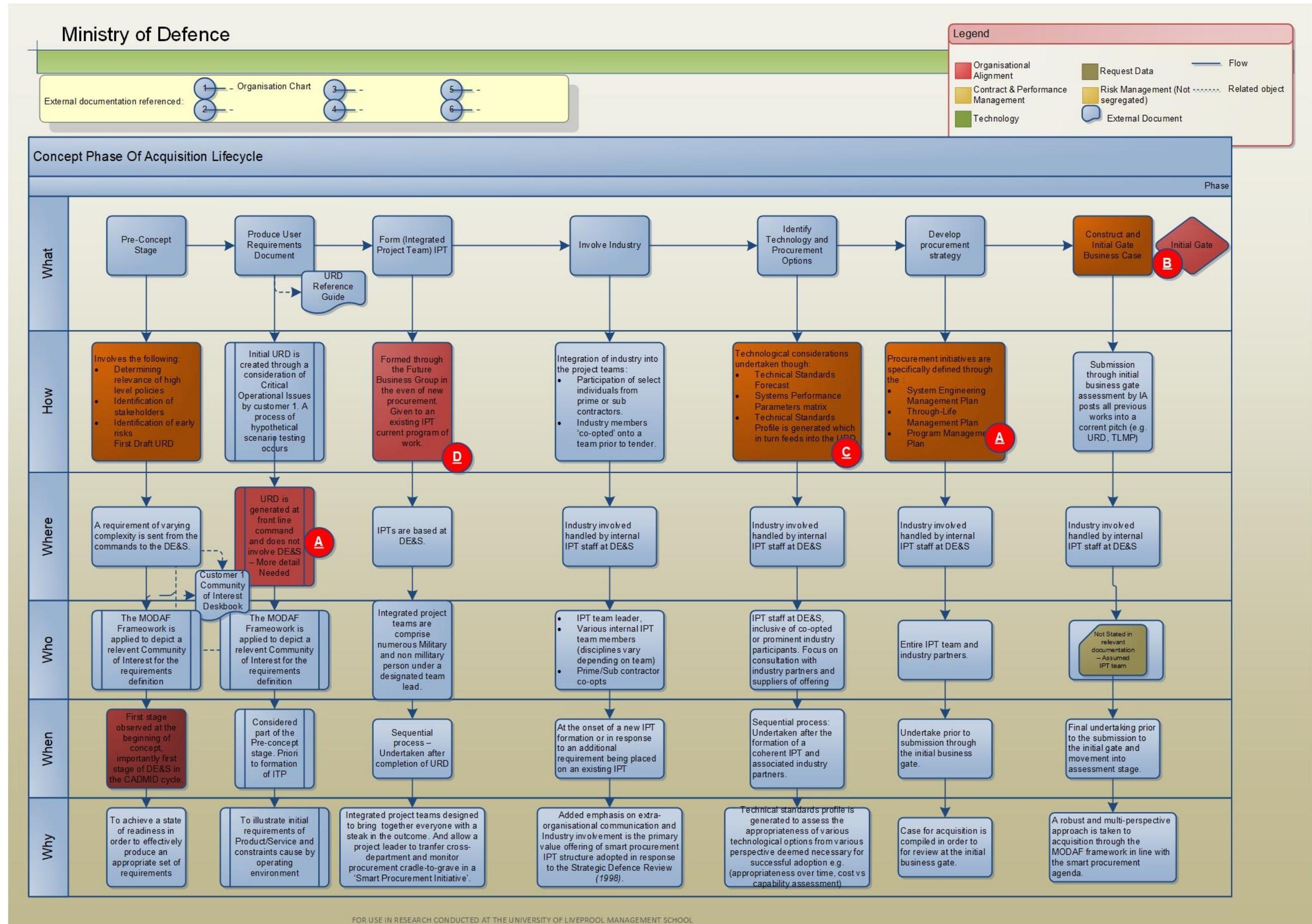
Phase	Thematic Area of Interest	Case study characteristics	Code on acquisition map
	Organisational Alignment, Performance Management	Support Enablers Operating Centre (SEOC)	F
	Risk management, Organisational Alignment	Risk Management Structure	G
IN-USE	Technology management	I.C.T Systems deployment and usage	I
	Organisational alignment	Policy Redundancy & Repetition	J
OTHER FACTORS	Risk Management, Organisational Alignment, Technology Management	Contracting types	H

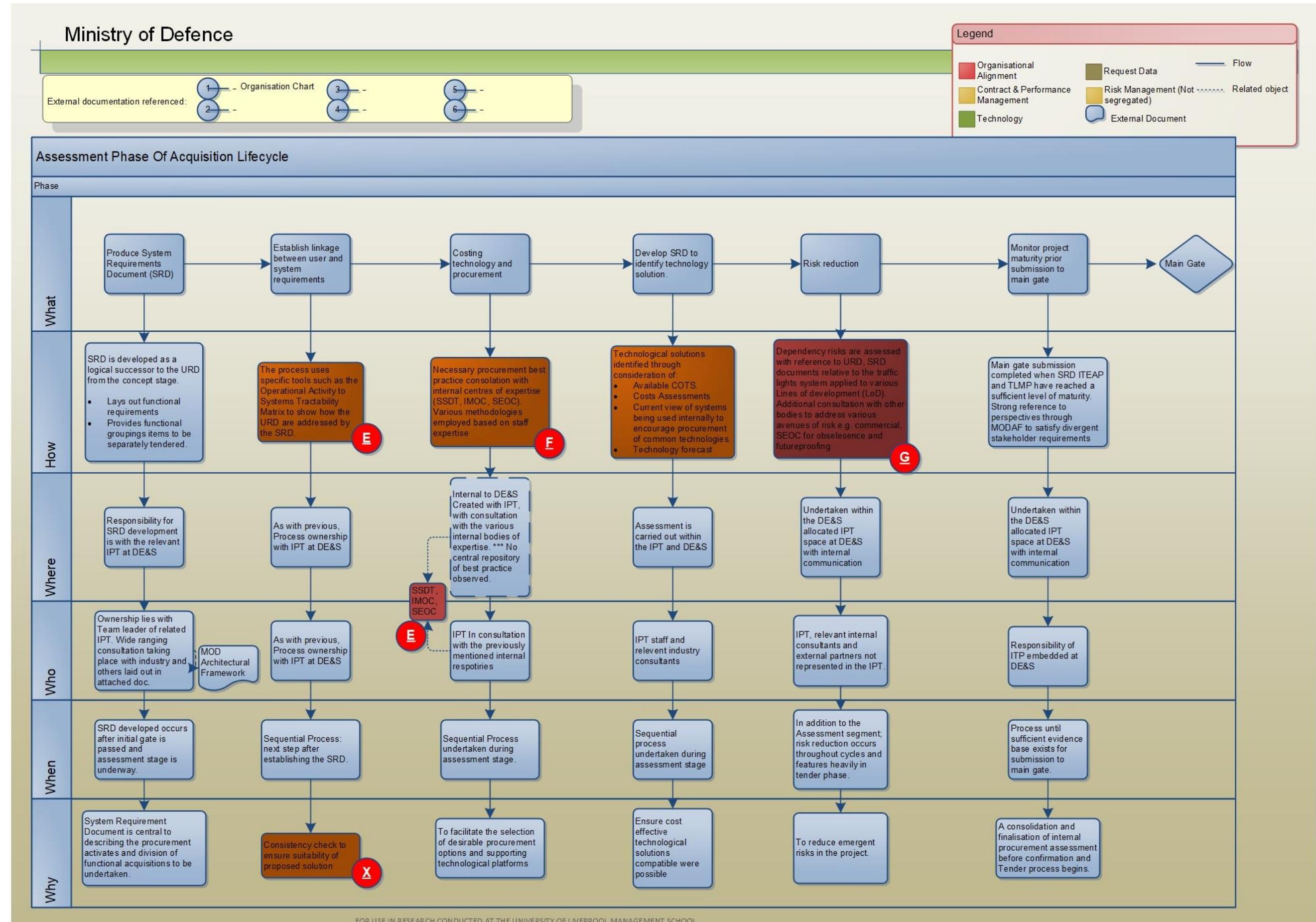
Table 11 - Summary of Case Study Characteristics (MOD)

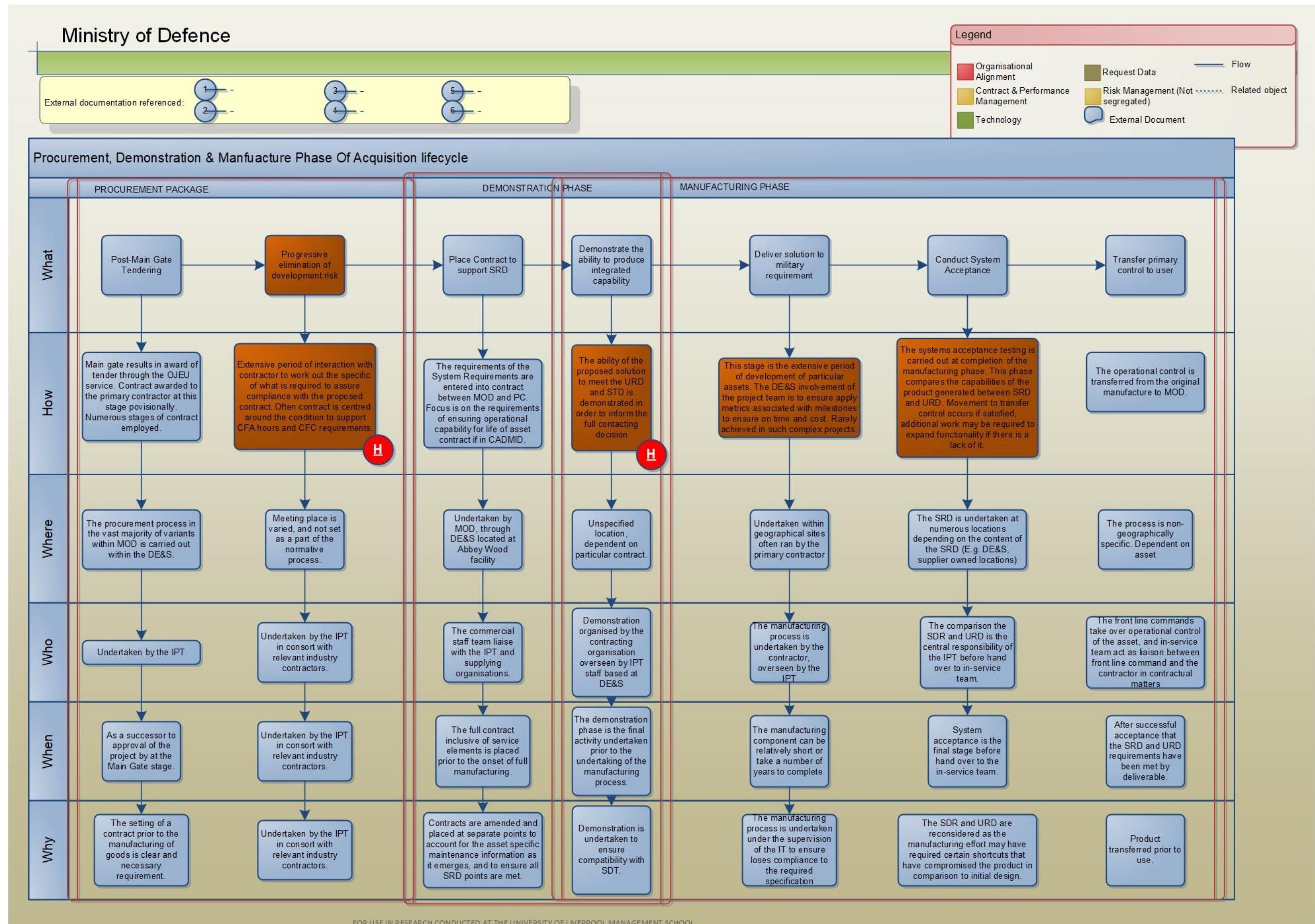
4.2.4 Acquisition Lifecycle Maps MOD

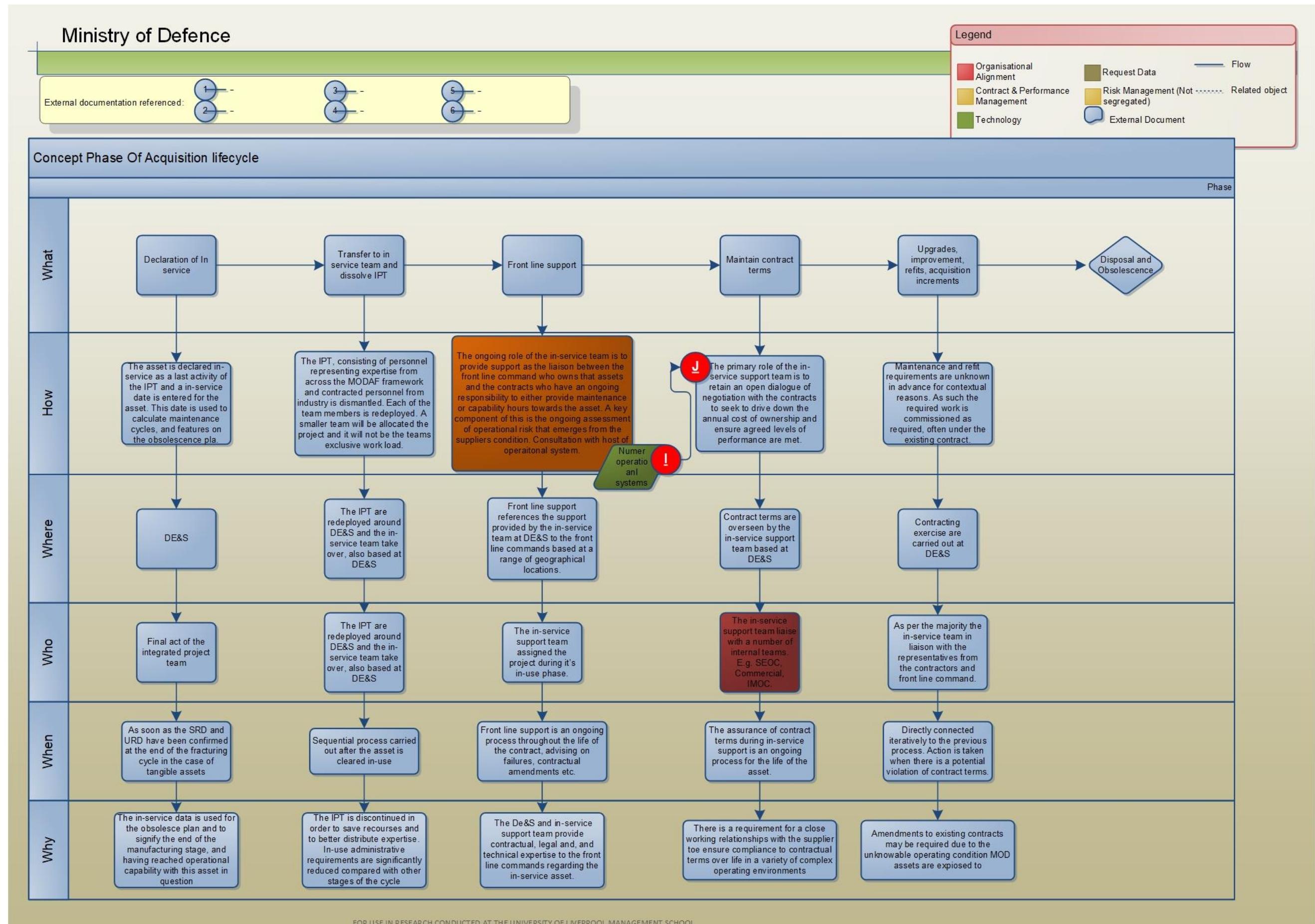
The following Zachman frameworks were used as the means of identifying process of interest as well as to provide an overview of the acquisition lifecycles general composition. The key processes are highlighted both through colour coding and have been associated with a letter that corresponds to the narrative explanation presented in section 4.2.3

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4.2.5 Case study characteristics

4.2.5.1 Support Enablers Operating Centre (SEOC)

SEOC is a subgroup of procurement and assurance experts based at DE&S (Defence equipment and support organisation) which act as the centre for acquisition, procurement and contract management between the front line commands and the suppliers within MOD's organisational hierarchy. The SEOCs (Support Enablers Operating Centre) objective is to provide advice and guidance towards the effective acquisition of long term complex assets to DE&S and MOD more generally. The unit operated independently from the project teams but is based at the same geographical location at Abbey Wood in Bristol. The specific focus of the unit is to ensure that the project teams are adequately planning and managing the obsolescence, reliability, in-service support functions and general future proofing of a project. As well as to assess the range of projects that are being undertaken. Whilst performing an essential function in the acquisition of complex assets the team is relatively small consists of only five personnel per area (Land, Sea, Air). The abstract below provides an in-context explanation of their function is understood by practitioners at the centre:

"We will scan project teams, we will talk them through the whole supportability issues. Be it obsolescence, be it reliability, be it how you are going to support it out in operations. Are you picking the right company to supply you with this equipment for the next 25 years, what is their enduring capability as well, what are the logistics systems? So we will talk to them about all of this stuff."

The functions performed by this unit are partially embedded in the project teams by having a range of expertise represented within these teams. The SEOC however acts as one of a number of central repositories within the DE&S. In attempting to identify the points at which the SEOC service was integrated within the normative procurement process structure (CADMID) it became clear that there was a significant subjective elements and an ad-hoc nature to the inclusion of this critical service, as suggests in the following quotation:

"I: So If I were to map out the CADMID where would I identify that you have predetermined interactions within it?

P: Yeah so we will get into concept, into assessment, into the demonstration and in-service. We don't tend to get involved in the determination or the disposal. However what we would expect to see, early on, is that you as a project team have thought about

disposal now. So you as a disposal team would be able to give me an answer for what you are going to do when you reach the back end of the lifecycle.

I: So can I drill down on those a bit. So within concept that pre-concept engagement you mentioned. Give me a clue what that is again. I am trying to plot out your points. So within concept, how many times would you interact with a project team?

P: Right, so this is where it gets a bit vague. It is unusual for us to get engaged in that stage [Pre-concept] it was just an example. However it tends to be on the personality you sit down and face. Right, it is THAT subjective. If you look at one project I was involved in then engagement with him was almost daily. The reason it was daily was because when the poor fella turned up to sit down with me, I asked him how he was getting on with his integrated logistics support and he went ‘what on earth is that?’ So you start to understand at that point OK this guy is going to need a little bit more stewarding than some others.”

Discussion point: The use of subjective interactions with the team in providing advice speaks to a lack of internal coherence which has been identified as a key area of potential improvement within MOD’s Grey report (2009). The interview participant here is directly pointing to the fact that the development of good practice, and consultation with a central, performance matric driven organisation is based to a significant extent on the personality of the project team member.

In terms of mandatory interactions with this centre of expertise worked into the normative process: The only two key interactions that the team has with the project team working on the procurement themselves is at ‘the initial gate’ and ‘the main gate’ which feature as quality control checks in the acquisition lifecycle. This is described below:

“I: Is there any points in which you will have to provide an assurance statement or have to interact with the project team.

P: Alright so we will right an assurance statement and that will be for, you know about the initial and main gates. That is when we need to interact with them. They have to present that report to ensure that they have interacted with SEOC. The actual mandate is on them though to make sure that they have come to us.

I: Do you track when a contract might be coming to its termination or is it the project teams’ job to come to you?

P: it's their job to come to us, however, as we are quite pragmatic about this we actually track what they are doing. So quite often we will go sit with the project team and quite often one of the first questions we will ask them is what else is on the cards here? It works well I think, far from perfect but we have good people”

With only two points of required interactions it is demonstrative of the expertise being embedded within people and not systems. This is particularly prevalent point of consideration when taking into account the fact that the military personnel only occupy a positon for two years before being rotated.

Discussion point: The lack of system based knowledge in favour of person centric knowledge base is a contributing element towards a potential lack of process consistency throughout the organisation.

4.2.5.2 Mechanisms for creating holistic control and process consistency

There were numerous examples within the data that showed a subjectivity and inconsistency in the internal reporting mechanisms and quality assurance process observed along MODS normative acquisition processes. As demonstrated in the abstract below the review of in-use capabilities within the acquisition lifecycle is limited:

P: on the back of the initial main gate engagement we have just started in service reviews as well. So we would expect to see that every year, but that is an aspiration at the moment.

I: You say that is an aspiration at the moment, what other interaction is there in that in-use phase then.

P: Once it's in in use, the project team project manager will endeavour to get it fielded and in services, once it is in service your project will almost stand down, the project team will be disbanded and it will go to in service delivery managers. So they will just sit there as part of a smaller project team and they will do the performance management for however long [the contract is]

The lack of data capture regarding projects in the in-use phase has been highlighted in subsequent reports in relation to how learning from experience practice could be improved. The extract below describes that the internal review process does not take into consideration in-service review or measure that aspect against performance metrics. It should be noted that there are some operational metrics used, stored in a separate system for front line

commands and not easily accessible to DE&S which is are the organisation attempting to negotiate effective outsourcing.

4.2.5.3 Organisational Coherence

Numerous data points discussed the lack of coherence and the lack of holistic control, which has emerged as a common theme throughout the various organisational units, project teams and senior staff across DE&S. In the following extract the participant is describing the systems and tools used towards creating a coherent assurance process across the various audiences:

P: Well there are no systems as such, so you have the LSE that is supported by something called the support solutions development tool (SSDT). That is literally a load of prompt questions for the project team to go away and look at. It is broken down into 24 support areas. It is broken down into four key support areas. That is the prime tool we use, after that it is looking at compliance against particular standards. So take obsolescence, we get a configuration management plan and we mark that against the standard for that. The guidance for that is all in JSP826. {...} it is not always applicable for all projects. For example it is not suitable for IT projects, and it is meant to be a one size fits all approach.

Further evidence of a divergence between the normative process standards expected and the actual work undertaken:

"P: Sometimes, where acquisition falls down is that some of these project teams are ran off their feet.

I: There is an approved supplier list and they are supposed to do analysis on this, although I've never seen anyone do this analysis."

Further evidence:

"Well whilst we assist generally... the central component is supposed to be the support solutions envelope which is 'supposed' to be the way in which we undertake acquisition"

Discussion point: In the application of standardised process there appears to be a lack of infrastructure that allows the enforcement of this. Instead the various organisational actors engaging with the process are required to seek out a customised means of carrying out the procurement process based on loosely enforced standards.

4.2.5.4 Complex stakeholder base and political instability

As described by one participant in the study the MOD “*Runs to the beat of a few different cycles that we can't control*”. Here the participant was referencing the number of stakeholders involved within the acquisition practice, particularly those political stakeholders that dictate national policy which in turn drives acquisition plans and strategy:

“P: We have got about 60 major projects on the go at the moment, it's difficult to answer what is typical. The reason I say it is difficult is because every so often, you get a change of government and everything just dies off because everyone isn't going to spend any money.

I: Can you elaborate on that a little bit.

P: alright yeah if we are going to election in say 1 years' time then projects won't spend any money and will just get on hold until the next government comes in and says “Yeah let us proceed with this”.

In addition to the changing preference of the nation, a significant number of projects are subject to the additional uncertainty created by a range of international oversight authorities thought the acquisition lifecycle. This created additional pressures to which the organisation must react and are difficult to predict.

The following extract is taken from a project team leader for the A400M transport aircraft.

“In terms of A400 specifically then, what we have done on that, as it was a brand new programme, a brand new aircraft, originally the staff requirements was set by defence, it was then let by a defence agency called OCAR on behalf of the six partner nations, and at this stage a competition was then ran to see what would be the solution for the new Aircraft. Airbus where then selected as the provider for the atlas aircraft, the A400M, a contract was negotiated on behalf of the six nations through OCCAR as a defence agency in Europe. OCCAR has a set of rules, OCCAR management procedures, that govern how they do business, and those rule where negotiated with the six partner nations. So that took into account national regulation for all six nations and then agreed a common set of rules for the A400M project that would follow, which in some areas will end up being a compromise and negotiated agreement between the six nations based on different requirements. So that would then take into account mandatory national requirements and would have had to have sought agreement from appropriate UK, Legal, commercial,

MoD, treasury to see if any of the procedures being adopted would cause issues for the UK nationally.”

“So, taking things forward for A400 is that OCCAR acts as the defence contractor for the nations in letting and running the contracts. However, nations can also pursue contracts for national elements if they so choose to, and then they would have to follow their national rules. Other Air projects like typhoon and Tornado have followed similar models, where they have used defence agencies like NETMA and NEFMA, which is what it became when it was Tornado and Euro Fighter. We can use central organisations, particularly in Europe, particularly on some of the collaborative projects. We also go direct on other projects to things like with the Americans on projects through them, and again we are looking at how national rules or rules on competition and procurement. Whether that is MoD rules, or UK government rules applied to the MoD in entering these partnerships. If you are going single source as a nation then your national rules would apply. “

Discussion point: As demonstrated in the above quotation, the context of MOD has additional layers of complexity over and above other cases featured within this case study set. The systems show hallmarks of this complexity when considering the phenomena from an institutional theoretical perspective. In that the organisations appear to be reacting to the complex phenomena by seeking legitimate compliant and reactive action as this emerges. In this particular case the acquisition operating procedure is dictated by numerous bodies including the native CADMID process embedded within MOD, the OCCAR rules agreed by the participating nations and the subjective ad-hoc expertise of the project team members, shown to be a critical importance in creating a bespoke acquisition strategy at MOD.

In addition to these short term political pressures there is also the changing preferences for doing business within the nation. Due to the long term nature of these contracts this often results in several shifts in preferred contracting solutions having occurred during the life of a given contract. Therefore the body of contracts on the books at any given one time have been derived through a significant variety of contracting methods. Below is an extract giving one such example:

“Outsourcing came about around 10-15 years ago as a political point: PPI was a huge political push into how you outsource a significant part of the estate, so in DE&S land we used to employ thousands more people but this political drive reduced the size of the

service. All of these come from the centre to find asset book reductions, therefore it does not matter that it is good value or not, these are political agendas which is strange and artificial, in a normal environment you would only outsource what is non-core and not the source of competitive advantage, therefore in a normal context you would outsource in a different way.”

Discussion point: The example here is because of the political pressure to conform to wider institutional norms. The organisation was forced to artificially outsource in such a way as to abide by these wider norms and achieve their objective. In this case that is asset book reductions on the number of major assets held by MOD.

4.2.5.5 Risk management structure

The risk management structure within MOD is multifaceted. Due to the densely layered hierarchy the management of contractual and operational risk responsibilities lies not with any individual unity or persons but across a range of units and actors. Throughout the research numerous data points highlighted the lack of consistency in the risk management structure, with numerous points of risk assessment and mitigation being undertaken again in an ad hoc fashion. In certain instances the risk management practice was deemed to be both reactionary (lacking in forward thinking and planning) and often lacking in the early application of risk remedies and mitigation actions.

With regard to the process of risk management being reactionary, this is demonstrated in the following quote:

“I: How do you believe your current setup works (the centralisation of expertise related to risk)?

P: I think the processes works but where it falls down if you take standard instruction 10 that informed the project teams what to do and when to do it. They took that away and it gives the project teams almost a licence to go away and do not quite their own thing, but their own thing with regards to timings. So where the whole acquisition process falls down for me is that quite often we haven’t got sight of the projects coming forward.[...] It isn’t till a project is going forward that they say we want a BCR gate off you so we will see something and somehow that is how we identify projects. The shortfall in that is a project could have been working away doing all this wonderful endeavour, and it’s got to a stage where they have afforded us very little time to go and do a full assessment of the process.”

This again demonstrates a certain lack of internal coherence described above, however in this quotation the focus is on risk management. While there exists some elements of the wider risk management practice that are certainly predictive, the people centric nature of the internal communications structure means that there is an absence in forward planning in regards to some of the more performance management based approaches to risk mitigation and management, as demonstrated in the quote above.

With regards to the process being lacking in the application of remedies, often the risk assessment process is ignored in favour of wider concerns. It should be noted that this is with regard to assurance and is not evidence of critical failure or operational risk, simply performative risks assessments not being actioned.

“That does get highlighted...also as well if we want to raise a risk we give it a red flag, projects sometimes will still go through and we accept that people will be looking at that thinking well why do we bother raising red cards if this is still going through?”

Furthermore, with regards to the risk management approach there was again evidence of the people centric over system centric approach. When asked to describe an exemplar of risk management structure that worked well one participant stated the following

“P: What we have seen is that we started recording a metric of risk against different government policies, so key support areas are broken down into government policies. So over the course of a year what I did was record instances of risk against the GP [Government policy] documentation. After that year I was able to go to the owners of that GP and say ‘Look you’ve got high instances here of risk. Why do you think that is? And what they went and did was that they changes the data that they were collecting, and so they recognised the process that they were asking people to go though was not fit for purpose.”

Discussion point: The above quotation is typical of reports featured throughout the range of interviews. The central component of policy and practice change is driven by individuals taking the initiative and not through a normative structure that encourage either learning from experience (LFE) or review existing policy.

4.2.5.6 Policy Redundancy & Repetition

An emergent factor at interview was the degree of repetition in both risk management policy and performance management policy. Often there were observations made of concurrent

initiatives or process that are designed to perform the same function, as demonstrated in the quotation below:

"P: [...] but in answer to your question in terms of where do I think it has gotten worse.. I would say losing the standard instruction, although the mandate to fulfil the SSE (Support solutions envelope) sits in the AOF (Acquisition operating framework) and so the mandate is there. It's just that people sometimes don't know to go and look for it.

I: For clarity what is the difference between the AOF vs the standard instructions that you were referencing."

*P: *Laughs* you know what? I don't know the answer to that."*

This factor was of potential strategic importance, aligned with a-priori areas of interest outlined in the research and the prevalence of potentially redundant processes is divergent amongst the body of cases.

Discussion point: The interview participant who was in a critical and senior position for creating and operating within the policies being discussed could not distinguish between the purposes of two major initiatives having been running in MOD concurrently. This is a prevalent example of policy and process redundancy that occurred as a major reoccurring theme.

4.2.5.7 Learning from Experience

The learning from experience systems have been shown to be a major source of criticism amongst the data collected. Often participants made reference to this while some other line of questioning was being perused. In discussion with I.C.T professionals in the organisation this was demonstrated to good effect. The following quotation provides a representative perspective of the view of the LFE systems within MOD:

"P: Oh without a doubt is there room for improvement in LFE, and this is my opinion, if there is one organisation that doesn't do LFE it is the MOD. So LFE, right we are ad-hoc, why is it ad-hoc? This is what I learnt from my last project and have taken it to my new project. OK so we set up some events where everybody sits down and asks ok well what did we do well? I've only been invited to one in two years. It does go on but it's not as robust as it should be. Plus there is no central repository, so let's say that you join the MOD and you think OK I have a helicopter procurement project, well there is no

centralised repository for you to consult with. It just doesn't exist. You would learn by osmosis sitting by somebody who has gone through this process."

Discussion point: The much-sighted lack of LFE practice is a major point of divergence amongst the body of cases surveyed. The lack of LFE practice in an organisation as dense in policy and process is of particular significance. Equally the lack of readily available quality management information seems to be related to this factor, and is again of significance and worthy of further discussion.

4.2.5.8 Oligopolistic pressures and prime contractor dependence

The research included a series of major interviews with a high profile project team procuring the A400M transport helicopter with European partners to replace the Hercules aircraft approaching the end of its predicted life span. With regard to this project the following quotations makes reference to a typical situation derived in the procurement of major assets at MOD. Namely that the technically complex nature and high infrastructural requirements of the sector omit the pursuit of multiple sourcing options and completion though having monopolistic or oligopolistic marketplaces. This situation as described below leads to a position where defence is dependent on the primary contractor to drive efficiency throughout the supply chain.

So the details as how exactly those political and shall we say 'defence discussions; and how they were achieved, I must admit, I don't have the detailed background, but that is broadly the process we went through to select A400M, and at this stage the contract for the production is then with airbus as the design authority, we then look to bring in a support solution with that and in the early phases it was recognised that because this was an airbus aircraft with international property rights etc., it would be extremely difficult to go anywhere but to airbus for support for this aircraft, and to the engine consortia which is called Europol international as the engine consortia working for airbus. So at this stage we have introduced the aircraft with a support contract which was reviewed internally and through to defence through the treasury, through our approvals to let a single source support contract and we are looking at around about 10-12 years' experience of operating and supporting this aircraft through the single source route but then look to drive in value for money through competition, through the single source at the moment we are looking to prime contractor to push to the subcontractor, to bring in value for money and completion that way."

Discussion point: Although the dependence on primary contractors through oligopolistic pressures is a relatively obscure phenomena within the context of wider procurement. It is however often cited as a common factor amongst organisations operating within a PCP domain. This dependence drives a lack of engagement with the wider supply chain and limits the sphere of visibility and supply chain wide influence able to be exerted by the procurer.

4.2.5.9 I.C.T Systems deployment and usage

The use of I.C.T systems within MOD is highly complex and difficult to map fully. After beginning interviews it became clear that the manifest of I.C.T systems listed across the defence gateway and other repositories of organisational data bore only a moderate resemblance to the actual usage and condition of I.C.T systems throughout the enterprise. MOD's I.C.T systems can be divided roughly into two categories of operational systems and commercial systems, with a number of systems bridging the gaps between these two categories. The operational systems are focused on storing and retrieving data pertaining to operational activities, inventory suppliers for military action etc. The commercial systems are what have primarily been explored within this research. These systems are the supply chain management, contract management, e-tender etc. systems that are more typically found with DE&S as the unit most prominently under investigation within this research. Amongst this latter category data has shown that the systems often overlap, are underutilised by their relevant function and omit some functionality that is both desired by MOD staff as well as is standard in other cases explored within this research. The following quotation summarised this view:

“We have so many views of management systems, commercial and finance have so many systems. They all come together as a kind of package of system management systems, all driven by different imperatives. Therefore when you get to the information systems that underpin this you see an increased level of non-integration and inconsistency”

The following quote further speaks to the convoluted nature of information systems deployment at MOD:

“In the logistics function alone there are over 200 systems, some of them are even character based dating back to the 1970's. So there is a myriad of systems, all overlapping showing inconsistent versions of the truth. What our systems need is a complete re-write going back to basics.”

This sentiment regarding overlapping redundant and inadequately integrated systems was restated across interviews with a wide range of interests. The following also demonstrated an additional complication in the defence context, operational actions must be prioritised over commercial efficiency and therefore major projects such as I.C.T system implementation that are technically non critical are always deprioritise on a tight budget. As expressed in the following quote:

"There are things we provide as DE&S to command, a tank, bomb, plane, bullets. Then another thing we provide is information systems. Now those information systems provided to the command contain information, some of which is needed by the command some of which is actually needed by us [the DE&S] to manage the assets that are actually on our books. So you see there is a mismatch between the owners of systems and where we keep and can interact with our data. So we end up with enterprise data help on operational systems. So the data has to work with the commands output and it's kind of 'Oh by the way DE&S you simply do not have a bespoke trading system that is able to operate in the way you want'.

Furthermore, the condition of information systems has led to a lot of impressive initiatives undertaken in house, in a reactive as-required manner to combat the lack of existing information systems infrastructure. This has mean that a number of critical risk and quality functions are performed on in-house processes generated on spreadsheets and basic database systems. Demonstrated in the extract below:

"What DE&S is currently missing... in making stuff there are two important things schedule management and cost management, DE&S don't really have any schedule management systems a lot of it is done on spreadsheets and stuff like that. So what I am trying to get across is that there are systems missing from the overall cycle as well as too many overlapping systems and redundancies in system functions."

"It would be fair to say that there is almost an initiative every year"

The following quote demonstrates well the extent of the systems redundancy at play within MOD:

"In the logistics function alone there are over 200 systems, some of them are even character based dating back to the 1970's. So there is a myriad of systems, all overlapping showing inconsistent versions of the truth. What our systems need is a complete re-write going back to basics"

I: Do you have anything in the pipeline to address this issue you are describing?

P: I think there has already been 20-30 bodies of work that have been mothballed over the last 10 years. There is also a big decade long piece of work to rationalise all of those whilst at the same time creating a new future for coherent systems. As well as that there are a few additional systems to be rolled out such as cost management, scheduling systems that should be rolled out as part of the [omitted] work.”

Discussion point: The above quotation provides evidence of a key phenomenon observed within MOD in that the complexity embedded in the organisation, in this case within their deployment of I.C.T systems is a disconnected set of systems that were required at the time to react to emergent requirements over time. The lack of cohesive design and pro reactionary is partially attributable to the complex context:

“This is very much a behaviour thing as the government has been burned my multiple attempts to implement a coherent IS system, and therefore procurement of IS systems over a million are treated with some issues. However then if you look at the how good we are compared to some of the better commercial enterprises then the requirement and the case is clear.”

“Then again a lot of that is ourselves [DE&S] finding our feet with the freedoms we have as an independent enterprise to the front line commands, negotiations for what we require etc.”

“I do find it astonishing that as a new project manager asked to come in and manage a supplier you’re unable to see the contract. As that is signed by the secretary of state, runs through the commercial people and is then made unavailable”

Discussion point: The high number of overlapping, partially redundant, older I.C.T systems in MOD is significantly divergent amongst the body of cases investigated, of strategic importance and directly aligns with the a-priori areas of interest. The condition of I.C.T systems is of particular extremes within the MOD case. The number of systems is high, the redundancy of the systems is also high, the capabilities of the system is also high in terms of what technically can be done and the diversity of functions supported. However, the systems are extremely poorly regarded, and despite the underlying capability the utilization of the capability or the overall efficiency or effectiveness of these capabilities is described in an overtly negative context, without expectation across all interviews conducted.

4.2.5.10 Contract performance evaluation

A major aspect of this comparative case study research centred on exploring the various usage of contracting methods, and contracting performance assessment used within the various cases to build up an adequate theoretical base from which to draw theory. Of the cases examined MOD's usage of contracting types and contract related process was significantly divergent and of direct strategic significance. In addition to 'contracting approaches' an additional factor emerged with regards to MOD'S capability to analyse and assess their exiting body of contracts, regardless as to the type used. The following quotation serves as a useful summary to the sentiment of contracting observed at MOD:

"Currently, in my estimations at least this is something we do very poorly, and one thing you will I'm sure get confirmation from the systems people on is that in order to effectively a proactively monitor the performance metrics laid out at the contract level, you require relevant up to date management information, and the systems capable of adequately disseminating that information, we don't have good management data. Up until now there has been a serious lag between collecting data and being able to analyse it, not least of all because of the different stakeholders that each have an opinion."

There is an inability in the organisation in being able to exploit the data that they already have in place. Further evidences in the following quotation:

"As an example we started a journey on something called performance metrics 13, and we are struggling 18 months later to exploit just the data we have today and make it meaningful."

4.2.5.11 Hybrid devolved/centralised control Organisational Alignment

A number of key interviews were conducted with the inventory management and operating centre. Whilst not procurers themselves they are in a critical position within MOD's hierarchy that exposes them to the details of a wider range of project. In asking about the quality control metrics applied thought the various projects the following quotation was given in response:

"With regards to IMOC, cost and consistency are very important. One of the things we are embarking upon is contract matrix management. So this is where you have a big pool of expertise, engineering, management, supply chain etc. When a PT gets put together they're going to need minimum two logisticians, two commercial people, one project

manager and so it goes on. In that way you end up with resources that are flexible, and you can get to a true optimum resource level from having that kind of approach.

I: So would you typically have the relevant experts embedded within the PT and then?

If you ignore who owns the person as they can become kind parochial sacred cows. If you think about the consistency piece, if the person is disciplined and he knows what he has got to do, and he has got the right skill set then you don't actually care who owns him or where he sits. He is doing the same thing in a repeatable patterns, which is coming up with an optimised solution”

Numerous points of highlighted during data collection are brought into focus in this above quotation. Firstly in the reference to the IMOC, which is one of a number of central repositories of expertise highlighted in the exploration of DE&S. In discussion of this organisation the participant references the importance of IMOC criteria of cost and consistency being paramount, and reference important initiatives deriving from this unit. In contrast, however, the interviewer then immediately makes reference to the benefits of having flexible decentralised expertise. Citing the importance of having the appropriate range of expertise embedded within the project teams and how this flexibility is what is desirable.

This positioning is indicative of a wider trend within MOD, whereby the organisation changes between pursuing two opposing strategic options over a long time period. These long pendulum like shifts in strategy are exemplified in the following quotation which discusses the change in preference for the agility of de-centralise decision making units and centralised units:

“If you look at the devolution of the DE&S with the DPA and the DLO, When it moved through these it was the ‘procurement agency’ whilst all those that were in Andover where through life support focus. So discrete areas of the CADMID – One community is acquisition focused one is support focused. Then the headline became about integrated project teams that are self-sufficient and therefore were free to create a capability solution on behalf of a command and then deliver that and each integrated project team had all relevant expertise. Then from this positon of integrated teams we started observing issues in inconsistency and therefore we tried to swing the pendulum back the other way...In order to address a symptom which was consistency coherence and

compliance then things like the support solutions envelope were created which was a way to create consistency in the newer devolved model.”

Currently the DE&S is a centralised hub consisting of de-centralised and centralised decision making units within its boundaries. These type of organisations have been observed in other cases, but never quite to the extent as observed within the MOD case:

“Effectively the DE&S is just an enormous programme management organisations, effectively we are just organising a supplier base, through us, to the commands”

Discussion point: A key discussion point for this research in address of how the cases compare in terms of their organisational alignment and arrangement involves a consideration of how each case compared

4.2.5.12 Contracting types

The DE&S and MOD more widely use a wide range of contracting models, however the interest in addressing of the research question lies in the normative process for deciding upon the application of particular models to particular projects or programme of projects. Of the interviews conducted and the wide range of documentation consulted there was little reference to normative organisational processes that supported contractual model decision making. An example of such practice:

“In regards to type 45 there was an initiative called the capability staircase. Which essentially was a spectrum between doing it in house and doing it in an entirely outsourced fashion. At the pinnacle of the staircase was contracting for capability. Now there is nothing wrong with contracting for capability provided that you are genuinely capable of managing a contract and that you have established that you are very clear in identifying the feedback loop and information sharing systems to support such a contract adequately.”

The initiative being described was not adopted widely and was simply deployed in reference to this project. Without any formal process of LFE the process, at the time of writing, had not been adopted into other projects. The mechanism as described also did not adequately account for the shortcomings of the I.C.T systems and processes that could support each of the contracting outcomes that could potentially be selected by the ‘capability staircase’. In the example given the participants suggest that the contracting option of ‘contracting for capability’ was not adequately supported via internal processes and systems.

Discussion Point: The capability staircase described in the above example is a tool for discerning the most appropriate contracting mechanism to use within a given context. The lack of adoption of such a tool enterprise wide has led to a position where there is some confusion regarding the contract section. This selection has been confounded by the fact that performative outcomes are deprioritised compared with operation requirements.

The following is a breakdown of the major contracting types observed within MOD during the course of this research along with a description of contextual setting in which they were observed, rational for using and perceived effectiveness of this approach:

(1) Integrated Support Contracts

MOD operate a fairly strict primary supplier centric set of contracting options. Owing to this contact amendments or recommissioning of additional action regarding an existing asset or project operating within the ‘in-use’ phase is often handled through operational integrated support contracts. Within these contracts the Primary Supplier of the existing project is commissioned for additional work on a preferential basis.

“Integrated operational support contracts, so what happens there: You’ll be running an operated integrated support contract and I will say “I want to modify my aircraft to do something” and because you are the preferred supplier running that contract, quite often you will get first dibs at the work. That is common place. If we think about C130, C130 is a Lockheed martin aircraft. We don’t go the stated to change the wings. What we do is we go to Martials in Cambridge who are Lockheed martins preferred supplier. Lockheed martin own the contract and so any emergent work on C130 goes through

As highlighted in other cases risk averse supplier contracting mechanisms such as primary contractor control created a lock-in risk and can lead to non-competitive contracting arrangements. The extent to which MOD are reliant on the primary contract model is divergent amongst the cases, of potential strategic significance and aligns with the a-priori categories highlighted within the literature review.

(2) Private Finance Initiative

A PFI (Private Finance Initiative) is a common contracting mechanism in public sector organisations. The contracts outsources some of the financing of for a project to the private sector, and this initial expenditure on behalf of the supplier will profit in the longer term. A senior interview participant had the following to say regarding PFI in MOD:

PFI- Private finance initiative, effective it is getting an external supplier over a seriously long term to invest in delivering a defence service from which it takes a huge cost, but then it makes money over the longer term. The trouble is that it fixes your cash flow with big sums of money, that you can have no variation change over time. So in the late 90's there was a huge surge in PFI, it didn't take long for industry to subsume the defence budget and commit it.

As demonstrated in the extract above the contacting models employed are also dictated in part by larger political pressures. Above is a good example of a negative outcome of this instability. The shift towards favouring PFI contracts is described as a way in which to reduce the assets listed on the books for DE&S , however now that the wider strategy has changed defence is still bound to the legacy of this trend in the late 90's. Newer forms of contacting preference strongly include the following two types: Contracting for capability, and contracting for availability:

The following quotation was in response to a conversation regarding problems having emerged from adopting these non-dynamic through life support contract risk that have been associated with lock-in risk.

*“PFI’s: Private Finance Initiatives tend to work similarly to that [with regard to lock in risk]. There is a PFI. There is a contract currently up at *Omitted* that is a PFI and works like that. The company that own the aircraft, provides the service and have therefore the first call on the work...but we aware that we do not have a good deal”*

Discussion point: The particularly pertinent point here is that there are manifestation of practical examples where non-dynamic contracting methods have caused negative consequences owing to the exposure to lock-in risk. However evidence of dynamic contracting methods or those methods that offset the risk through some other system are notably absent.

Contracting for Capability (CFC) – In this contracting type both the ownership of the assets, and the necessary requirements for its operation and service is retained by the supplying prime contractor. This is therefore a type of PFI contract but where the entirety of the cost is retained and the asset is essentially ‘rented’ on an as needed basis.

Contracting for availability (CFA) – Under this contracting model the ownership of the asset is held by MOD (the customer), however this operation and maintenance of the asset (its

availability) is the responsibility of the primary supplier. An example of this from is vendor managed inventory. This is therefore a departure from PFI contract.

Service Contracts - A standard contract type is where the contract is tendered only with a contract to provide the maintenance of a standalone service where there is neither financial investment in or creation of a tangible asset.

Future Logistics Information service (FLIS) contract- A FLIS contract is a contracting type only observed only within MOD amongst the body of cases investigated. It was explained as the following:

“This is a contract type we have engaged in a few times, this is where we have a single prime that will contract to a range of suppliers on our behalf. So here we are essentially outsourcing even some of the strategic outsourcing. It’s quite frustrating however, because in those eventualities we are still bound by the European OJEU rules etc. and so can’t always follow this single supplier path as we would want to.”

While there are numerous other contract types employed, the majority of major contracts undertaken at DE&S utilise one of these forms in addition to a more traditional procurement and maintenance fixed fee contract. While the range of contracts available in this case are clear, the divergent point of focus remains on the organisations ability to be able to extract value form these contracting type. Summarised in the following two quotations:

“There is something called the support options matrix, a project team is supposed to test its requirements against an order to define the service. However we can’t make the determination on purely performance based criteria. It’s all about the environment and the context so are we going to be able to have an externally supported maintenance contract that involves ford engineers working whilst bullets are flying? Probably not. So it doesn’t work perfectly”

“There have been some examples of this where the user has been contracted for availability but in reality they are providing the service using our parts and infrastructure, so it’s hardly vendor managed inventory. So we have outsourced in a very strange way, done in a very piecemeal way so in effect we have not bought a complete through life contract”

The following extract is a good example of how the level of complexity in combination with inconsonant processes of contract determination can result in convoluted non-optimised contracting arrangement:

"If we look at the weapons sector, we actually get paid to do stuff for them [contractors] that we have contracted out to them [contractors]. It sounds a bit nuts... With industry, some of the specialist staff required to do that contract work are actually our employees, so our employees do that, so they [the contractors] then pays us back for performing that work for them, which we contracted for them to do... [Laughter]."

"Also with these contracts there are difficulties in effectively estimating the amount of hours contracting for an often we are paying for more hours than we use, so you know there are pitfalls with that kind of contract. It mixes with institutional behaviours, which is around the need for us to have assured support, Just in time vs Just in case" what is the requirement for a particular capability"

Discussion Point: The variation amongst contracting models is not significantly divergent amongst the body of cases. However there was evidence of a lack of desirable performative outcomes expressed by both senior and project team based service persons. Participants expressed a degree of dissatisfaction in outcomes due to the inability of process to determine effective contracting option within given context. Of those processes that did perform this function, they proved to not deliver the desired results as they did not take into account all necessary factors in order to make an effective choice. Furthermore the initiatives were not effectively distributed around the organisation, or brought into standard practice in a meaningful and lasting way.

4.2.5.13 Power Dynamics in oligopolistic markets

Despite MOD's significant role in the UK economy and significant purchasing power the nature of the defence sector and the pressure of dealing in oligopolistic markets leads them often to be unable to extract economies of scale, or leverage favourable contracting terms. The degree to which this is a natural state of the market place or can be affected by appropriate procedural and strategic change is unclear. An example of a real work case is given in the extract below:

"The issue we have is that we have a complete spectrum of suppliers, so there is a commercially sensitive contract right now where a major worldwide firm just turned to us and said "Sorry, we are not interested" and this particular contract was for more of

that item than had ever been procured before and this particular firm just said “sorry, we don’t fancy it”. Then on the other side we get some SME’s where it is the complete other way around. We had one example not so long ago where we awarded a contract and it was at their current capacity essentially several decades of work for them.”

“You get it with all the big companies, trying to use their size to influence contract terms, as we are quite small fish to some of them.”

The following is an example again of how there are systems in place, thus the capability to organise towards creating economies of scale does exist within the organisation however it the execution of this leads to poor results:

“We are very bad at leveraging our buying power because we have lost that central control. So very bad at creating economies of scale despite our size. If you take defence travel for an example we negotiated a system that defence personal go through in order to receive favourable rates...However if you take my journey this morning as an example, had I gone to the internet I actually could have gotten it for cheaper. So defence travel could not provide me with something that met the criteria. So you know there is a real balance between centralised power vs decentralised freedom.”

Discussion point: Despite the significant size of MOD they have demonstrated to be non-effective at extracting economies of scale from their purchasing power. The reason is partially because their primary supplier base are disproportionately comprised of the very largest organisations in the world and thus MOD are not the largest and most influential organisation across the supply chain relationship. Additionally however is the complex set of stakeholder requirements cause undue bureaucratic pressures that result in these initiatives being less efficient and effective than those alternative available directly from the private sector. This is exemplified adequately within the above quotation.

4.3 Encirc Case

4.3.1 Case Background

Encirc has its origins in the manufacturing of glass bottles, but the organisation has vertically integrated downstream and now produces, stores, fills, packages and distributes beverages for a customer base of hundreds, including numerous multinational supermarket chains and drinks manufacturers.

In the last 10 years, Encirc undertook a nationally-significant programme of procurement activities in order to facilitate the creation of the largest automated warehouse in Europe. The organisation operates out of three primary facilities. The latest of these facilities, opened in Cheshire in 2006, contains the automated warehouse which forms the key asset being investigated in the case study.

4.3.2 Data Collection Overview

Data collection consisted of four major interviews and substantial document analysis. The initial interview was conducted with the operations manager who was in direct operational control of the installation of the automated warehouse. During this initial interview and overview of the acquisition lifecycle was gathered and mapped onto an initial Zachman model. There was then a substantial phase focusing on completion of the Zachman framework based on documents that were made available. The organisation released to the researcher the entire archive of documentation associated with the automated warehouse. This included acquisition strategy documents, requests for quotations, meeting minutes, as well as more operationally and financially focused documentation. This document base allowed the population of the majority of the Zachman mapping. Subsequently there were interviews with the programme head, as well as another major follow-up with the operations manager in which the missing elements revealed by the Zachman modelling were captured.

4.3.3 Composition of Acquisition Lifecycle

Figure 19 shows the way in which the aquistion lifecycle at Encirc maps onto the four generic categories. Encirc aligned with the standardised categories in both the concept, assessment and in-use stages. Given that the focus on the procurement was in investigating the procurement of a major infrastructure asset there were significant differences in the procurement stage. Instead of numerous procuremenet initiatives passing through the normative system as separate projects, Encirc instead had one mega-project that constituted numerous procurement. This is

expressed as the installation stage as the requirements for new procurements emerged during this period.

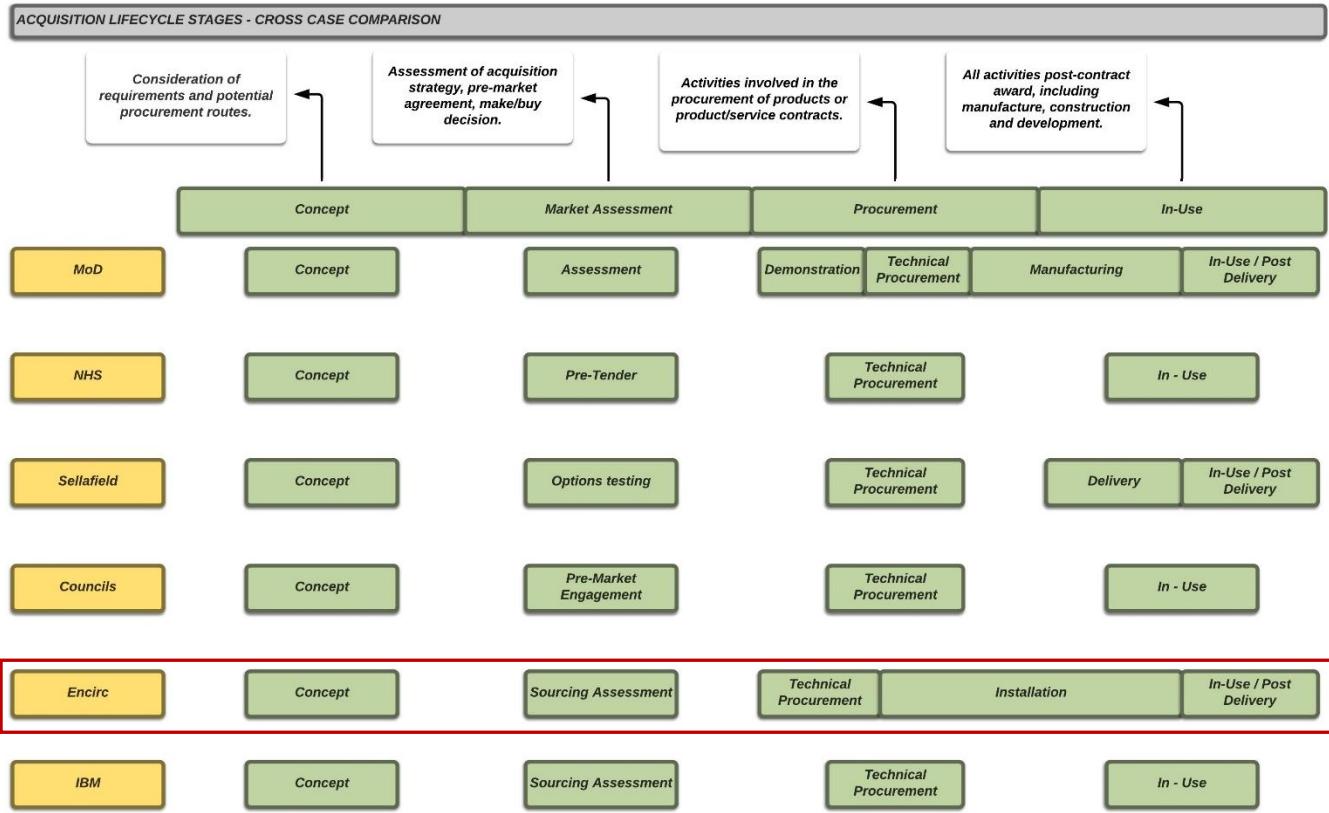


Figure 19 - Composition of Acquisition Lifecycle stages (Encirc)

4.3.4 Summary of case study characteristics (Encirc)

The following (Table 12) depicts the stages of the acquisition lifecycle that the emergent case study characteristics were identified in. As with each of the cases, the Acquisition lifecycle is plotted chronologically and areas of thematic areas of interest are highlighted on the maps. The highlighted process then derive into the case study characteristics that are explored through further inquiry via the abductive method.

Phase	Thematic Area of Effect	Case study characteristics	Code on acquisition map
CONCEPT	Organisational Alignment	Procurement through consultant	A
	Organisational Alignment/ Performance Management	Comprehensive programme of benchmarking	B
	Organisational Alignment, Risk Management	Technical PT team	C
	Organisational Alignment, Risk Management	Extensive pre-market engagement	D
ASSESSMENT, PROCUREMENT & INSTALLATION (INTEGRATED)	Organisational Alignment, Quality Management,	Negotiation & Re-work	E
	Organisational Alignment, Risk Management	Modularised, devolved work streams - Multiple Primary Contractors	F
	Technology Management	Enterprise systems component weighed by range of functional users.	G

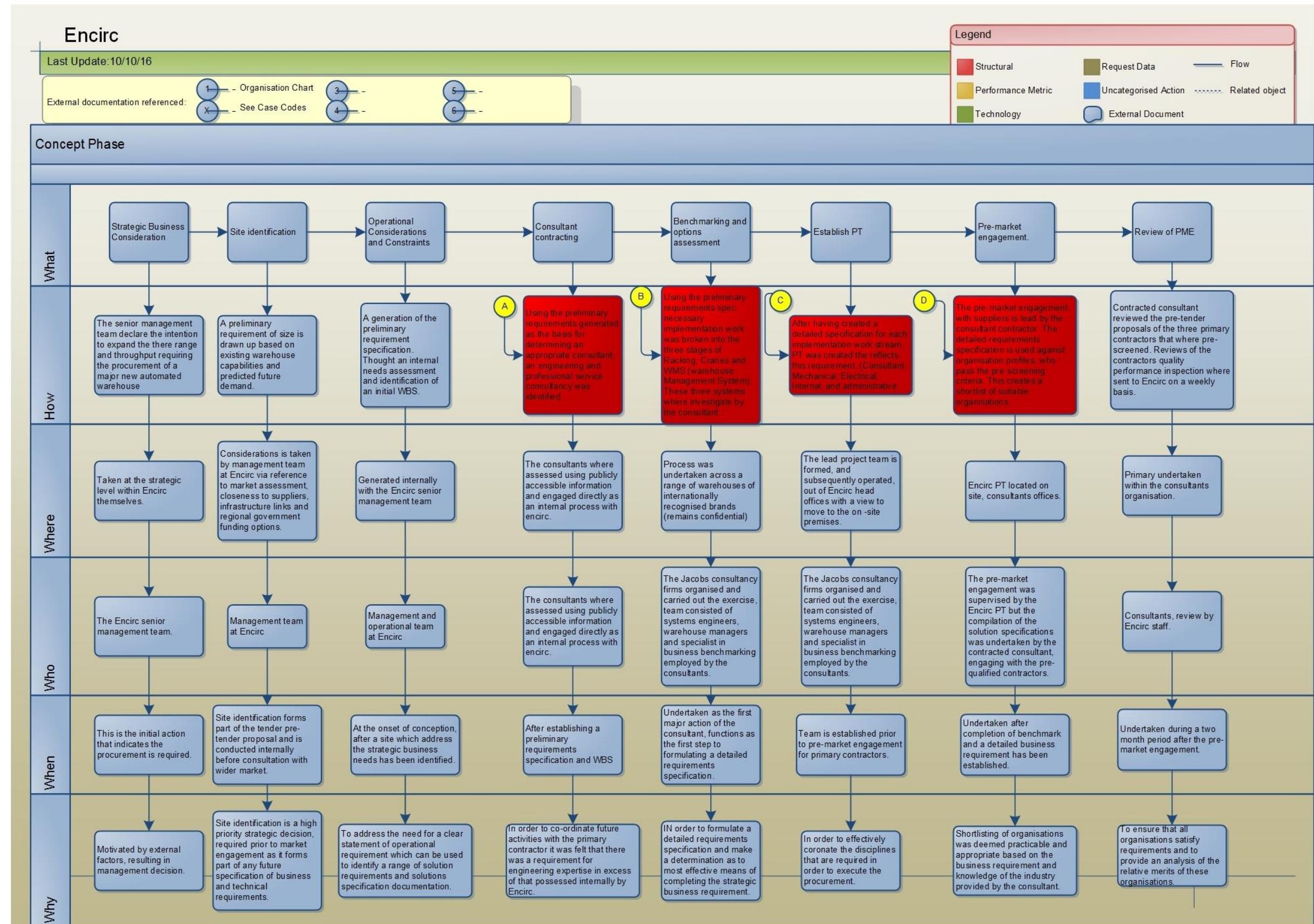
Phase	Thematic Area of Effect	Case study characteristics	Code on acquisition map
	Risk Management	Ad-hoc tendering	H
IN-USE	Technology Management	Integrated IT systems	I
	Technology Management	Predictive maintenance system involved in re-tender.	J
OTHER FACTORS	Risk Management	Contract Lock-In	K
	Organisational Alignment	Renegotiating Best-of-Breed systems	L

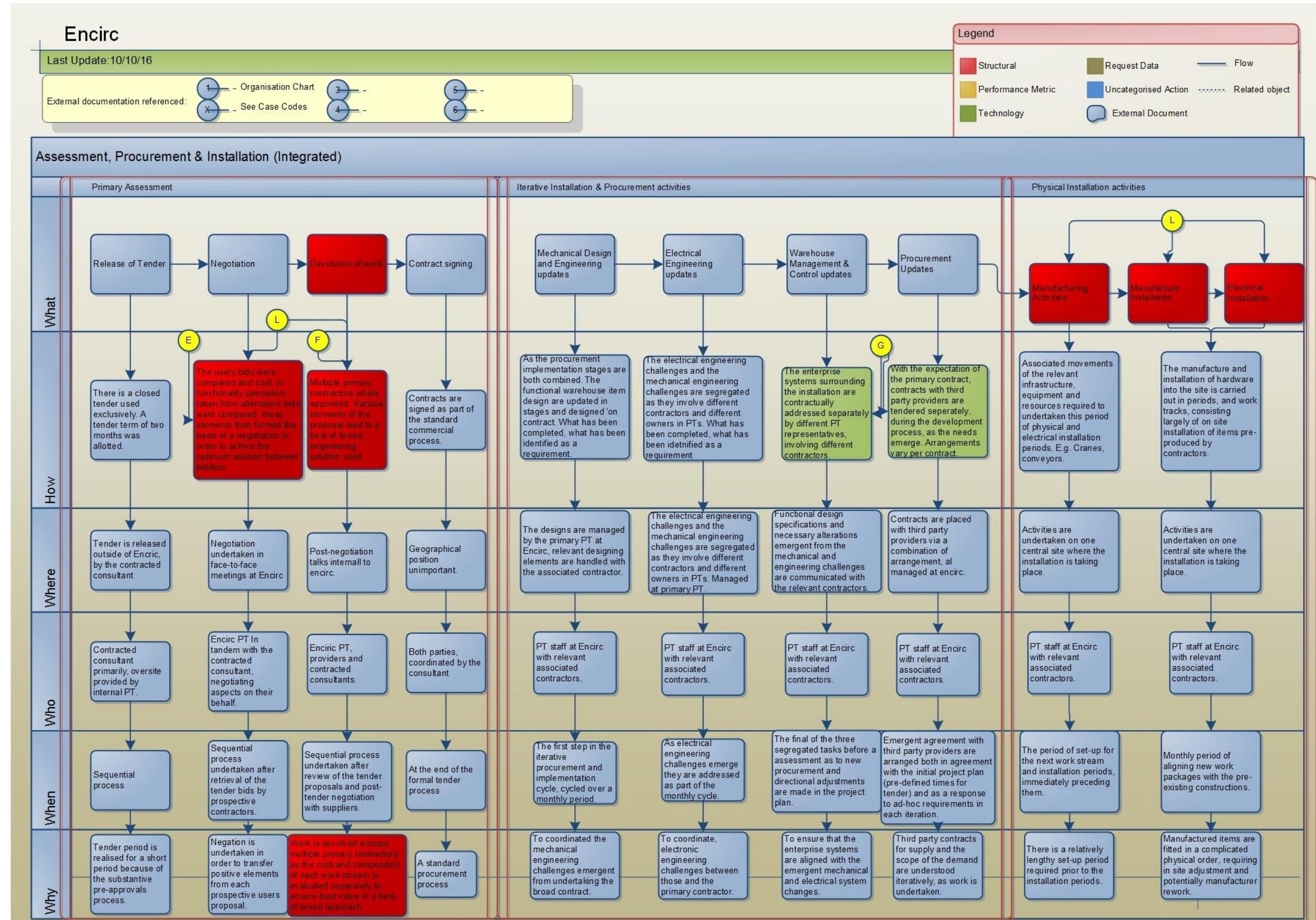
Table 12 - Summary of Case Study Characteristics (Encirc)

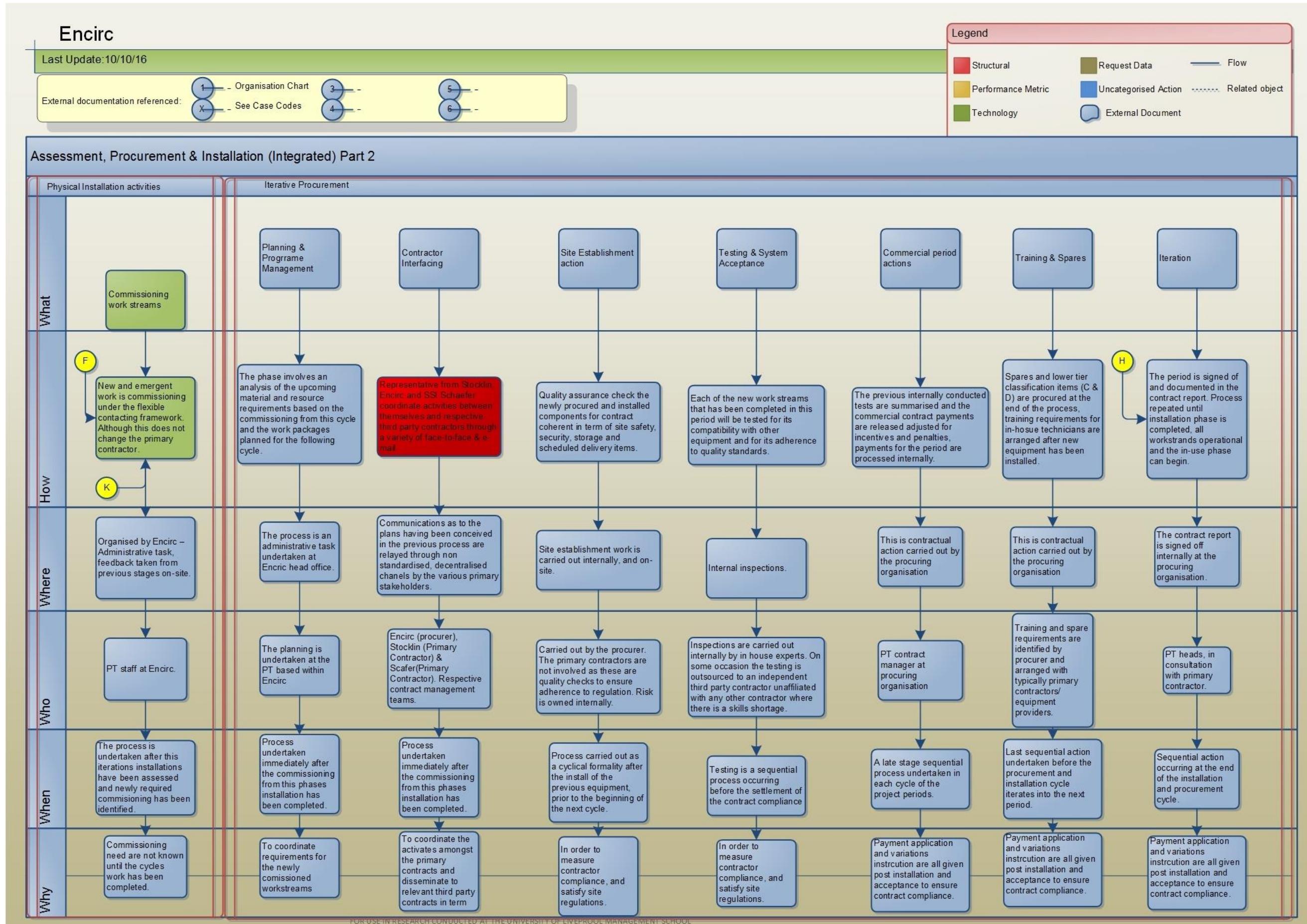
4.3.5 Acquisition Lifecycle Maps Encirc

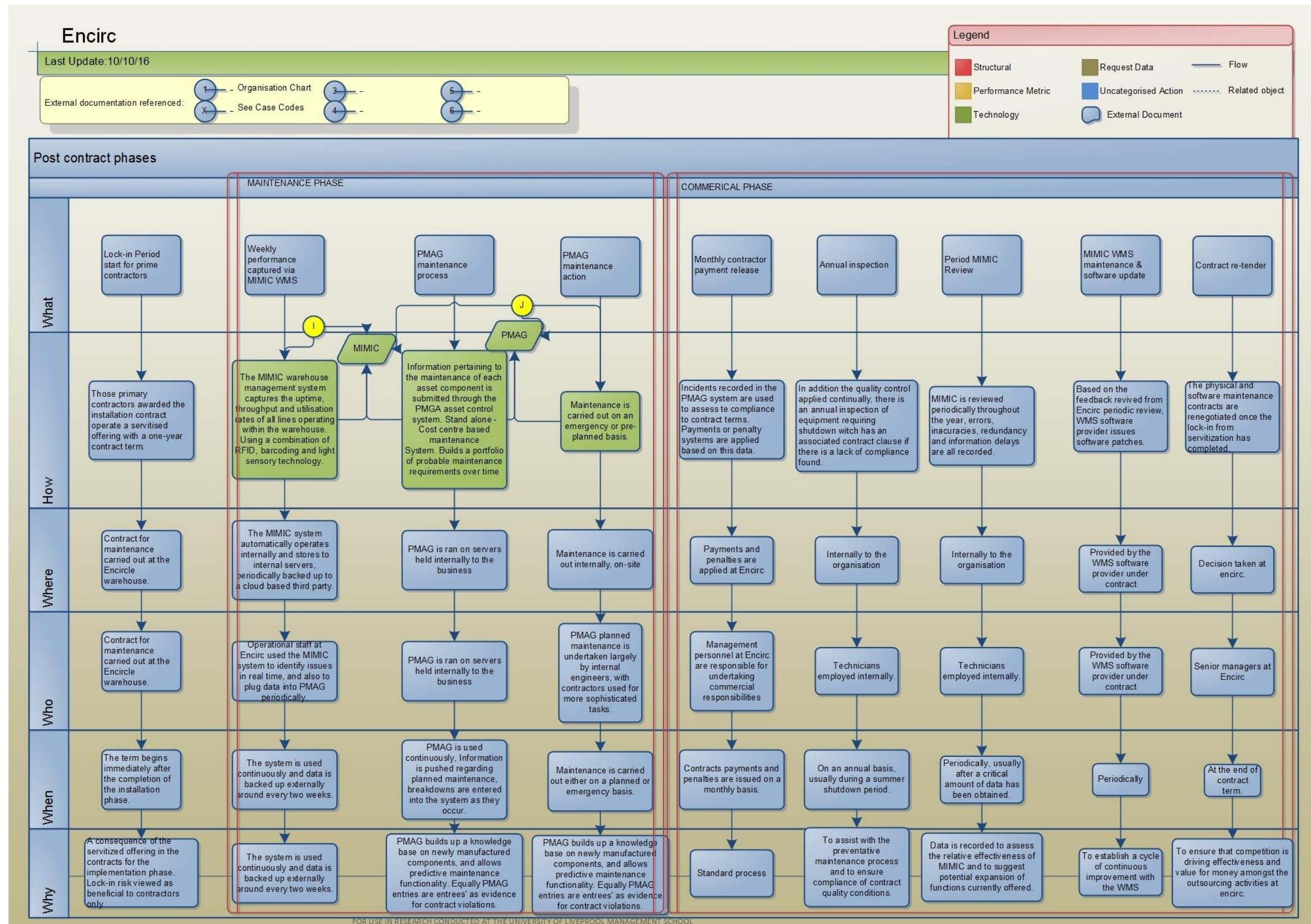
The following Zachman frameworks were used as the means of identifying processes of interest as well as to provide an overview of the acquisition lifecycles general composition. The key processes are highlighted both through colour coding and have been associated with a letter that corresponds to the narrative explanation presented in section 4.3.6

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4.3.6 Case study characteristics

4.3.6.1 Procurement through third party consultant (A)

Encirc made the strategic decision to contract a third-party consultant to oversee the programme of procurement efforts necessary to complete the automated warehouse project. This was picked up as a divergent process from other cases, is of potential strategic significance and can be thematically classified under one of the a-priori items highlighted in the literature.

In consultation with staff within the organisation the reasons given for this were threefold:

Firstly the technical expertise required to make effective decisions about the engineering tasks involved in the installation of the automated warehouse were outside of the range of expertise available internal to Encirc.

“...the idea behind working with Jacobs was to give us the extra assurance that we would be asking for the right solution and we wouldn’t have the contractors dictating the requirement [...] we needed the market knowledge and they functioned as an extension to our internal PT in the commercial areas we needed help with.”

Secondly, from a contractual basis Encirc felt that during the installation period, a contractor’s commercial and contracting department would offer an added layer of security and assurance to their limited commercial expertise.

Lastly, it was felt that due to the consultants wide reaching expertise of the market, that they would be adequately placed to exploit suitable channels for tendering the various work streams covered under this project. While not possible to quantitatively measure the benefits received from having used a consultant, participants expressed nothing but positivity for the value received from having engaged a third party consultant in this manner.

Discussion point: The process appears to be a response to the specific conditions of Encirc, specifically that there is insufficient PCP procurement to justify significant resource in terms of staffing a process development for an entirely in-house solution. The requirement for this point is indicative of a smaller organisational structure governing the processes.

4.3.6.2 Comprehensive programme of benchmarking (B)

During the concept phase, Encirc engaged in a programme of benchmarking the potential solutions that could be offered by the market. In discussion with the consultants the team

had broken down the work into its associated disciplines; electrical engineering, mechanical engineering and I.C.T. Systems related. The prevalence of the benchmarking method was unique amongst the body of cases, aligned with multiple a-priori themes of interest and was deemed to be of potential strategic significance.

Within each of disciplines the relevant work was categorised and three primary work-streams were conceived Racking, Cranes and Enterprise Systems. In order to achieve a comprehensive view of the market, organisations were selected with well-regarded warehousing solutions with these primary three areas. These solutions were then appraised within each of these categories by the consultants.

Encirc regard the process of benchmarking as having been instrumental in choosing the effective system type that was eventually decided upon.

[...] we made the decision at the time that there was a lot of variation in how each of the companies we looked at handled the different parts of their solutions... so we decided to go with a best-of-breed approach with our tender, and waited to see what we were offered. ”

The benchmarking process itself was undertaken at central warehouse sites used by international food and drink organisations. Encirc cite the activity as being invaluable as it allowed the organisation to justify devolving the work streams and eventually contracting to numerous primary contractors.

Discussion point: The process again seems to be the property of having sufficient manpower to undertake an extensive benchmarking programme resulting from the lack of pressure on Encirc' procurement function. A key discussion point for this work is how process like this could be conceived of in the largest of enterprises examined.

4.3.6.3 Technical Project Team (C)

As a result of the benchmarking exercises undertaken, the decision was made to assemble an internal project team that consisted of a range of technical expertise. The project team consisted of a project team head, electronic engineer team member, and two mechanical engineering team members associated with the different work streams, an enterprise systems architect, a commercial member and a representative from the engineering consultants. This was deemed necessary in order to create a meaningful dialogue with potential suppliers after tender submission and pre-market engagement.

It was cited as being equally important in being able to effectively translate strategic business requirements into actionable points taken from the consultants benchmarking exercise.

“We had a great team [project team] at the time, it was a massive investment for the business and so we spent some time getting that right [...] in the end it made a huge difference with what we decided to go for”

Generally, the approach is a structural deviation from those seen typically within project team dynamics in the wider body of case studies explored in this research. Whilst there are industry and situational differences that may explain this divergence, this is a point worthy of discussion.

Discussion points – The capability to embed such a diverse range of expertise within a project team centred around the project is conditional on their being sufficient expertise available for singular projects. This runs in opposition to the situation observed in other cases.

A key finding here is that holistic vision across the acquisition lifecycle is achieved without bureaucratic systematisation of the process in those organisations with smaller institutional complexity. This would seem to be impossible to replicate in those areas

4.3.6.4 Extensive pre-market engagement (**D**)

Encirc relied heavily on the contracted consultant for pre-market screening. With the consultant's knowledge of the industry and without having to adhere to the public procurement regulations, the consultant was able to pre-screen certain prospective suppliers against the preliminary technical and functional specifications that had been created in order to effectively assemble a group of organisations suitable for pre-market engagement. The degree of pre-market engagement was seen to be divergent, of potential strategic importance and aligned with the a-priori categories identified in the literature review.

Organisations were selected based on their capability to meet the technical specification, reputation for quality and timely delivery. Each of these organisations were then contracted to provide pre-market proposals, with the technical and functional specifications having been released to them. The knowledge of the pre-market screening allowed the organisation to settle upon a closed tender approach with the pre-selected companies representing the

majority of the marketplace for providing the various work-streams required in order to create the automated warehouse.

[...] we felt that the pre-screening was so thorough we would just be tendering to find out what we already knew, that there was a handful of potentials [...] The process of pre-screening and then waiting for the [pre tender proposals] specs from the suppliers took longer than our two month tender period”

“This approach worked well for us, not appropriate for smaller projects but we would certainly repeat our approach the next time the requirement emerges.”

The above mentioned approach was highly regarded within the organisation, and was described as being particularly effective in situations where the project and procurement portfolio being undertaken was a novel one in which the organisation was lacking experience.

Discussion point: Further evidence of advanced planning within organisations that exhibit lower overall institutional complexity.

4.3.6.5 Negotiation & Re-work (E)

Data collected at Encirc revealed that the organisation achieved improved contract terms compared with what was originally proposed through a pre-planned period of renegotiation. The process shows clear signs of strategic significance, given that there has been performative impact, as well being divergent from a majority of other cases and aligned with one of the key a-priori themes. The performative effect was attributed to the fact that by dividing the relevant activities into separate groupings, Encirc was able to re-negotiate aspects of the work to alternative firms based on more competitive propositions that were received by other organisations tender proposals.

Encirc were able to auction the cost and composition of the tendering offerings between bidders.

“No, it [the approach to tendering] worked very well. We went to ‘company I’ and told them that we preferred their overall solution but that their estimate on the racking wasn’t competitive in the slightest [...] so while they did eventually lower their racking estimate, it was beaten by the original bidder and we went for the multiple supplier approach.”

As demonstrated in the excerpt above, the heavily involved, small tender grouping allowed for a change in the power dynamics between the organisations and the potential supplier base, limited thought it was.

Discussion point: In this above example it seems that Encirc benefit from an oligopolistic rather than monopolistic marketplace, able to leverage providers of different sub-systems to achieve a better price. This further suggests that there are gradients of PCP environments, with the pressures of the most complex exceeding the complex.

4.3.6.6 Modularised, devolved work streams - Multiple Primary Contractors (F)

Instead of opting for a primary supplier approach, Encirc appointed numerous primaries to different aspects of the project. As previously stated, the rationale for doing so was to create competition between the shortlisted contractors and therefore drive down the cost.

Additionally, the secondary benefit of being able to leverage the maintenance capability of the other primary contractors was of benefit during the In-use phase. In response to a question about risk:

Interviewer: "Do you not feel that you are exposing yourself to greater degree of risk? Instead of one single primary contractor assuming the risk for the entire project you have multiple potential points of failure."

Participant: "Well there's always risk involved, but if we have one big contractor we might be less willing to impose penalties [if the performance criteria are not satisfied as], we don't want to not maintain good will with our main partner, splitting it up makes a little easier"

The implication here is that splitting up the contractors makes the outsourcing organisation less dependent on one monolithic supplier, which strengthens the position of the contracting organisation for enforcing the contract terms or renegotiating there position.

Discussion point: Multi-source contracts have been employed here as a means of staving off the lock-in risk and retaining the more dominant position within the supply chain.

4.3.6.7 Enterprise systems evaluated on a multi-modal basis (G)

The importance of effective enterprise systems has been emphasised throughout the procurement process undertaken at Encirc. During the installation phase, the desired

functionality was arrived at through an ongoing dialogue between a wide range of internal stakeholders and the contracted Warehouse Management System (WMS) partner.

"We try and involve everyone in deciding upon what functionality we wanted from our systems, the engineering guys need to be kept aware of failures and maintenance schedules etc., we need an understanding of functionality so we tried to get as much of an understanding upfront as was possible."

The team eventually decided that there was a need for multiple systems to be contracted for upfront to address the range of functional requirements put forth in their initial design criteria.

Encirc retained a ‘hands on’ approach with regards to their operations systems creation, however the integration with procurement or enterprise systems was minimal. Documentation points to predictive maintenance functionality for the components being recorded and utilised in future negotiations with contractors. The process by which this occurred was predominantly manual. Enterprise systems only existed within part of the enterprise.

Discussion point: Relatively low procurement systems usage. International with operations systems for procurement purposes was governed though manual process.

4.3.6.8 Ad-hoc tendering (H)

The suite of third party contractors that are required under the three primary contracts were not established at the onset of the award.

"We didn't know exactly what the requirement would be, we wanted to oversee what aspects would be contracted to third parties and have some involvement, but ultimately the responsibilities lies with the primary contractors"

"[...] yeah, not having already made pre-agreements let us be able to contract out work as it was required, or at the point where we had better visibility of our requirements I should say"

While the primary contractors retained the risk for all third party contracts, Encirc overviewed all contracts and request for a third party contractor involvement by primary contracts through the life of the project.

Discussion point: The ad-hoc tendering and monitoring of additional second and third tier suppliers was not supported through rigid systems architecture or normative processes. Rather this became an emergent performative advantage based on willingness of Encirc staff to involve themselves within the process.

4.3.6.9 Integrated I.C.T. systems (I)

Encirc operate SAP Enterprise Resource Planning (ERP) systems modules in some areas of their business and are attempting a roll-out to all areas of the business resulting in an all-encompassing solution. In the context of Encirc, the composition of the organisation (stable location, discrete product lines, and limited contractual dependencies) allows for a low risk transition to a total enterprise wide solution like SAP. While this will not be the case with a number of the other cases included within the scope of this research, the system that they are transitioning from had still proved to be effective and demonstrated a high degree of integration.

The organisation currently uses a primary condition monitoring system called MIMIC. The combination of Radio Frequency Identification (RFID) tagging technology, sensors placed throughout key points in the organisation and supply chain allow for a visibility both operationally and crucially allows information to flow into the predictive maintenance functions. Additionally, an understanding of internal operations also allows the organisation a quantifiable set of criteria with can be used to negotiate with their future suppliers and inform decision making in future options.

Discussion point: An unsurprising finding was that the advantage of stable geographical location of their operating base, discrete product lines, and limited contractual dependencies lead to staff feeling the rolling out of traditional enterprise systems such as SAP was highly achievable.

4.3.6.10 Predictive maintenance system (J)

Interviews revealed that Encirc were entirely satisfied with the processes and systems that had been used in their maintenance contracting. Specifically, there were numerous data points that described value being delivered as a result of their predictive maintenance capabilities and information sharing systems.

Encirc use a system called PMAG – A standalone Windows based asset maintenance software package. The system is deployed on the internal servers. Each asset is identified

with a unique identifier and entered into the system. The system pulls information from the MIMIC system the details time of breakdown, time and duration of underperformance. Engineers then enter into the system the relevant additional details such as downtime, correction time, type of correction, whether a third party or primary contractor was needed, cost of replacement parts projection of impact to business.

This data can then be used to project a maintenance portfolio for each of the assets over time, and assign an appropriate level and frequency of preventative maintenance interventions for each of the assets.

[...] Due to the wealth of information we build up for each of the assets under any given supplier in PMAG, we are able to argue the case then. Saying well it has cost us X amount in terms of downtime and repair costs.”

“Yes, it works well, it’s certainly worked well for us, and I have no complaints about the system generally.”

In the contractual renewal or payment stages, this ‘wealth of information’ gives Encirc the ability to be able to negotiate from an evidential basis about the value of and drawbacks of the existing maintenance contracts which as described in the quote above, they have found to be highly effective in generating preferential contract terms with their various suppliers.

Discussion point: Numerous processes highlighted point to the capability of this relatively (compared with other cases) non-complex enterprise to be able to leverage value from contractors through negotiation throughout the acquisition lifecycle.

4.3.6.11 Contract Lock-In (K)

A notable issue highlighted in the data was lock-in risk that emerged as a result of servitization. While the organisation has had a great deal of success with the contracts negotiated after the expiry period of the primary contractors’ maintenance term, they found this term to be unsatisfactory.

Of the three primary contractors there were a variety of lock-in time periods associated with the initial installation contract, the shortest of which was a year. The organisation reported that while they were content with the service and value for money in the installation period, the locked-in maintenance aspect proved to be unsatisfactory. As has been suggested the servitization of these major asset acquisitions is prominently in favour of the supplier in the principal-agent relationship.

“We were unhappy with [company x] for the duration of the maintenance period, as soon as we were released from that part of the contract we changed provider and our downtime was reduced, [the new provider offered] just a better service all round.”

Servitized business models provide an opportunity for contracts to lower cost for the initial service but lock in the principal contracting organisation into what can be unfavourable longer arrangements, a point demonstrated empirically within this case organisation.

Discussion point – The servitized elements where deemed undesirable in this case, the organisation was locked-in to uncompetitive terms.

4.3.6.12 Renegotiating Best-of-Breed systems (L)

Throughout the case a key differentiating factor from other acquisition lifecycles has been the strong drive to separate out the key elements of work and contract this to multiple primary contractors.

This functions somewhat like a ‘strategic procurement alliance’ that has been seen in other cases. However, as in the case of a strategic alliance, the contractors are allotted work under one single overarching contract that covers them all, this best-of-breed approach engages each contractor on an entirely separate contract. This results in the following key differences:

- **Contractors are in competition for maintenance:** In this case each of these providers could provide the other elements of the maintenance contracts. Therefore they are incentivised to perform so as to potentially take over the entire contract, and so as not to allow their current work contract to be replaced by the other provider.
- **Contractors are in competition for initial tender:** Whereas in an alliance or collaborative procurement arrangement potential contractors work collaboratively as a group of companies in order to bid for the whole group: The scenario used in this case of multiple, first tier contractors (who took primacy) caused a reverse auction of prices and an expansion of functionality offered through tender and renegotiation. Driving by the competitive pressure of each prospective contractor.
- **Risk sharing:** While in an alliance the risk of penalty can be split between the associated providers in a best of breed approach to the solution the risk is spread

across numerous organisations. This does potentially increase the likelihood of issues arising but also spread the burden across more parties, creating a more secure supply chain with redundant providers.

Discussion point: Variation of contractor strategies amongst cases of different composition.

4.4 Local Government Case

4.4.1 Case Background

The following section of the findings presents the local government case study. The councils examined include Liverpool City Council, Blackburn Council and a collaborative procurement hub representing numerous authorities across the Manchester Area.

The Local governments procurement departments procure on behalf of local front line services such as the fire brigade, refuse collection, local transport organisations, local infrastructure, social facilities and particular aspects of local health provision. With some substantial variation year on year and between cases the annual budgets fall between 0.5 and 1.2 billion, with a majority of this being used on contracted services and infrastructure procured. The local councils were joined together into one single composite case owing to similarities in their procurement practices and the comparatively non-complex set of processes observed within the case.

4.4.1.1 Data Collection Overview

The data collection at the Local Councils case was carried out with six major interviews and across three geographically dispersed sites. Firstly, an interview was carried out with the head of procurement at Liverpool City Council. This is where the researcher plotted the major process points on the Zachman framework and made request for supporting documentation. Following this an interview was conducted with the head of procurement at Blackburn City Council, and documentation requested for this case. At this point in the data collection process it was observed there was little significant difference in the acquisition lifecycle composition. The third of the initial interviews with a project head at the Manchester-based procurement hub AGMA. The Zachman framework was completed based on documentation shared and these initial three interviews. Gaps were then identified and follow up interviews with each of these participants was undertaken. Leading to a total of six interviews overall for this case study

4.4.2 Composition of Acquisition Lifecycle

Figure 20 shows the way in which the acquisition lifecycle within the local government maps onto the four generic categories. The local councils aligned well with the standard four categories compared with other cases observed, with one notable exception: the in-use stage of the councils case was essentially outsourced. The majority of the councils procurement

was undertaken on behalf of front line services such as the fire brigade. These services were then responsible for managing the assets and services contracts after they had been initially procured. Given this, the process details embedded within the very limited ‘in-use’ stage was not sufficient to justify the use of a Zachman framework map.

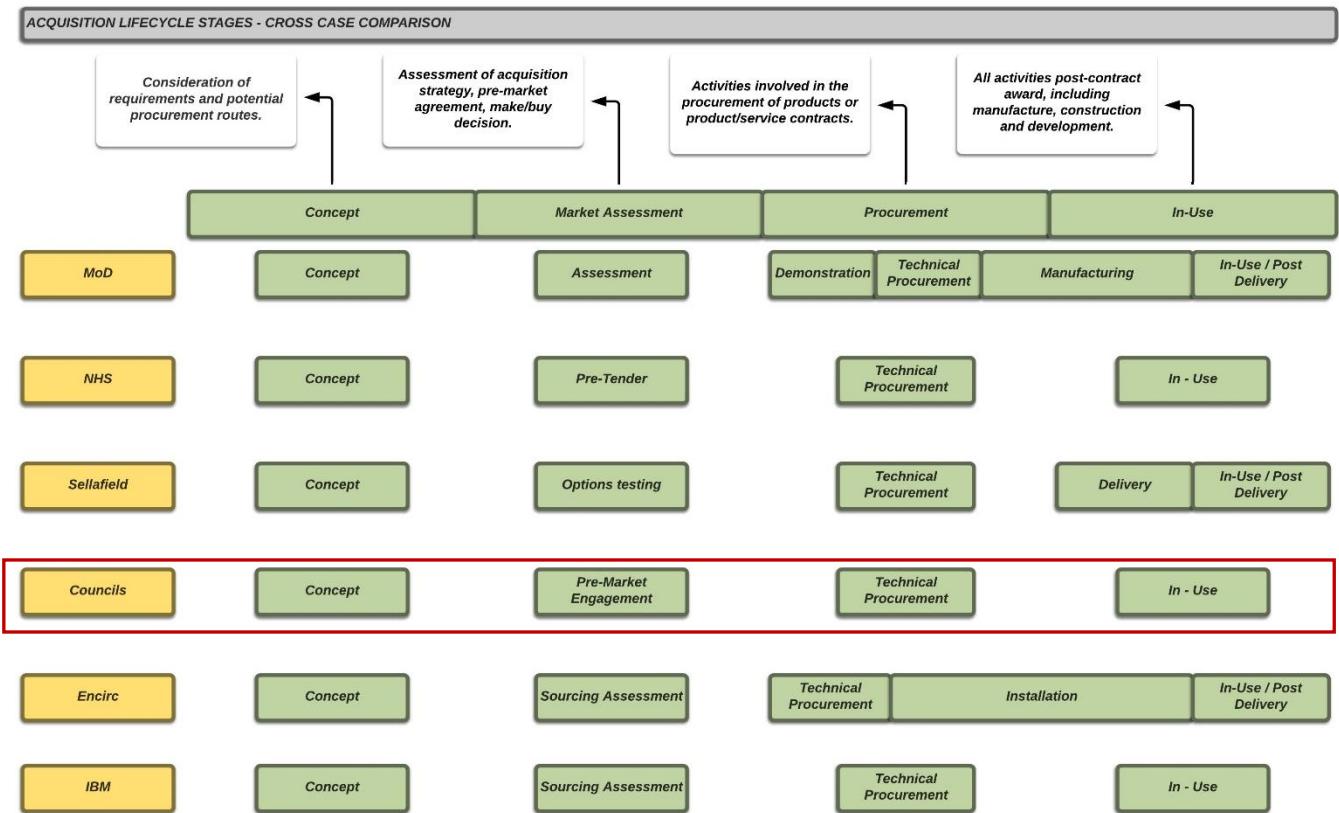


Figure 20 - Composition of Acquisition Lifecycle Stages (Local Government)

4.4.3 Summary of case study characteristics (Councils)

The following (Table 13) depicts the stages of the acquisition lifecycle that the emergent case study characteristics were identified in. As with each of the cases, the Acquisition lifecycle is plotted chronologically and areas of thematic areas of interest are highlighted on the maps. The highlighted process then derive into the case study characteristics that are explored through further inquiry via the abductive method.

Phase	Thematic Area of Effect	Case study characteristics	Code on Map
CONCEPT	Organisational Alignment,	Reactive Procurement system	A
	Organisational Alignment, MoD Priorities	Consultations	B
	Organisational Alignment, MoD Priorities, Performance Management	Collaborative procurement programme	C
	MoD Priorities, Organisational Alignment,	Continuous Information sharing amongst collaborating councils	D
ASSESSMENT	MoD Priorities, Organisational Alignment,	Joint Strategic Approach	E

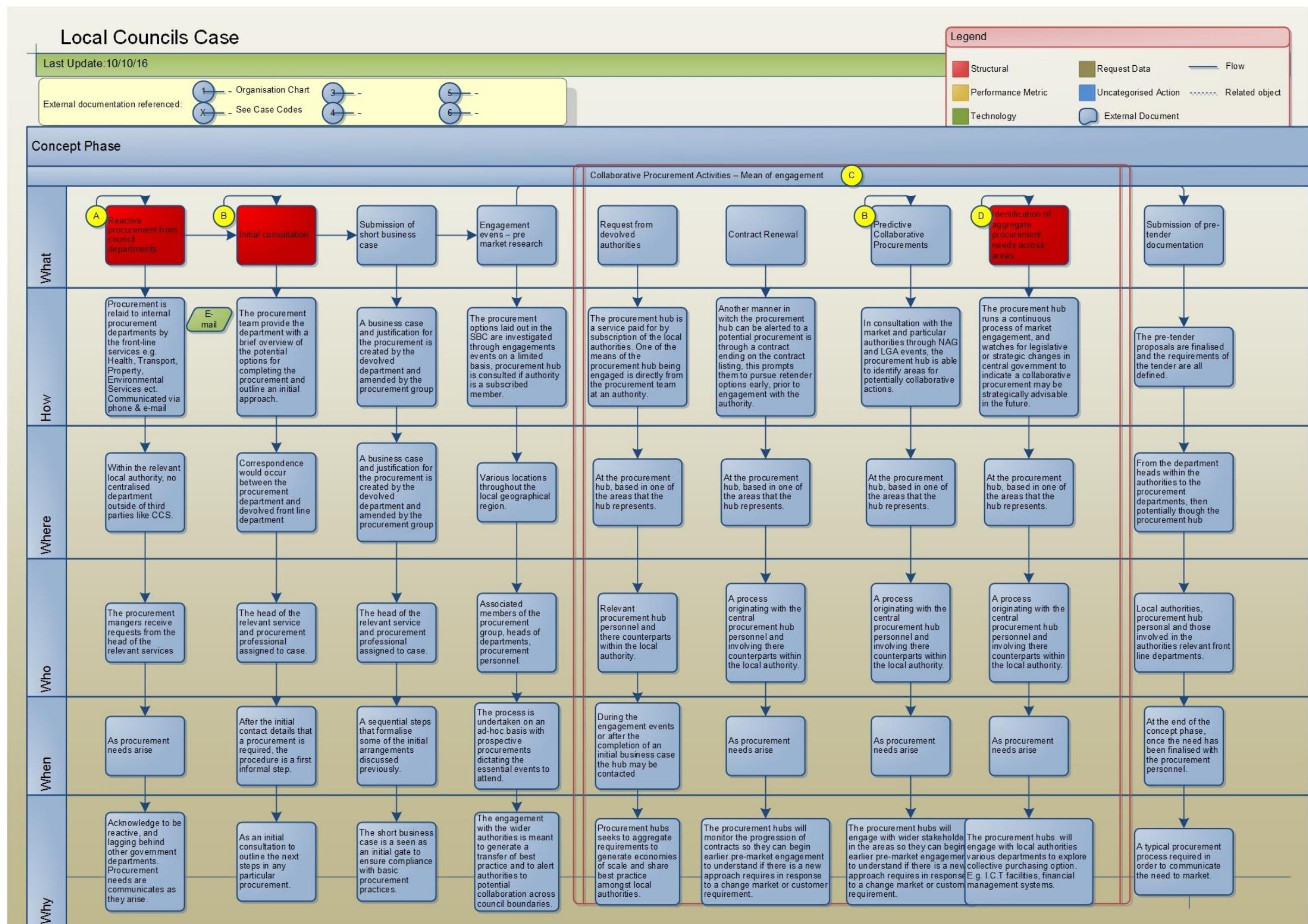
	Performance Management, Technology Management, MoD Priorities, Risk Management	Investing in supply chain / Public Finance Initiatives	F
	Performance Management, Technology Management, MoD priorities.	Predictive Collaborative procurements	G
	Organisational Alignment	Collaborative Institutional action	H
PROCUREMENT	Technology Management, Performance Management	Dynamic Purchasing System	I
	Organisational Alignment	Extensive renegotiation cycles	J

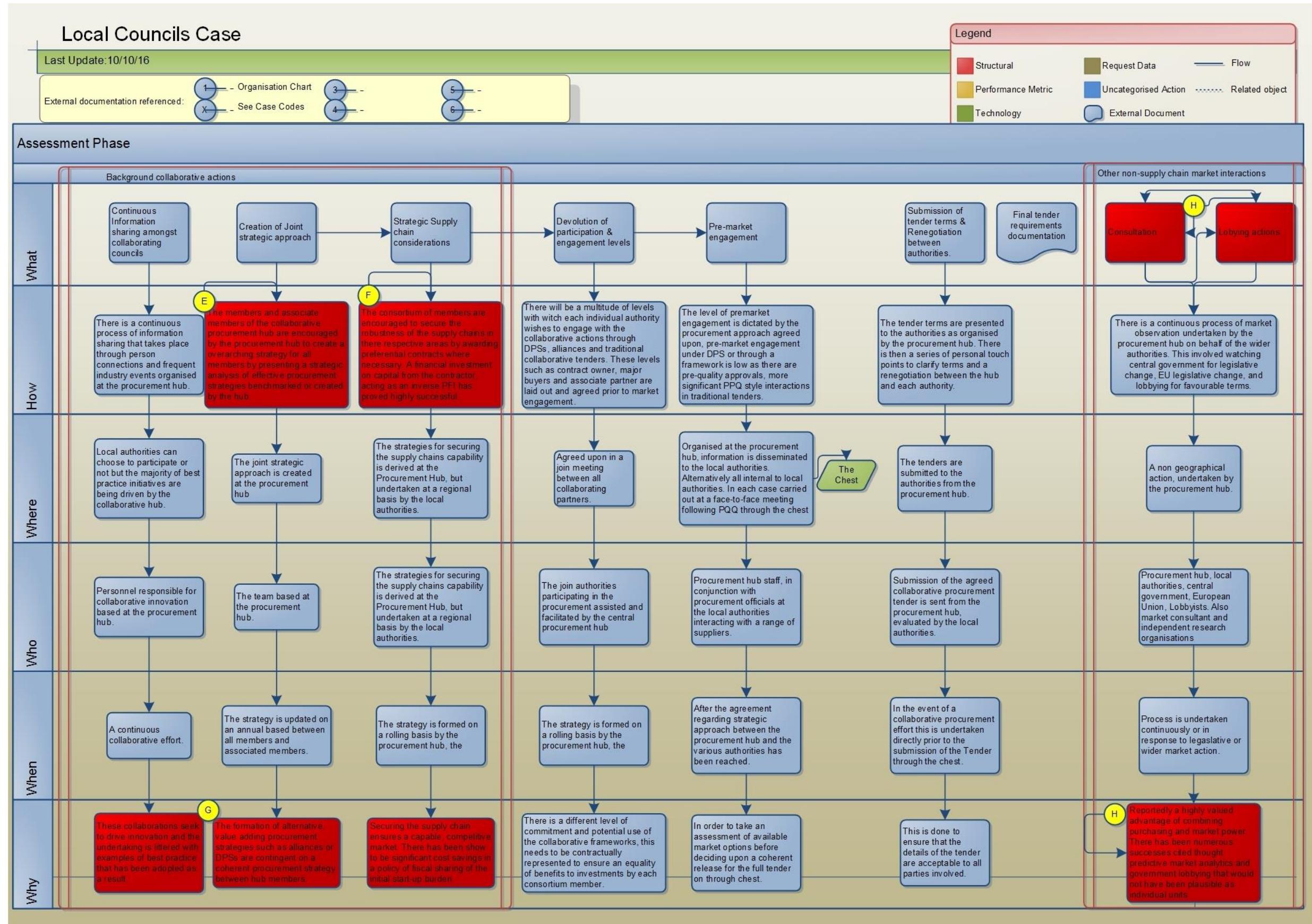
Table 13 - Summary of Case Study Characteristics (Councils)

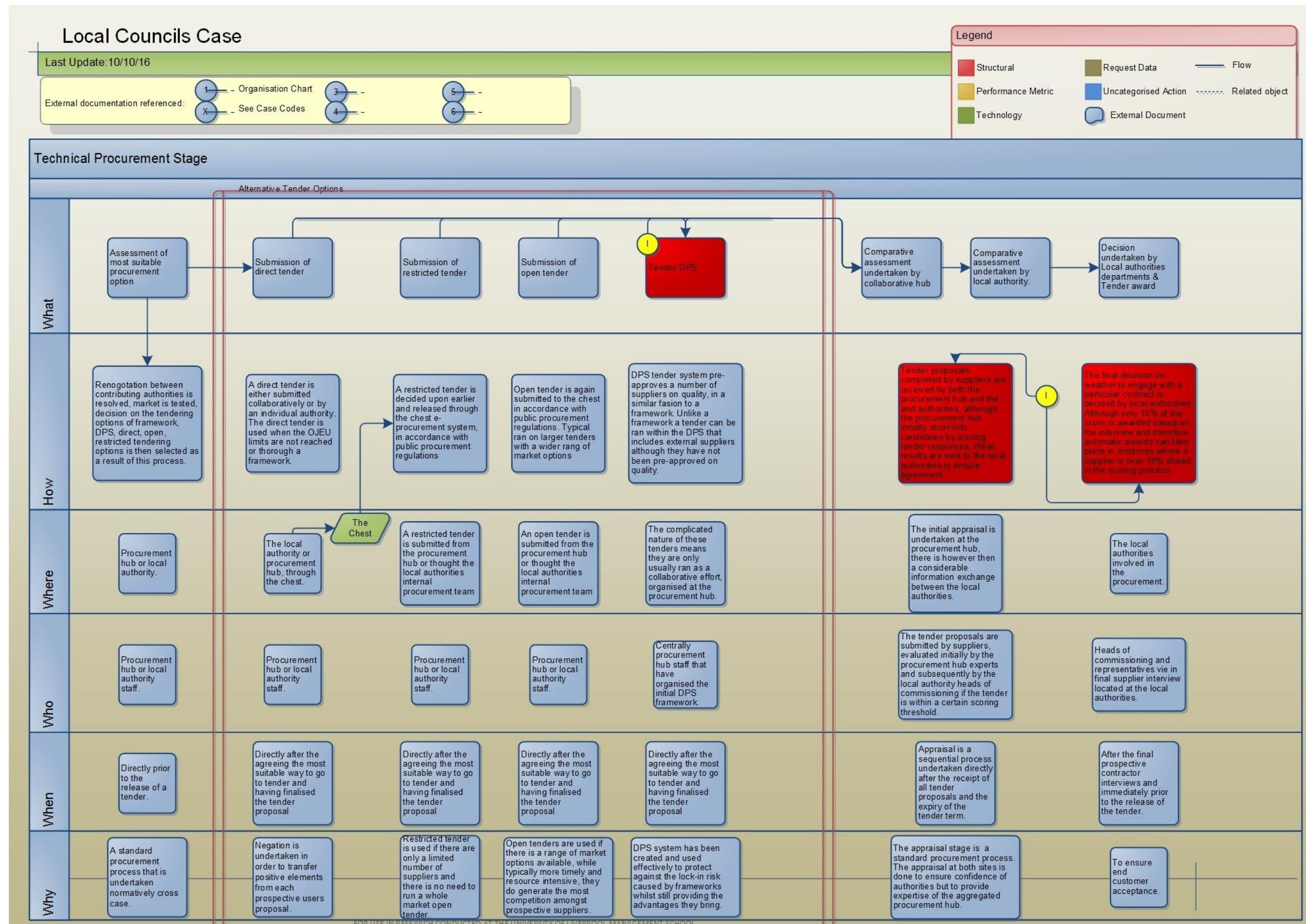
4.4.4 Acquisition Lifecycle Maps Encirc

The following Zachman frameworks were used as the means of identifying processes of interest as well as to provide an overview of the acquisition lifecycles general composition. The key processes are highlighted both through colour coding and have been associated with a letter that corresponds to the narrative explanation presented in section 4.4.5

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4.4.5 Case study characteristics

4.4.5.1 Reactive Procurement system (A)

The councils operate both independently and as part of a wider consortium of authorities, known as a procurement hub, both represented within this case. This can vary by region, although it is commonplace for an increasingly interconnected network of councils to procure through a hub in the majority of regions throughout the UK, as demonstrated at interview.

It is evident that there is a marked increase in the sophistication of the procurement processes that are undertaken at the collaborative procurement level in comparison with the individual procurement practices embedded within the individual councils.

Within the individual councils, there is less formal process to anticipate the procurement requirements of the products end users. This is a divergence from practice observed within other case organisations. Within the councils there is a disconnect between the users of the system and procurers of the product. They are not contained within one organisation.

In the instances where the procurement is not being carried out on collaborative basis the system works reactively. This reactive approach was deemed to be a significant divergence from processes observed in other cases, of potential strategic significance and aligns directly with one of the a-prior themes identified.

The reaction in the local councils arises from one of the following two cues: Either the end user will contact the local authority informing them of the upcoming need for a procurement, or the contract terms end which prompts the authority into contacting the end user. While collaborative procurement initiatives are proactively searched for by the collaborative hub, this is not the case at the authority level. This has been stated to be an inadequacy of the current system.

“We are trying to professionalise the procurement role, currently we don’t have a system in place that tries to look toward to the future, and future proof it if you like. That is why everyone is subscribing to services (like AGMA), I think that is where it is going to go in the future [...] it’s an issue currently, it’s something that we are trying to change, no firms plans yet, but we are aware”

Discussion point: There is some variance here between the functions embedded within the case organisation and that observed within the procurement hub AGMA. With regard to the

practiced embedded within the councils, there is a prominent focus on changing the reactive nature of the procurement model into a more predictive one inclusive of more functionalities.

4.4.5.2 Consultation Culture (B)

There is an increased role of consultation in the procurement process. The authorities routinely defer to procurement professionals embedded in regional procurement hubs. The hubs work on a subscription base membership service. Those councils with typically the lowest procurement requirements are more becoming associate members of the subscription service in order to benefit from the knowledge exchange.

The organisation of the wider marketplace to support involvement of third party consultants is of strategic significance, divergent amongst the body of cases and in alignment with one of the a-prior categories of interest identified within the literature.

Whilst the capabilities to provide services within local government remains devolved, the practical realities of leveraging economies of scale through aggregated procurement and the increasing need for informed procurement practices and policies have led to the devolved agencies seeking a partially centralised approach that had been seen previously within the NHS. This is again an example of how organisations appear to be going through cycles of devolution and centralisation.

Discussion point: There is an increased role of aggregated consultancy services in those organisations transferring towards more and more complex procurement requirements such as the councils. This model is apparent in the NHS, however it is more developed in the NHS as it is in-house and performs a greater range of functions. Again, a further requirement is in the MOD, where the procurement hub is entirely in house, integrated, and performs an even wider range of processes yet again.

4.4.5.3 Continuous Information sharing amongst collaborating councils (C)

Interview data pointed consistently towards the benefits derived from continuous information sharing between the councils as being the primary advantage of the centralised procurement hub form of local government.

This information sharing takes multiple forms and is undertaken through numerous mediums, observed within this researcher where the following forms of strategic data sharing:

- Investment in joint research for market
- Benchmarking between authorities
- Community services research
- Staffing forecasting – employment market research
- Legal changes
- Sharing of technical strategies
- Awareness and use of emerging technologies

The following abstract in response to an interview question on information exchange between the organisations:

"So supporting groups is something we do a lot of [at the procurement hub], there is a recruitment portal that has been set up through a collaborative contract and there is a contract for agency and temporary staff that has been set up as a result of the way we work together, that has made really significant savings but also dealt with a lot of the legal aspects around compliance, not just with procurement law but also with employment law. There is a framework in place for consultancy services, specialist professional service [...] It's not called DBC [Disclosure and Barring Service checks], you used to have to be CRC [Criminal Record Check] cleared to work in an areas with safeguarding issues, the DBC service that replaced it... Basically within the heads of HR that had a discussion about how long it takes for someone to get appointed after this clearance and it can sometimes be two or three weeks for it to be processed by the DBS people. We decided that it would be a lot simpler if we could do it electronically, so we set up a contract [...] it does that last bit with DBC people a lot quicker, saved in postage etc., but more importantly we are able to get people in to post more quickly as a result of that, now that had to be supported by a procurement and we wouldn't have known that if we hadn't been attending those heads of HR meeting etc."

Disclosure and Barring Service checks (DBS) – As taken from the quote above there was a regional database of pre-approved potential workers that, in the event of a staffing shortage in one of the public front line services can be used to search suitable staff and as a means of preapproving application on the list. This service was particularly effective with regards to safeguarded and sensitive areas. The benefits of information sharing systems was divergent amongst the body of cases, of reasonable potential strategic significance and aligns with the a-priori themes highlighted in the literature review.

Discussion point: There is potential significance in enacting a strategy to arrange the enterprise in a wider collaborative outwork of smaller elements compared to within singular centralised enterprises.

4.4.5.4 Dynamic Purchasing System (D)

The Dynamic Purchasing System is an alternative to a procurement framework that has been cited as an especially effective innovation being used by the AGMA (Association of Greater Manchester Authorities) procurement consortia in and around the greater Manchester area. This process was deemed to be of significant potential strategic importance, was identified as being in line with the a-priori areas of interest identified within the literature and is divergent as a process among the body of cases.

In many ways, DPS functions as a procurement framework but provides an agility advantage for the contracting organisation over the procurer. In a typical public procurement framework an OJEU (Official Journal of the European Union) notice will be issued, the tender applications are reviewed and the appropriate number of candidates are approved to the framework. The specific detail of work to be undertaken is not precisely described at the onset of the contract and is awarded directly to suppliers on the framework, or alternatively a competition is run between the suppliers that have already been approved to the framework.

A DPS system features in much the same way. An OJEU tender is advertised, with the outline of work to be undertaken given but no specific details given. In the case of DPS this is especially true of costings. The tender proposals are received and a place on the DPS framework is awarded to the successful bidders. These bidders are then pre-approved in terms of quality but not cost competitiveness. These quality checks are around typical areas such as legal compliance, capacity, expertise etc. The difference in the approach occurs when work does arise, it can either be awarded to the DPS consortium in a similar fashion

to a procurement framework or a second OJEU tender can be run. The organisations approved to the framework are able to bid for this work, however so is the wider market.

This approach is detailed in the following extract from the head of the AGMA procurement hub:

“Dynamic purchasing system, so it is the same a framework, what used to happen was that when you set up a framework you would post an OJEU notice, stating what it is you are going to do, and for a framework it would be; ‘these are the people that are participating, and we are not sure what they are going to buy over the course of the framework, but this is what they bought last year, for example, and if you want to get onto the framework, then give us your quality submissions and give us your price and then it may be that you will put a single supplier onto the framework and everybody uses that. Or maybe it will be that the framework will run direct awards to whoever is the highest scorer or there may be mini competitions that you run. Whereas in a dynamic purchasing system you put an OJEU notice out, you don’t say anything about price and just request information about quality, so you then assess the people that apply and admit those onto the framework that are above a certain threshold. When you have some requirements, you then put a new OJEU out that includes those requirements so anyone that is not on the framework can submit a tender, so you have to do the full quality assessment of anybody who is not on the DPS but the people who are on the DPS are simply completing on cost. [...] yes it functions as a pre-approvals process, what used to be cumbersome about it was the OJEU process repeated each time.”

Interviewer: What cases do you find that the DPS is particularly appropriate for?

Participant: Well it has only just been established for the training framework but I think in social care there will be lots of uses for it. A framework didn’t work very well for social care procurements, but a dynamic framework will. If you need to change the way in which you do things, [for reasons of budgetary, or other changes]. A framework cannot accommodate that change, and so you end up for five or six frameworks in place, that nobody gets any work from [...].”

While this requires the use of second OJEU tender and may appear to be more bureaucratic, it has the following advantages:

- **Removes lock-in risk of emergent innovation:** In the event of wider market innovation the innovating organisations can be brought into the framework.
- **Removes lock-in risk of reduced competition:** The organisations within the framework are not assured closed competition and are therefore incentivised to remain competitive within the context of the wider market.
- **Removes lock-in risks associated with capacity:** Situations that cannot be effectively fulfilled by the organisations within the framework can be supplemented by wider market engagement in a DPS.
- **Removes lock-in risk with legislative change:** A change in legislation may either entirely invalidate, or devalue the competitiveness of a pre-existing procurement framework and therefore force a creation of an alternative framework, without having the legal capability to close the pre-existing frameworks.
- **Avoids defunct frameworks:** In the case of wider market innovation, capacity issues, compliance issue it is frequently required to either run an independent open tender or to tender for another framework the takes into account the wider market changes. DPS avoids the need for this and thus, as with the above example, reduced the administrative effort over the long term.

Discussion point: Of the divergent process highlighted the DPS is a self-contained strategy of abetting some of the lock in risks featured in other contracting models, and a comparison of the contracting strategies observed is considered within the discussion section.

4.4.5.5 Investing in supply chain / Public Finance Initiatives (E)

Local authorities are intent on securing the prosperity and robustness of the supply chain and local economy. This is both because authorities are obliged as branches of government to encourage local and nationwide economic success, but also to secure the effective competitiveness of the local marketplace. The willingness to invest in the wider supply chain was a distinct process observed amongst the body of cases and was of potential strategic significance.

The investment in the local supply chain is achieved in numerous ways. Research is commissioned to assess the potential landscape of the local populous requirements over a medium and long term period, and to subsequently test the markets capability to meet that requirement. This test can take the form of a market capability tender, where a tender is submitted through OJEU, no contract is awarded but suppliers declare their capability and intention of meeting such a tender.

There are a range of outreach meeting between the local authorities, procurement hub and front lines services that encourage both the sharing of market testing and ‘blue skies’ thinking as to what the supply chain will require in order to stay robust. Similar meeting occur with the aforementioned groups and the typical primary contractors operating in that region.

A specific point of divergence that emerged from these initiatives is the use of public funds to augment the capability of the supplier, described as a reverse of the Private Finance Initiative (PFI). The interview describes the process in the extract below:

“If an authority has got a joint venture, let us say for refuse collection vehicles [...] say they have a joint venture or even just a contract which is an outsourced contract with somebody who is going to provide those services, if the contractor is made responsible under the contract for providing vehicles, then they will invariably borrow money in order to buy those vehicles. The best interest rate that they ever get will be around 8% in the current days, and over the contract length there will be depreciation of those assets, but the best rate will be around 8%. If the council, was to fund the borrowing of the vehicles under prudential borrowing the council pays something like 0.75%. So if you have ten refuse collection vehicles and they cost £130,000 pounds each, that’s £1.3 worth of

credit at 8% that you are paying your supplier of the refuse collection service for him to hold the vehicles that he is borrowing at 8%. So the difference between 8% and 0.5-0.75% on larger assets is significant. So I'm advocating now, that any supplier who has significant borrowing requirements to support the contract should have a discussion [with the authorities...] So if the authorities borrowing strategy allows it to, because they don't all have enough head room In their capital strategy then they could save money on the contracts and just reduce their payments by that.”

“As a result, I would advise any authority whose capital procurement strategy is set out in such a way as to not allow this, then they should change it because you could be talking about significant amounts of money”

“If you are going to be adding all of your requirements together then your small local suppliers might be disadvantaged by that and that has a knock-on effect on the local economy and so strategically we look at how procurement decisions will affect and or otherwise contribute to the core objectives of the stronger together strategy, with is basically to grow the GVA [of the local economy].”

The basic proposition is that the public entity leverages there favourable borrowing rates under the prudential borrowing rules and in turn loans this to the supplier in place of borrowing they would undertake in the private sector. At time of writing, the percentage difference in interest is around 7.5% of total loan amount, this is a saving that can be directly subtracted from the contract payments amount to the supplier. There also exists the possibility for a ‘better than commercial rate’ loan from the principal to the agent, although no example of this was discussed at interview.

Discussion point: As is demonstrated in the above extract, the savings potential for thing kind of strategy employees by public organisations is substantial. An interesting potential output of the research is to consider supply chain security strategies within the cross case comparison and have this feed into the discussion.

4.4.5.6 Predictive Collaborative procurements (F)

In contrast to the local councils the collaborative procurement hubs have a number of mechanisms for engaging the end user community in order to ascertain changes over the

near, medium and long term. This process was deemed to be of strategic significance, and aligned with the a-priori areas of interest identified in the literature review

Groups such as the National Advisory Group (NAG) for local procurement act as outreach meetings between the customers and the surrounding government infrastructure. This is combined with internal meetings to discuss future collaborative actions. Within the business areas in each of these organisations there are also sessions designed to predict the next major step change in legislation, technology, law or end user requirement. I.T managers, or commercial contractors are two such examples of expert groups connected horizontally in the supply chain. As demonstrated in the following extract:

“Within AGMA there is the I.T. Managers group, there is the HR group. Organisational development groups, etc. As a procurement hub we will attend that to look out for any future procurement activities than my result from a strategic change in direction by being round the table and listening to the discussions. If it looks like they are going to go to market at the start then we can advise them as to the best way of doing that.”

“So you get to hear about things that are possible [...] I have a monthly procurement meeting with the shared service users [local councils and front line services] in addition to that and the NAG you are able to chase potential collaborative procurement actions.”

“It is possible to identify commonalities across the different parts of local government, transport is another example, the majority of their spending is on trams or infrastructure and generally speaking they will probably become only authority that do that but in a great majority of cases it is possible”

Discussion Point: Whilst there exists actions to predict future demand, the level of sophistication in these devices is markedly lower than has been observed in other case organisations.

4.5 Sellafield Case

4.5.1 Case Background

Sellafield is the organisation responsible for securing and clean-up of the Sellafield nuclear decommission site. The organisations is the primary contractor the UK governments Nuclear Decommissioning Authority (NDA).

Whilst Sellafield operates across a number of geographically dispersed sites as an organisation, the firms' operational activities are carried out at the expansive Sellafield nuclear decommissioning facility based in Cumbria. Sellafield operate a number of major projects associated with the different nuclear treatment facilities based at this sight. One of the most prevalent of these facilities is the First Generation Magnox Storage Pond (FGMSP) which is the focus of the inquiry based in this research.

4.5.2 Data Collection Overview

Initial contract with Sellafield was a non-recorded interview that largely centred around ensuring that both the researcher and university was compliant with stringent security regulations imposed by Sellafield, however some overview of the process and organisational structure was conveyed. Following the successful completion of the legal work there was an initial round consisting of three major interviews with high ranking personnel followed by an extensive exchange of strategic documentation and clarifying correspondence. These participants and their position details were requested anonymised, but they were programme head level or higher.

During the second phase of data collection at Sellafield there was another round of clarifying questions sent via e-mail and a further two interviews were conducted. One of those interviews was with a highly senior participant in the first round who had pre-prepared extensive answers based upon the e-mail correspondence.

4.5.3 Composition of Acquisition Lifecycle

Of those organisations examined within this research Sellafield is in a category along with the Ministry of Defence and Encirc for having normative procurement practices that are geared exclusively towards COPS and or industrial product service systems. Sellafield's list of suppliers was sufficiently oligopolistic that instead of a 'market assessment' phase the organisation had something more akin to options testing amongst the pre-established group of suppliers. There was however alternative sourcing options considered. The remainder of the phases mapped onto the generic categories reasonably directly, with the exception of a slightly protracted delivery phase in which the organisation worked closely with the supplier on some of the infrastructural or technical contracts.

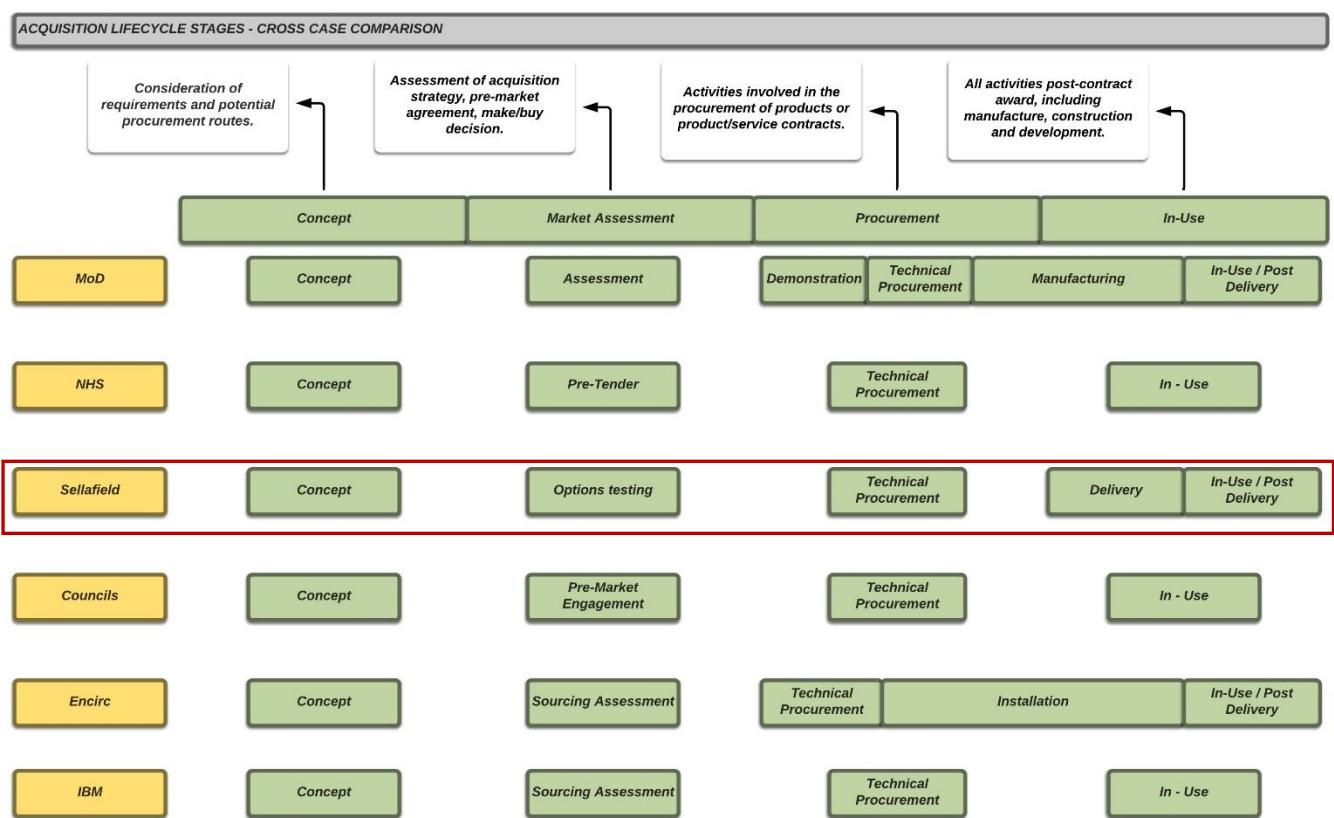


Figure 21 - Composition of Acquisition Lifecycle Stages (Sellafield)

4.5.4 Summary of case study characteristics (Sellafield)

The following (Table 14) depicts the stages of the acquisition lifecycle that the emergent case study characteristics were identified in. As with each of the cases, the Acquisition lifecycle is plotted chronologically and areas of thematic areas of interest are highlighted on the maps. The highlighted process then derive into the case study characteristics that are explored through further inquiry via the abductive method.

Phase	Thematic Area of Effect	Case study characteristics	Code on Map
CONCEPT	Organisational Alignment, Risk Management	LFE	A
	Organisational Alignment, MoD Priorities	Internal/external dependencies	B
	Organisational Alignment, MoD Priorities, Performance Management	A.L.A.R.P paper	C
	MoD Priorities, Organisational Alignment,	Standard 'Fragnets' (Scope)	E
	Performance Management, Technology Management, MoD priorities.	Early involvement of alliance workers.	G

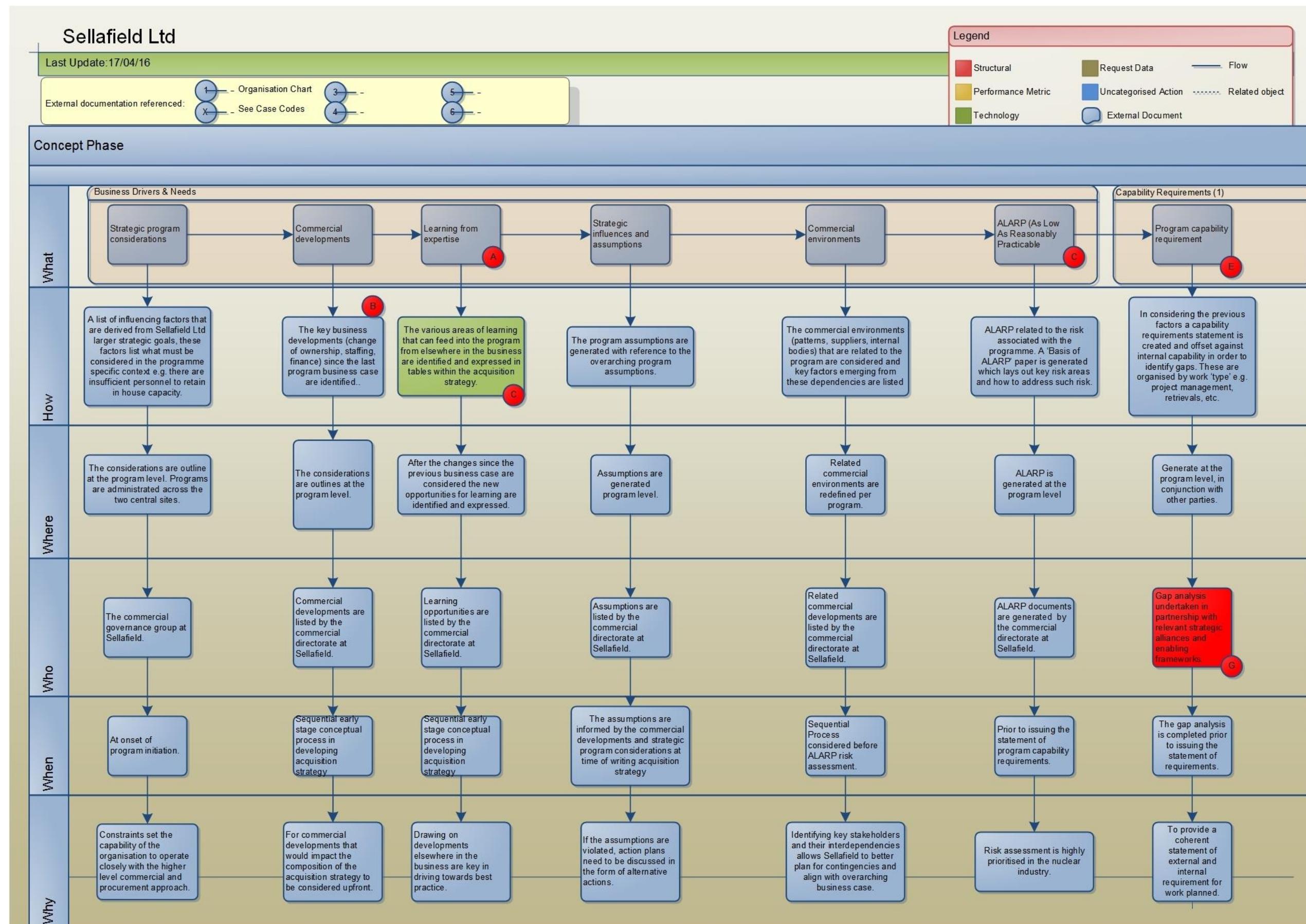
Phase	Thematic Area of Effect	Case study characteristics	Code on Map
ASSESSMENT	Risk Management, Organisational Alignment.	Value Transition Point	K
	MoD Priorities, Organisational Alignment, Technology	CMART contract management / Complete Tender Management – Atlas	D
PRODUCTION / PROCUREMENT	Technology Management, Performance Management	Cross Lot tendering	I
IN-USE/POST CONTRACT	Organisational Alignment	Direct award work	H
	Performance Management, Technology Management, MoD Priorities,	‘Five Board’ model	F
	Organisational Alignment	Flexible contract workers	J

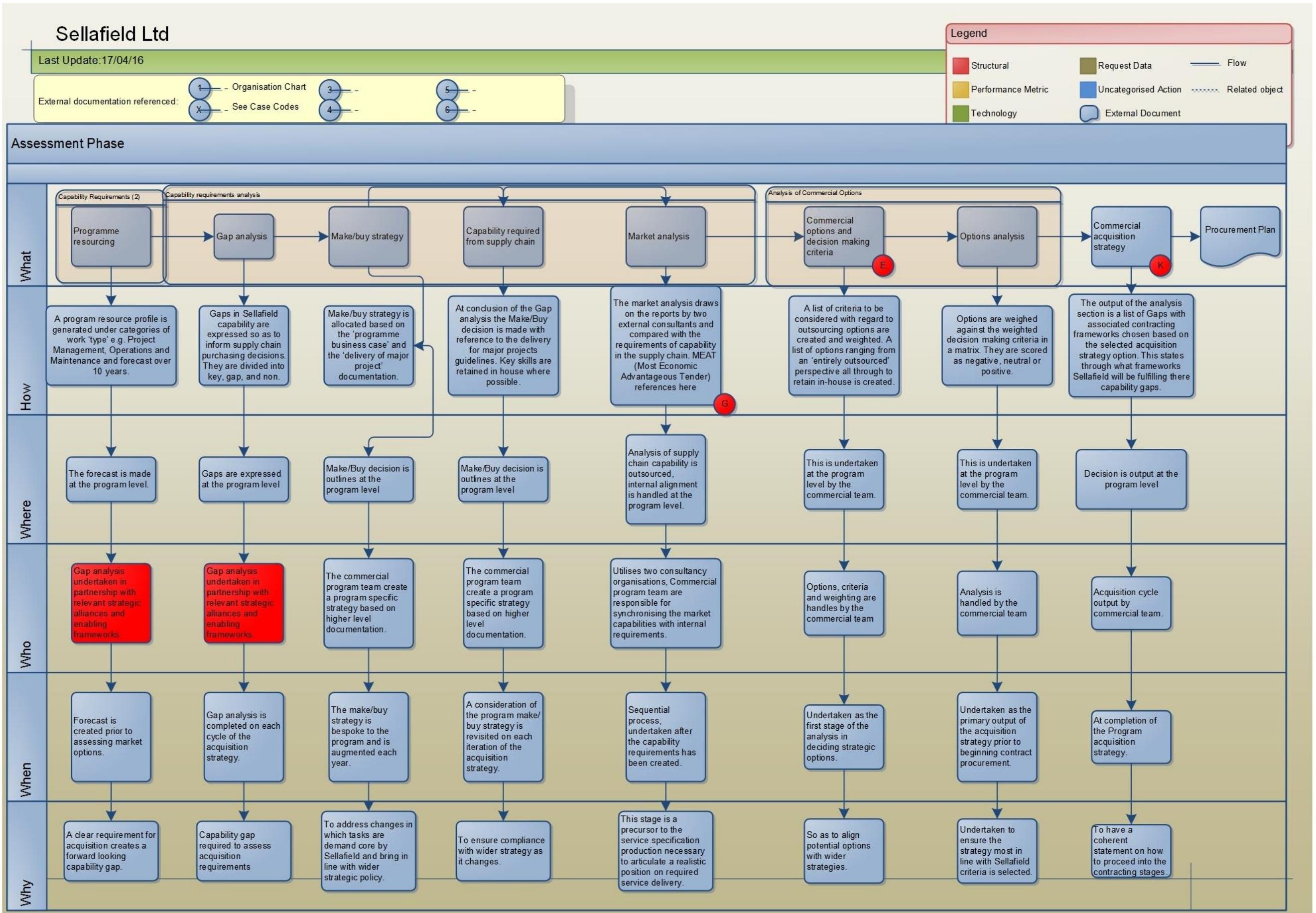
Table 14 - Summary of Case Study Characteristics (Sellafield)

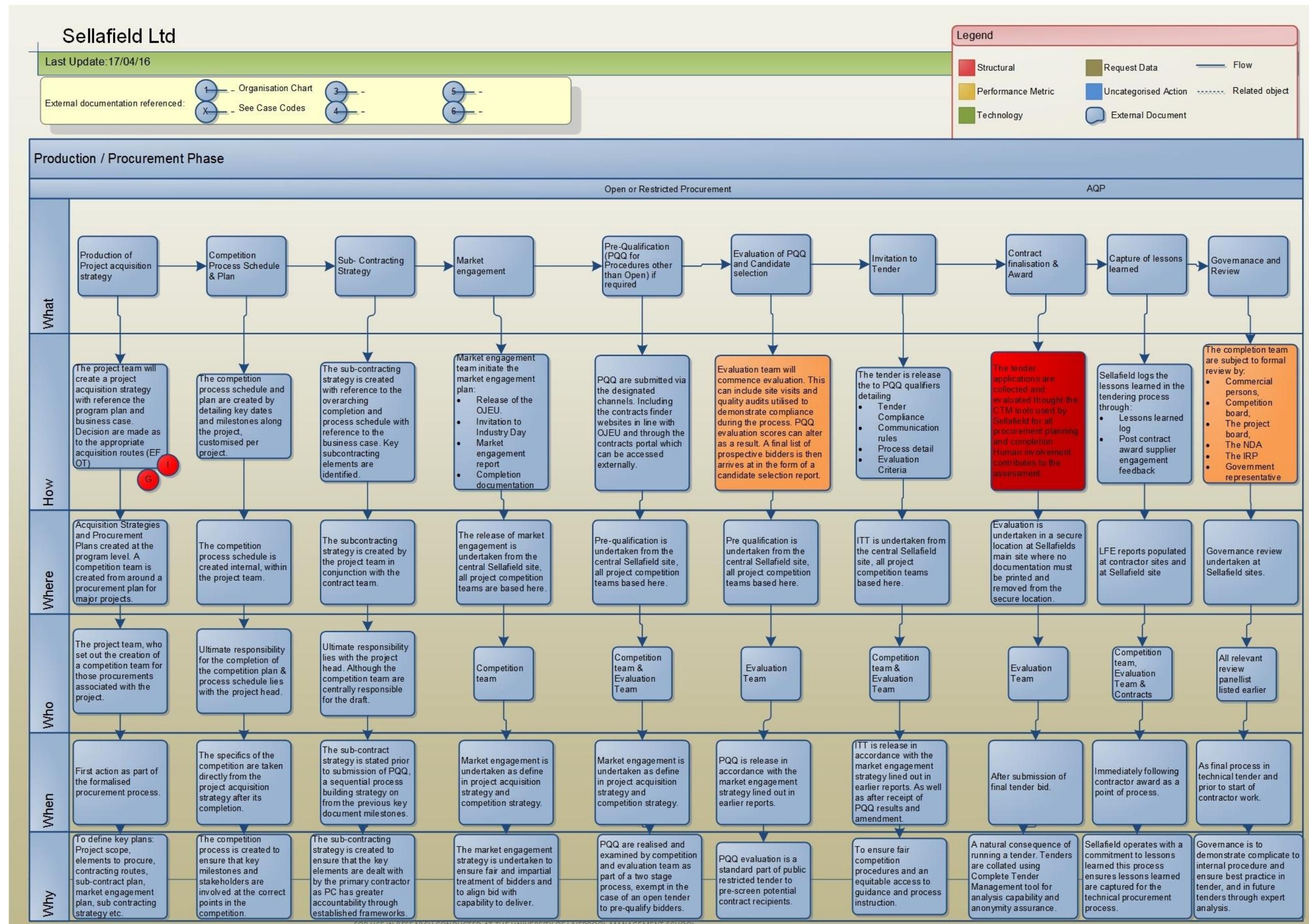
4.5.5 Acquisition Lifecycle Maps Sellafield

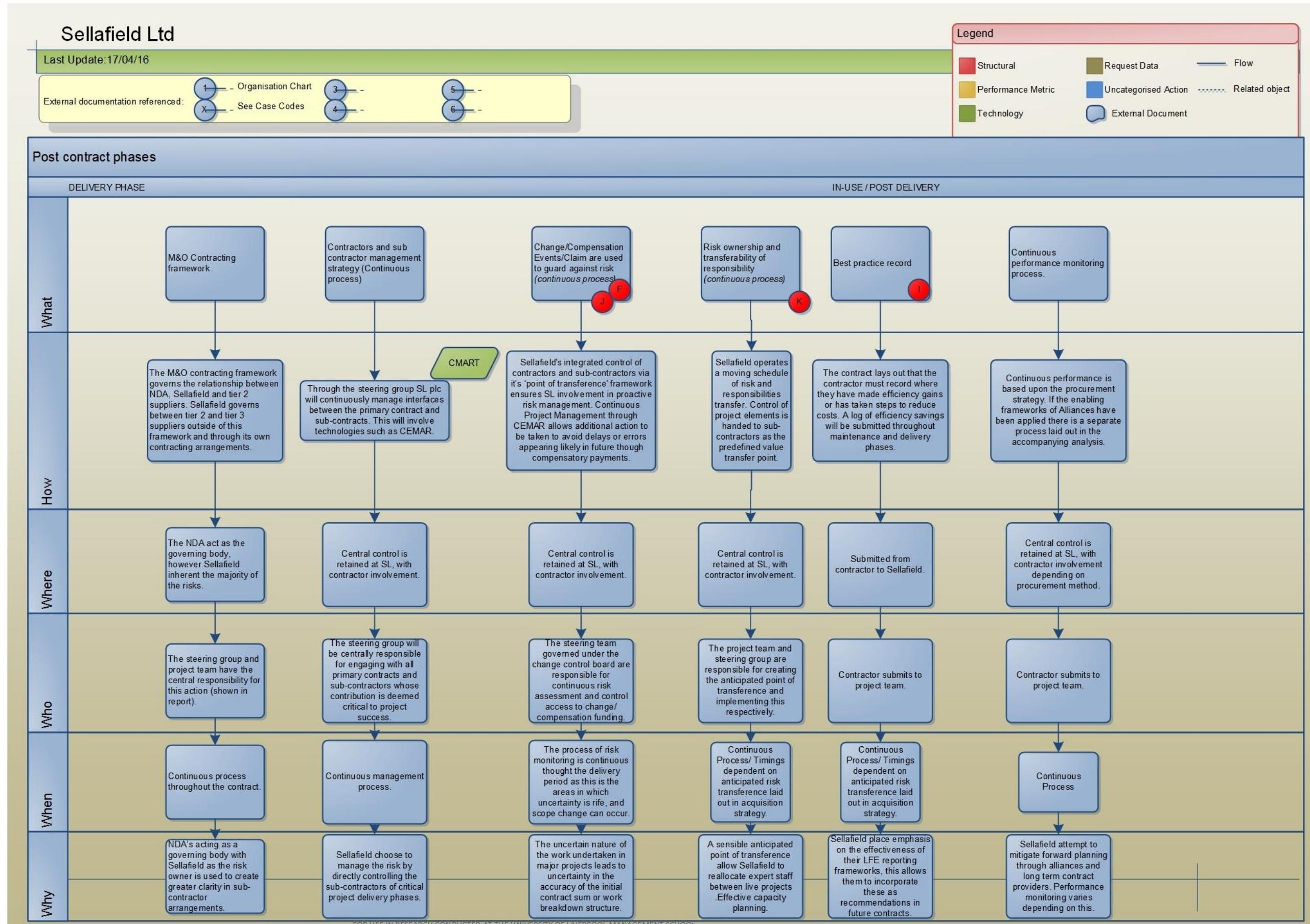
The following Zachman frameworks were used as the means of identifying processes of interest as well as to provide an overview of the acquisition lifecycles general composition. The key processes are highlighted both through colour coding and have been associated with a letter that corresponds to the narrative explanation presented in section 4.5.6

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4.5.6 Case study characteristics

4.5.6.1 Learning from Experience (LFE) system (A)

LFE reports are prominent throughout the case and highlighted at numerous points in filling out the Zachman framework. This is evidenced in both the acquisition strategy where LFE influences feature prominently, as well as within interview transcripts, as shown in the quotes below.

“This Acquisition Strategy has been developed taking account of the strategic assumptions and influences, LFE and other commercial considerations set out in Section 4. In preparation of this paper, cognisance has been taken in respect of existing Site and Decommissioning Directorate guidance regarding delivery models for Major Project delivery, and the preparation of Acquisition Strategies.”

“Our LFE reports are heavily integrated into our acquisition strategy; we would consult lessons learned from each area of our business and include these explicitly into any new acquisition strategy.”

The official documentation being referenced above shows the process to be expansive. During the concept phase the LFE reports are compiled from a number of clusters in order to cross reference best practice and identify common pitfalls. LFE reports will be gathered from: the programme’s historic procurements, the reports from major alliances; Design Service Alliance (DSA), Infrastructure Service Alliance (ISA) and the Production Plant Programme Partners (4P) as well as from other programmes in part.

LFE reports are consulted in the concept stage prior a statement of requirement and gap analysis is created as a result and references throughout the remainder of the process. The LFE practice observed is significantly divergent amongst the body of cases viewed, if of potential strategic significance, and aligns with the a-priori categories of interest taken from the literature review.

4.5.6.2 ATLAS System with LFE

LFE practices are defined as ‘The process to be applied by commercial staff in gathering, filtering, placing and learning from experience’. These activities are collectively referred to as simply ‘knowledge’ and is all controlled through one central knowledge management platform called ATLAS (brand name).

Knowledge is categorised according to the following areas:

- **Customer / Client Knowledge** – typical, but essential knowledge to most organisations
- **Knowledge in Processes** – applying the best know-how while performing core tasks
- **Knowledge in products (and services)** – smarter solutions, customized to users' needs
- **Knowledge in People** – nurturing and harnessing employee capability
- **Organisational memory** – drawing on lessons from past or elsewhere in the organisation
- **Knowledge Assets** – measuring and managing the intellectual capital of these areas.

Knowledge is gathered by practitioners from internal and/or external source and may be in differing formats. It is not necessary to require knowledge to be provided in or transposed into any particular format however, to be of use, it is stipulated that information held on the ATLAS (knowledge management) system cannot be classified above OFFICIAL. Knowledge gathered activities are centrally related to Supply Chain Management in all its facets, but ATLAS may also include some other specialist areas of interest.

While entering knowledge into the ATLAS system directly, practitioners are tasked with making a judgement as to whether the knowledge is vital.

Knowledge is considered vital if its capture and storage will retrieve better outcomes for the business. A better outcome is tested with the following propositions:

- Costs saved or avoided
- Improvements in schedule or avoidance of lost time
- Improvement in 'right first time' quality

Knowledge is codified at numerous levels within the knowledge management system, firstly by SCM topic area e.g. procurement of works, suppliers, services, maintenance areas. The knowledge is then codified by user defined keywords, e.g. acquisition strategy, benefits

realised, conflicts of interest, category management, candidate selection, insurance, incentives, pre-market engagement, supplier audit and numerous other categories.

A final stage of coding is then applied by OE personnel whereby recently entered elements are WANO coded. This codifies the system in preparation for any horizontal engagement with nuclear industry partners, as the data is pre-sorted according to an industry wide standard nomenclature.

Over time the codified knowledge acts as a guide to best practice. Consultation with ATLAS is embedded within the procurement practices and each task along the acquisition lifecycle must be proceeded by a corresponding search of keywords in the ATLAS system. If a procurement professional is considering an appropriate incentivisation model then ATLAS must be searched for both incentivisation models and similar projects to provide guidance. This is repeated for all activities along the acquisition lifecycle.

Users interact with ATLAS through an interface modularised by function. Some of these are industry bespoke functions; in the case of Sellafield they have a nuclear regulation compliant module. Others are generic business intelligence modules for a knowledge management system such as the primary LFE Module. This can be seen in Figure 22. An expanded version of the LFE module can be seen in Figure 23.

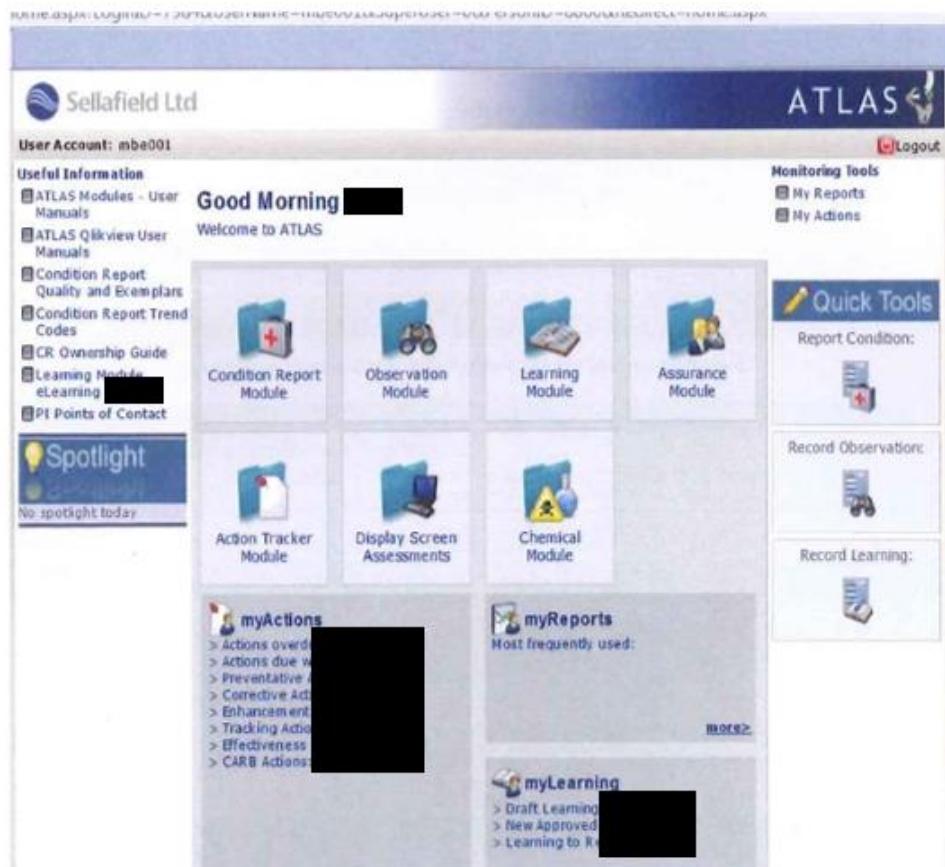


Figure 22 - ATLAS Main Screen

Reference	Date	Backlog/Approved	Source of Learning
Title: OPEX Green - Defects in the Manufacture of Shield Windows LN05055/1	09/09/2016	During an inspection by Sellafield's Transparency & Certification Team (Approved)	Adhoc Learning
Title: East End Crane - Tender Process LFE LN05020/1	17/08/2016		Adhoc Learning
Title: East End Crane - Tender Process LFE LN04605/1	03/05/2016		Adhoc Learning
Title: East End Crane - Tender Process LFE LN04605/2	03/05/2016		Adhoc Learning
Title: East End Crane - Tender Process LFE LN04605/3	03/05/2016		Adhoc Learning

Figure 23 - ATLAS learning module

Some of the modules, such as the performance management modules come with a separate interface. The performance management dashboard is divided into the following four sections.

- Functional Performance
- Supply Chain Performance
- Procurement Performance
- Post Contract Management Performance

These can be seen in Figure 24. While there are numerous omissions in the image due to confidentiality, the RAG system can be seen applied to each sub-category under these four primary performance headings.

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Figure 24- ATLAS performance desktop

How ATLAS is used to store & retrieve Commercial LFE

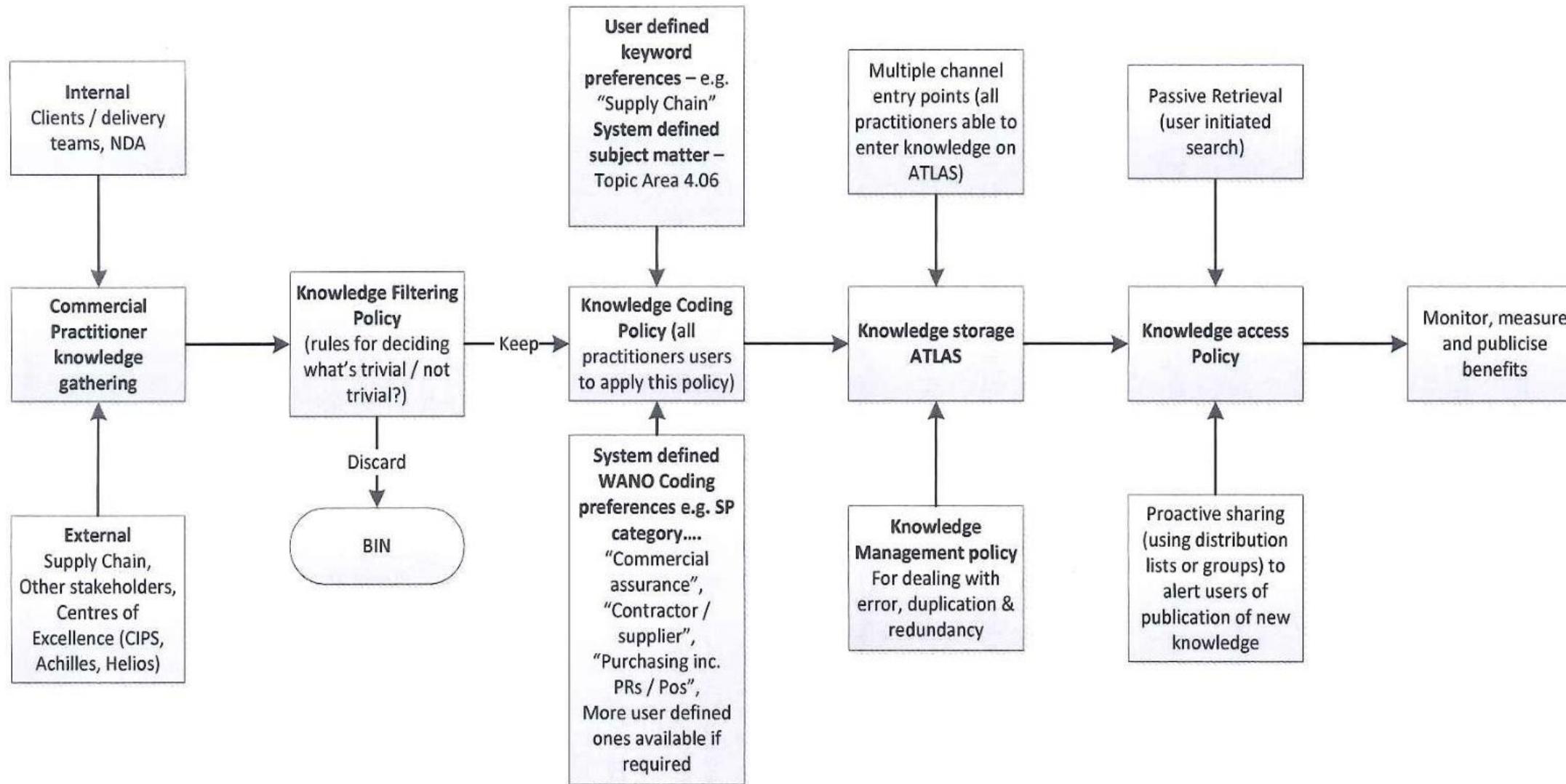


Figure 25- Atlas LFE Process Map

Discussion Point: The level of integration and prevalence of the practice described at interview suggests this process as a major factor of divergence to be highlighted in the discussion section of the work.

4.5.6.3 Internal/external dependencies

The concept phase is aligned with coherence between departments strongly due to the emphasis placed upon explanation of the internal and external dependencies through the use of wiring diagrams.

This is done on an internal and external basis and articulates dependencies between the internal programmes, various projects and the facilities that are engaged onsite. It also articulated the relationship between the programme and the wider supply chain networks through the alliances.

This occurs in tandem with a consideration of commercial developments in the concept phase. While a relatively minor process in comparison to others observed, it is identified as it aligned with the a-priori areas of interest, is divergent amongst the body of cases and aligns with the a-priori areas of interest and is of some potential strategic significance.

Discussion Point: A consideration of how and why this process exists within this context but not in others. Processes that increase the general coherence of the enterprise may be visible within certain enterprises and not in others.

4.5.6.4 As low as reasonably practicable (ALARP) paper

ALARP papers are a common tool in risk averse environments such as the nuclear industry. However the integration of such a function was demonstrated to be divergent amongst the body of cases, as well as of potential strategic significance and thus was highlighted in the review. The process is described in the excerpt below:

“Each Project generates a “Basis of ALARP” paper. This identifies issues relating to nuclear safety and defines respective cases for what is acceptable levels of risk. The Basis of ALARP papers are reviewed by both the Head of Operations and the site Management Safety Committee, (MSC), has oversight of the FGMSP (First Generation Magnox Storage Pond) Stream and Plant Safety Cases which enables it to place in context respective FGMSP Basis of ALARP papers.”

A basis of ALARP paper defines the constraints in which procurement options can be undertaken in relation to safety and defines in part the viable options in the acquisition strategy

of any programme business case and subsequent acquisition strategy. ALARP is a key component of risk mitigation included in Sellafield's overarching risk management structures as demonstrated on the acquisition maps.

4.5.6.5 CMART contract management / Complete Tender Management (CTM)

C-MART and CTM are amongst the ATLAS system as the most prominently used software packages throughout Sellafields acquisition structure. While CMART has application in the organisation and day-to-day running of the organisation, CTM is used far more widely and has application throughout most stages in the acquisition process.

In the concept phase CTM is used to reference the feedback of previous tenders received from competition participants in order to better direct the proposed acquisition. This is done in conjunction with the LFE phase denoted by 'D' on the acquisition maps. The process is highlighted because it directly aligns with the a-priori themes highlighted in the literature review.

Discussion point: The use of information technologies is a superordinate a-priori code and thus a comparison as to the way in which technology is employed in the acquisition lifecycles of different organisations is of direct importance in addressing the research question.

4.5.6.6 Standard 'Fragnets' (Scope)

Sellafield make extensive use of 'fragnets' as an output from their accumulated knowledge. Fragnets are standardised models of predicting the time and cost of particular activities. The LFE reports are analysed by a range of stakeholders throughout the organisation and disseminated thought the ATLAS system, standardised templates coherent across programmes and through the use of 'fragnets' to approximate the length and cost of new acquisitions. 'Fragnets' are used in scoping the likely cost and time estimates in the concept stage. The use of this system is of potential strategic significant, and is divergent amongst the body of cases. The process also aligns with the a-priori categories of interest identified in the literature review.

Discussion point: A theme common to the processes featured within this case has been the push towards having holistic visibility and standardised operating procedures across the organisation.

4.5.6.7 ‘Five Board’ model

Sellafield’s governance structure for major procurements is divided into five boards: Delivery Board, Program Board, Change Board, Supplier Board and Project Board.

The boards are collectively responsible for approval of all acquisitions at different stages along the acquisition lifecycle. The model aims to involve a variety of stakeholder perspectives in significant decisions along the acquisition lifecycle. The programme board is responsible for consideration of the impact of an activity on the overall programme and jointly used resources, the delivery board for assessing the practicability of the action and so on.

The model was cited in interviews as being highly robust and necessary as a risk reduction strategy in a context such as a nuclear decommissioning facility. While the board’s involvement is often specific to the risk factors of each case, typical involvements are depicted on the acquisition maps, denoted by the letter ‘F’.

4.5.6.8 Early Involvement of alliance workers

Sellafield’s heavily integrated contract workers are able to provide external expertise to potential procurements being awarded through the strategic alliances and enabling frameworks. The involvement of contract staff in the early stages allows for a more complete understanding of the challenges mutually faced and allows for more accurate predictions of time, scope and cost.

Contracting staff based within enabling frameworks but the specific pre-tender involvement is depicted on the acquisition maps as denoted by the letter ‘G’.

4.5.6.9 Direct award work

Through the enabling frameworks and strategic alliances, Sellafield is able to direct award aspects of work under the pre-existing contracts, thereby skipping the public procurement regulations and lengthy competition and tender processes.

A specific ‘lot’ of work is anticipated at the start of the long term strategic alliance or enabling frameworks awarded directly to a contractor whom is part of that consortium. The possibility of direct award is highlighted on the acquisition maps with ‘H’.

4.5.6.10 NEC3 contracting Framework

Sellafield subscribe to the principles of the NEC3 (new engineering contract) framework to organise their relationship with partners. The approach is widely used in engineering and construction industries and focuses on the adoption of a ‘partnering’ approach to contracting

as opposed to that of an adversarial approach. The focus centres on proposing a simplified contract terms universally accessible to all contract parties and to empower contractor staff to become involved in the decision making aspects of the project. This approach is the basis for the development of Sellafield enabling frameworks and strategic alliances. There is clear evidence the ethos of collaboration has derived in part from this approach. NEC3 is also the basis for the well-defined value transition points that are discussed heavily in Sellafield documentation based on the principle of risk sharing. This is an approach to contract management and not in itself a practice or set of processes and is thus not represented in the acquisition maps.

4.5.6.11 Template documentation

The templates referred to here are key documentation used in critical processes along the acquisition lifecycle: contract management plans, procurement plans, business case documentation, acquisition plans etc. Sellafield invest heavily in its LFE templates to ensure procedural best practice in future procurements.

Template documents are a rigid adherence to incorporating best practice into common business process and occur throughout the organisations acquisition lifecycle.

4.5.6.12 Community of Practice

The community of practice group operates with authority and relative independence within the organisation's hierarchy. It continually monitors differing operations amongst project teams and programmes in order to try and better standardise appropriate processes and encourage best practice.

4.5.6.13 Cross Lot tendering

Cross-Lot Tendering is a strategic action made available through the use of enabling frameworks and alliances and is cited as having had a profoundly positive effect on contractor relationships and outsourcing efficiency. Within a particular alliance, items can be directly awarded to a contractor or a competition can be run amongst the organisations within the alliance. Within major projects the contract is awarded under one single contract, but consists of work streams broken into work 'lots'. While one organisation may only be dealing with one 'lot', they are required to bid as a consortium and are measured under one set of KPI's. Depicted by 'I' on the acquisition lifecycle.

4.5.6.14 Direct Management of sub-contractors

The management of 2nd tier subcontractors is often held at Sellafield. While they are not subject to the same regulatory framework as Sellafield itself, via the NDA. The primary contractors from a Sellafield perspective are managed directly, as are the 2nd tier suppliers. The reasons given for this were twofold, firstly that there is a need to ensure a retention of skills within the wider supply chain for highly specific engineering tasks and thus direct interaction allows for assurance of future works, secondly that the risk is deemed unacceptable to transfer to the primary supplier wholly. This is regarded as a value adding process within the interview participants. The format of this is laid out in Figure 26.

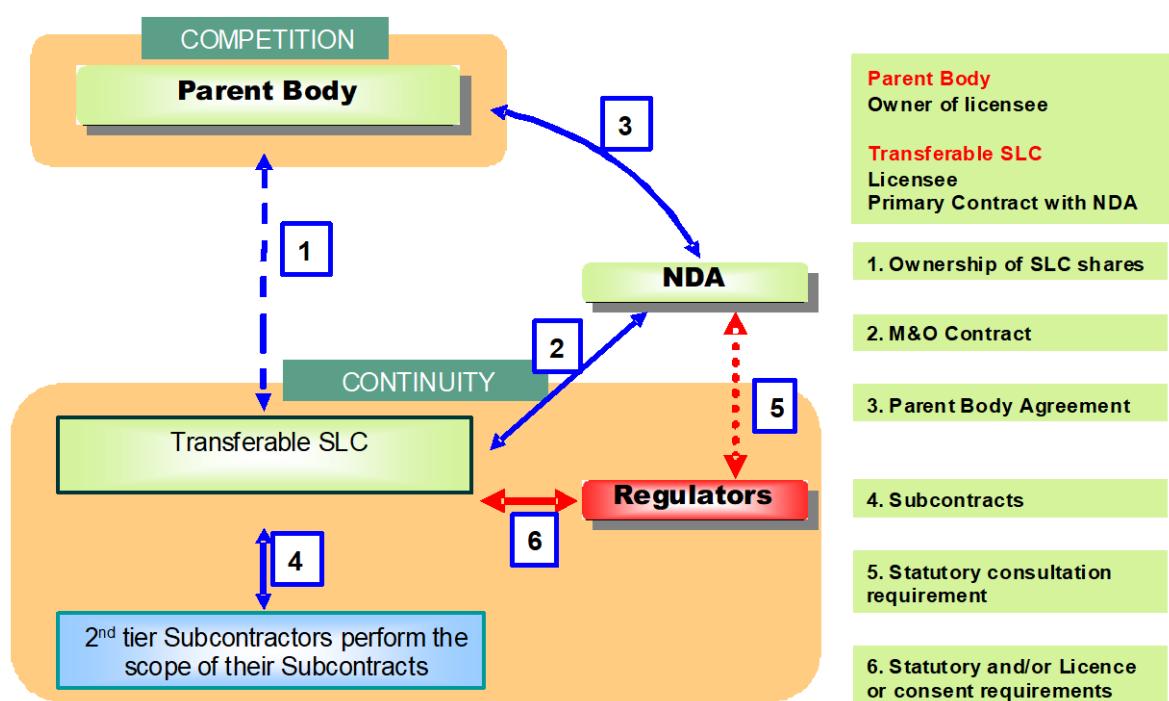


Figure 26 - Management Arrangement

4.5.6.15 Flexible contract workers

Due to the joint effort enforced by the enabling frameworks, consortium members are able to subsidise staffing shortfalls or expertise shortfalls of other members to ensure that the contract as a whole remains on track by providing capacity planning options in terms of staffing, equipment and expertise. Represented by 'J'

4.5.6.16 Long term contractual engagement

The organisations involved in the frameworks are engaged for a longer period of time than would typically be the case with a single project action. The relationships between the organisations, therefore, have time to mature and be effective.

4.5.6.17 Value Transition Point

A point at which your organisation's ability to add value (to an idea, design, specification) changes and it is time for a more appropriate contracted party to take the work forward.

Sellafield highlight the following as pre-requisites for determining an effective VTP.

- Knowledge of what's required (output/ desired outcome – the 'what', not the 'how')
- Knowledge of your organisations skills and capability
- Knowledge of the supply chain's skills and capability.

Adding value can equate to reducing risk and uncertainty – but reducing uncertainty also reduces scope for others to innovate.

There is no single transition point solution – it depends on what is being worked on what the drivers and balance of skills and capability are, therefore each work stream may have a contractually separate value transition point. E.g. phases of a particular engineering installation or phases of a design stage.

Risk usually passes at the transition point. At what point this occurs within the project cycle, and what the residual risks are, will not affect the kind of commercial arrangement used. Sometimes risk stays with the buyer.

A project / programme consisting of different elements (e.g. pieces of equipment) often has different transition points for each equipment type). When dealing with niche technology there can be circumstances where the client can start work early with a specialist contractor to develop a solution which can subsequently be incorporated into the wider project as a 'black box' [only inputs / outputs defined].

An acquisition strategy defines the VTPs for each of its constituent elements, not necessarily as dates, rather, what criteria have to be satisfied for it to be determined that the VTP has been reached. VTP is treated as a Rubicon - as attempt to backtrack will destroy value, impact time, cost and quality.

The placement of the VTP is decided upon by weighing the skills and knowledge of Sellafield that are required, and then weighing the skills and knowledge of a contractor that are required. Remembering that a value transition point can be installed between primary and secondary contractors as Sellafield engage with third tier supply chain partners. This considerations takes place along thematic lines. E.g. what value adding skills owned by Sellafield are required prior transition and after transition. The following two tables show an example of considerations related to ‘knowledge and skills’ and to ‘engineering and commercial strategy’.

VALUE TRANSITION POINT	
High Value-Add Opportunities	Efficient Predictable Delivery
Skills and knowledge needed before <ul style="list-style-type: none"> • Knowledge of Sellafield, generally; • Knowledge of programme strategy; • Skill to develop project delivery strategy; • Knowledge/understanding of project mission; • Scientific/conceptual process knowledge; • Knowledge of related facilities/ processes/equipment/materials; • Lessons from operation and maintenance; • Innovative use of new or transferred technologies; • Design optimisation for best value; • SL cost and schedule data and experience; • Knowledge of SL engineering standards; • Knowledge of SL standard designs; • Comprehensive safety case understanding. 	Skills and knowledge needed after <ul style="list-style-type: none"> • Precision execution of contract specification high productivity bulk engineering; • Use state-of-the-art engineering automation; • Precision integration of disciplines; • Fully integrated Engineering and Procurement; • Detailed application of “constructability”; • Rigorous configuration management.

Figure 27 - VTP Overview

VALUE TRANSITION POINT	
Before	After
<ul style="list-style-type: none"> Overall objective: prepare specification for EPC design/build/commission contract, also supporting definitive schedule and estimate; SL collaboration for innovation in: <ul style="list-style-type: none"> - Design Services Alliance; - Specialised vendors under contract; - Specialised vendors on their BD budget; - EPC contractor under limited contract; Specialist subcontractors T&M contracts. 	<ul style="list-style-type: none"> Overall objective: complete Detailed Design efficiently, produce a compliant and cost effective design; SL maintains Intelligent Customer role; Supply chain (DSA, etc) supplements SL Engineering, as needed; EPC or site alliance contractor completes Design, subject to SL approval of key documents and calculations; EPC ownership of out-turn to meet specification; EPC fixed or target-cost contract.

Figure 28 - VTP Before & After

Dividing tasks along the functional lines and considering where the skills of the upper echelon start showing diminished returns allows there to be a value transition point created, by function and between each echelon in the supply chain. Therefore there is a different value transition plan between each echelon, and the value transition point differs from overarching project plan, dependent on which functional area is being transferred. An example is given below in Figure 29.

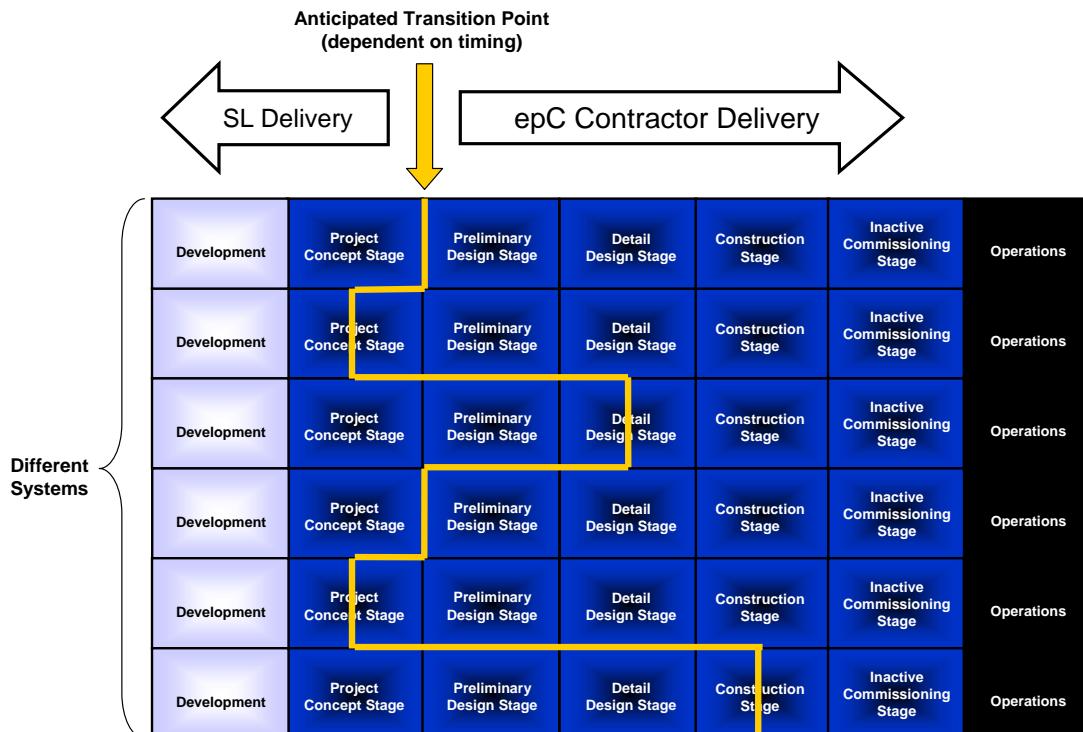


Figure 29 - VTP Conceptual Overview

The following two figures give an illustration as the makeup of a projects hierarchy pre and post transition point:

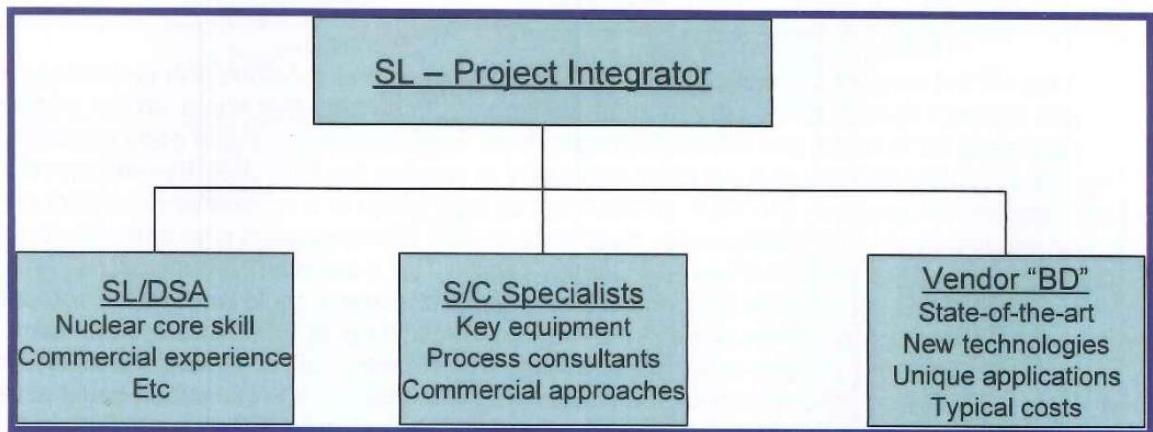


Figure 30 - Pre VTP Alignment

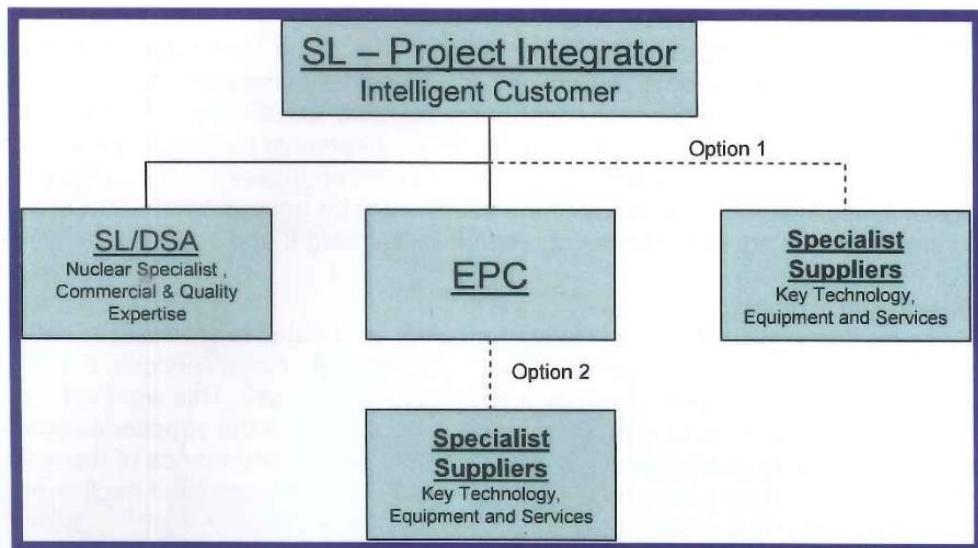


Figure 31 - Post VTP Alignment

In figure X the Engineering Production and Construction (EPC) group which consists of Sellafield, design service alliance members and specialist suppliers for the particular project assume central responsibility of orchestrating supply chain interactions after the majority of the technical value has been delivered by Sellafield.

As is described earlier the value transition point varies depending on the nature of the project and it is recognised that Sellafield deliver a whole range of projects and it is not intended to develop a full set of models that cover every scenario. Moreover, through the consideration as to which supply chain member has value to give and at what point, the transition point is derived on a case-by-case basis, with reference to some typical standard composition. The

following table is an example of where a value transition point would be expected in an array of typical projects undertaken at Sellafield.

Project Type	Features	Examples	Transition Point
Conventional	Non-nuclear environment Ready market technology	Grid Transformers Security programme	Concept review
Simple Nuclear	Repeat use nuclear technology Simple hazard management Material behaviour well understood	EPS 3 SMF	Prelim review
Complex Nuclear	Novel nuclear technology Complex hazard management Material behaviour unknowables	SDP	Prelim review
Major Plant mod (decomm or production)	Complex interfaces in nuclear facility Equipment deployed in nuclear environment Nuclear safety functions	THORP evaporator Skip handler refurbishment	Detail Design Gate

Table 15 - Project Type Overview (Sellafield)

In Figure 32 below we can see how a value transition point appears weighted according to total engineering effort of a project across the acquisition lifecycle.

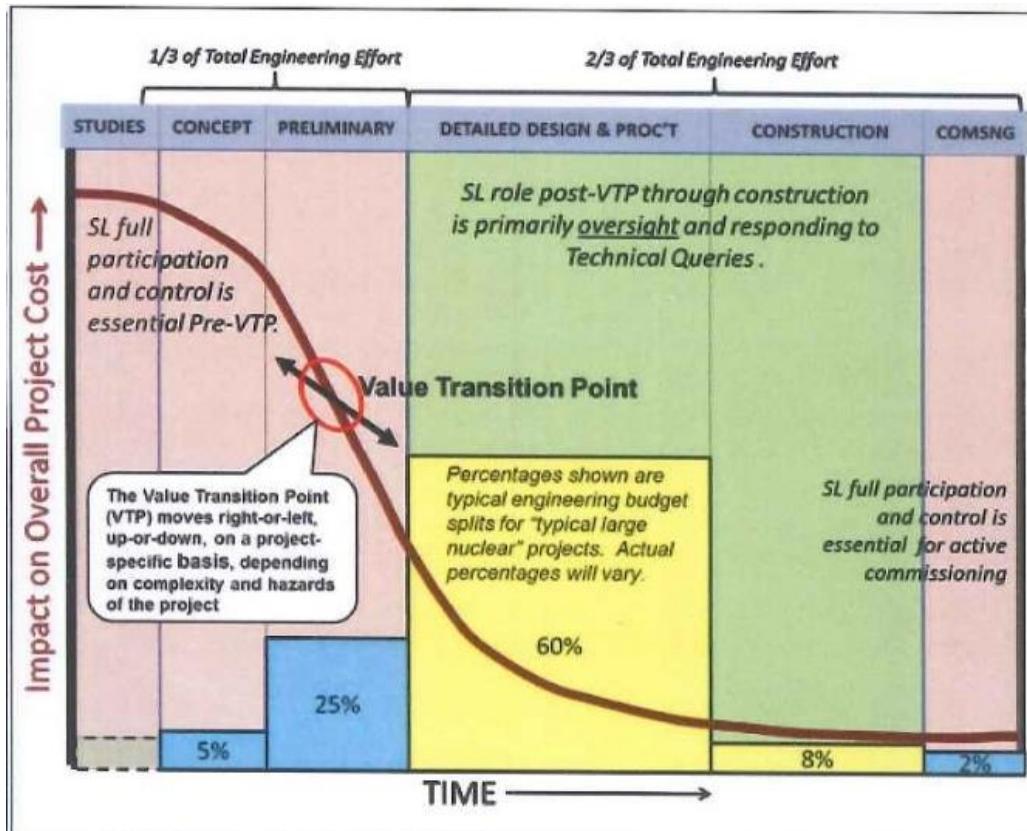


Figure 32 - VTP in acquisition lifecycle

4.5.6.18 Contracting Approaches

Guided by the NEC3 contract there is a variety of incentivisation mechanisms used to encourage cooperation and coordination between Sellafield and contractor organisations. Specifically there are six alternative contractual methods for reimbursement.

GMP – Guaranteed Maximum Price

A GMP Contract is essentially a cost reimbursable contract where the Contractor is paid the defined costs plus fee up to a pre-agreed maximum price. This price is fixed irrespective of changes on the principle (employer), and not just the product/service provided by the supplier. It is the most rigid of the contracting methodologies.

The intention of this method of reimbursement is to transfer the vast majority of risks to the contractor and allow for no increase in price, with exception to potential bonuses.

Suitability - The method of reimbursement is more suited to standard commercial developments. Such as non-technical procurements where there is a good degree of stability and the procurement deliverable dates are predictable upfront.

Typically the VTP for the procurer and contractors interactions will be placed after the concept stage.

Fixed Price A fixed price contract is where the contractor undertakes the work specified by the employer and all risks under a contract for a fixed sum. Payments are typically made against milestones. In this case, the principal retains risks pertaining to changes within their actions e.g. changes and issues with items procured through other supplier routes but required in the wider project.

Suitability - A standard contract method that favours a more stable project, and is therefore better suited to those projects where the milestones and costing are knowable in advance. Unlike GMP, fixed price method can be used on more complicated projects, assuming the following:

- The contracting organisation has clearly defined the requirement specification and is willing to transfer risk to supplier.
- The contracting organisation is willing to apply effort in ensuring that changes are kept to an absolute minimum as they retain overall risk for the wider project.

Typically the VTP would be located post-design, or post-delivery a fully requirements specification. Later than with GMP.

Target Cost

Under a target cost contract the supplier is reimbursed on the basis of expenditure (defined cost + the fee) with the opportunity to enhance profitability if the project is delivered at a price below the target price.

The rationale behind this model is that it encourages both parties to work collaboratively to manage risks and release savings for the mutual benefit of both. The retention of specific risks and the degree to which each part can benefit are detailed in the contract.

Suitability - In a similar manner to the GMP and fixed cost models the target cost model can be used with contracts that have well known deliverables upfront. Although the target cost model is most suitable in instances where cooperation is imperative or in areas where contractor performance is critical to drive the project deliverables.

Typically the VTP would be located post-design, or post-delivery a fully requirements specification. Later than with GMP, retaining more involvement and more risk than in the previous two methods.

Target Cost Incentive Fee (TCIF)

In the model the contractor is reimbursed on cost overruns up to a value cap that is set below the contractors' tendered fee. The purpose of introducing this cap is to transfer a significant proportion of the risks held by the contractor back to the procuring organisation. This means that the risk exposure of the contractor is limited, and is used in areas where the contractor has the greater power in the principal agent relationship.

Suitability - This is generally an undesirable methodology to undertake from the perspective of the principal as they are ultimately responsible for the financial risk of the project. It may however be necessary on very large or complex projects where the contractors overall exposure is high.

Typically used in complex projects, with a variable VTP.

Measured Work Contract

Under a measured works contract a procurer is generally reimbursed for the work executed on the basis of a unit of measurement. For example on the basis of raw materials used e.g. concrete.

This can either take the form of a Bill of Quantities (BofQ) whereby the activities required and the measures associated them under different conditions (e.g. laying bricks on overtime rate versus normal rate). Or through a Schedule of Rates which functions similarly but without the detail of quantity required under each rate that would be laid out in a BofQ.

The primary risk for the outsourcing organisation is in quantifying the actual quantity of work in advance.

Suitability – This contract is used in specific circumstances where there is a discrete, knowable tasks that can be effectively judged by discrete measures. Time to create a BofQ and the extension to PQQ and tender period times must be taken into account with this delineated, front loaded approach.

Cost Reimbursement

Under a cost reimbursement approach the contractor is refunded the costs of their entire expenditure. The fixed and variable costs of the project are calculated by the provider and reimbursement is paid by the procurer.

This contracting methodology has the greatest risk exposure for the outsourcing organisation as there is no financial risk that has been assumed by the contractor.

Suitability - This type of contract is the least preferable of the six discussed from the perspective of the outsourcing organisation. It is most appropriate where the suppliers are unwilling to undertake the project on another basis and where the scope of the project is poorly defined upfront.

4.6 National Health Service (NHS) Case

4.6.1 Case Background

The NHS is the largest public sector entity in the United Kingdom with UK health spending exceeding £140 Billion per year since 2008 (ONS, 2018). The NHS has a complex procurement structure that involves budgetary control following from central government through to the 211 Clinical Commissioning Groups (CCGs) that act as devolved regional commissioning experts spread across the UK. These groups are supported in the procurement process by commissioning support groups (CSU) that are deployed also on a devolved basis, but do not align one-for-one with the CCG's.

These CSU's act as the centres for procurement expertise and thus a majority of the interviews and document requests undertaken within this research were with a CSU based in the north west of England.

4.6.2 Data Collection Overview

An initial interview was conducted with a procurement officer working at the aforementioned CSU. This person acted as a key contract person for the study. An initial interview was conducted in order to generate a general overview of the practice within the NHS, this was then compared and contrasted with a substantial amount of documentation in order to generate the initial Zachman process overview. A further two interviews were conducted with the initial interview participant to address basic questions prompted by the Zachman technique. Subsequent to this interviews were conducted with the head of contracting, two I.C.T specialists and a head of procurement based with then CCG, with each participant providing additional documentation as questions emerged.

4.6.3 Composition of Acquisition Lifecycle

Figure 33 demonstrated the breakdown of acquisition lifecycle stages of the NHS against the standard categories. The NHS has a typical procurement structure as the majority were on complex service contracts delivered with current assets existing within the different organisational units, thus no specific installation or manufacturing stages were covered in the normative process.

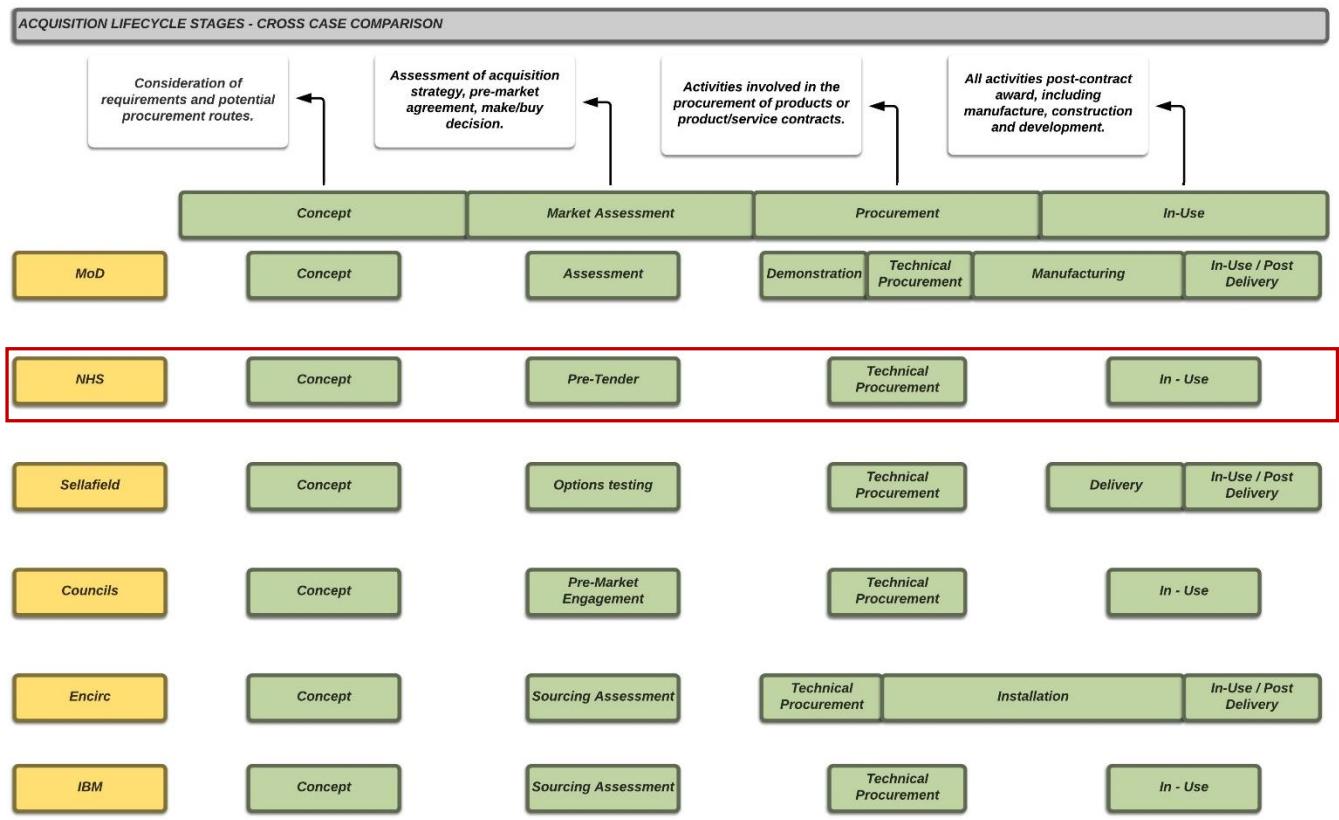


Figure 33 - Composition of Acquisition Lifecycle Stages - (NHS)

4.6.4 Summary of case study characteristics (NHS)

The following table depicts the stages of the acquisition lifecycle that the emergent case study characteristics were identified in. As with each of the cases, the Acquisition lifecycle is plotted chronologically and areas of thematic areas of interest are highlighted on the maps. The highlighted process then derive into the case study characteristics that are explored through further inquiry via the abductive method.

Phase	Case study characteristics	Thematic Area of Effect	Code on Map
CONCEPT	Free market system	Organisational Alignment, Performance Management	B
	Holistic Control (personnel)	Organisation Alignment,	C
	Rigour in Information Systems	Technology Management	D
ASSESSMENT	AQP Contracting Framework	Performance Management	A
PROCUREMENT	Holistic control (Org units)	Organisational Alignment	F
	Technological sophistication	Technology Management	O
IN-USE	Private Sector unable to derive efficiency	Organisational alignment	J
OTHER FACTORS	Sharing best practice	Performance Management, Organisational Alignment	E

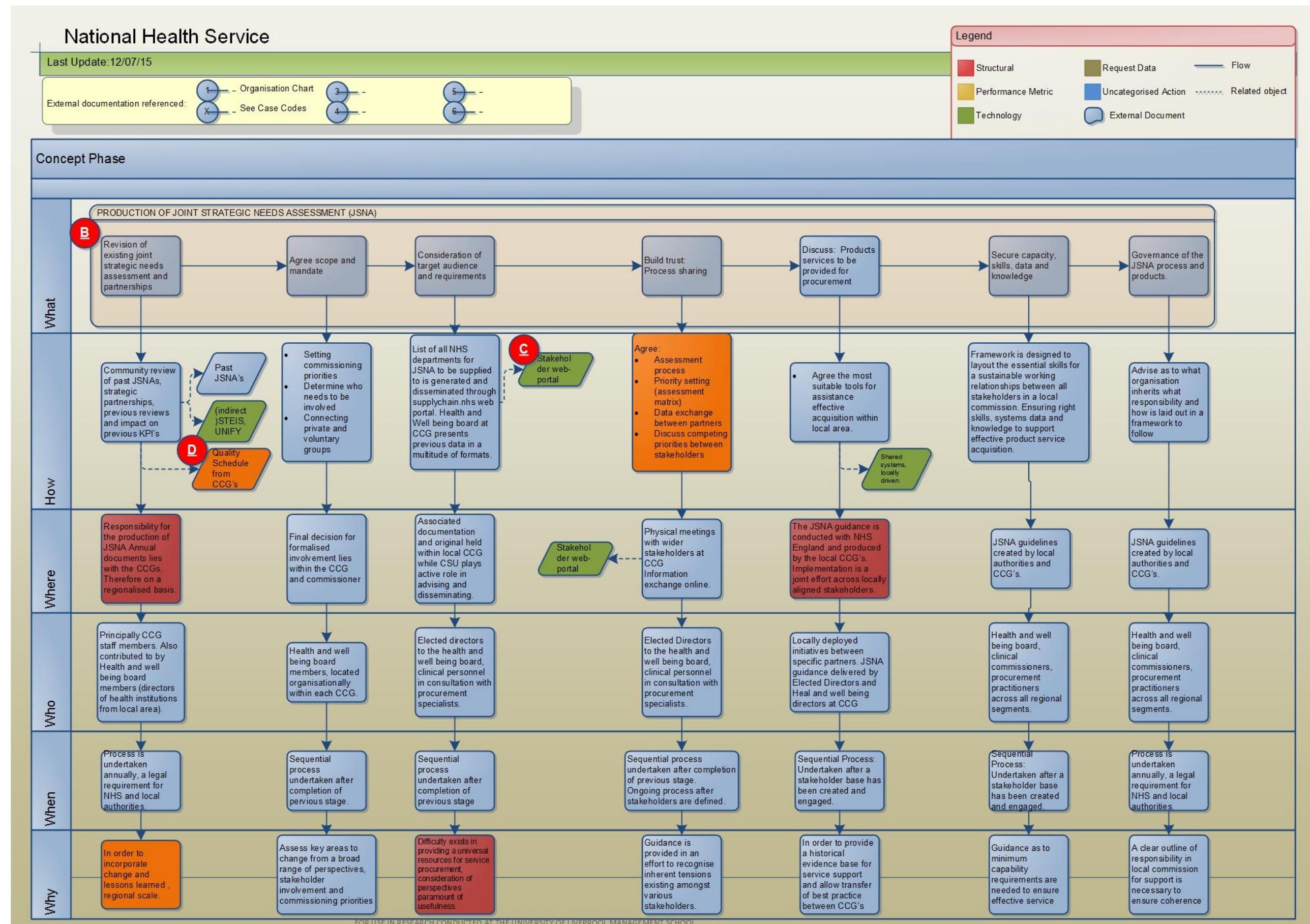
	Myopic goals in sub-units	Risk management, Organisational alignment	G
	Long term uncertainty	Risk Management, Performance Management	H
	Change Resistance	Organisational Alignment	I
	Tension between units	Organisational Alignment	K
	Consistency of performance metrics	Performance Management	L
	Encouraging process innovation – Lacking.	Performance Management, Organisational alignment	M
	Improvement frameworks	Performance Management	N

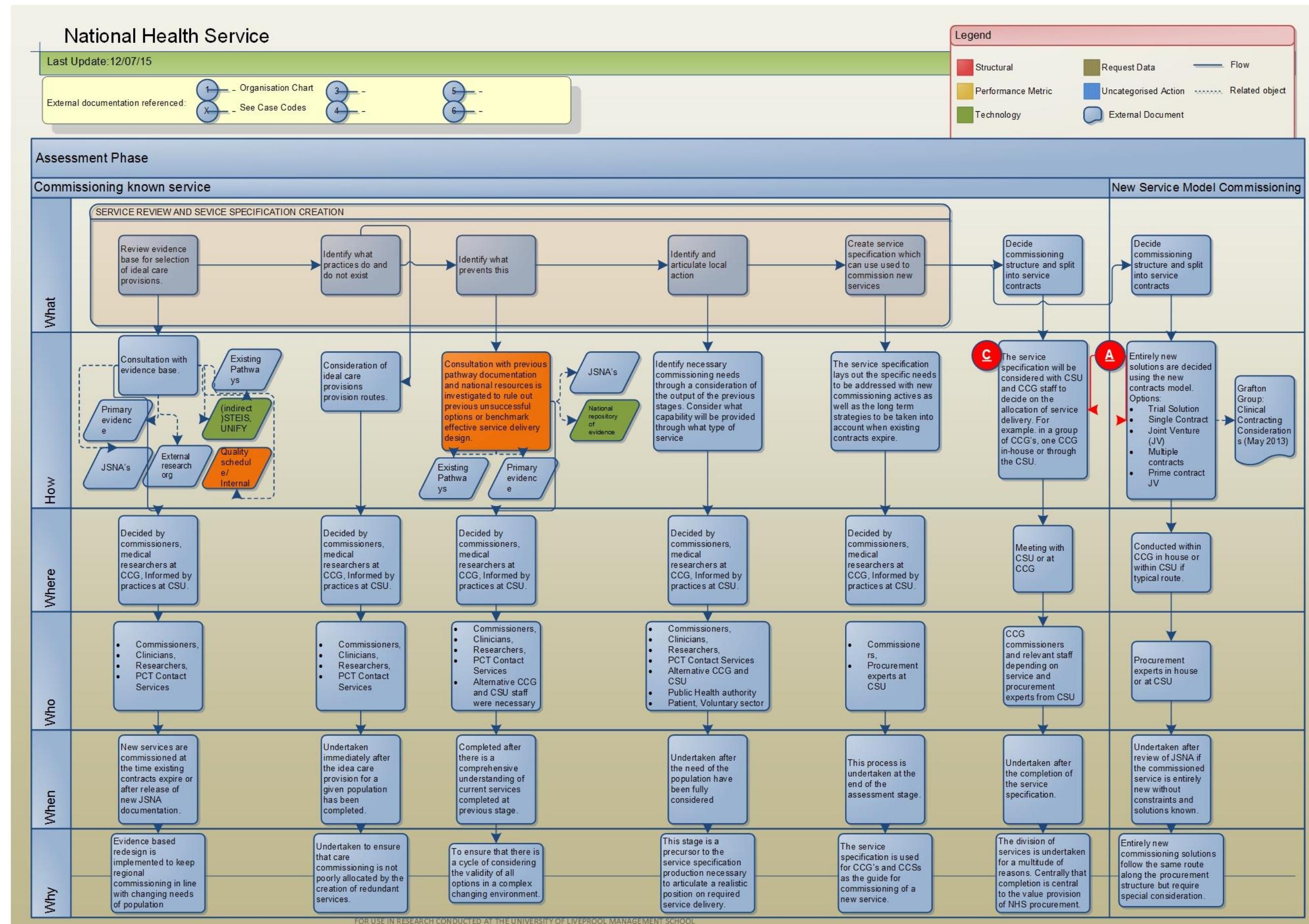
Table 16 - Summary of Case Study Characteristics (NHS)

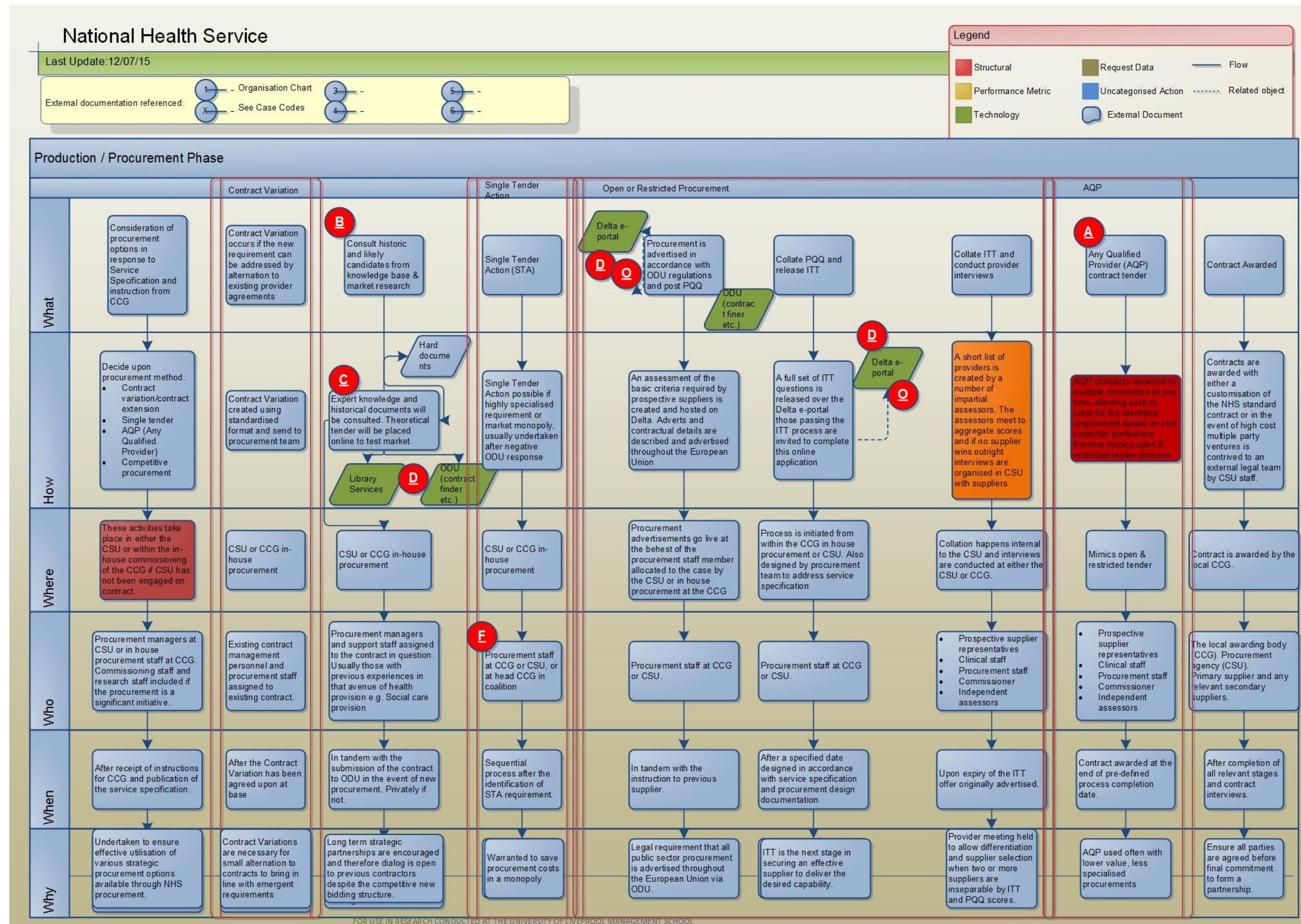
4.6.5 Acquisition Lifecycle Maps NHS

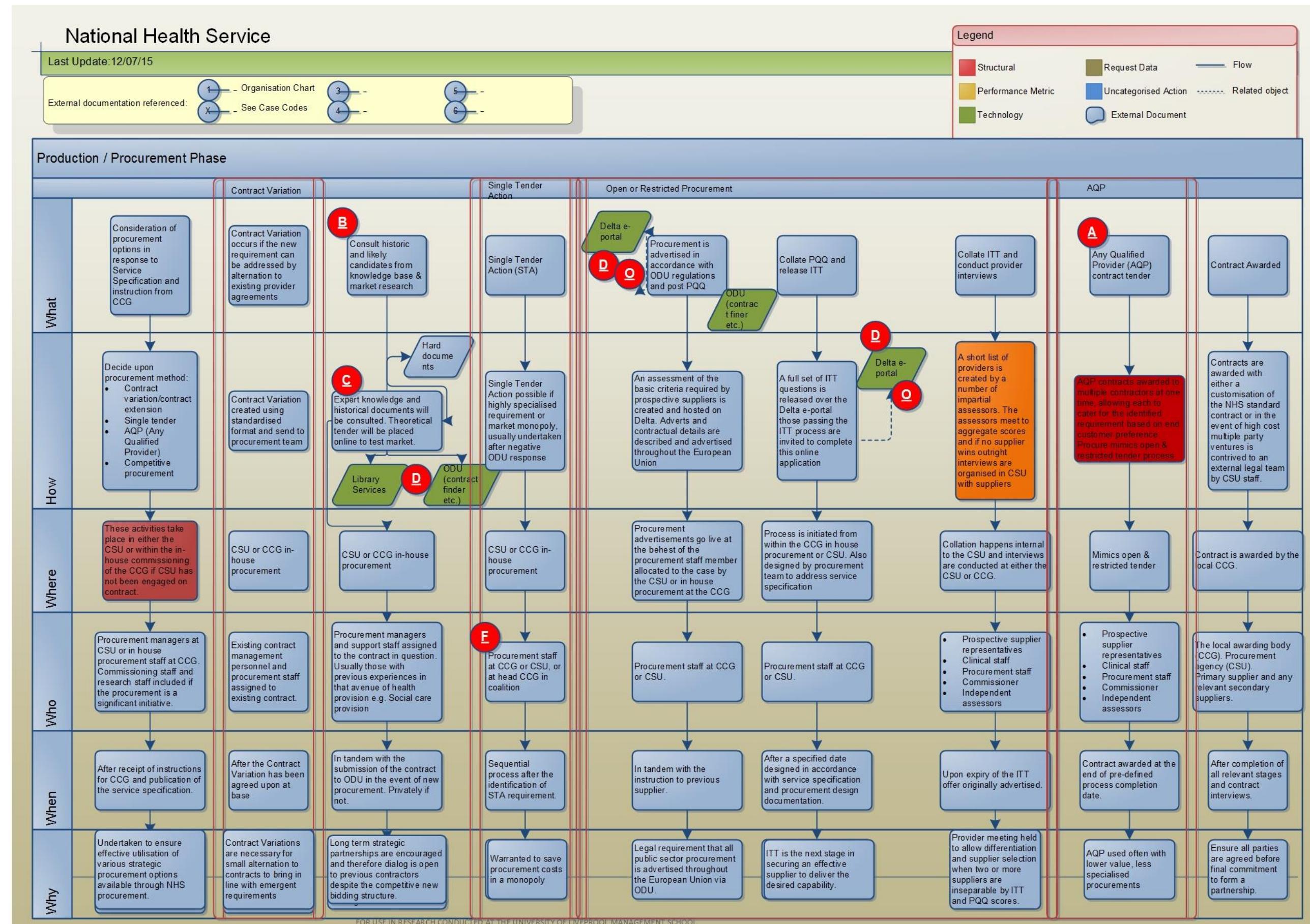
The following Zachman frameworks were used as the means of identifying processes of interest as well as to provide an overview of the acquisition lifecycles general composition. The key processes are highlighted both through colour coding and have been associated with a letter that corresponds to the narrative explanation presented in section 4.6.6

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4.6.6 Case study characteristics

4.6.6.1 Free Market System

The free market system in the NHS is a fundamental feature of the 2012 health and social care act reforms, and has been highly controversial from a political standpoint. The system is discussed negatively throughout the data set, despite some obviously beneficial characteristics.

Central to the free market system is that each of the commissioning support units (CSUs) are able to compete to represent the various clinical commissioning groups (CCGs) and provide a range of ancillary services. This has been a deliberate attempt to leverage free market efficiency generating practices within the boundaries of the organisational hierarchy. This has been shown to create additional complexity when there is not a clear hierarchy of service provision to the central CCG's as demonstrated below:

“Then some contracts have a separate contract points for quality as well as for finance and information meeting. So that’s the relationship that we have with that provider. One of the contracts I have, we have each of those three meetings, but I will also meet separately with and informally to ease the relationship. So to summarise our contact with the providers, we have meetings, formally minutes, terms of reference for all of those meetings etc.”

One consequence of offering modularised services in a free market system is the extra bureaucracy it creates. Numerous codes of free market correlate with a deviation from the agreed process and added complexity. In short, it appears the general perception of the system is that it is over complicated.

The quote above refers to the management of a small contract taking up significant time due to the fact that contracts require personal intervention in their running. Additionally, as services are modularised by CCGs being able to purchase services internally (Business intelligence, Quality Management) this leads to diseconomies of scale when many of the CCGs have purchased only small packages of business services for small supplier contracts.

Discussion point: A consideration as to the capability to leverage economies of scale across the large scale public organisations and the coherence of the internal system is required within and across the cases.

4.6.6.2 Holistic Control (personnel)

This theme denotes areas where there is a breach of the normative process arising due to a confusion of the responsibilities in the multifaceted system. Examples observed include. Clinical staff speaking with potential contractors before the award of a contract or procurement staff discussing Pre-Qualification Questionnaire (PQQ) scoring methods with clinicians in hospitals. In the quote below a senior procurement manager discusses how the CCG's are bypassing the CSU to procure large services and thus cutting out the expertise that is embedded in the organisation structure. Although this is possibly an emergent consequence of such a highly layered structure.

"I think in terms of a business or any business model in my view you don't outsource core business, and contracts is core business. I think in any company they will outsource the cleaning and outsource the catering because it doesn't really matter who brushes the floor or who makes the food, it's not core business, but contracting, which is effectively contracting for services for the population that is serviced by the CCG.... I suppose I am arguing with myself now, effectively if the commissioners commission the correct service then the contracting should be fairly straightforward and it doesn't matter who does it but I think in terms of historical experience, because a lot of these services have been going for a long time and I think recently there have been a lot of instances where the CCG has not known the history behind it because they have never been involved in contract, they don't know how much money went into this particular service. Whereas because I have done it for quite a long time when it was the start of the PCT's I was able to help them and able to support them but I suppose moving forward though time they will become ok with that."

Furthermore, the quote below illustrates where formal lines of communication are being bypassed, causing breaches of procurement regulations in these instances:

"we are now getting doctors and nurses who have started the process that we are having to tell 'Do not talk to anyone you know about this, any questions to do with this tender has to come through the portal, we will get the response and we will answer it for everybody'"

As illustrated in this example, clinicians routinely violate tender confidentially and bypass the formal lines of communication. This action violates fairness rules of public sector procurement by speaking with their colleagues at the front line services who are bidding for the procurement

that is being tendered. This confusion of individual responsibilities has been observed throughout. In the below example, it demonstrated how this exist cross-department. In the text below a senior manager describes the interplay between organisational sub units as being like ‘A tangle of wool’:

“It does get complicated, particularly in Merseyside where there are a number of neighbouring CCG’s, all of which have contracts with a number of different hospitals, so they cross each other’s boundaries. It’s very unusual to have a CCG that is the only CCG that is contracting with a provider. Most providers would have several CCG’s working for them. A suitable analogy would be a tangle of wool, with all of the CCG and provider boundaries crossing over. So it is very rare for us to be able to have a nice clean portfolio where there is one manager looking after three different hospital contracts and reporting, or supporting one-to-one with a CCG. So it’s here there and everywhere.”

Again the confusion of responsibilities and lack of coherence between departments is prevalent here. There is no clear definition as to which organisational unit has governance over certain requirements. This is a further drawback of a heavily layered architecture.

Discussion Point: The normative communications structures are often bypassed as a result of the complexity embedded in the organisational structure.

4.6.6.3 Rigour in Information Systems

There are multiple incidents where the manual input to the information systems has caused errors. As observed in the during the in-use phase of the Zachman section that is because the submission to the centralised systems such as UNIFY are not universal, each contractor has the choice of submitting themselves or having the CSU or in-house CCG business intelligence department submit, again not every CCG has such a unit. This and the separation of the spreadsheet held KPI reports makes the market research section and development of the Joint strategic needs assessment (JSNA) potentially quite laborious. Additionally, while not relevantly depicted on the acquisition maps: there are numerous, clear instances where the latest ICT technologies could be of use in sharing best practice and proving real time data to diverse departments in particular.

Discussion point: Whilst the lack of technological sophistication is featured as a separate factor uncovered through the mapping exercise, this closely related area speaks to a wider issue of misapplication of systems, rather than an innate lacking in technological capability.

4.6.6.4 AQP Contracting Framework

The Any Qualified Provider (AQP) contracting framework was highlighted as an innovative framework unique to the NHS. The process was picked up as it is of potential strategic significance, divergent amongst the body of cases, and aligns with a-priori areas of interest.

AQP is a contracting framework which allows multiple providers to service needs that would have been previously or traditionally allocated to one contract. The AQP process involves going through an open tender in the traditional manner but instead of selecting a single contractor the contracting organisation awards a ‘contract licence’ to every provider that passes the assessment process. These contract licence holders are then qualified to provide the health service in question and will be reimbursed financially based on the amount of work undertaken. It should be noted that the specific term ‘contract licence’ is only a euphemism used at interview to describe the arrangement and not a legal term.

AQP is an example of a novel approach to outsourcing not frequently observed in literature. The data does not clearly indicate whether AQP is wholly positive. However, the approach is divergent from the traditional approach and has been viewed as positive to the end customer. Multiple providers delivering services on a transactional basis reduces long term commitment from the perspective of the NHS and fosters competition amongst service licence. An alternative perspective of its value is shown below in an extract from an interview with a senior member of personnel at the

“The disadvantage of it [AQP] is that if you have too many providers delivering a service then it’s more complicated in terms of contract management, so there are additional levels of bureaucracy. There is only one pot of money and if that is spread out too thinly the providers can’t recoup all of their costs that they might need to for fixed costs.

Int: OK so the cost to the NHS, say if you have ten or twenty providers that are all alive at the same time, they are all accredited providers of that health care at the same time. Does that put a strain on the business intelligence or the contract management team?

Par: Yes, because it is something that they don’t actually have to want to do [providing the same service multiple times].”

There are several examples of undesirable behaviour, particularly prominent when creating the ‘in-use’ phase of the Zachman mapping tool, particularly in reference to the use of the AQP framework. The negative aspects of this framework are highlighted in the quote. The lack of

predictability in volume of work means that the model becomes less viable when fixed costs are high. Additionally there is repetition of work in administering and providing ancillary services (such as business intelligence) to multiple contractors instead of to a single contractor.

Instances where AQP is discussed from a positive perspective is also present within the data. A typical representation is demonstrated in the following:

“Now the benefits of that are: It improves patient choice, it means that patients can be in community venues, where historically they have not been. It allows people to have a choice of provider, it can reduce your waiting times because it gets rid of bottlenecks and it can reduce your price through incentivised competition.”

Positive aspects of the service are the added redundancy providing more security, availability of options, competitive pressures over quality, a higher total capacity as well as the competitive pressures over price.

Discussion point: A key aspect of the performance metrics dimension of the PCP literature is a considerations as to the contracting mechanism employed by procurers of PCP and as such a consideration of all novel agreements should be included.

4.6.6.5 Holistic control (Org units)

The original intention of the reorganisation of the health care system was as a result to the Health and Social Care Act 2012. The purpose of this was to create a system of decentralised control and place the clinical staff in a position to directly affect NHS commissioning. Thus the clinical commissioners in place within the CCGs would contract for the health needs of the population with the business skills required being insourced by the CCGs, through the NHS's numerous commissioning supports units. The output of this practice has led to mixed results as discussed throughout this case report:

“Yeah well with Liverpool they are attempting to absorb their own contracting procedures. They have appointed a contract manager and they are gradually pulling some of the contracts the CSU would manage towards themselves. They are also pulling in work from the other CCG’s so Liverpool CCG will manage a particular contract on behalf of a number of other CCG’s and our role would be to ensure that those co-commissioners would receive the best terms in contract terms in that case. We would approach Liverpool CCG in the capacity of agents for the co-commissioners.”

As is demonstrated in the above quote, over time segregation of expertise into distinct organisational units has become blurred. This is demonstrated consistently throughout the data.

The distinct segregation of acquisition cycle supporting services has been obscured through the in-housing of ancillary services by the CCG's. CCG's are in-housing to achieve tighter control for themselves while overlooking the diseconomies of scale this inevitably causes to the CSU's. The arrangement as to which business service will be provided by which organisational unit is decided on a case-by-case basis and therefore creates a discontinuity of process throughout the organisation. Equally the 'sale' of partial packages to the CCG's by the CSU causes a strain on them internally. An assessment of this shows newly emergent confusion of roles.

There has also been an emergence of joint internal ventures. A number of commissioners can cooperate to commission a large public or private contractor. The benefit of this remains unclear as while this creates economies of scale for each CCG's, it runs against the over-arching strategy of personalising health needs to particular geographical areas, causes a loss of work for the CSU's and overburdens the lead CCG with having to either source for in-house ancillary services associated with the contract or request them an alternative CCG or CSU. The trend of clustering seems set to continue (as shown in the quote below) and is a significant source of anxiety for public health procurement practitioners, with unknown long-term effective.

"In the very near future there is going to be a move towards co-commissioning of primary care services. Whereby NHS England will involve CCG's more in the commissioning of primary care services. Exactly how that works is yet to be decided upon. It could range from NHS England simply saying "Yes we believe you are capable of doing this, you have the proper procedures in place that mean you will not have any conflict of interest and we will therefore give you responsibility." Or it could be that NHS England will still hold the authority but will include the CCG in the contract discussions, negotiations and the procurement process, more of a partnership kind of role."

Discussion point: There is a lack of certainty around how the flow of funds and services will work precisely through the NHS. The competitive nature of the CCG's has created an internal market structure that is significantly divergent amongst the body of cases, of strategic significance and aligns directly with a-priori areas of interest.

4.6.6.6 Private Sector unable to derive efficiency

While other organisations outsource specific functions to the private sector, the NHS has fitted private sector organisations into their existing infrastructure, by sub-contracting to the private

sector on an as needed basis, treating internal and external to the same tendering process in many instances. The NHS operated as numerous government institutions have in accordance with wider trends present in the late 1990 towards major outsourcing of non-core services by public organisations. While contracts are customised from a standard template multiple interviews made reference to the public organisation being unable to extract value from the private contracts, with a few examples to the contrary. The reason given for this was that the private sector would essentially only engage in those activities that were financially viable and leave the non-financially viable services to the in-house provision, thus adversely affecting the overall financial picture of the in-house activity.

4.6.6.7 Sharing best practice

The NHS IQ team is the central units for sharing best practice. Aside from this one dedicated centre, the information is handed informally or through a consequence of the natural cycle of the contracting process. KPIs are reported in the quality schedule which can then be fed back up the chain in summary reports. Information is not centralised and there is no incentive for innovations to be shared once created due to the competitive internal structure and lack of mandatory formal mechanism. The factor was highlighted due to it being divergent amongst the body of cases, strategically significant and directly in line with a-priori factors identified.

“They do to an extent but it is very ad-hoc, there is no formal mechanism for it. Within NHS England there is however a team called NHS IQ which stands for “improving quality”. They do try their best to try and corral people and share best practice and knowledge but they are a very small team now compared to the resources they had before the NHS reforms. NHS IQ was formed from the ashes of a number of different improvement bodies within the NHS. There used to be specialised teams acting in this capacity that attempted to share best practice in specialist lines, cardiac, cancer etc. All of this funding was removed and replaced with a relatively small team called NHS IQ. So they do what they can but that’s it. They are based with the NHS commissioning board in London. “

Coherent spread of best practice within organisational processes is centralised in a small team embedded at the national level. This team was mentioned relatively few times in all interviews, indeed only the head of quality discussed the IQ team in any meaningful way. While they are the only means by which the NHS has to formally transfer best practice across each of the independently operating silos.

Discussion Point: As with factors observed within other cases the LFE practice observed was somewhat ad-hoc and fell outside of the remit of formalised normative systems. A comparison between the approaches to process improvement seems critical in creating meaningful comparisons between the cases.

4.6.6.8 Myopic goals in sub-units

This theme refers to how organisational sub-units that are in many ways in competition with each other are incentivised to ignore the prosperity of the larger system in favour of concentrating on the needs of their own organisational unit.

4.6.6.9 Long term uncertainty

The NHS as major UK institution operating within a complex procurement environment is sensitive to wider political changes, as well as changes in the long term strategy. This causes a position (not dissimilar to MOD) whereby the organisations structures and ways of working intermittently undergo a fundamental shift in the way they work. This phenomena is of strategic significance and directly aligns with a-priori areas of interest. The quotation below demonstrates this well:

"I think the CSUs were meant to move outside the NHS by a certain year, so we were kind of housed within NHS England for a period of time just to let us find our feet and work with the CCGs and get our business, and I think we could jump out at any time within the next four years from the NHS. I think the timeline finishes 16/17 when we would probably have to move out. We would then be fully ingrained within the private sector. "

The above quotation demonstrates the uncertainty as to future strategy of the NHS. The CSU currently caters to private firms and so there is a lack of clarity about what any future shift would mean. This uncertainty prevents investing in staff, knowledge and resources for the future as there is no long term plan to design to base resource requirements on, from this perspective.

Discussion point: The comparison between the NHS and the MOD is of particular interest. The organisations have a comparable pseudo-public/private organisations responsible for the procurement activities. In the case of the NHS this is the CCG's and in the case of MOD it is DE&S. These organisations are both comparable in that they occupy this position are subject to the same long term uncertainty about the arrangement of the unity or its commercial status.

4.6.6.10 Change Resistance

Change resistance is visible in multiple ways throughout the NHS. The relative immaturity of the new reforms (Health and Social Care Act 2012) is likely to be a factor in its pervasiveness but the comparative nature has created an apparent sense of frustration amongst commissioners who feel they are a hindrance to achieving their objectives. The overarching strategy of efficiency improvement through competition seems largely invisible at the service commissioning level. Acknowledgement of its merits is infrequent.

I: Do you think that you are getting a bit of resistance to change there?

P: Massively, massively. Because of the amount of time that it takes to undertake these exercises, commissioners don't always feel they get an outcome that is proportional to the amount of effort that they put in.

For example, if commissioners feel they have a provider who is doing a good job, and they have a contract that has ran for the maximum amount of time that it could run. Then you are duty bound to go out to tender again. However, you could go out to tender, go through all that effort and then end up with the same provider, so you know commissioners feel a bit hacked-off because they have gone through the whole process and then ended up with what they already had.

The above interview was carried out with a head of procurement based at a CCG in the north west of England with over 20 years' experience. As demonstrated in the above quote the participant stressed the degree to which there was resistance to change. The senior personnel in positons that allow them to extract value from the system are making direct comparisons with the previous system and noting the negative changes.

Discussion point: This factor is likely to be related to the factor of long term uncertainty, as the interviewer suggests there is growing frustration that the working practice are unstable within the organisation.

4.6.6.11 Tension between units

This change resistance is a contributing factor to the emergence of a degree of tension between the various organisational units that exist within the NHS.

The change responsibility for internal quality assurance and approvals is again evidence as creating a source of change resistance with the restructuring and devolution of powers. There

appears to be some tension existing between organisational units who are now reporting to individuals previously integrated into the same teams as them.

“What [Omitted] (Labour MP) said the other day is that we are trying to fix something that wasn’t broken in the first place and I think that I cannot see personally why it was changed. It was not tremendous but it probably wasn’t as good as it is now and the reason I say that it probably wasn’t as good as it was then is mainly because of the decision making process. Our own colleagues that we were sitting alongside now sort of become gatekeeper and are effectively rating us each month on something that we do not know how they are rating us.”

Discussion point: As highlighted in the above quote the fact that there has been a reorganisation of roles with the existing staff members has created a degree of frustration as previously collaborating partners are now acting as gatekeepers within the structure.

4.6.6.12 Consistency of performance metrics / Encouraging process innovation – Lacking.

The application of performance metrics is done on a case by case basis. While there are numerous nationwide KPIs and guidelines, the specifics of contract management, and the tools used to support contract management differ from region to region and across different units. With clusters of CCGs emerging around a particular technology or service. In the example below the CMIP was regarded well and cited as an innovation. However, without a consistent approach the long-term strategic objectives of the organisation may be compromised. Equally without the means of feeding up emergent technology so that they can be adopted by the wider enterprise there is no large scale benefit to the innovations. This factor was deemed to be of strategic significance, divergent across the body of cases and aligns with the a-priori areas of interest identified previously.

“That would all get tied up into a monthly contract report that gets posted on a SharePoint site. So rather than use e-mailing it to all different clients and having us have concerns about version control we just publish it to a portal. We call our porta, CMIP (Cheshire and Merseyside Intelligence Portal). Also on the CMIP side, and some of this is still in development, is kind of interactive work boards. So if someone working in the CSU or a client in the CCG wanted to play around with some of the data then they could go in and change axis on graphs and reports and drill down to things etc. They might for example, on screen, be

able to see emergency activity is ahead of plan this month, i.e. there have been more emergency admissions than we have been expecting, and they would be able to drill down and find out what those emergency reports are for, you know if there has been a lot of emergencies for falls because it has been icy etc. They can go down to that level of detail. That kind of interactive bit is still in development, some CCG's have full access to it others are still on board."

4.6.6.13 Improvement frameworks

As demonstrated above process innovation within the NHS coincides with a negative description of the organisation's capability to absorb this innovation. Many of the process innovations, specifically with regard to information systems solutions and organisational arrangement of subunits, are created grown regionally and not adopted as wider policy amongst groupings of CCGs.

The NHS derive much of its process from standardised legislation with regards to acquisition planning and execution (ODU requirements etc.). While the majority of the contacting and incentivisation models follows those standard contract types seen within OJEU there were a number of points observed in the data that were divergent from these/.One specific point of note was the use of the commissioning for quality and innovation standards (CQUINS). CQUINS offer an incremental way for KPIs to be added into the contract requirements. AQP also emerged here but is discussed separately, the move towards private integration again appeared here but is again discussed separately.

CQUINS are summarised well in the extract below:

"Once it is embedded then the measures come out of CQUINS and new CQUINS go in to replace them and the measures turn into indicators in the quality schedule. So then, that's where the carrot disappears and the stick comes in. Now we have given you an incentive to improve your quality to embed your new way of working we are now going to performance manage it to make sure you continue."

Paraphrasing form a full discussion regarding CQUINS this with the business intelligence director: CQUINS allows the NHS to withhold around 3.5% of a contracts worth from the contractor, made payable if they pass certain KPI thresholds in predefined areas. Around 2% of these incentivise target are set nationally and 1.5% locally. As observed in the above quote, once a CQUIN is being met regularly then it became a standard part of the quality schedule

and is no longer incentivised, thus continuously improving quality by iteratively moving incentivised KPI's into mandatory KPI's and reinvesting in more over time.

4.6.6.14 Technologically unsophisticated:

It has been evident from early on in the investigation that the NHS is unsophisticated with regard to the information technology solutions. It is further apparent that the technologies that are used have been supported poorly in terms of upgrades and extensions to functionality. The systems are disparate, functioning in silos with the same data held at multiple locations throughout the infrastructure, large parts of which are comprised of basic stand-alone off-the-shelf software packages. A number of the currently process are handled through basic standalone desktop packages as demonstrated below:

“The actual collation of the KPIs was all done within Excel, pretty horrendous but it worked. It’s not very technical but it does a job.”

The only two centralised or partially centralised information systems used are UNIFY and STEIS each of which has its specific purpose. They are integrated into the wider process only though manual input by various stakeholders at different levels of the process.

“There are a few, a lot of the nationally mandated information gets put on national databases the biggest of which is called UNIFY. A lot of the key big hitting headline performance things such as cancer waiting times get reported to UNIFY, we get sent a feed as well in the form of an Excel template to our BI team. In fact one of the verification checks that we will do is to check that they are submitting to and submitting the same information to UNIFY”

As can be seen above national standardised I.C.T systems are in place. The inputs and outputs of those systems are handled largely through non sophisticated systems. Thus, there is both data redundancy and data accuracy issues created here:

In relation to the lack of a framework for innovation discussed in a previous section: The quote below is another example of how small innovations do occur, however they are generated in situ amongst the dispersed organisational units and there exists no mechanism for these innovations to be adopted more widely throughout the organisation.

“Yes and no is the answer to that one. A good chunk of the information we use comes directly from the providers in excel format which the BI team turn into dashboards that we use as Excels or PDF’s etc. These would eventually turn into monthly contract

provider reports, any penalties that are applied and worrisome areas etc. That would all get tied up into a monthly contract report that gets posted on a SharePoint site.

4.7 IBM Case

4.7.1 Case Background

The IBM case was smaller in scope than the other cases undertaken. Whereas in the previous cases there was an attempt to map out a majority of the major processes in chronological order along the acquisition lifecycle, this level of granular detail was not possible for the following two reasons:

Firstly, IBM are very protective with their intellectual property as they consider their acquisition and procurement processes to be a core competitive advantage. Thus access to the data required in order to comprehensively apply the method was limited. In interview with a senior participant the following statement was given:

I think the challenge again will be whether there is any documentation that is sharable.

I can talk you through some meaningful points on all four areas, there is probably going to be some difficulty even some conscious reluctance on our part to provide the kind of detailed documentation, because we're not totally sure how it would be used, and it is a highly prized set of Intellectual properties that we have here. We are very protective of what we are doing so it is easier for me to respond in a meaningful way.

Secondly, the IBM case was performed as the final case within the research and the key contract person at IBM was based in the United States. The geographical constraints combined with the lack of adequate time contributed to the difficulties in exploring the case fully.

These two factors in combination led to the decision to conduct a case study that was smaller in scope, instead of mapping a majority of the top level process in an acquisition lifecycle only those key processes that had been identified at interview and from document analysis was used. Thus there is likely still to be insights into IBM's procurement practice that would emerge from a full investigation. However the number of meaningful characteristics identified in this smaller case validated its included within this research.

In consultation with IBM they did however describe that major projects utilised the same systems and functionality as the more traditional procurement mechanisms within the organisation. Thus, whilst the organisations acquisition practice is not arranged towards the PCP type acquisitions, they have found that the systems offers the flexible capability to be able to undertake major project driven acquisitions.

4.7.2 Data Collection Overview

As stated earlier the IBM case was smaller in scope than the other cases undertaken within this research, and also the last case to be conducted thus no reorganisation of the interrogative framework was required. The primary contract person was approached and agreed to conduct a primary interview, after which there were numerous e-mail correspondences exchanging relevant documentation to the research. After subsequent analysis of the data a follow up interview was conducted with the same participant.

4.7.3 Composition of Acquisition Lifecycle

The acquisition lifecycle stages at IBM mapped onto the generic stages identified directly. However it must be stated that the IBM case data collection was limited, and thus the exact composition of the cycle could have potentially changed if the case study had continued.

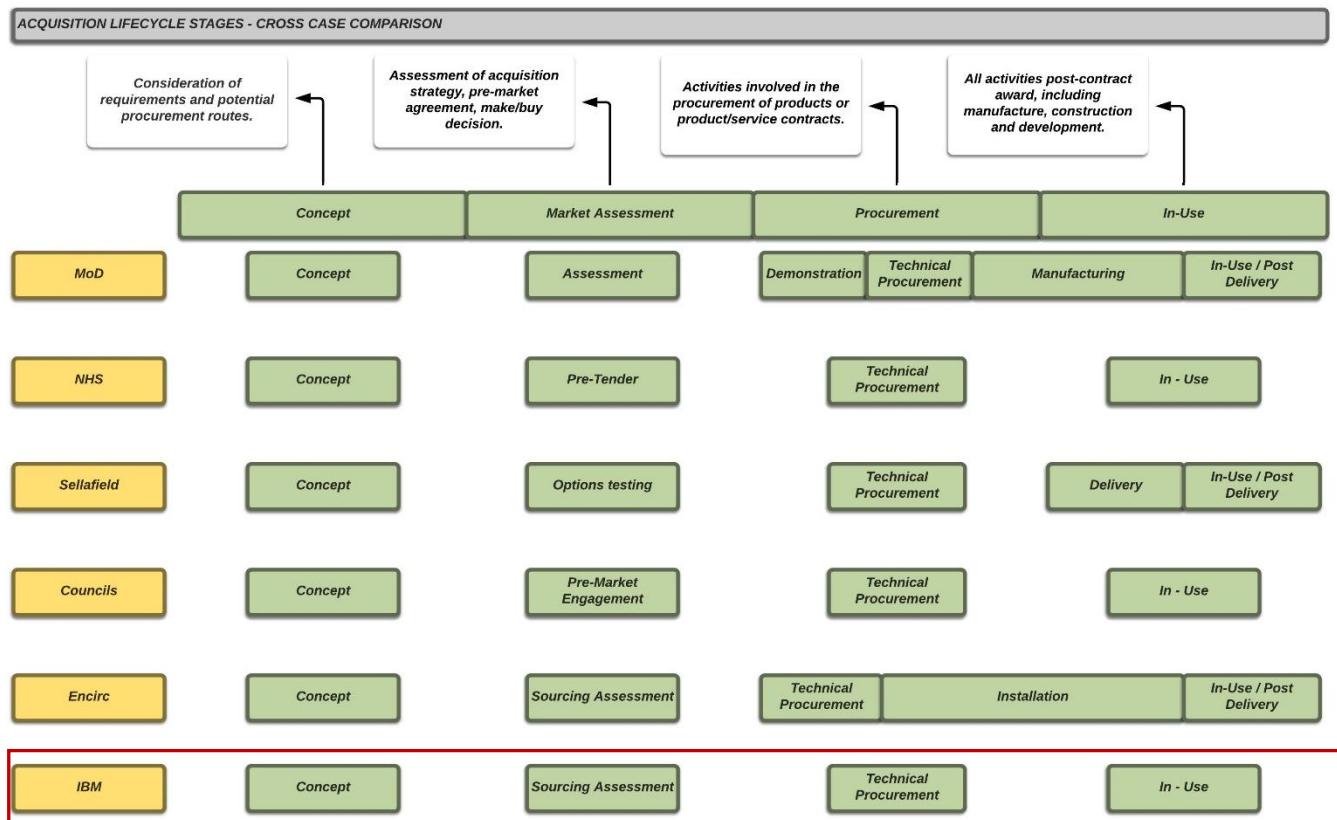


Figure 34 - Composition of Acquisition Lifecycle Practice (IBM)

4.7.4 Summary of case study characteristics (IBM)

The following (Table 17) depicts the stages of the acquisition lifecycle that the emergent case study characteristics were identified in. As with each of the cases, the Acquisition lifecycle is plotted chronologically and areas of thematic areas of interest are highlighted on the maps. The highlighted process then derive into the case study characteristics that are explored through further inquiry via the abductive method.

Phase	Thematic Area of Effect	Case study characteristics	Code on Map
ASSESSMENT	CONCEPT Organisational Alignment	Centralised procurement practice	A
	Organisational Alignment	Economies of scale – leveraging purchasing power	B
	Technology management, Performance Management, Risk Management	Emptoris Supplier Lifecycle Management (SLM) Solution	C
	Technology management, Performance Management, Risk Management	Compliance Automation	D
	Technology management, Performance Management, Risk Management	Cognitive capabilities (Risk & Performance)	E

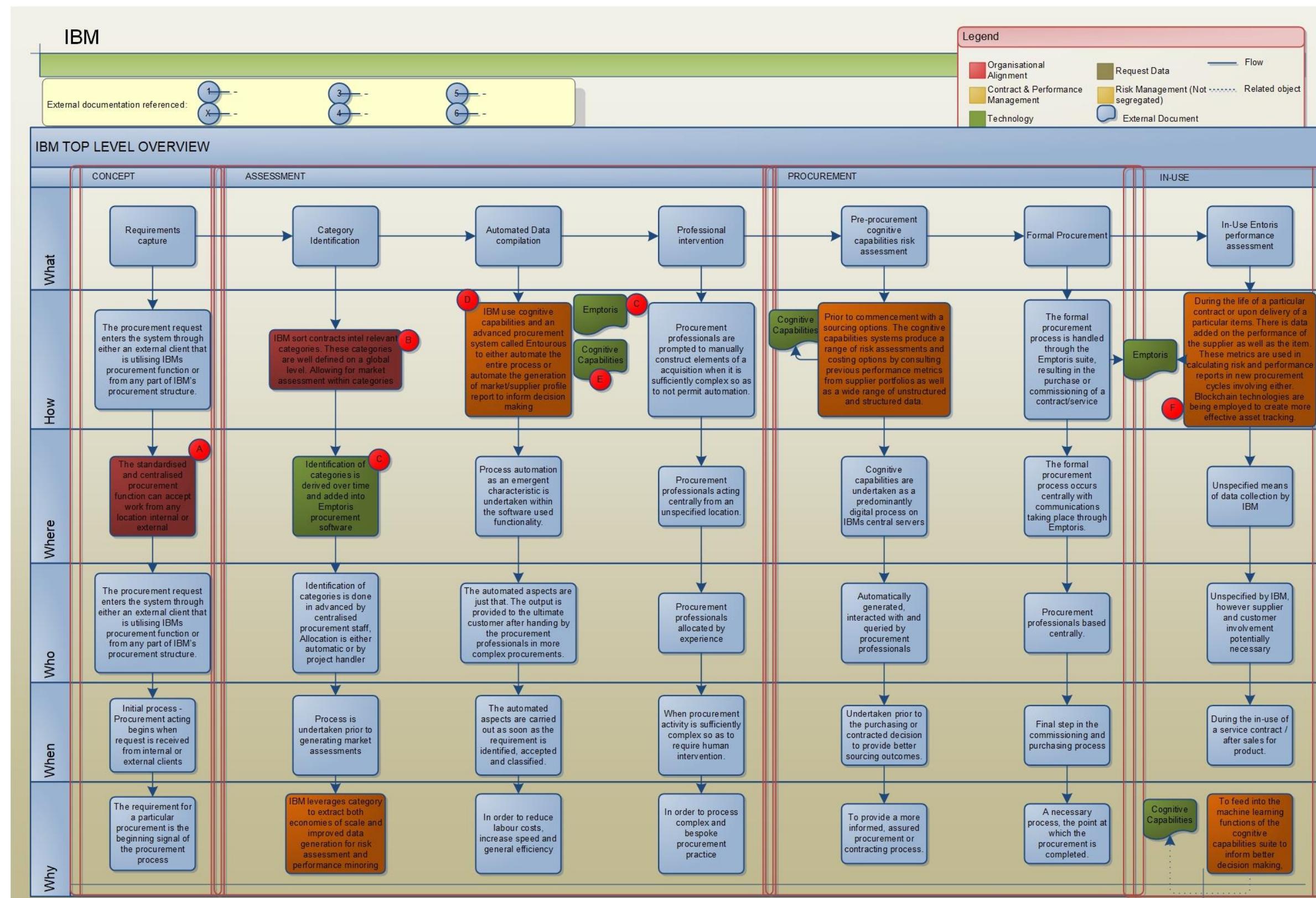
IN-USE	Technology management, Performance Management, Risk Management	Blockchain applications	F
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Table 17 - Summary of Case Study Characteristics (IMB)

4.7.5 Acquisition Lifecycle Maps IBM

The following Zachman frameworks were used as the means of identifying processes of interest as well as to provide an overview of the acquisition lifecycle's general composition. The key processes are highlighted both through colour coding and have been associated with a letter that corresponds to the narrative explanation presented in section 4.7.6

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4.7.6 Case study characteristics

4.7.6.1 Centralised procurement practice

A key divergent characteristic within IBM is that the organisation has centralised its procurement activities. This is true of both the physical spread of people and assets as well as the conceptually centralised process through having standardised processes adopted across the organisation as demonstrated in the case below:

“I will tell you IBM procurement is very centralised, we moved over to that direction in the mid 90’s. We are a very mature procurement organisation, globally centralised with common processes and tools used around the world, to support our purchases that we do for IBM internally which is around \$25 Billion of purchases that we do internally, but there is another \$25 Billion or more in purchasing that we do for other companies because we have a procurement services business.”

The IBM procurement systems enables supply for both commodities and more complex servitized commissioning items for an extremely high number of users as demonstrated below:

“So principally the systems that are used for purchasing, so that could be the systems that are used by nearly 400,000 IBM’ers, right, when they need to buy something internally. Or it could be the systems that are used just by the procurement people themselves to support those procurement clients.”

IBM credit their world renowned procurement capabilities and high throughput to the various innovations that IBM have made over the years. They in turn reference that these innovations are made possible by common process adopted across the organisations procurement activities, as demonstrated in the quotation below:

“Most of what IBM does now from a procurement standpoint is hands free, over 90% of our transactions actually move through the process in a hands free way where there is no procurement buyer involved. That is because we have had some look over the years in centralising our processes and tools”

“you’re right that we do have large centralised systems that support procurement at IBM. It is a Globally integrated architecture here”

Discussion Point: IBM’s procurement infrastructure attracts over \$25 billion annually for usage from external organisation due to its overall efficiency, as such it is clearly an

exemplar in class. While this procurement systems handles both commodities and more complex PCP offerings with servitized elements the system differs in having a completely homogenous set of process and systems globally.

4.7.6.2 Economies of scale – leveraging purchasing power

As stated earlier, IBM's procurement systems under investigation are designed to accommodate both PCP style acquisitions and the more traditional procurement requests. Given that the PCP capability came first, the systems have evolved to accommodate a range of acquisitions over time. Due to this the system is organised to enable economies of scale to procurers using a range of suppliers for a variety of goods and services. The way in which this is done is through categorical organisation of spend within the centralised systems:

“So sourcing would be when we organise our centralised procurement years ago we set up categories of spend so we could leverage the purchasing power we have. So these consist of a number of direct and indirect purchasing categories”

These categories of spend then provide a basis for some of IBM's sophisticated supply chain analytical capabilities that are described later.

The ability to leverage economies of scale through categorical organisation of procurement was grown from an original context of hardware. However as the wider economies trend and IBMs own business has changed the vast majority of work running through the system is now embedded within the category of indirect spend. Within this category of indirect spend the largest sub category is that of labour. The trend towards servitization and after sales support indicative of the PCP context as service outsourcing has increased. This is demonstrated in the quote below:

“We have more spend on the indirect spend because as you have probably picked up over the years IBM has moved from mainly a hardware company many years ago to much more of a services and software company. So a lot of our purchases are indirect now. So for example the single biggest category of purchasing we have now would be labour. So the purchasing of contract labour in support of IBMs internal need but also in support of customers that IBM has. Not just procurement services customer but also customer who you know have outsourced their data services to IBM etc. So there is an awful lot of labour services that are purchased.”

Discussion point: Whist there is a gap between the capabilities of traditional purchasing capability and procuring for PCP, the possibility of moving towards a hybrid model that can cater to both eventualities is potentially a source of additional competitive advantage.

4.7.6.3 Cognitive capabilities (Risk & Performance)

A major and prominent divergence in the acquisition practice of the IBM case was the use of cognitive capabilities enabled by IBM's proprietary Watson supercomputer technology. This characteristic was of strategic significance and aligned with the a-priori areas of interest throughout the work. Cognitive capabilities are essentially a suite of machine learning based artificial intelligence functions that have been applied across a range of services at IBM, but with procurement being more developed. As described at interview:

"I guess some of the meaningful points that I would share with you, because of the company that we are we have gotten really into cognitive capabilities in terms of what we support our customers with. Using IBM'S Watson supercomputers, so these are applications that really allows us to transform the old way of doing things into application that really understand reason and learn about what we are doing."

"What is exciting about IBM here is what we are moving towards is from the traditional procurement applications and we are moving towards applications that are using cognitive capabilities. So that could mean that applications that take not just structured data from systems that we have but also unstructured data about what is going on In the various categories of sourcing outside of IBM. So unstructured data is anything from new articles to twitter feeds, and you know internet sources. So we now are starting to create applications and use applications that look across structured and unstructured data inside and outside IBM to help procurement professionals understand where market trends are moving, information about companies, you know, suppliers that we are potentially working with including news regarding them that could be a source of risk."

The above quotation is particularly relevant to the research. IBM's cognitive capabilities searches through a wide range of data sources in order to assess the potential risk of choosing a particular supplier. *Figure 35* diagram demonstrates the wide range of data sources that are taking into account by the cognitive capabilities suite when evaluating the risk of a given procurement option:

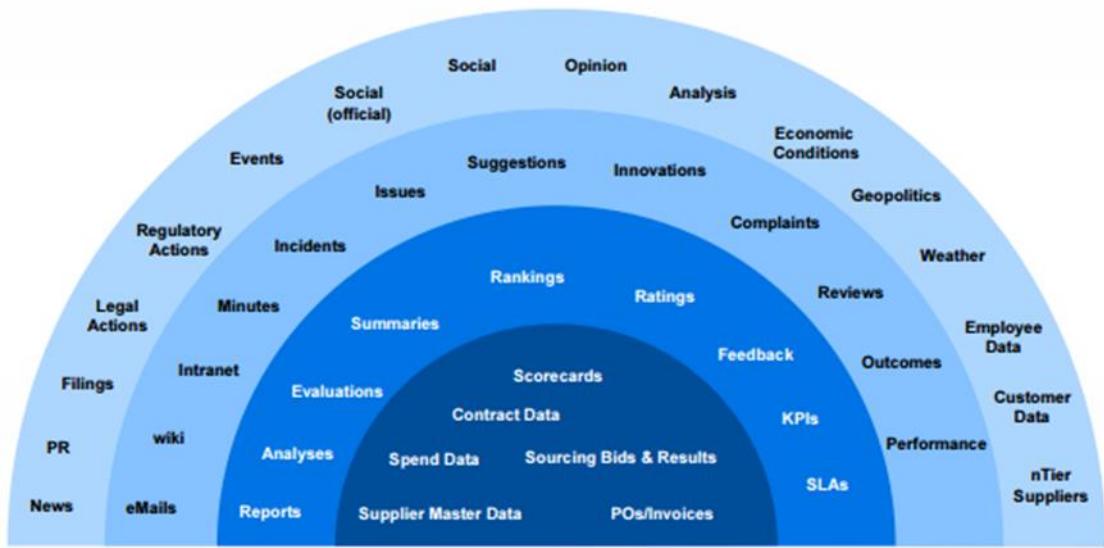


Figure 35 - Cognitive Capabilities Data

This allows for a comprehensive risk and performance profile of a given sourcing option to be evaluated at the assessment stage of an acquisition. As the outcome of particular contracts are observed over time then these metrics are recorded and the systems increases accuracy over time as it is exposed to more and more data through machine learning. This was described by the interview participant in the following passage:

“We actually have entire systems that we have built for risk management that you know, started on a hardware side but were looking at things like weather events and labour union activity and other things that could affect supply risk. We have systems that look at that, so that is the cognitive capabilities powered by Watson is one of our absolutely key directions of what we are moving towards. It’s not just the process of data analytics, but what you can do with these super computers now is that you can get them to the point where they actually start to learn from what you have already given them and from the interactions that you have with them. So think of it as kind of an artificial subject matter expert, you feed it a corpus of knowledge and data, which is both structured and unstructured, then as it interacts with that it learns from that and gets smarter.”

“So that is kind of the power of cognitive and what we are starting to build into the capabilities that support us, both across IBM but it is definitely the case that procurement is leading the way, in the transformation towards cognitive.”

As described in the quotation above IBM have developed cognitive capabilities for a range of business processes but one of the key areas of development is within the context of

procurement. The following paragraph details how these capabilities are used from the perspective of procurement professional operating within IBM:

"In terms of how this manifests to a procurement professional, it could start with a dashboard that display the outputs, but we are working on interfaces with the users and internal clients that use natural language processing right. So right now, the way we connect our systems to the capabilities, to Watson's capabilities is through a series of APIs. Which is really just a way to pull in these capabilities, these cognitive capabilities to an application. So there are API's that are based on natural language processing. So for example one that allows the cognitive capability to go out and scour the internet, and is able to process natural language to harness what is in there, this connect to the interfaces to the user like you see with iPhone and Siri and all of that, so they can interact verbally with the user. We are not totally there yet but those are the kind of things that are being worked on so it isn't just dashboards but it could be an actual verbal interaction."

As detailed in the above passage: The cognitive capabilities in applications are presented to the procurement user through a dashboard built into custom IBM systems. This dashboard gives the user access to the wide range of supplier profiling options provided by the wide range of data collection capabilities shown in Figure 35 above, thus enabling better decision making with regard to the supporting options. As stated also, IBM are attempting to enable natural language processing to enable a more interactive dimension to empower a procurement professional or project team compiling a business case for major acquisitions.

Discussion point: A key consideration of the research is in the identification of divergent characteristics that offer new and emergent capabilities to the toolkit of the PCP practitioner. The cognitive capabilities are particularly divergent of a practice with no other organisations offering anything comparable in terms of supplier selection evaluation, performance management and risk management.

4.7.6.4 Blockchain applications

A further meaningful characteristic identified at IBM was their development of block chain technologies into the procurement process. Blockchain capabilities were outlined at interview by IBM as the following:

"Another area that we are starting to build applications is block chain, it's the technology that underpins bitcoin, so whilst IBM is not really interested in bitcoin itself

the technology that allows bitcoin to work is called block chain. It is a distributed ledger technology, we are starting to develop Blockchain applications for the supply chain where we can create.. err Blockchain is kind of a peer-to-peer distributed ledger that keeps track of the state of really any asset, whether it be a virtual or physical asset and it could track it in a way that is very secure and immutable. So we are starting to work internally and with other companies to build Blockchain technology, so that is kind of another emerging area that you probably aren't going to hear about that from a lot of others but we are doing some exciting stuff in that area right now. Not just for procurement but for the supply chain itself."

The purpose of these applications as highlighted above is to provide provenance to the tracking of assets procured. This created the capability to provide immutable real time asset tracking. Therefore a greater level of detail can be provided into the procurement systems regarding existing contracts to inform future procurement activities.

Discussion Point: While IBM were reluctantly to detail how the application of block chain technologies towards procurement practice would manifest precisely the usage of such technology within the field of procurement is highly divergent amongst the body of cases and is of note when considering the variance amongst in-use performance management tracking of metrics.

4.7.6.5 Emptoris Supplier Lifecycle Management (SLM) Solution

The Emptoris system was acquired by IBM a number of years ago and acts as the central system that runs the IBM's procurement applications. The Emptoris SLM is the platform that is used to enable the emergent cognitive capabilities. Specifically, the Emptoris system is a highly advanced procurement system that provides functionality towards the through life management of assets procured. The system also includes learning from experience (LFE) functionality by recording a wide range of metrics associated with the various suppliers, and assets having been procured through the system. This is explained in the following:

"In terms of contract management, and specifically contract management associated with risk. We have a set of model contracts, we are actually using IBMs Emptoris procurement suite. This is an acquisition that IBM made some years back, and that is kind of our repository for contracts but also it has a set of mode agreements that we use depending on which categories and types of transactions that we use. So what's great about a system like that is that we can decide what terms and conditions are important

for IBM for different circumstance and our procurement professionals that are doing the contracting start with those model agreements, and we can track the changes that are being made to them. Then if we have some future need to make a change then we can see which engagements, with which suppliers, have which terms and we can go back and make the adjustments. So you know there is kinda this smart approach to keep track of what our terms, metrics and risks are across our supplier base.”

The Emptoris systems performance management capabilities and learning from experience is driven by IBMs centralised structural procurement processes, and category sourcing strategy. This Emptoris functionalities allow comparative analysis cross-purchasing category to develop specific contract addendums to cater to problems emergent within specific categories or across groups of categories, these findings are deployed across each sub-unit as Emptoris is globally used amongst IBM, available in 30 different languages. With regard to specific suppliers, IBM also leverages the Emptoris performance management systems to build up a working profile of risk management that feeds into future sourcing decisions. This is discussed in the following:

“But everything from you know where we develop a strategy from where we are going to leverage our spend from a category standpoint, to on boarding suppliers, to connecting them to our systems and having them go through the kind of tests to determine whether they are qualified to be an IBM supplier because of ethics etc. You know, some of that goes to risk management.”

“When I think about all of those processes we do use a set of common processes and tools that are supporting at least 30 different languages but it is the same buying system for how users of IBM, of nearly 400,000 employees go through the same process”

“In term of performance management and the use of metrics generally we measure a number of things, depending on what subject we are talking about. Whether it is performance of suppliers, side effects with clients, average payment terms, cost savings in so many different ways. We categorise the type of savings that we make associated with each project, for each stakeholder. There are all kinds of different metrics.”

The widespread use of a single system, distributing a single set of standards and practice is divergent amongst the body of cases investigated, of strategic significance and aligned directly with a-priori areas of interest.

Discussion Point: A comparison of the capabilities embedded within procurement systems and communications structure is relevant to the discussion when considering the whole body of cases.

4.7.6.6 Compliance Automation

A further emergent characteristic of the IBM's procurement functionality is the use of automation throughout the lifecycle. This was expressed at interview as the following:

"Most of what IBM does now from a procurement standpoint is hands free, over 90% of our transactions actually move through the process in a hands free way where there is no procurement buyer involved. That is because we have had some look over the years in centralising our processes and tools so that when somebody needs to buy something we systematically, automatically check are they complying to standardised model given that nature of the purchase. If they are then it goes through without touch. So there is a small percentage of transactions that actually have a procurement professional engage with them. Of course these do tend to be the larger complex projects and acquisitions because there is always going to be customisation but even in those cases parts of the process are automated."

As described above the process is automated as much as is realistically possible, while the interview participant cites that 90% of the interactions are hands free this pertains to commodities and less complex purchasing. The complex elements are still partially automated with market risk assessment, supplier risk portfolios and comparative price/risk assessment cross contracting options all generated to a point, which can then be expanded and customised by professional procurement practitioners.

At the point where a procurement professional does take over there is a set of guidelines to guide the remainder of the process with a particular focus on red lines. Thus, even in the case when there is human involvement within the question process it is guided by normative, globally distributed, standardised processes.

"We do have a set of policies that are procurement people must adhere to in order to complete it ethically, comply with our overall strategic policies. This is all from something internal we call the 'bluebook' which really guides the procurement professionals in the way that they do their job. You know it's not a desk procedure as such but it really covers those things that we would care about from risk standpoint"

certainly. That is not something that I would be able to share with you itself but I just wanted to let you know about its existence.”

Discussion point: The widespread use of systems with IBM means that the organisation is far less reliant on individual capabilities and expertise and is more reliant on their internal working practice, systems and their intellectual property. This is significantly divergent amongst the body of cases, and runs directly counter to the expertise lead project organisations that make up the bulk of the cases.

4.8 Cross Case Analysis

The cross case analysis, as described in the methodology section, uses a process of systematic combining and thematic reduction amongst the case study characteristics identified in the findings chapter. This process identifies themes that fit across the characteristics identified for each case. These themes are structured hierarchically, with the second and third order themes forming the basis of the case comparison. Given that one case can apply to more than one of the key areas of interest the characteristics require sorting.

4.9 Sorting characteristics by category

Given that a single case characteristic can feature in more than one category it was necessary to duplicate such cases within their relevant categories. An example: if an emergent characteristic of a case is ‘organisation uses a sophisticated tender management package’ as is true of numerous of the cases, then this characteristic is applicable to more than one key a-priori area. Whilst it is overtly related to the use of technology in managing the supply chain, the fact that all KPI and performance metric data runs through the systems makes the characteristic also highly related to the ‘performance management’ category, thus it appears in both given its shared relevance. Sorting the characteristics in this way allows the reduction of data to create cross-case themes pertinent to each category, without overloading and underrepresenting certain categories.

Therefore the following table lays out the characteristics which relate to each category:

Superordinate Grouping	MOD	NHS	SELLAFIELD	ENCIRC	LOCAL COUNCILS	IBM (MINI-CASE)
ORGANISATIONAL ALIGNMENT	Mechanisms for creating holistic control and process consistency	Free market system	Learning From Experience	Procurement through consultant	Reactive Procurement system	Centralised procurement practice
	Organisational Coherence	Holistic Control (personnel)	Internal/external dependencies	Comprehensive programme of benchmarking	Consultations	Economies of scale – leveraging purchasing power

	Oligopolistic pressures and prime contractor dependence	Holistic control (Org units)	A.L.A.R.P papers	Technical PT team	Collaborative procurement programme	Compliance Automation
	Hybrid devolved/centralised control Organisational Alignment	Private Sector unable to derive efficiency	Standard ‘Fragnets’ (Scope)	Extensive pre-market engagement	Continuous Information sharing amongst collaborating councils	Cognitive capabilities (Risk & Performance)
	Support Enablers Operating Centre (SEOC)	Sharing best practice	Early involvement of alliance workers.	Negotiation & Re-work	Joint Strategic Approach	Blockchain applications
	Risk Management Structure	Myopic goals in sub-units	Value Transition Point	Modularised, devolved work streams - Multiple Primary Contractors	Collaborative Institutional action	
	Policy Redundancy & Repetition	Change Resistance	CMART contract management / Complete Tender Management – Atlas	Renegotiating Best-of-Breed systems	Extensive renegotiation cycles	

	Contracting types	Tension between units	Direct award work			
		Encouraging process innovation – Lacking.	Flexible contract workers			
			'Five Board' model			
PERFORMANCE MANAGEMENT	Learning from Experience	Free market system	Learning From Experience	Comprehensive programme of benchmarking	Collaborative procurement programme	Emptoris Supplier Lifecycle Management (SLM) Solution
	Mechanisms for creating holistic control and process consistency	AQP Contracting Framework	A.L.A.R.P papers	Negotiation & Re-work	Investing in supply chain / Public Finance Initiatives	Compliance Automation

	Oligopolistic pressures and prime contractor dependence	Sharing best practice	Early involvement of alliance workers.	Modularised, devolved work streams - Multiple Primary Contractors	Predictive Collaborative procurements	Cognitive capabilities (Risk & Performance)
	Hybrid devolved/centralised control Organisational Alignment	Long term uncertainty	Cross Lot tendering	Renegotiating Best-of-Breed systems	Dynamic Purchasing System	Blockchain applications
	Support Enablers Operating Centre (SEOC)	Consistency of performance metrics	Direct award work			
		Encouraging process innovation – Lacking.	Flexible contract workers			
		Improvement frameworks	CMART contract management / Complete Tender Management – Atlas			

TECHNOLOGY MANAGEMENT	Mechanisms for creating holistic control and process consistency	Rigour in Information Systems	Learning From Experience	Enterprise systems component weighed by range of functional users.	Investing in supply chain / Public Finance Initiatives	Emptoris Supplier Lifecycle Management (SLM) Solution
	I.C.T Systems deployment and usage	Technological sophistication	Early involvement of alliance workers.	Integrated IT systems	Predictive Collaborative procurements	Compliance Automation
	Contracting Types	Sharing best practice	CMART contract management / Complete Tender Management – Atlas	Predictive maintenance system involved in re-tender.	Dynamic Purchasing System	Cognitive capabilities (Risk & Performance)
		Consistency of performance metrics	Cross Lot tendering			Blockchain applications
			‘Five Board’ model			

RISK MANAGEMENT	Learning from Experience	Myopic goals in sub-units	Learning From Experience	Technical PT	Investing in supply chain / Public Finance Initiatives	Emptoris Supplier Lifecycle Management (SLM) Solution
	Risk Management Structure	Long term uncertainty	Standard 'Fragnets' (Scope)	Extensive pre-market engagement		Compliance Automation
	Contracting types		Value Transition Point	Modularised, devolved work streams - Multiple Primary Contractors		
				Ad-hoc tendering		
				Contract Lock-In		
				Integrated IT systems		

Table 18 - Sorting Characteristics by Category

4.10 Thematic Reduction

This section demonstrates the process of thematic reduction as applied to the key categories across the body of cases. The visualisation of this process has been based on the gioia methodology (*Gioia et al, 2012*).

Characteristics have been sorted into the categories of interest that they are pertinent to in the previous section. Characteristics' sets are then created by combining characteristics from across the range of cases. Characteristics can be included in one characteristic set and then recombined with other characteristics in a different set to construct additional themes of commonality across the case.

This results in a dense hierarchical representation of areas of thematic interest as applied to the body of cases. These themes can be thought of as a means of understanding the areas of relevant strategic difference across the acquisition lifecycle of organisations procuring in the PCP context. The output of this process is a key contribution of the research. These themes are a structured thematic architecture to be used in the process of analysing PCP acquisition lifecycle practice.

The following is a short summary of the process explained chronologically: The superordinate themes of organisational alignment, performance management, technology management and risk management are identified within the literature a-priori and integrated into the interrogative framework up-front. These a-priori themes were then used to identify characteristics that ascribe to these themes within the Zachman process maps of each organisation. The second and third tier themes are then derived through the process of combining sets of these characteristics. This derivation of the 2nd and 3rd tier themes from case characteristics resulting in the following combinations:

4.10.1 Reduction of characteristics to themes for the category of Organisational Alignment

4.10.1.1 Contractor Engagement

ORGANISATIONAL ALIGNMENT CHARACTERISTICS REDUCTION (CONTRACTOR ENGAGEMENT)

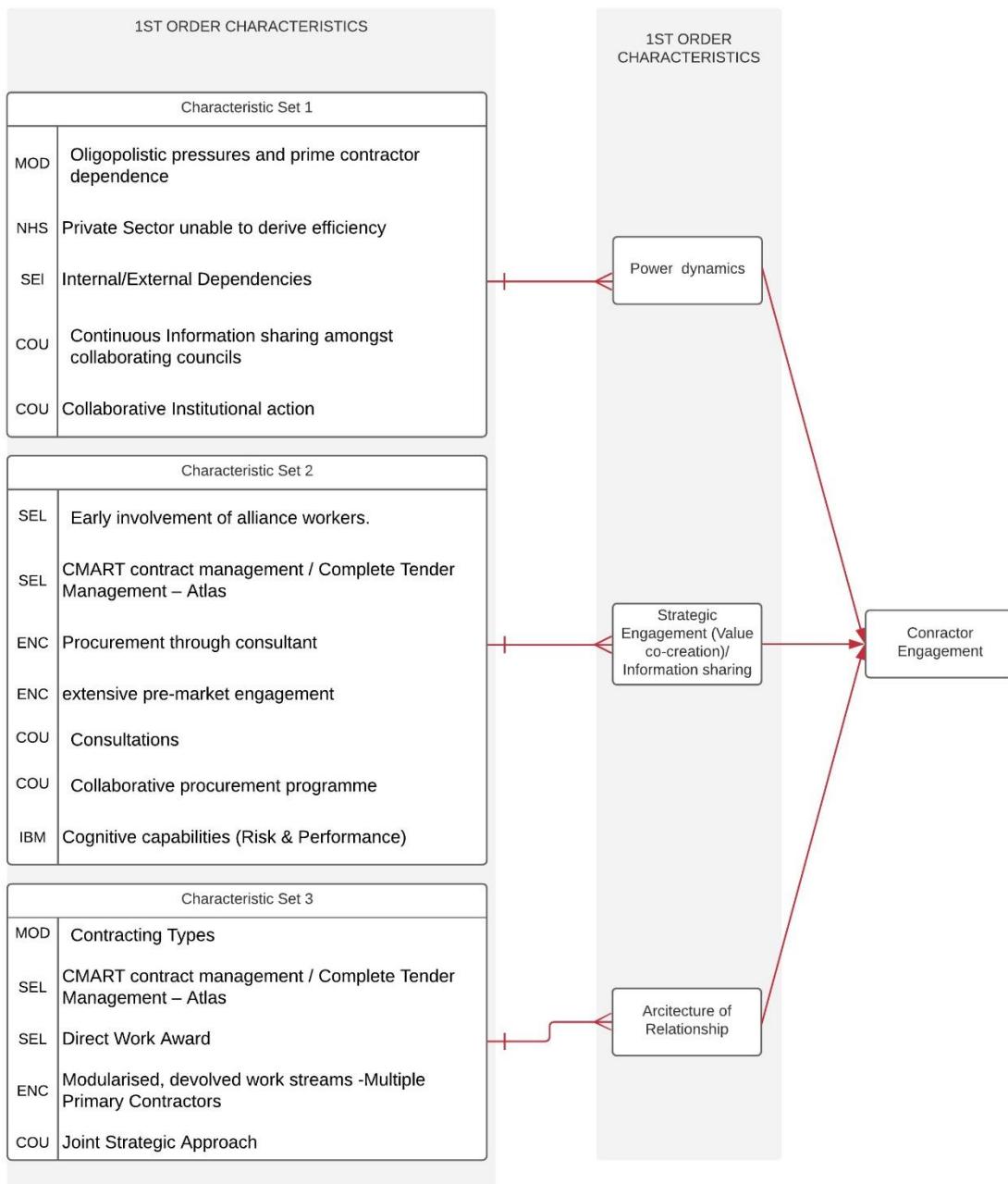


Figure 36- Reduction to Contractor Engagement

4.10.1.2 Spread of organisational control

ORGANISATIONAL ALIGNMENT CHARACTERISTICS REDUCTION (SPREAD OF ORGANISATIONAL CONTROL)

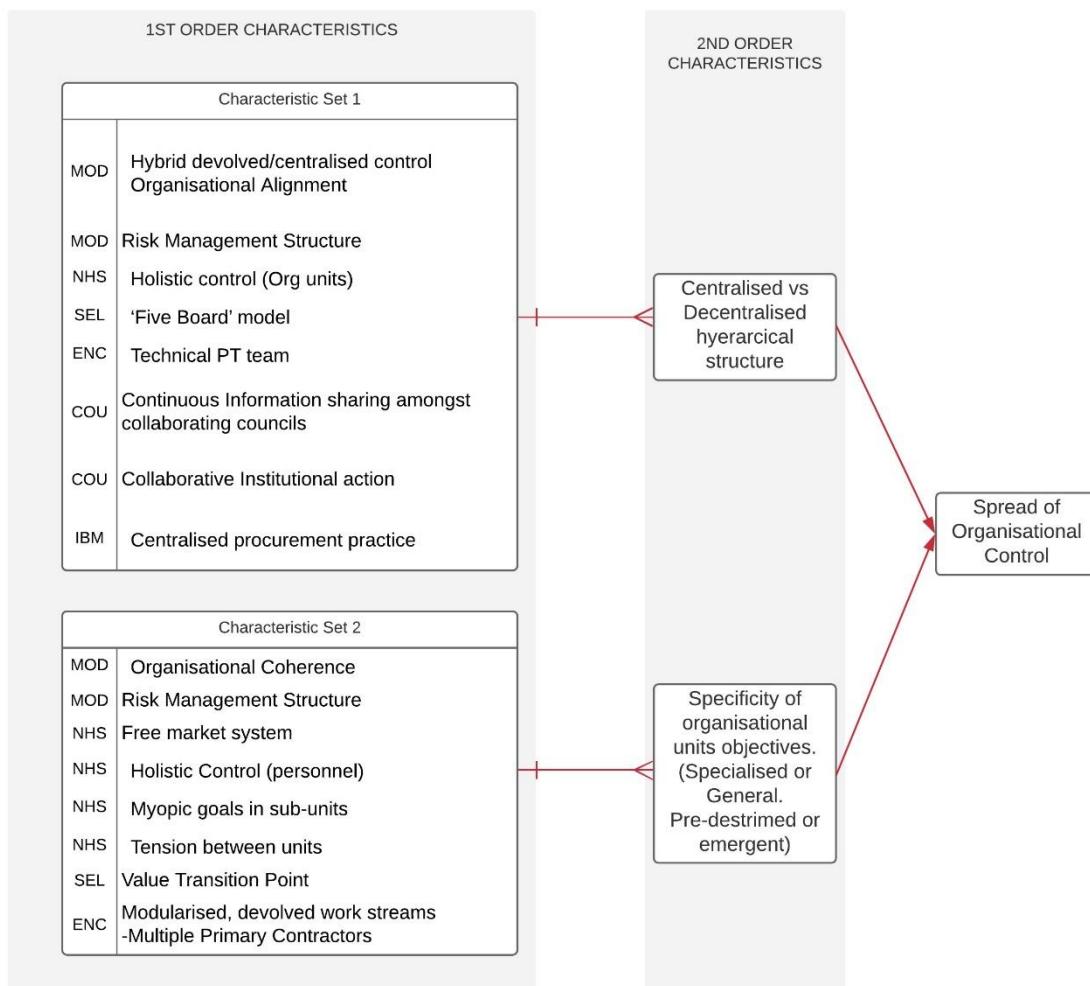


Figure 37 - Reduction to Spread of Organisational Control

4.10.1.3 Internal Coherence / Communication

ORGANISATIONAL ALIGNMENT CHARACTERISTICS REDUCTION (INTERNAL COHERENCE / COMMUNICATION)

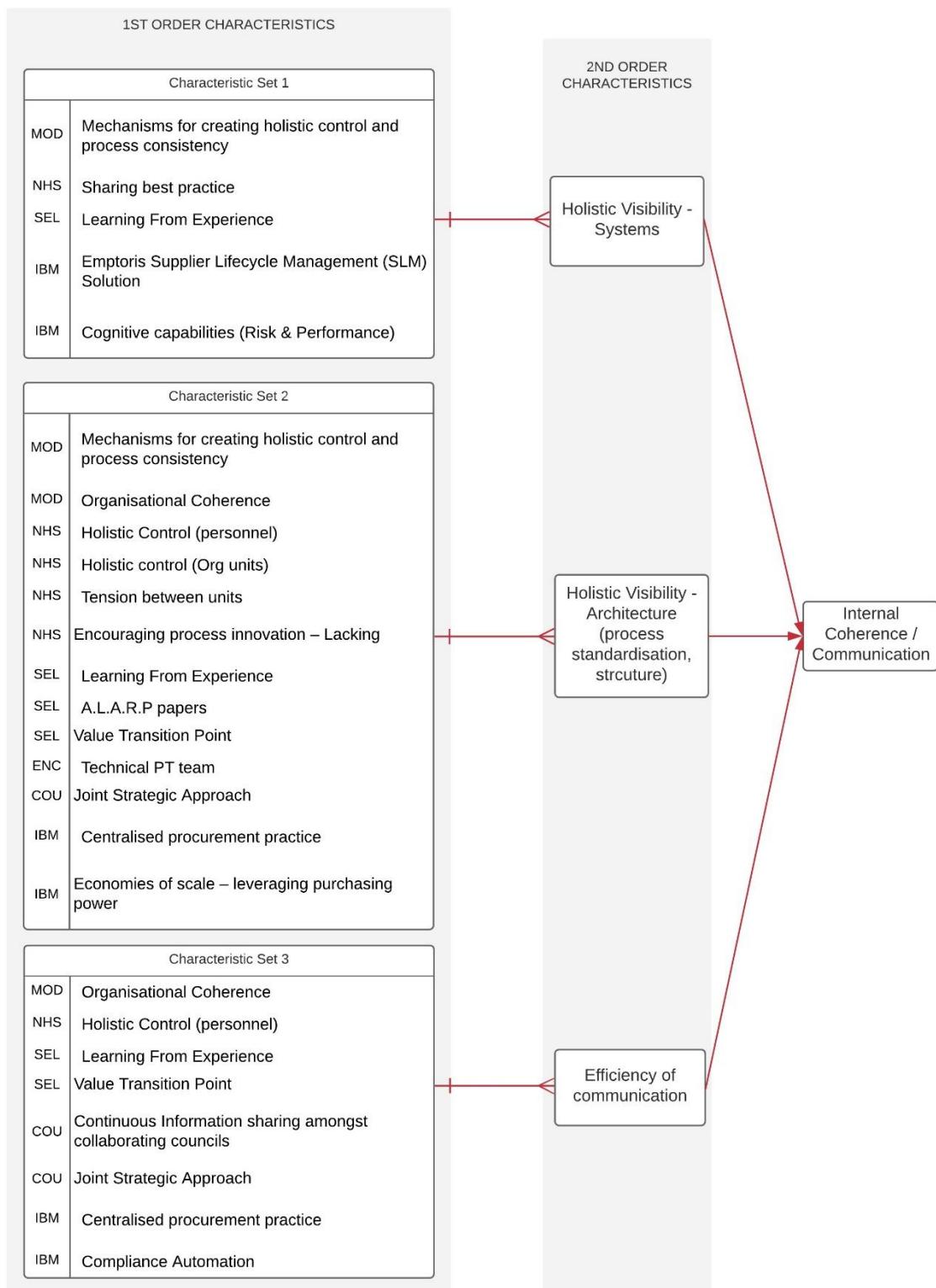


Figure 38 - Reduction to Internal Coherence / Communication

4.10.1.4 Fit between normative and observed processes

ORGANISATIONAL ALIGNMENT CHARACTERISTICS REDUCTION (FIT BETWEEN NORMATIVE AND OBSERVED)

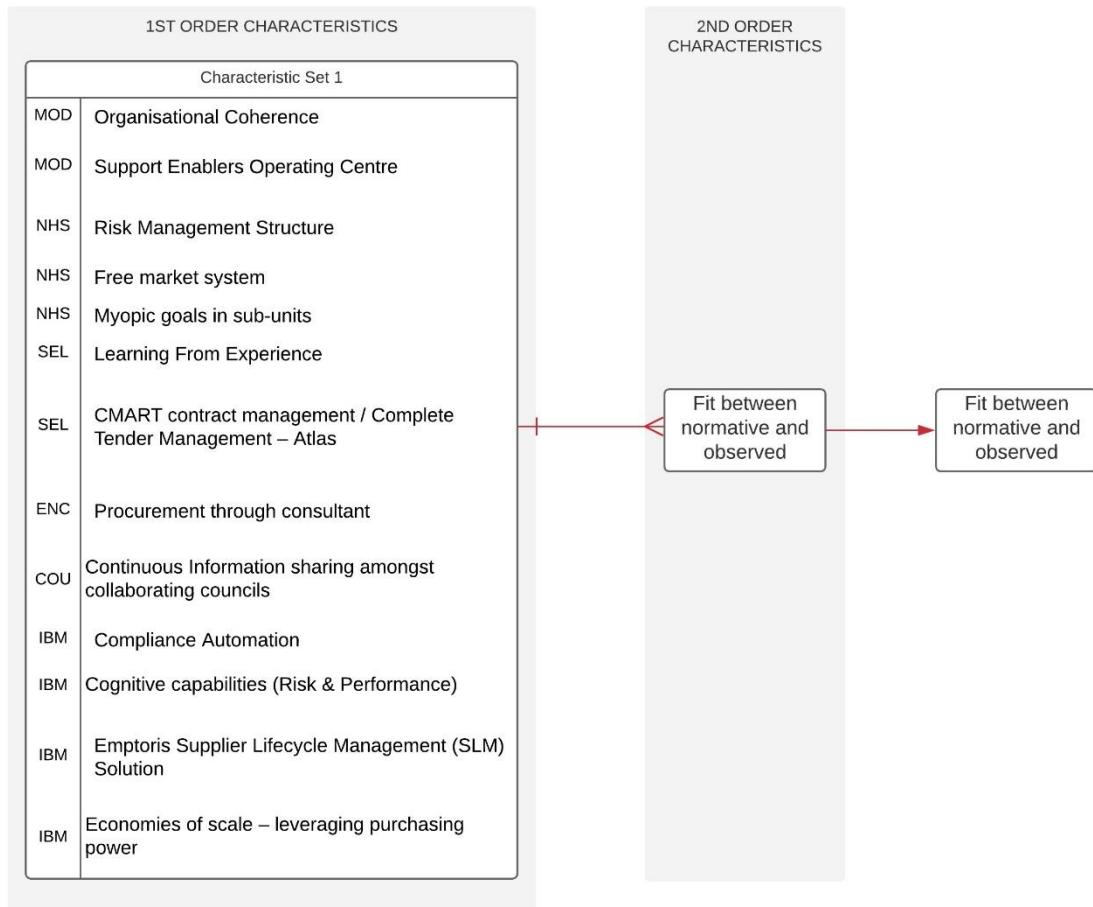


Figure 39 - Reduction to Fit between normative and observed

4.10.1.5 Geographical Spread of stakeholders

ORGANISATIONAL ALIGNMENT CHARACTERISTICS REDUCTION (GEOGRAPHICAL SPREAD OF STAKEHOLDERS)

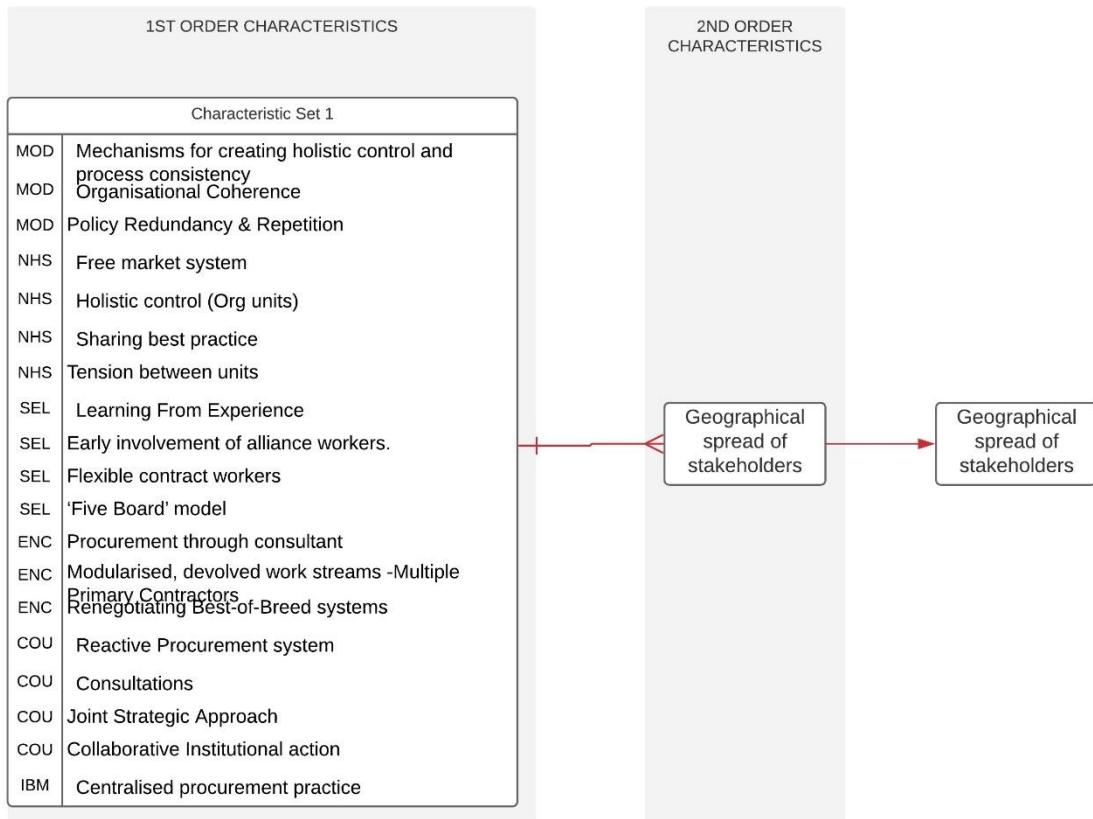


Figure 40 - Reduction to Geographical Spread of Stakeholders

4.10.2 Reduction of characteristics to themes for the category of Performance Management

4.10.2.1 Quality Filters and KPI's

PERFORMANCE MANAGEMENT CHARACTERISTICS REDUCTION (QUALITY FILTERS AND KPI)

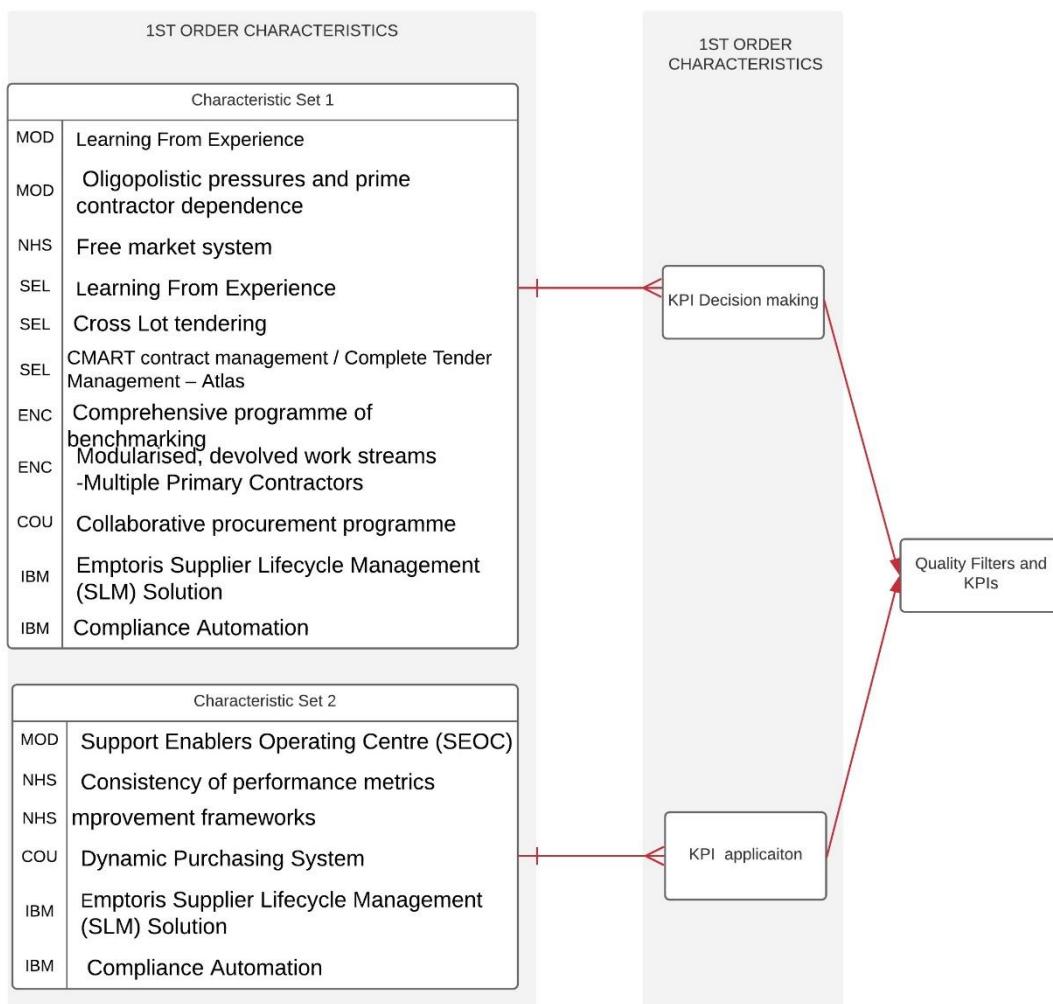


Figure 41 - Reduction to Quality Filters and KPIs

4.10.2.2 Contractual Techniques

PERFORMANCE MANAGEMENT CHARACTERISTICS REDUCTION (CONTRACTUAL TECHNIQUES)

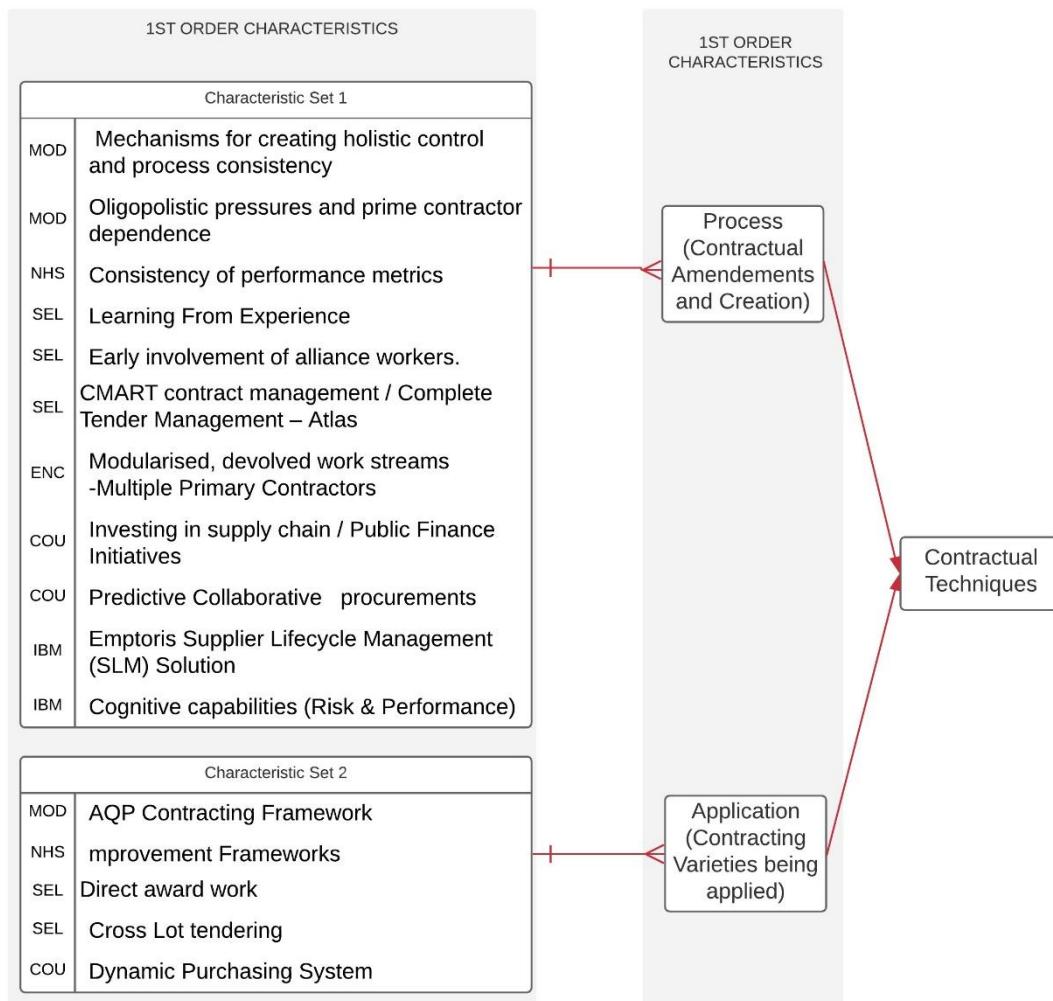


Figure 42 - Reduction to Contractual Techniques

4.10.2.3 Collaborative practice

PERFORMANCE MANAGEMENT CHARACTERISTICS REDUCTION (CONTRACTUAL TECHNIQUES)

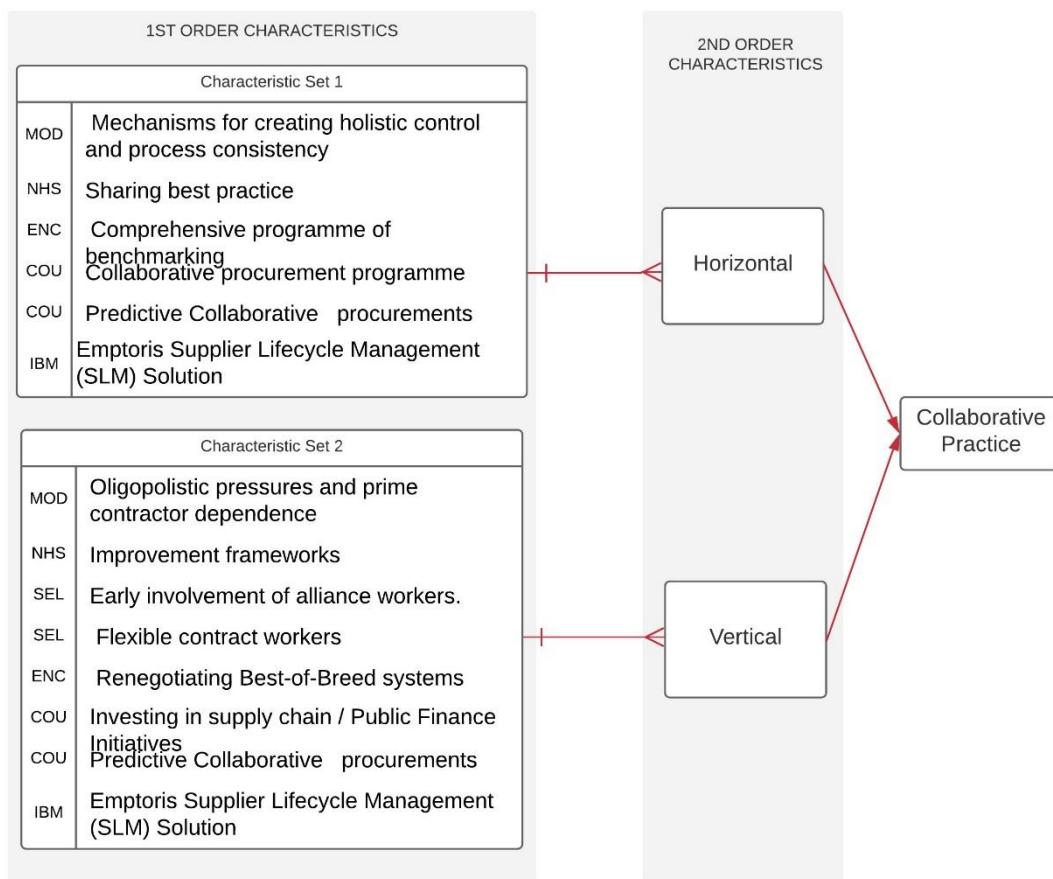


Figure 43 - Reduction to Collaborative Practice

4.10.2.4 Coherence of internal project control

PERFORMANCE MANAGEMENT CHARACTERISTICS REDUCTION (COHERENCE OF INTERNAL PROJECT CONTROL)

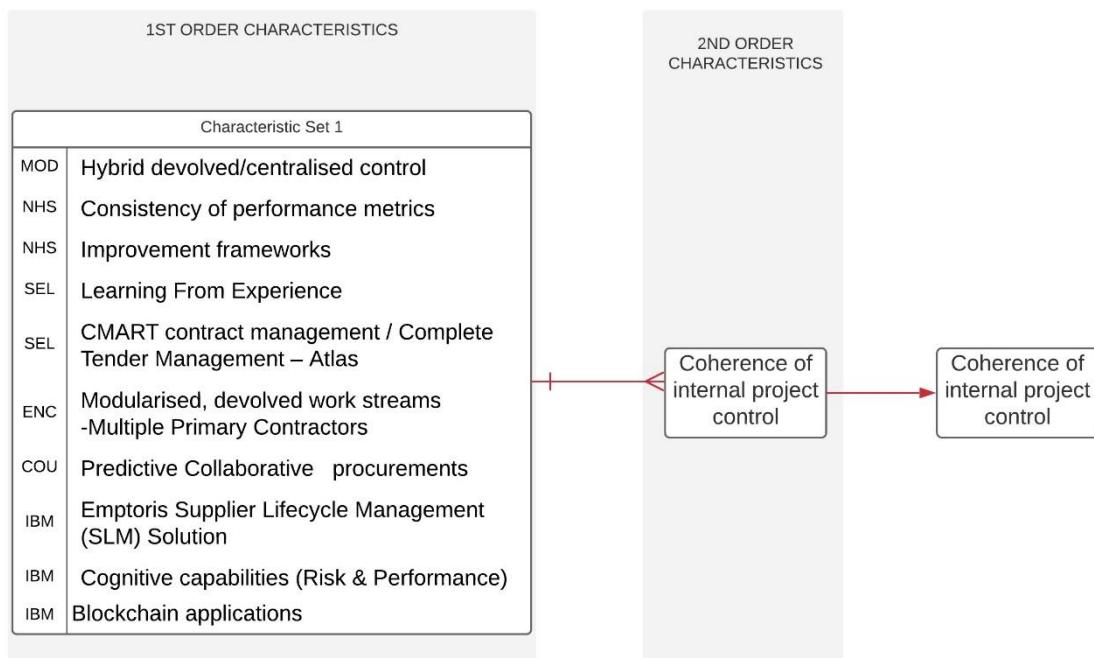


Figure 44- Reduction to Coherence of Internal Project Control

PERFORMANCE MANAGEMENT CHARACTERISTICS REDUCTION (PREDICTIVE ANALYTICS)

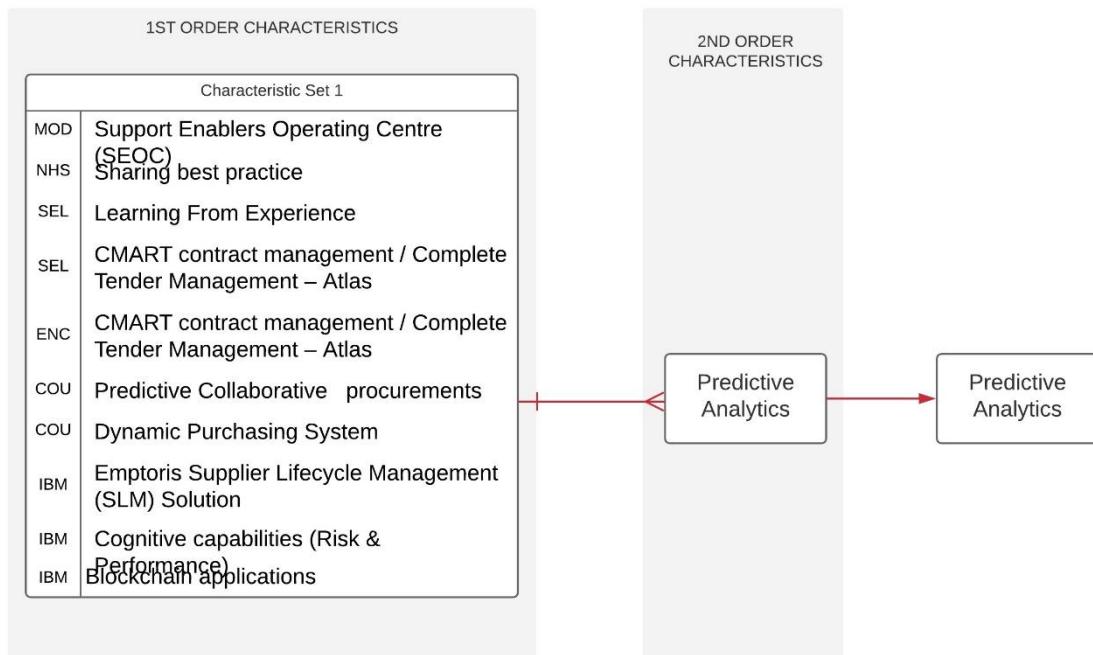


Figure 45 - Reduction to Predictive Analytics

4.10.3 Reduction of characteristics to themes for the category of Technology Management

4.10.3.1 I.C.T System Variety

PERFORMANCE MANAGEMENT CHARACTERISTICS REDUCTION (I.C.T SYSTEMS VARIETY)

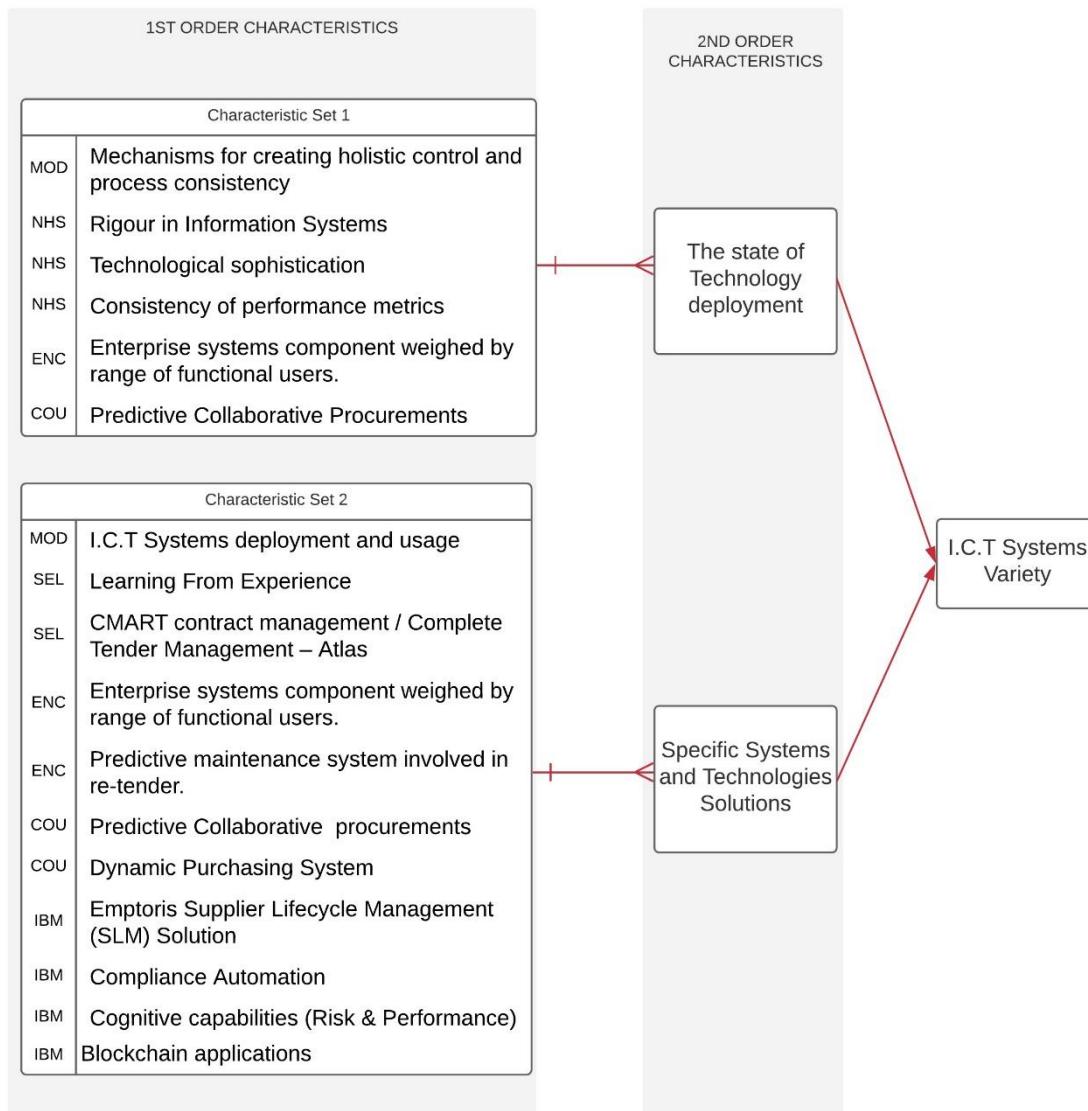


Figure 46 - Reduction to I.C.T Systems Variety

4.10.3.2 E-procurement systems

PERFORMANCE MANAGEMENT CHARACTERISTICS REDUCTION (E-PROCUREMENT SYSTEMS)

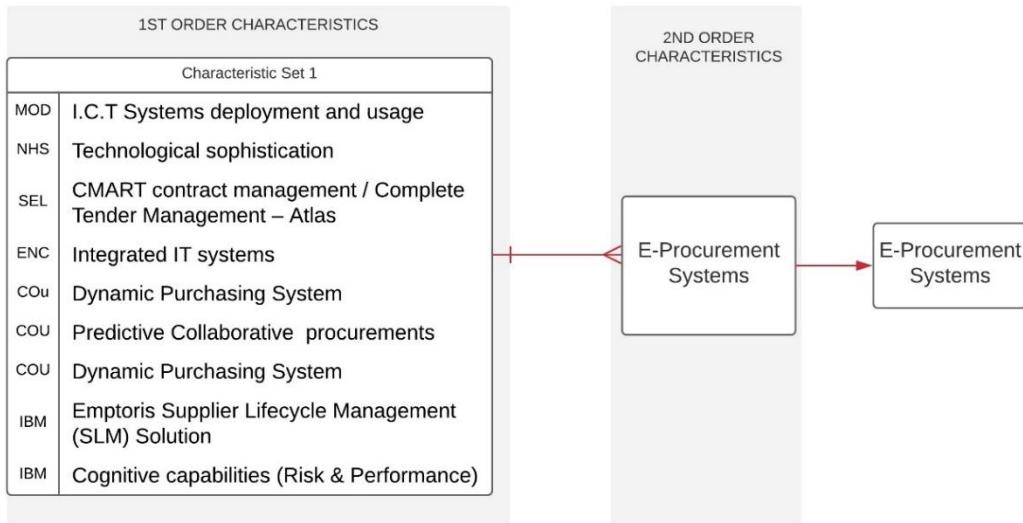


Figure 47 - Reduction to E-procurement System

4.10.3.3 Knowledge Management Systems

PERFORMANCE MANAGEMENT CHARACTERISTICS REDUCTION (KNOWLEDGE MANAGEMENT SYSTEMS)

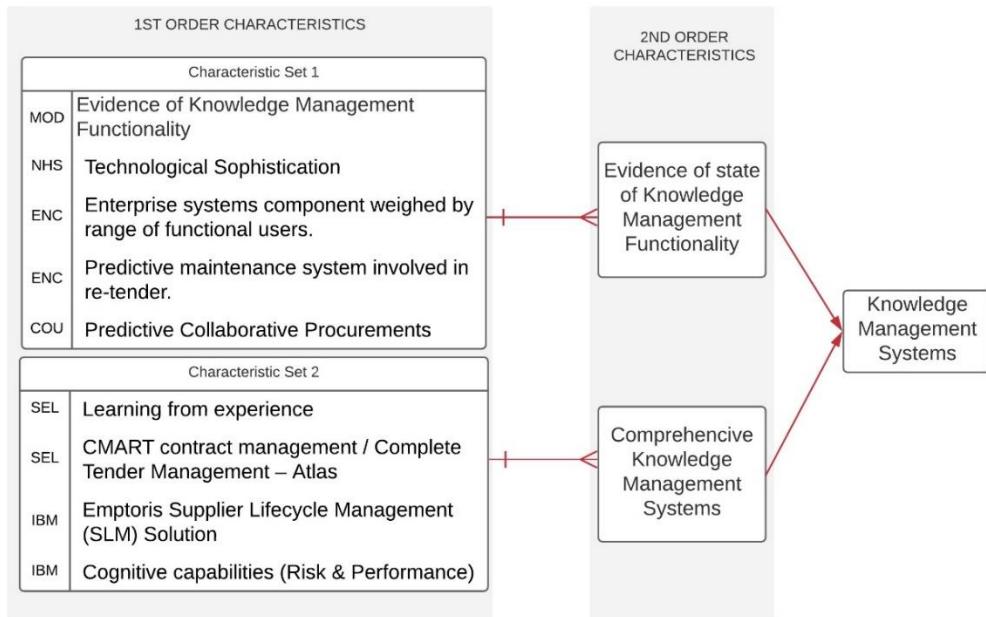


Figure 48 - Reduction to Knowledge Management Systems

4.10.3.4 Coherence Across Organisations

PERFORMANCE MANAGEMENT CHARACTERISTICS REDUCTION (COHERENCE ACROSS ORGANISATION [SYSTEMS USAGE])

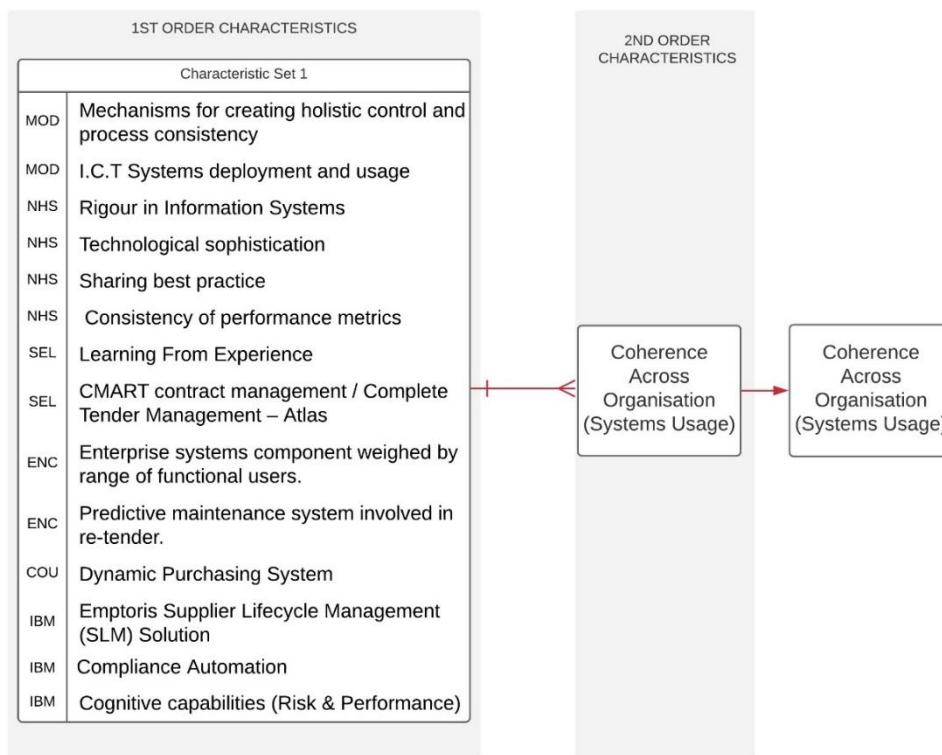


Figure 49 Reduction to Coherence Across Organisation (systems usage)

4.10.3.5 Extra Organisational Systems Usage

PERFORMANCE MANAGEMENT CHARACTERISTICS REDUCTION (EXTRA-ORGANISATIONAL SYSTEMS INTERACTION)

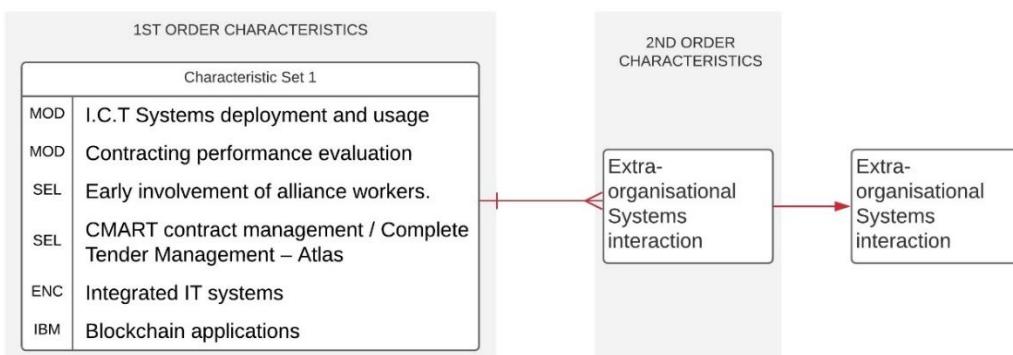


Figure 50 - Reduction to Extra organisational Systems Interaction

4.10.4 Reduction of characteristics to themes for the category of Risk Management

4.10.4.1 Use of Avoidance/ Reduction, transference strategies

**RISK MANAGEMENT CHARACTERISTICS REDUCTION
(USE OF AVOIDANCE/REDUCTION, TRANSFERENCE STRATEGIES)**

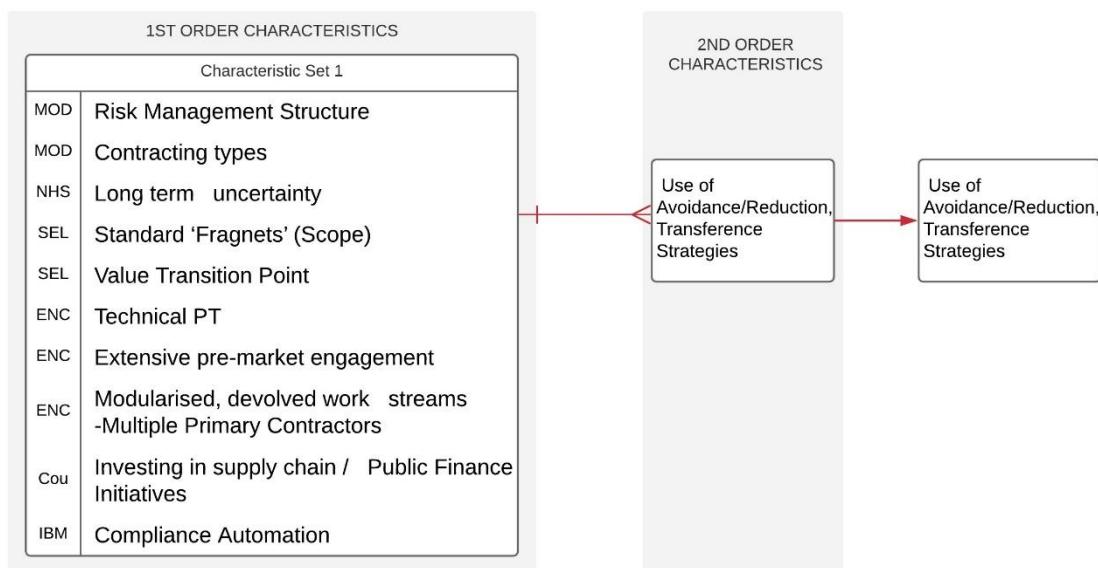


Figure 51- Reduction to Use of Avoidance...

4.10.4.2 Density of risk management practices throughout acquisition lifecycle

RISK MANAGEMENT CHARACTERISTICS REDUCTION (DENSITY OF RISK MANAGEMENT PRACTICES THROUGHOUT ACQUISITION LIFECYCLE)

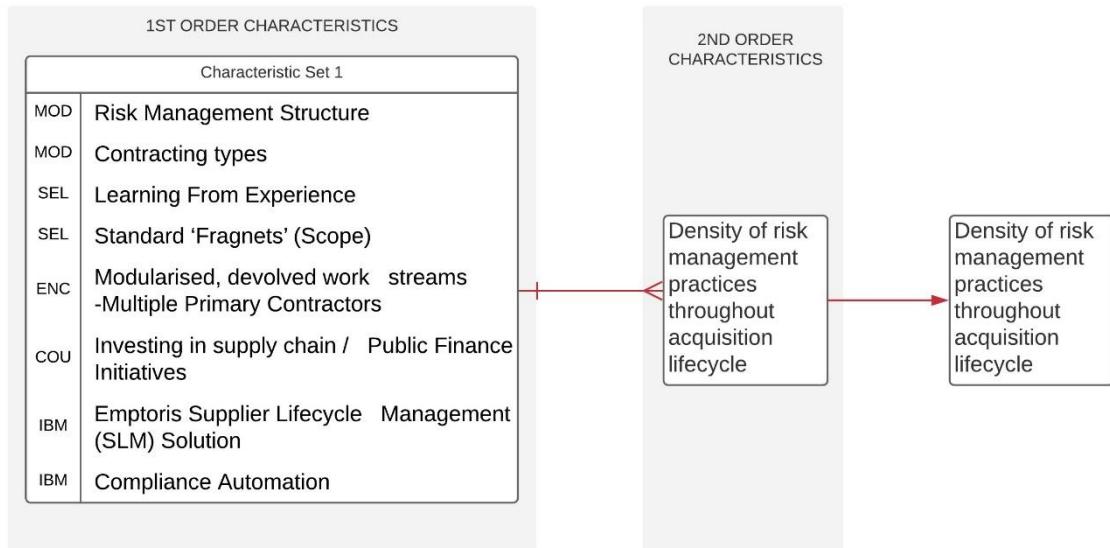


Figure 52 - Reduction to Density of risk management practice.

4.10.4.3 Risk reporting and information gathering structure

RISK MANAGEMENT CHARACTERISTICS REDUCTION (RISK REPORTING AND INFORMATION GATHERING STRUCTURE)

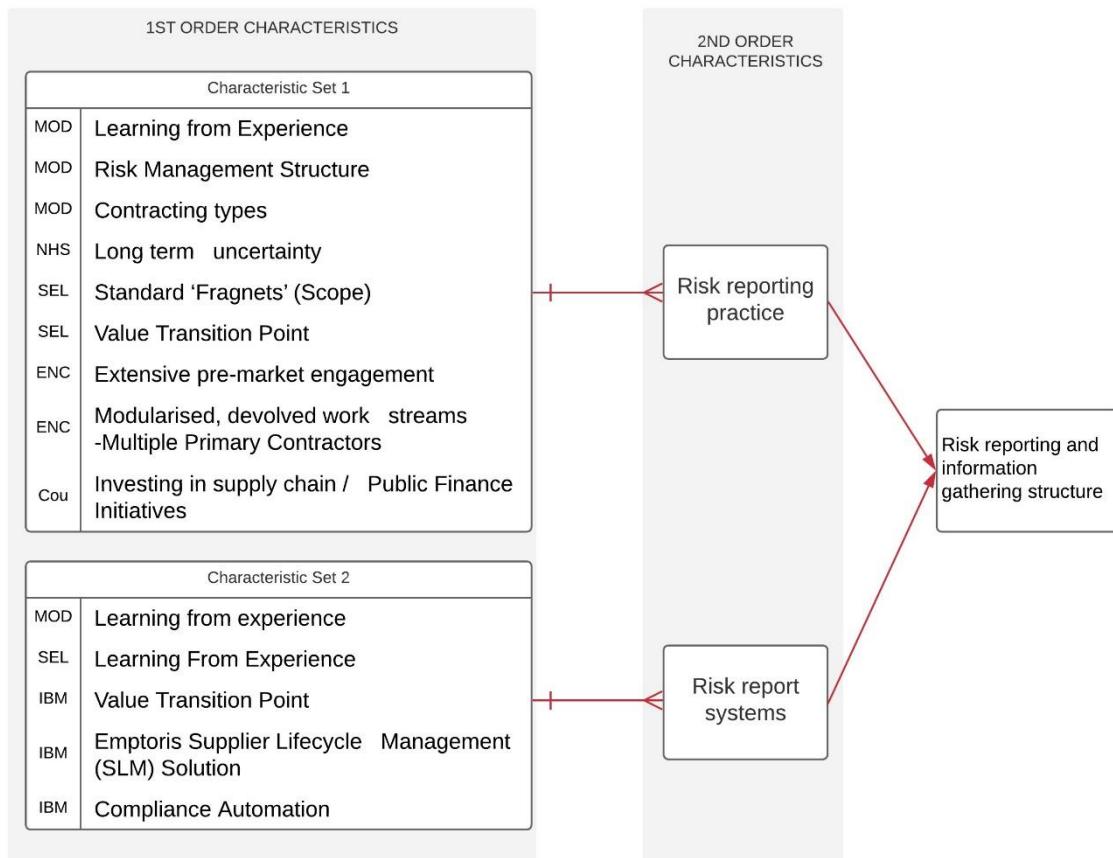


Figure 53 -Reduction to Risk reporting and information gathering structure

4.10.5 Summary of thematic reduction

The following table is a summary showing how each of the a-priori areas of interest align with the second and third tier themes. The superordinate themes were used in this abductive research design to set the boundaries of what processes along the acquisition lifecycle were relevant in terms of addressing of the research question. Over the course of the research, case characteristics were identified that aligned with these superordinate themes. These characteristics were then compared and contrasted to create a second tier of themes, which were in turn compared and contrasted to create a further reduced number of third tier or ‘final tier’ themes.

SUPERORDINATE THEMES (1 st Tier)	CASE CHARACTERISTICS	
PERFORMANCE MANAGEMENT	KPI Decision Making	Quality Filters and KPIs.
	KPI Application	
	Process (Contractual Amendments and Creation)	Contractual techniques
	Application (contracting varieties being applied)	
	Horizontal	Collaborative practice
	Vertical	
	**No 2 nd stage reduction	Coherence of internal project control
	**No 2 nd stage reduction	Predictive analytics
	**No 2 nd stage reduction	Use of Avoidance/Reduction, Transference Strategies
	**No 2 nd stage reduction	Density of risk management practices throughout acquisition lifecycle
RISK MANAGEMENT	Risk Reporting Practice	Risk reporting / Information gathering
	Risk Reporting Systems	
	The state of technology development	I.C.T System Variety
	Specific systems and technological solutions	
	**No 2 nd stage reduction	E-procurement Systems
	State of Knowledge Management Functionality	Knowledge Management Systems
	Comprehensive Knowledge Management Systems	
TECHNOLOGY MANAGEMENT	**No 2 nd stage reduction	Coherence created across organisations

	**No 2nd stage reduction	Extra-organisational Systems
ORGANISATIONAL ALIGNMENT	Power Dynamics	Contractor engagement
	Strategic Engagement (Value co-creation/ Information Sharing)	
	Architecture of Relationship	
	Centralised vs Decentralised Hierarchical Structure	Spread of organisational control
	Specificity of Organisational Units Objectives	
	Holistic Visibility Systems	Internal Coherence / Communication
	Holistic Visibility – Architecture (process standardisation, structure)	
	Efficiency Of Communication	
	**No 2nd stage reduction	Fit of Normative & Observed
	**No 2nd stage reduction	Geographical spread of stakeholders

Table 19 - Summary of Thematic Reduction

4.11 Prevalence and perceived effectiveness ranking

The following table is the result of a thematic analysis of prevalence and perceived effectiveness across the third tier themes. These two cross-cutting themes were codified to each characteristic during repeat interviews.

In more detail: The process of abductive research has resulted in the selection of characteristics and the reduction of themes taking place iteratively. At the point that a case organisation was reengaged, the later interviews were used to query each of the identified characteristics in greater detail. During this process, participants were also asked to rate the degree to which those characteristics were present within the organisations (prevalence), and whether the participant believed the ‘as-is’ process was suitable or effective (perceived effectiveness).

These themes were codified at the levels: high, moderate or low. The author’s intention was not to have these as distinctly bounded categories, but to convey a simple means of discriminating between the cases in an accessible format. Thus, these levels were defined in contrast to the other case organisations featured within the study.

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4.11.1 Performance Management

Superior dinate theme	Subordinate theme	CASE 1	CASE 2	CASE 3	CASE 4	CASE 5	CASE 6
		DEFENCE	HEALTH	NUCLEAR	LOCAL GOVT	ENCIRC	IBM
Performance management	Quality KPIs.	D	High Diverse and extensive range of filters throughout acquisition process	High Extensive KPI listing with several filter points	High Extensive quality tests, less in terms of supplier facing KPI.	Low <i>General KPIs not managed centrally.</i>	Low <i>Little application of performance metrics observed</i> <i>Performance evaluation and recording built into centralised system fundamentally</i>
	PE	Low	Moderate	High	Moderate	Moderate	High
Contractual techniques	D	High Numerous contractual models used.	Moderate <i>Case-by-case selection</i>	High Numerous contractual models used. Extensible integrated into process.	Low <i>Some variation on standard contract.</i>	Moderate Some variety of contracts used to good effect.	High <i>Wide range of contracts used with significant customisation options</i>
	PE	Moderate	Moderate	High	Low	Moderate	High
Collaborative practice	D	Moderate <i>Significant variation in Information communications practice extra-organisationally, complex internal structure.</i>	Low <i>infrastructure and practice not used for exploitation of collaborative stakeholder practice</i>	High Extensive use of collaborative sub-contractor not used for exploitation of collaborative stakeholder practice	Moderate Generally self-contained units. Emergent horizontal arrangements in particular.	Moderate Small horizontal structure, not contextually appropriate	Unknown <i>*Insufficient data</i>
	PE	Low	Moderate	High	High	Moderate	Unknown
Coherence of internal project control	D	Low <i>Decentralised systems used throughout, wide internal stakeholder base.</i>	Moderate <i>In-use acquisition phase</i>	High <i>Centralised concept and assessment regionalised</i>	High <i>Small locus of control stages standards across projects coherence</i>	Moderate <i>A small but coherent set of process leads to highly effective control</i>	High <i>A highly systematised & procurement structure.</i>

	<i>PE</i>	<i>Low</i>	<i>Moderate</i>	<i>Moderate</i>	<i>Moderate</i>	<i>High</i>	<i>High</i>
<i>Predictive analytics</i>	<i>D</i>	<i>Moderate</i> <i>High strategic consideration, some operational reporting</i>	<i>Moderate</i> <i>Centralised use of key reporting, ad-hoc regarding operational data.</i>	<i>High</i> <i>High use of technology for operational as well as operational LFE.</i>	<i>Low</i> <i>Ah-hoc agile systems</i>	<i>Moderate</i> <i>A developed predictive internal maintenance function – coordination with suppliers</i>	<i>High</i> <i>A highly developed predictive analytics function across all aspects of performance management.</i>
	<i>PE</i>	<i>Moderate</i>	<i>Moderate</i>	<i>Moderate</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>

4.11.2 Risk Management

<i>Superordinate theme</i>	<i>Subordinate theme</i>	<i>CASE 1</i>	<i>CASE 2</i>	<i>CASE 3</i>	<i>CASE 4</i>	<i>CASE 5</i>	<i>CASE 6</i>
		<i>DEFENCE</i>	<i>HEALTH</i>	<i>NUCLEAR</i>	<i>LOCAL GOVT</i>	<i>ENCIRC</i>	<i>IBM</i>
<i>Risk Management Strategies</i>	<i>Use of Avoidance/Reduction, Transference Strategies</i>	<i>D</i> Extensive points of risk reduction and avoidance, several reluctant to retain risk (primary contractor model)	<i>Moderate</i> Extensive KPI listing with filter points, otherwise little variance.	<i>High</i> High minimum standards for contractual partners, layered strategic variance.	<i>Low</i> Onus is on procurement practice with relatively low acceptable risk mechanisms for risk reduction.	<i>Low</i> Relatively few formalised mechanisms for assessing unacceptable risk	<i>High</i> <i>Formalise risk management practice through analytical capability. Not fully explored but interview data suggests very mature</i>
<i>Density of risk management practices throughout acquisition lifecycle</i>	<i>PE</i> Multi-layered, although lacking in coherence	<i>High</i> Moderate	<i>Moderate</i> Muti-layered although lacking in both coherence and systems support	<i>High</i> Sophisticated risk assessment structure observed throughout organisation	<i>Moderate</i> Risk assessment at contracting level, non-predictive, not systematised.	<i>Moderate</i> Risk is dealt with at contracting level, and on an ad-hoc basis with some automated analytics.	<i>High</i> <i>Highly systematised, coherent and extensive application of risk strategies throughout.</i>
<i>Risk reporting /</i>	<i>PE</i> Risk is handled in silos with some interconnection,	<i>Medium</i> Moderate	<i>Moderate</i> Centralised, extensive, technologically enabled	<i>High</i> Technologically enabled	<i>Low</i> <i>Limited formalised feedback mechanisms, limited</i>	<i>Moderate</i> <i>Basic risk structures in place. Little formalised risk</i>	<i>Unknown</i> <i>Highly formalised risk</i>

<i>Information gathering</i>	reporting widespread but notably lacking central coherent view.	Some technologically enabled elements to support.	LFE and risk reporting systems.	enabling through technology.	structure. Reported to ad structure supported by advanced systems.	
<i>PE</i>	<i>Moderate</i>	<i>Moderate</i>	<i>High</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>

4.11.3 Technology Management

<i>Superior</i>	<i>Subordinate</i>	<i>CASE 1</i>	<i>CASE 2</i>	<i>CASE 3</i>	<i>CASE 4</i>	<i>CASE</i>	<i>5 CASE</i>	<i>6</i>
<i>Theme</i>	<i>Theme</i>	<i>DEFENCE</i>	<i>HEALTH</i>	<i>NUCLEAR</i>	<i>LOCAL GOVT</i>	<i>ENCIRC</i>	<i>IBM</i>	
<i>Technology Variety</i>	<i>I.C.T System D</i>	<i>High</i>	<i>Moderate</i>	<i>Medium</i>	<i>Low</i>	<i>Low</i>	<i>Moderate</i>	
<i>Management</i>	<i>Highly extensive use of I.C.T throughout project lifecycle, reporting systems operate within silos</i>	<i>Centralised reporting systems, other systems vary regionally.</i>	<i>national</i>	<i>Largely standardised with some partially integrated bespoke applications</i>	<i>Tendering tools as standard/</i>	<i>There is a minimalist use of systems. Some generating + Basic tender tools</i>	<i>Systems integrated into suite of interoperable systems.</i>	
<i>E-procurement Systems</i>	<i>D</i>	<i>Moderate</i>	<i>Low</i>	<i>High</i>	<i>Moderate</i>	<i>Moderate</i>	<i>High</i>	
	<i>Documentation drive, existing infrastructure omits ERP linked functionality/.</i>	<i>Standard public tendering tools. E-chest.</i>	<i>Extensive interactions between e-tendering and other tools.</i>	<i>Some use of tendering tools. Extended functionality not evidences as standard.</i>	<i>Some use of standard tendering tools</i>	<i>Some use of standard tendering tools</i>	<i>Extremely sophisticated e-procurement package</i>	
<i>Knowledge Management Systems</i>	<i>D</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>	<i>Low</i>	<i>Low</i>	<i>High</i>	
	<i>Functionality added to other systems. Substantial manual process.</i>	<i>No dedicated systems observed, some manual functions.</i>	<i>systems</i>	<i>Significant usage of centralised KMS, highly integrated into normative processes.</i>	<i>Some horizontal collaboration integrated into normative processes.</i>	<i>No meaningful functionality observed</i>	<i>Extremely pervasive use of KMS at all stages.</i>	
<i>Coherence across</i>	<i>D</i>	<i>Moderate</i>	<i>Moderate</i>	<i>High</i>	<i>Low</i>	<i>Low</i>	<i>Moderate</i>	
	<i>Inherent complexity and org structure give rise to connectivity in</i>	<i>Segregated by region, some connectivity in</i>	<i>'serious'</i>	<i>Consistent use of centralised systems.</i>	<i>Coherence is apparent, although not supported</i>	<i>Lack of variety in systems creates coherence as default</i>	<i>Sophisticated, block chain supported coherent systems</i>	

<i>organisation</i>	<i>s</i>	<i>concurrent initiatives and incidents' technological silos of systems.</i>	<i>reporting function.</i>	<i>through Information systems.</i>			
	<i>PE</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>	<i>Unknown</i>	<i>Moderate</i>	<i>High</i>
<i>Extra- organisation al Systems</i>	<i>D</i>	<i>Moderate</i>	<i>Low</i>	<i>Moderate</i>	<i>Low</i>	<i>Low</i>	<i>High</i>
		<i>No uniform means of communication, although numerous instances of extra organisational system</i>	<i>No inputs from dedicated systems from suppliers into the formal procurement process, aside from tender submission.</i>	<i>Tender management, and feedback collected through the formal procurement web-enabled KMP.</i>	<i>No observed interaction outside of tender responses.</i>	<i>Little observed interaction with supplier directly through systems</i>	<i>Sophisticated means of engaging with diverse stakeholders</i>
	<i>PE</i>	<i>Moderate</i>	<i>Moderate</i>	<i>High</i>	<i>Low</i>	<i>Low</i>	<i>High</i>

4.11.4 Organisational Alignment

<i>Superior dinate theme</i>	<i>Subordinate theme</i>	<i>CASE 1</i>	<i>CASE 2</i>	<i>CASE 3</i>	<i>CASE 4</i>	<i>CASE 5</i>	<i>CASE 6</i>
		<i>DEFENCE</i>	<i>HEALTH</i>	<i>NUCLEAR</i>	<i>LOCAL GOVT</i>	<i>ENCIRC</i>	<i>IBM</i>
<i>Organis ational contractor alignment / Other Factors</i>	<i>Sub-contractor engagement</i>	<i>D</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>	<i>Low</i>	<i>Low</i>
			<i>Primary contractor model takes precedents.</i>	<i>Specific control of multiple sub-contractor elements</i>	<i>Specific interaction with sub-contractor</i>	<i>Direct management of sub-contractors not observed.</i>	<i>Non observed</i>
				<i>I.C.T platform enabled</i>			<i>Information collection high, management is non-direct</i>
		<i>PE</i>	<i>High</i>	<i>Moderate</i>	<i>High</i>	<i>Unknown</i>	<i>Unknown</i>
<i>Spread of organisation al control</i>	<i>D</i>	<i>High</i>	<i>High</i>	<i>Moderate</i>	<i>Moderate</i>	<i>Low</i>	<i>Unknown</i>
			<i>Diverse, heavily layered range of stakeholders and practitioners across several</i>	<i>Standardised but numerous procurement sites located across country.</i>	<i>Stakeholder located in alternate governing bodies, basis</i>	<i>Segregated on a regional basis with strong collaborative elements.</i>	<i>Only primary locations under management.</i>
							<i>Centralised, shallow hierarchy</i>

		<i>discreet enterprise units and geographical areas.</i>		<i>reasonably separated by major project group.</i>		
	<i>PE</i>	<i>Low</i>	<i>Moderate</i>	<i>Moderate</i>	<i>Moderate</i>	<i>Unknown</i>
<i>Internal Coherence / Communication</i>	<i>D</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>	<i>High</i>	<i>High</i>
		<i>Diverse, multi-layered project team structure. 'Too discrete big to be agile'.</i>	<i>Geographically intimate procurement structure.</i>	<i>Few, geographically intimate project team based procurement structure.</i>	<i>Geographically discrete procurement structure.</i>	<i>Simple communication structure effective in small stakeholder group</i>
	<i>PE</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>	<i>High</i>	<i>Unknown</i>
<i>Fit of D</i>		<i>High</i>	<i>High</i>	<i>Moderate</i>	<i>High</i>	<i>Low</i>
<i>Normative & Observed</i>		<i>Normative process, is subject to numerous case-by-case amendments.</i>	<i>Heavily structured, with high procedural compliance.</i>	<i>Tightly controlled normative procedural process. Flexibility made high normative, exceptions identified.</i>	<i>Heavily structured, with procedural exceptions compliance.</i>	<i>Little structure in procurement process</i>
	<i>PE</i>	<i>Moderate</i>	<i>Moderate</i>	<i>Moderate</i>	<i>High</i>	<i>High</i>
<i>Geographical spread of stakeholders</i>	<i>D</i>	<i>High</i>	<i>Moderate</i>	<i>Low</i>	<i>Moderate</i>	<i>Low</i>
		<i>Numerous geographical locations of primary project stakeholders, Governing bodies and operations over local.</i>	<i>Numerous CCG sites across country, although uniform nature of the CCG changes spread over additional local.</i>	<i>Small geographical spread of primary practitioners.</i>	<i>Spread over regional procurement units, central government involvement.</i>	<i>Core location only</i>
	<i>PE</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>	<i>Moderate</i>	<i>Moderate</i>
						<i>Unknown</i>

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4.12 Summary of prevalence and perceived effectiveness amongst emergent themes

		CASE 1 DEFENCE		CASE 2 HEALTH		CASE 3 NUCLEAR		CASE 4 LOCAL GOVERNMENT		CASE 5 ENCIRC		CASE 6 IBM	
Superordinate theme	Subordinate theme	Prevalence	Perceived effectiveness	Prevalence	Perceived effectiveness	Prevalence	Perceived effectiveness	Prevalence	Perceived effectiveness	Prevalence	Perceived effectiveness	Prevalence	Perceived effectiveness
PERFORMANCE MANAGEMENT	Quality Filters and KPIs.	H	L	H	M	H	H	L	L	L	M	H	H
	Contractual techniques	H	M	M	M	H	H	L	L	M	M	H	H
	Collaborative practice	M	L	L	M	H	H	M	H	M	M	U	U
	Coherence of internal project control	L	L	M	M	H	H	H	M	M	H	H	H
	Predictive analytics	M	M	M	M	H	M	L	L	M	M	H	H
RISK MANAGEMENT	Use of Avoidance/Reduction, Transference Strategies	H	H	L	U	H	H	L	M	L	M	M	U
	Density of risk management practices throughout acquisition lifecycle	H	M	M	M	H	H	L	L	M	M	M	M
	Risk reporting / Information gathering	H	M	M	M	H	H	L	L	M	M	H	H

TECHNOLOGY MANAGEMENT	I.C.T System Variety	H	L	M	M	M	H	L	M	L	M	M	H
	E-procurement Systems	M	L	L	M	H	H	L	L	L	L	H	H
	Knowledge Management Systems	L	M	M	M	H	H	L	L	L	L	H	H
	Coherence created across organisations	L	L	M	M	H	H	L	U	M	M	H	H
	Extra-organisational Systems	M	M	L	M	M	H	L	L	L	L	H	H
ORGANISATIONAL ALIGNMENT / OTHER FACTORS	Sub-contractor engagement	L	H	M	M	H	H	L	U	L	L	M	U
	Spread of organisational control	H	L	H	M	M	M	M	M	L	M	U	U
	Internal Coherence / Communication	L	L	M	M	H	H	H	H	L	M	H	U
	Fit of Normative & Observed	H	M	H	M	M	M	H	H	H	H	H	H
	Geographical spread of stakeholders	H	L	M	M	L	H	M	M	L	M	H	U

Table 20 - Summary of Prevalence & Perceived Effectiveness

Key: H = High effectiveness, M=Moderate effectiveness L= Low effectiveness, U=Unknown

4.13 Chapter Summary

This chapter has outlined the findings from each of the case organisations investigated within this research. Each organisations acquisition lifecycle has been mapped, and key case characteristics have been extracted and outlined in detail. Having delineated the findings, the following chapter will now discuss these in depth with reference to existing literature and the implications thereof.

5 CHAPTER 5: DISCUSSION

5.1 Introduction

This chapter consists of three main sections. Firstly a presentation of the cross case analysis. This section demonstrates the logic of the analysis and explicitly details how these themes were derived from each set of case characteristics.

Secondly, after having presented each of the emergent themes, each theme is discussed systematically. The discussion focuses upon how each of the cases compares in terms of each theme. This section is structured in accordance with the four key areas of interest identified in the literature review: organisational alignment, performance management, risk management and technology management. At the end of each of these major sections, the author applies the theoretical lenses of both agency theory and institutional theory to the emergent discussion points. The purpose for doing this is to generate theoretical insights that link directly with the conclusion of the thesis.

Lastly, after the findings have been discussed this chapter revisits the literature in order to identify where this research is situated in the current body of knowledge post-discussion. The focus here is on identifying amongst the body of core literature what the areas of contradiction and confirmation are with the work presented in this thesis.

5.2 Discussing key categories of interest

The discussion section uses the thematic architecture identified from the cross case analysis as a structure to organise the remainder of the discussion chapter. Each of the key areas of interest are explored in turn, with each sub-ordinate theme discussed within those categories.

5.2.1 Organisational Alignment

Organisational alignment represents the amalgam of organisational structure and organisational arrangement. Organisational structure refers to the physical distribution of the organisation in terms of what processes are undertaken at which geographical location. The arrangement of the organisation references the conceptual structure of the organisation, how it is organised into operational centres, teams of people and the decision making architecture. These characteristics were used as a filter through which to highlight relevant processes along the acquisition lifecycle. As the Zachman mapping technique was used to chronologically plot process along the acquisition lifecycle, those processes or interview transcripts that referenced

the organisational structure or organisational arrangement of the case organisations were highlighted and explored during later interviews and within document analysis.

The organisational alignment characteristics were compared across case and the process of thematic reduction resulted in the emergence of Contractor engagement, Spread of organisational control, internal coherence / communication, fit of normative and observed and geographical spread of stakeholders. These subordinate themes will now be discussed in turn.

5.2.1.1 Contractor engagement

Contractor engagement was reduced from a larger set of second order themes, namely: Power dynamics, Strategic engagement and the architecture of relationship.

The concept of power dynamics describes those characteristics of the organisation that pertained to systems, process or arrangements of the two that caused advantage or disadvantage to the negotiations between the procuring organisation and their supplier. In MOD the arrangement of organisations was focused towards internal compliance rather than exploitation of power in the supply chain relationships. Individual project teams operating on separate and bespoke contracts led to a situation whereby the organisational structure is not arranged so as to encourage cross communication and economies of scale. This capability for MOD to create purchasing power by amalgamating contracts is not fully exploited. This situation is largely replicated within the NHS given that the organisation's procurement structure is highly devolved into discrete operating centres (CCG's CSUs). This structure causes contracts to be made on a more numerous, but a smaller basis between the NHS and suppliers. Also, the internal power dynamics between competing sub-units was also a relevant factor in deriving self-reported inefficiencies with the NHS. In opposition to MOD and the similar position of NHS the procurement infrastructure at Sellafield and IBM was specifically organised towards extracting economies of scale from their procurement efforts. Whilst IBM's procurement structure catered to a range of both PCP and more traditional non-servitized purchasing, Sellafield's system sought to extract economies of scale from its set of predominantly PCP requirements. This was done through heavy use of collaborative alliances, long term contract awards, and heavily incentivised procurement practices. The remaining two cases employed a range of collaborative procurement options, however the overall purchasing power and sophistication was generally less and so the opportunities to exert power on the supply chain was diminished.

Strategic contractor engagement was a second order theme that devolved into contracting engagement. This sub theme refers to the degree to which an organisation structure supports inter-organisational collaboration with supply chain partners. Whether this be through jointly owned premises, personnel exchange or having job roles dedicated to collaboration and the co-creation of value each of the organisations engaged with the supplier base in a range of different ways. MOD, Sellafield and Encirc utilised integrated project team structures where personnel from the supply chain partners are embedded within the organisation. Each organisation used formal meetings at various points in the cycle as the main interaction with suppliers on PCP contracts.

Architecture of the relationship (another sub theme) refers to the logical arrangement of processes that govern the interactions with suppliers. In MOD and the NHS the relationships were a combination of ad-hoc and highly formalised supplier interactions. Numerous formal points of necessary interaction and information exchange were encoded into the normative process (E.g. initial gate, main gate, and CHEST required interactions). In the local government case and at Encirc the architecture of the relationship was significantly less formally structured and was prominently more ad-hoc. The organisation also demonstrated a far smaller hierarchy of roles, responsibilities and sub-units. As a result a smaller number of individuals were responsible for the management of supplier relationships on a 1-1 basis without the necessity of formalised structures to enable inter-organisational communication on a much larger scale.

These factors were reduced to the general theme of supplier engagement in relation to how the organisations were structured (organisational alignment). The outcome of this showed a sub grouping of organisations. Van der Valk & Wystra, (2010) make the distinction between relational and traditional mechanisms of control between the supply chain actors. In the case of supplier engagement there is a clear distinction between these mechanisms. The Local government and Encirc featured a lower level contractor engagement in general, but significantly less in terms of the relational mechanisms, the majority centring on the legal requirements placed upon these organisation by OJEU. MOD and the NHS showed significantly higher degrees of both traditional and relational mechanisms. IBM provided insufficient data to make a defensible suggestion, however Sellafield was the clear outlier in terms of each of this grouping of characteristics. In terms of both the degree of traditional and relational mechanisms of control and engagement. Suppliers were fully integrated into extra-organisational systems that performed a variety of functions, they also displayed the integration of people into working groups that could also be seen within MOD.

5.2.1.2 Spread of organisational control

A prevalent area of meaningful divergence amongst the body was in the spread of organisational control. This theme describes the variety and volume of organisational units and their arrangement to each other. It can be through of as the hierarchical complexity embedded within the case organisations.

This factor is an amalgam of two second order themes. First of which is the centralised vs decentralised structural hierarchy, and secondly the specificity of organisational units objective. The first theme relates to the degree to which the organisational management of procurement activities is controlled through either a central decision making authority or through disparate organisational units. The second themes refer to the rigidity of the organisational structure as an emergent theme.

MOD and the NHS were similar in that while there was certain centralised specialist activities such as ‘cross-organisational practice improvement’, or ‘contracting’, the organisations generally had a significant spread of control across segregated organisational units often referred to as ‘silos’ of operational control. In contrast Sellafield, Encirc and the local councils operated a largely centralised structure in term of their operational control, with some variance. IBM also cited that their procurement practice was heavily centralised.

In regards to the second theme it was observed that some of the organisational units had a multiplicity of roles while in other cases the procurement related units were embedded within rigid hierarchies through information flow was limited to the pre-approved channels. In regards to MOD and the NHS both exhibited significant flow of information outside of the organisations’ channels of communications and control, to the extent of being able to reference multiple issues emergent from this. Sellafield and IBM operations were driven by standardised integrated process that did not encourage ad-hoc communication and control mechanisms. In the case of Encirc and the local government each of the organisation’s relatively flat hierarchies guarded against this and it was infrequently observed.

These two factors were combined to the third theme of organisational control. There were three distinct categories of user in accordance with this. MOD and the NHS who operated a densely layered decentralised organisational control structure with significant information flow outside of rigid, formalised channels. Secondly was Encirc and the local councils which operated a largely centralised model, however the comparatively flat hierarchical structure mitigated the emergent necessity for significantly decentralised operational control. Lastly, the third category

was amongst IBM and Sellafield. Despite a significant and complex organisational hierarchy control was retained from a central base and managed with a high perceived effectiveness.

5.2.1.3 Internal Coherence / Communication

The last theme concerned the structure of the organisational units themselves as a manifest characteristic of PCP organisation. Internal coherence/communication is distinct in that it relates to the communications infrastructure that supported interaction between different parts of the organisation. The internal coherent/communication theme is an amalgam of three other themes namely: ‘Holistic visibility pertaining to systems’, ‘holistic visibility pertaining to architecture’ and the efficiency of the communication.

Holistic systems visibility refers to the organisational systems ability to convey a coherent view of the organisation’s current and historic activity to a given member of its hierarchy. There was significant variance with the organisations’ ability to record, process and disseminate the latest information.

Holistic visibility through architecture refers to the informational recording, processing and retrievals process outside of systems. Where some organisations such as IBM had robust standardised processes to dictate what information is recorded, by whom and at what point, other organisation’s information collection and dissemination was somewhat more ad-hoc.

Effective communications relates to the ease with which information regarding different aspects of the organisations can be engaged with. For example, while certain information is available because the architecture permits its storage, and it can be procured through a system that has access to it, is it prohibitively difficult due to access due to system efficiencies.

Numerous points raised throughout the data within the MOD case strongly indicated that the organisation’s ability to effective retrieve information regarding its operation was a core problem. The findings chapter talks about particularly pertinent examples of poor inter-organisational communication causing a plethora of operational issues regarding the procurement and contracting operations. The NHS had a variety of well incorporated systems spanning the organisations which were codified as being relatively high in terms of process density. However there were numerous examples of communication failures also. The ability for Sellafield and the NHS to retrieve and process relevant information as to the condition of the organisation generally was codified as moderate, Sellafield’s advanced LFE systems gave exceptions good clarity of historical organisational action and consequences, while the local government close working proximity elicited the same effect by default. Whilst Encirc has a

robust normalised reporting structure the low use of systems to manage this caused some communication issues. Whilst the communications architecture is not perfectly known from the data collected at IBM, the use of advanced systems in combination with globally distributed working practices is suggestive of a high level of internal coherence.

5.2.1.4 Fit of Normative & Observed

The capability for the organisations to affect effective control of their procurement processes across the organisation's hierarchy varied in accordance with the other characteristics listed in this section. However, it was also observed in the data that there was often significant normative process points in place to support holistic control, however due to these processes not being followed by staff members the potential benefits did not manifest. This was seen across the cases in numerous instances. This theme was directly codified from the characteristics without being derived from a reduction of second tier themes.

Across the cases the vast majority of processes highlighted in the normative structure were broadly adhered to when interview participants were queried on this. MOD, the NHS, Encirc, IBM and the local government cases all displayed a general fit between normative and empirical action. There were however numerous notable exceptions to this, a particularly prevalent factor was variance between mandatory and optional organisational practice embedded into the structure. MOD's SEOC group offered a range of expertise free for consultation by the integrated project teams, however this wasn't introduced as a mandatory requirement in the normative procurement programme and thus was underutilised. This was true of numerous specialist business services provided by the CSU within the NHS Case.

5.2.1.5 Geographical spread of stakeholders

A key component of the organisational alignment theme was the physical distribution of the organisation's procurement practice. Separate from the earlier factor of organisational control, this theme refers to the explicit geographical distribution of stakeholders of the procurement process. The spread of stakeholders geographically was derived directly from the cross case analysis of case characteristics without being reduced into second order themes.

MOD was by some significant margin the case most geographically dispersed if you discount the NHS's repeated units, it was also observed that this split of geographical basis between procurement, procurement assisting units such as the scrutiny units, product users and integrated supplier facilities cause a number of communication difficulties as well as tension between the organisational units. To a lesser extent this is true of the NHS, while the spread of

NHS stakeholders across numerous geographically dispersed organisational units there was evidence of poor communication. Sellafield and Encirc were the inverse with the majority of stakeholders being centred in a few intimate geographical locations. Interview participants at Sellafield recorded this as being a positive characteristic of the organisation, and so to a lesser degree so Encirc. IBM's spread is global, the effect of this is obscured by their integrative sophisticated technologies, however the research could not record comment as to the effectiveness of their current geographical arrangement for procurement.

5.2.2 Applying the theoretical lenses to organisational alignment

As stated in the methodology, the purpose of applying the theoretical lenses of both agency and intuition theory is not to juxtapose the implications of interpreting the results through either an agency theoretic perspective or an institutional theory perspective but instead to utilise both theories in tandem to derive a more robust examination of the phenomena (*Allison, 1971; Feyerabend, 1981; Kuhn, 1970*). At the end of each of the major discussion sections the theories will be applied to the emergent insights in order to posit theoretical insights into the state of acquisition lifecycle practice in organisations procuring complex performance.

5.2.2.1 Agency theory as applied to organisational alignment

Agency theory fundamentally explains the relationship between a procuring organisation (the principal) and a supplying organisation (the agent). Given that organisational alignment seeks to understand the logical and physical structures of the case organisation, the application of agency theory to understanding these logical and physical choices is in focusing upon those points where the organisation's structure interacts with an agent, or is arranged so as to accommodate or address the behaviour of an agent.

In terms of MOD, the agency theoretic explanation holds with their risk averse organisational structure. MOD's complexity prompts them to organise so as to avoid the information asymmetry between themselves and their highly competent supplier base. Their structure involves the use of integrated project teams throughout which suppliers are embedded within the organisation. There is evident example of goal conflict (*Eisenhardt, 1989*) leading to MOD being vulnerable to the self-interested behaviours of the agent. Whilst MOD's organisational structure is designed to ensure that the product delivered by the agent is fit-for-purpose, their fractured complex and often incoherent decision making process makes them vulnerable to 'simple' panacea solutions offered by the agent. Simply put, if the agents offer an assurance of capability MOD's organisational structure does not facilitate commercially

sensitive thinking and will opt for simple, cost-ineffective solutions that address their operational concerns. In contrast to this the coherent, centralised, data intensive structures embedded within both Sellafield and IBM serve to address the apparent information asymmetry and thus offer a means by which the procurer can more competently discriminate between effective means of addressing the self-interested behaviour of the agent in each emergent context.

Whilst not achieving the same decision enabling coherence as either IBM or Sellafield, the NHS's devolved model offers some natural protection to managing the self-interested behaviours when compared with MOD. The NHS devolves its acquisition into regionalised CCGs, and thus the commercial assessment of the competing options is reduced in complexity from the procurers perspective, in doing so they reduce the information gap. Agency theoretic metrics offer little insights when considering the organisational arrangement of the local government and Encore's flat more simplistic organisational alignment.

5.2.2.2 Institutional theory as applied to organisational alignment

Of the two theories, the sociological variant of institutional theory is far more applicable to explaining the causes of adopted organisational alignment and organisational structures generally. Whereas previous applications of agency theory have focused centrally on the contract between two organisations. Institutional theory looks wider to explain the emergence of particular isomorphisms through legitimacy seeking behaviours (*Eisenhardt 1989*).

It has been noted that there are groups of organisations formed within the cases. Encirc and local government, NHS and MOD and finally Sellafield and IBM. These organisations are grouped firstly in order of their outright density and complexity of their organisational structure (as defined by the thematic characteristics). Encirc and local government typically have a lower degree of overall relational complexity and organisational complexity. Secondly MOD and NHS have extremely high relational and organisational complexity, and thirdly so do IBM and Sellafield. However, the former grouping of MOD and the NHS also have a lower degree of internal coherence. In taking an institutional theoretic perspective, we can see that these emergent groupings scale with the institutional theoretic pressures that are applied. The organisational structure at Encirc and local government can be explained as a consequence to the coercive pressures placed by governing bodies. The structures centre on the completion of the mandatory OJEU requirements, there are no additional applications of sub-groups to cater to emergent requirements that derive from higher relational complexity. In the other four cases the organisational structure is partially explained through the legal coercive pressure but also

significantly more coercive pressures, mimetic pressures and normative pressures. MOD and the NHS are shown to be particularly sensitive to the combination of mimetic and coercive pressures placed upon them. MOD have a variety of coercive pressures derived from wider political intervention and high levels of mimetic pressures emergent from attempting to cope with changing organisational focus. A keen example of this is in MOD's numerous, partially redundant operating centres such as SEOC. SEOC emerged to address a particular problem by benchmarking how private sector organisations operated (mimetic pressure to address decommissioning risk in uncertain environments) and then proved ineffective as project teams rushed to adhere to internal deadlines, the functionality of the group was then partially offloaded back to the project teams, leaving a half-way-house solution. A parallel example of this was also observed within the NHS and discussed heavily in the findings chapter, whereby the organisation reshuffled its organisational roles in an attempt to address the coercive pressure to provide a local service and then a mimetic pressure to centralise expertise.

The notable points regarding the organisational alignment of both Sellafield and IBM were that while they were subject to many of these same pressures as MOD and NHS, the latter group took a significantly longer term view of how the pressure would be handled and thus introduced a stability into the normative acquisition process.

5.2.3 Performance Management

Performance management represents the amalgam of contract management practices as well as inter-organisational management of performance. The use of performance management techniques and contract management tools featured heavily within the initial problem space regarding PCP by Howard and Caldwell (2010). A notable point is made in the literature is that the performance monitoring and management strategies, the use of incentivisation mechanisms and the means of engaging with contractors is fundamentally different within the PCP context when compared with the traditional performance management strategies observed in fast moving supply chains (Brown, et al., 2014, Howard & Caldwell, 2010). As with each of the four main areas of interest, the characteristics that related to how each organisation managed performance were highlighted along the Zachman acquisition lifecycle maps. These characteristics were then compared across the range of cases to create a set of themes that seek to describe performance management within procurers of complex products and services. The process of thematic reduction across these characteristics results in the following five final thematic categories: 'Quality Filters and KPIs', 'Contractual techniques', 'Collaborative practice', 'Coherence of internal project control' and 'Predictive analytics'.

5.2.3.1 Quality Filters and KPIs

The types of information that are recorded throughout a procurement process in assessment of the performance was a commonly occurring thematic areas within the research. This factor pertains to both the logic that is in place to aid the decision making process about what KPI can be utilised as well as the actual range of KPI's used. Thus this final tier theme is an amalgam of the two sub areas KPI decision making and KPI application.

KPI Decision making refers to the logic that supports the choice of KPIs. Some organisations provided a range of KPI decision making aids, while others operated on a more ad-hoc approach. KPI Application refers to specific KPI's used within the systems, as well as the locations within the procurement process at which they are applied (maintenance KPI's, manufacturing deliverables, after service support), the reaction to those KPI's (Punitive KPI's, KPIs designed to incentivise).

Across the range of organisations in the cross case analysis the majority of cases made extensive use of KPI's and often had clear programmes for how these KPI's were arrived at. Of the six case Encirc and the local government had what could be termed, basic mandatory application of performance indicators. The KPI's were applied to milestones along project delivery stages and some additional application of performance metrics in the servitized elements such as maintenance. The decision making process was generally customised and not built from a pre-existing bank of knowledge or through any kind of formalised rigorous decision making process. The other cases, MOD, NHS, Sellafield and IBM all demonstrated an extremely wide ranging application of KPI's. While IBM and Sellafield report that the wide ranging use of KPI's is perceived to be an effective solution, the NHS reported only moderate satisfaction and Defence low. MOD's lack of an internal repository of similar projects was cited as a major barrier to effectively creating a set of appropriately customised KPI's whilst they maintained that this effect was achieved through expertise often. MOD also demonstrated a reliance on the primary contracting model whereby the model passed all risk to the supplier in the majority of cases. Other organisations made good use of dynamic metrics and a range of contracting options with particular KPI's built in as standard. In Sellafield there was a wide range of contrasting options discussed as per the normative process, each of these came with specific set of incentivising and penalising KPI's. The NHS had numerous prominent examples of incentivisation mechanisms such as CQUINS. Interestingly, the least satisfied was MOD with a wide range of complex procurement available, however the consistency of the decision making process architecture was linked with causing the perceived dissatisfaction.

5.2.3.2 Contractual techniques

While KPI's can be applied in accordance with a contract and at various stages in the lifecycle, the approach to generating and forming contracts was a distinct separate emergent category of interest and was derived as a separate theme. This theme was in turn derived from the reduction of its two constituent parts, namely; Process of contractual decision making and application of contractual techniques.

The process of contractual decision making refers to the logic that is used to decide upon what contract type, or specific contract will be utilised by the organisation. The application of contracts is an assessment of the range of contracts that are used by a particular organisation.

Across the body of cases the use of contracts and the sophistication of the mechanisms for applying particular contracts to particular procurement contexts was widely ranging. Sellafield, defence and IBM had a very large range of contracting mechanisms, with Sellafield and IBM also demonstrating highly sophisticated methods for deriving appropriate contracts.

In comparison amongst these three: MOD utilised a range of contractual techniques however there was little in terms of normative process for deriving these options beyond individual expertise and wider political pressure. Sellafield had a sophisticated means of deciding what contracts were suitable for what procurement types and was also fastidious on reporting how the application of these various techniques had been applied. In addition, MOD also followed wider trends, in that they went through a period of PFI style contracts for wider political reasons. Sellafield case-by-case approach resulted in a more integrative network of suppliers that better leveraged economies of scale through the wide adoption of procurement alliances. As a result of these factors Sellafield reported high perceived effectiveness as opposed to MODs low. Whilst less granular detail was made available by IBM, their cognitive capabilities systems provided the procurement professional with a range of historic reporting regarding the outright effectiveness of previous application of contracts in similar situations.

Of the remaining cases the NHS and Encirc had a moderate variety of contracting types used. The NHS employ a wide range of contracts, however similarly to MOD, the decision making process was based around the NHS standard contract with only minimal use of intelligent systems processes to aid in contract customisation or type selection. The local government cases employed only a small range of contracting types and the decision-making process was people-centric with little expert knowledge being offloaded into systems or processes.

5.2.3.3 Collaborative practice

Collaborative practice refers to instances of case organisations collaborating with external parties towards generating increased performance. The collaborative practice theme is an amalgam of the second order themes of horizontal collaboration and vertical collaboration. This theme exemplifies well the iterative nature of an abductive research design, whereby originally having highlighted collaborative practice as a meaningful factor pertaining to performance management, further investigation created the two separate themes of supplier collaboration and collaboration with other procuring organisations or third parties towards supplier engagement. These two themes were then recombined in the final cross case analysis.

Vertical collaboration refers to the collaborative action that is undertaken between the case organisation and the suppliers outside of the normal procurement interactions. The literary themes of co-creation of value lead in strongly to the identification of practice like this. Horizontal collaboration refers to activities undertaken by the organisation that involve other procuring organisation or third parties in a horizontal relationship to either extract mutual benefit, or leverage purchasing and negotiating power against a supplier.

Of the case organisations investigated Sellafield showed the most extensive inclusion of collaborative practice in their organisation general ethos and specific activities undertaken. The heavy use of frameworks, contract alliances created a situation of mutual dependencies and value co-creation between vertically aligned collaborators. Non-directly aligned collaboration also occurred as Sellafield invested in local enterprises that supported their suppliers in order to ensure a fully capable local marketplace. The example of investing substantially in a local manufacturer of cranes was a prominent example in the findings. The remainder of the cases demonstrated considerably less collaborative engagement in either direction with the NHS not demonstrating any substantial collaborative investments or initiatives. The local government engaged in moderate levels of cross-council engagement and collaboration to bolster purchasing power, however the process was non-normalised and still an emergent trend within that field.

5.2.3.4 Coherence of internal project control

Coherence of internal project control was directly derived from a cross case analysis of the case characteristics without any intermediating second order themes. The coherence of internal project control refers to the degree to which the performance management strategy has been enacted consistently across the organisation.

In the case of Sellafield, Encirc and IBM the use of performance management tools and techniques was centralised both in a geographical sense and in a logical hierarchical sense. The organisations had a central repository where the expertise was retained and practitioners could access easily and at multiple points along the acquisition lifecycle. This created a great degree of consistency and coherence in the execution of the wider performance management strategies. This was true to a lesser extent with the local government case also. A significant caveat to this is apparent when considering the organisational alignment of the Encirc and local government case. Their substantially smaller hierarchies and small geographical spread of key stakeholders has meant that the consistency and standardisation of performance management practice has emerged as a natural consequence of their close proximity rather than as a result of skilful intervention. The degree to which performance management practice is undertaken general is also a factor. This is however not true of Sellafield where the coherence of the performance management strategy derived directly from a meticulously adopted set of standard working practice enabled by a coherent knowledge and performance management system. IBM was similarly enabled although the exact makeup of this was not fully explored within this study.

The NHS has some universal standardised factors that were adopted widely throughout the organisation, however the regionalised approach towards handling business intelligence needs had led to significant variance within the system and caused some examples of redundant process to be observed within the case characteristics. MOD were marred by having a wide range of I.C.T systems (as discussed later) and few methods of formalised control. Whilst there was standard documentation, the lack of a centralised repository of expertise and depth of organisational unit hierarchy lead to little standardisation of the performance management process both in terms of its output and the logic of its application.

5.2.3.5 Predictive analytics

Predictive Analytics referred to the analysis of previous procurement or other data sources in making assessments about the optimum way by which to organise future performance management strategies. This theme was not derived from other second order themes and instead was reduced directly from case characteristics in the cross case analysis.

Sellafield and IBM were again the exception in that there was widespread use of predictive analytics compared with the other cases. With IBM the nature of this analytics was of a different order of quality and capability, owing to who the organisation is, it is not unreasonable to suppose that these capabilities are perhaps world leading. Within IBM the cognitive

capabilities suite and Emptoris procurement suite provide structure and unstructured data analytics on market and supply chains from sources as wide as weather reports and twitter. Outside of these very advanced capabilities Sellafield displays the highest level of predictive analytics, the ATLAS procurement management practice provide profiles on supplier and supply chain alliances that can be utilised in risk assessment and inform the selection of performance management of any given contract. Each of these approaches was well regarded in terms of their perceived effectiveness.

In the case of MOD and the NHS, the organisations had similar levels of predictive analytics, there was evidence of initiatives to create holistic control that would allow better management of suppliers. However, these initiatives often failed as top level organisational requirements changed and organisational units underwent restructure. The result is thus that there has been continuous growth of complexity which has outpaced the organisation ability to coherent apply systems capable of the kind of rigorous data storage required to perform predictive analytics on a supplier base. This is of course done on a case-by-case basis and formal reports are submitted regarding each major supplier interaction as per the official documentation. Of the remaining two cases there was simply no evidence of this within the local government case. Encirc did have automated capabilities to record in-use asset breakdown and maintenance repair which prompted discussion with suppliers present and future. This was the only example seen within that case.

5.2.4 Applying the theoretical lenses to performance management

5.2.4.1 Agency theory as applied to organisational alignment

Performance management is the component of acquisition lifecycle practice amongst procurers of complex performance that is most suitable for interpretation through an agency theoretic perspective as it most centrally focuses on the contractual arrangement between the two organisations.

Zsidisin & Ellram (2003) in applying agency theory to a case study in supply, noted that the metrics that were placed upon the agent by the principal in order to restrain the self-interested behaviours increased as the complexity of the context increased (and thus uncertainty increased). This research largely confirms this proposition. The emergent grouping of cases by cross case themes identified after the interpretation of the organisational alignment themes broadly holds here. The groupings show a clear difference in density of the KPI's and behaviour modifying controls in the more complex cases. This variance between the cases in self-

interested behaviour monitoring was replicated when observing the emergent theme of ‘Contract Management’. The higher the degree of relational complexity the greater the variety of contracting methods and reporting mechanisms that were embedded within the principal organisation’s acquisition to restrain the behaviours of the agent.

Within the cases the local government and Encirc case applied a moderate amount of key performance indicators to the agent. However, these were embedded within a typical fixed price contracting framework and the focus was on penalising clauses rather than incentivisation clauses. An exception to this was in local governments’ use of the dynamic purchasing contract, which sought to alleviate lock in risk from the perspective of the principal. MOD and the NHS as the second emergent group utilised a considerable variety of behaviour moderating strategies in the form of a diverse range of KPI’s an alternative contracting mechanisms. The NHS made particularly novel usage of KPIs thought having rolling rotas of continuous improvement metrics applied to their performance management techniques, these metrics were however not standardised across the range of projects. MODs contracts whilst embedded with behaviour moderating conditions, generally took the form of risk averse, self-interested, protectionist arrangements. The majority of contracts were fixed term contract awards with heavy penalties associated. Or private finance initiatives that took the form of either contracting for availability contracts (agent holds risk for maintenance) or contracting for capability (agent holds all risk and owns asset).

The fundamental agency theoretic principle proved to be a major distinguishing feature between the cases. Norrman (2008) applied agency theory to an alternative body of cases and found that the most effective form of contracts were those that applied in depth controlling mechanisms and showed a willingness to engage in risk sharing mechanisms. This willingness to share the risk was not apparent in MOD, NHS, local government or Encircs apparent form in a few isolated examples. In contrast to this Sellafield adopted an approach of constant balancing of responsibilities in their contracting frameworks, as expressed through heavy use of strategic alliances and sharing mechanisms such as the value transition point. These factors were in addition to a widespread use of incentivisation and penalty mechanisms as observed in the other cases. In the case of IBM whilst it was apparent that there was a range of mechanisms used the specific of where and when were considered a tightly controlled part of their intellectual property and could not be examined, thus a limitation of this study.

5.2.4.2 Institutional theory as applied to organisational alignment

Of the major characteristics of acquisition lifecycle practice within PCP contexts the performance management characteristics were most suitable for interpretation through the agency theoretic lens and less so through institutional theory. However, the effect of coercive pressures was again clear. This is particularly apparent with the public sector organisation under investigation within this research. MOD, NHS and local government and Sellafield were all required to enforce mandatory minimum KPIs from central government across a range of measures. Whilst this manifested at the micro level in terms of rejecting suppliers' whom had inadequate carbon management policies for example. It also applied on the macro level with specific metrics having to be included in the standard contracts. The mechanisms for deriving the effectiveness of particular metrics were also absent from the NHS MOD and local government, while there was some assessment there was no use of sophisticated analytics to assess the effectiveness of the approach. Thus, in agreement with Zsidisin et, al (2005), the organisations were often adopting KPIs through the mimetic and normative pressures rather than through rational assessment of overall effectiveness.

5.2.5 Risk Management

Risk management represents the amalgam of risk management strategies and risk reporting characteristics. Howard and Caldwell (2010) also featured the management of risk within their initial problem space, as with performance management, the requirements to manage risk in the context of PCP are distinctly different from that of traditional procurement (*Mayer & Argyres, 2004; Spring & Araujo, 2014*). In the initial examination of the cases, risk was entangled with performance management and thus risk related elements were entangled with the performance management elements. Each of these elements was encoded along the Zachman acquisition lifecycle maps. The characteristics pertaining to risk were then compared across the range of cases to create a set of themes that seek to describe risk management within the organisation procuring complex performance. The process of thematic reduction across these emergent characteristics resulted in three final thematic categories: Use of 'Avoidance/Reduction', 'Transference Strategies', the 'density of risk management practices throughout acquisition lifecycle' and 'Risk reporting / Information gathering'

5.2.5.1 Use of Avoidance/Reduction, Transference Strategies

This use of risk avoidance, reduction and transfer strategies refers to the explicit observed practice of how each of the case organisations manage risk throughout the various stages of the acquisition lifecycle. This theme was derived directly from the set of characteristics featured within the cross case analysis without first being reduced through second order themes.

The cases varied significantly in their application of risk remedies and their attitude towards risk generally. It should be noted that within the context of this work the risk management is pertaining to the management of financial, contractual and procurement risk, not operational risk of the organisations core business offering (defence, decommissioning etc.). MOD applied a relatively high range of risk remedies, most prominent of those was to avoid risk of financial overrun by transferring the ownership of risk to the primary contractor. This was done through the typical MOD contracting model of fixed price contracting, contracting for availability or contracting for capabilities. In the latter two contracting models, the risk for the in-use capability of the asset was also retained by the primary supplier. MOD were highly risk averse amongst the body of cases as compared with the majority of the other organisations. Sellafield also demonstrated a high number of risk intervention strategies, however as compared with MOD they were often more likely to retain the risk rather than transfer or avoid it. They used highly sophisticated practices such as value transition points. In this strategy, a project is segregated into numerous sections and the ownership of the risk of these subsections transfers to the contractor at relevant points. The logic here was that Sellafield were better suited to manage the project risk until a certain point in the project. Each organisation reported significant perceived effectiveness of these approaches.

Of the other cases the NHS was middle of the road in terms of its application of risk management strategies, the NHS tended to have pre-established red lines for risk avoidance built into its supplier assessment, and penalty KPI's in application to supplier failure however no long term risk assessment mechanisms were observed as part of the normative process. The local government and Encirc both reported relatively few formalised mechanisms for assessing risk, mandatory risk remedies were of course included in the contract.

IBM was again an exception. The cognitive capabilities package described in the case was making continual assessment of risk in the market and providing this to practitioners who were then able to action the appropriate decision making. Whilst the organisations reluctance to

share the specifics of it's still emerging IP protected practice, interview participants did remark on the pride of the systems capabilities and overall effectiveness.

5.2.5.2 Density of risk management practices throughout acquisition lifecycle

Whereas the previous theme was derived in seeking the range of risk remedies applied throughout the acquisition lifecycle, an additional theme emerged in the density of risk management practice generally. Some organisations adopted risk management assessment as only the mandatory points within the acquisition lifecycle whereas other organisations had risk assessment points throughout, thus the volume rather than variety of risk management practice is what has been thematically reduced here. This theme was reduced directly from the case characteristics without the intermediate stage of being reduced into second order thematic constructs.

Similarly, with numerous other process expressing the depth and degree of process used: Sellafield, MOD and IBM all had a dense arrangement of risk management practice throughout the acquisition lifecycle. In contrast the NHS had risk management assessments built into the standard contract, and some in service KPI's but the remainder of the cycle had only minor risk management practice included. Encirc was similar to the NHS in this regard with a few pre-determined points having risk management mechanisms built into the normative process such as in automated maintenance reporting and responses. The lowest rate of usage of risk management practise was observed within local government with only the basic practice surrounding legally necessary procurements points of OJEU.

Of the three cases with high degree of risk management practice embedded within the acquisition lifecycle Sellafield and IBM both stated the dense use of risk sensitive interventions to be of a high perceived effectiveness. MOD again cites trouble with ensuring that the risk management practice were adopted in a standardised way across the wide range of projects.

5.2.5.3 Risk reporting / Information gathering

The theme of risk reporting and information gathering refers to the organisation's capability to record and disseminate risk related information for use in future decision making practice to emergent and known risks. This theme is an amalgam of the risk reporting practices that are in place within the organisation (when, what, where, why) and the risk reporting systems (how, why).

The risk reporting practice refers to the normative organisation's structure that dictates what information should be in reports, in what format and at what time. A typical example of this would be in recording failure modes of complex projects so as to build in risk mitigation to this failure in future similar contracts.

Risk reporting systems refers to the means by which risk reporting is captured and is re disseminated to practitioners. This typically undertaken through integrated I.C.T systems with risk management capabilities built into them, or alternative some nonspecific centralised but technologically enabled repository in which risk reports can be stored, organised and accessed through.

These two characteristics were reduced into 'risk reporting and information gather structure' as a third order theme. As is the case with all of the risk-related themes MOD, Sellafield and IBM make a far greater use of risk-related data retrieval, processing and dissemination. IBM offer the same advanced capabilities towards risk management as they do towards performance management. The cognitive capabilities suite is used to feed into ongoing risk assessments, thus the data is automatically retrieved from the wide range of sources and disseminated to the relevant procurement or project team professional at required moments in the acquisition lifecycle. Sellafield utilise the ATLAS knowledge management system as the central repository for reporting risk related matters to and retrieving for future and current projects. Sellafield also made good use of standardised processes rolled out across the organisation such as 'fragnets' and A.L.A.R.P reports. MOD's risk management reporting structure was arguably the most complex of the organisations investigated in this research. However, as with a number of the communication related factors, the fractious nature of the information systems within MOD meant that relevant information to compile risk assessments and mitigation strategies was spread through a number of disparate systems, thus the complication of a comprehensive risk assessment was reliant on the enthusiastic efforts of the IPT pursuing the procurement or managing the in-service contract.

Of the other organisations in the study again the NHS had a moderate degree of reporting mechanisms. Generally the risk management practice was managed regionally, with the CCG acting on information provided by business intelligence units based within an associated CSU. The serious failure modes, which are an integral part of risk mitigation were globally accessible though the UNIFY and STEIS systems. Again the local government case had non-technologically enabled methods of recording risk and assessing them, although it was part of the formalised procurement practice. This is precisely true for the condition within Encirc.

5.2.6 Applying the theoretical lenses to Risk Management

5.2.6.1 Agency theory as applied to Risk Management

Agency theory has been used to assess risk management strategies that emerge in the process of the principal constraining the self-interested behaviours of the agent. Zsidisin (2005) in another case study, examined the early involvement of agent workers to address informational asymmetries and reduce emergent risk in principal-agent relationships. Other works that address risk in a similar fashion (Zsidisin & Ellram, 2003). A common theme when applying agency theory is toward understanding the mechanisms of restraining the self-interested behaviours of the agent through the diminishment of mutual risk via the co-creation of value (Zsidisin, 2006).

Within the body of cases there is a wide range of risk mitigation and management strategies adopted. In line with the previous work mentioned, the Sellafield case was the organisation that performed the highest number of integrative tasks with the agent. Sellafield both integrated alliance worked into the formalised procurement process at an early stage (Zsidisin, 2005) and adopted dynamic project ownership protocols (VTP) to manage self-interested goal divergent behaviours and address information asymmetries. MOD and the NHS also demonstrated the early involvement of workers from the supplying organisation to mitigate risk and align goals, however in the case of MOD the integration was far more expansive. This effect was observed less within both Encirc and local government. Unfortunately the specifics of IBM's integrative risk management practice with agents was not studied in the necessary granular detail owing to intellectual property issues.

5.2.6.2 Institutional theory as applied to Risk Management

In applying institutional theory towards understanding the emergent of risk management practice observed in the empirical environment of each case study the research asks: Of the practices observed what are the plausible mimetic, coercive and normative pressures affecting the emergence of the particular risk management practice observed. Within the MOD the preponderance of risk sensitive practice appears to be derived coercively from central government and, in turn, public opinion. Interestingly, there is a split in the adoption of risk averse behaviours. MOD are highly sensitive to operational risk and not to commercial risk, thus the organisation is coercively adopting highly risk averse operational practice at the expense of commercial sensitivity which is highly visible in the contract frameworks that outsource commercial risk (e.g. CFA, CFC, PFI, fixed term). The tendency to focus on

operational risk is also true of Sellafield. Similarly to MOD the operational risk is so highly critical that it takes priority within the organisation, although Sellafield successfully benchmark best practice risk management practice and have implemented them effectively (mimetic). The focus on the coercive pressures of adhering to politically sensitive delivery measurements is also evident within the NHS and to a lesser extent within local government. The private sector organisations are free from the alternative coercive pressures of public perception and central government and therefore are far more focused on the commercially orientated elements of risk assessment. The clear implications here are that the public organisations require a balancing of the coercive public pressure related risk policies and the mimetically adopted commercially sensitive risk policies seen favoured in Encirc and IBM.

5.2.7 Technology Management

Technology management represents all involvement with information systems that occur as a project or procurement progresses along the acquisition lifecycle within an organisation. As the Zachman mapping technique was used to chronologically plot process along the acquisition lifecycle, those processes or interview transcripts that reference the use of technology within the case organisations were highlighted and explored at later interviews and in document analysis.

The technology management characteristics were compared across cases and the process of thematic reduction resulted in the emergence of I.C.T System Variety, E-procurement Systems, Knowledge Management Systems, Coherence across organisations, Extra-organisational Systems as cross-case themes describing the usage of information systems and technology management within the body of PCP case.

5.2.7.1 I.C.T System Variety

I.C.T System variety is the amalgam of ‘state of technological development’ and ‘specific system and tech solution’. I.C.T system variety refers to the spread of I.C.T systems throughout the organisations, the quantity of systems deployed, where they are deployed, which areas they are deployed in and how they communicative if at all.

The state of technology development as a 2nd order characteristic refers to the overall organisation of the systems. This describes whether the systems are integrated or not integrated and the degree to which the systems are able to speak together.

Specific systems and technology systems refers to specific examples of I.C.T systems that were observed as interacting with the acquisition lifecycle and feature within characteristics shown.

Of the cases involved in the research, MOD has the widest variety of I.C.T systems that interacted with the procurement process, both in terms of the overall number but also in terms of types of systems and the locations at which they are maintained, deployed and primarily operate. For example, the inclusion of maintenance contracts required interactions with inventory management systems that store information of parts usage that is maintained by the front line commands. This system is not held or maintained by any agent directly interacting with the procurement process but the data held within is required within the acquisition process. MOD is littered with examples such as these, it was quoted that there was over 200 disparate systems, some of which dated back to the 1970's and were still in use. IBM and Sellafield were shown to have a moderate variety of systems interaction. Whilst there were a number of systems interacted with they were largely managed through one individual meta system, in the case of IBM the majority of interactions was filtered through the Emptoris procurement suite. In the case of Sellafield there were a number of systems that facilitated the majority of I.C.T requirements such as ATLAS and CMART. The NHS was similar in this regard, CHEST along with UNIFY and STEIS were the majority of the major systems used, however there was also widespread usage of non-bespoke digital information exchanges (Excel). IBM and Sellafield reported high degrees of perceived effectiveness. Of the remaining cases there was a low degree of variety, with only a handful of minor systems visible in Encirc and only non-bespoke systems visible in local government outside of the online procurement tools.

5.2.7.2 E-procurement Systems

The usage of E-procurement systems were highlighted as a theme in and of itself amongst other themes that consider the wider use of I.C.T systems. E-procurement systems were derived directly from the case characteristics without first being derived through 2nd order characteristics. The theme refers to the utilisation of the e-procurement systems and their integration into the acquisition lifecycle process.

Amongst the cases featured in this study, IBM and Sellafield are once again the organisations that demonstrated the highest degree of association with this theme. The utilisation of e-procurement systems and the integrative nature of the systems was significantly in advance of the other organisations observed. Sellafield's procurement system was a single point of entry that managed data collected from current and historical supplier, and facilitated informed decision making by informing procurement professionals. IBM's e-procurement systems performed a wide variety of function, such as knowledge management and risk assessment. The Emptoris suite is the most expansive and functionally capable system observed amongst

the body of cases. Again, the groupings of organisations repeat with the NHS and MOD being closely aligned in terms of their usage of e-procurement systems. Whilst MOD did have slightly greater use of their central procurement practice, largely the two organisations used the e-procurement system for the tendering and supplier communications without any incorporation of additional functionality. Lastly, Encirc and the local government use no primary procurement systems outside of the publicly available services for OJEU. The general effectiveness of the organisation's systems tracks this order.

5.2.7.3 Knowledge Management System

Knowledge management systems is an amalgam of two 2nd order themes. Namely, evidence of knowledge management functionality, and comprehensive knowledge management systems. Evidence of knowledge management functionality refers to those knowledge management-related functionalities that are embedded within non-dedicated knowledge management systems. Conversely, comprehensive knowledge management systems refers to those specific systems that are dedicated towards the gather, processing and dissemination of inter and extra organisational knowledge.

The same broad splits between the organisations exist again for this theme as with a number of other themes and all I.C.T related themes, that being: IBM and Sellafield have comprehensive, centralised knowledge management capabilities embedded in one single holistic system. In the case of IBM the processes surrounding the acquisition of knowledge for the system was less detailed as they were not willing to share the exact details for reasons of IP. However, their centralised Emptoris suite supported by cognitive capabilities was cited as being highly effective. One of the key case characteristics for Sellafield was the use of the ATLAS knowledge management system in support of their highly structured, and universally adopted set of LFE practices, the organisation reported this as being highly effective. The NHS while lacking a dedicated knowledge management system but did utilise some basic universal reporting systems for risk assessment as discussed earlier, the organisation also made extensive use of historic KPI lists for suppliers. MOD, as has been a recurrent theme within the organisation do not utilise central reporting systems for the purpose of acquisition planning. Whilst there exist a number of shared drives for deposit of the extensive sets of strategic and guidance documentation this was not bundled within a centralised, user friendly knowledge management system. This situation was reported as being a known area of frustration for MOD. In terms of the other cases the emerging pattern of organisations was again repeated. Encirc and the local government had no dedicated management systems and there was only minor

suggestions that knowledge management functionality was built into other systems. Even within those cases the extent of the functionality was minimal.

5.2.7.4 Coherence across organisations

Coherence across the organisation in terms of I.C.T systems is strongly linked to the other themes under I.C.T but proved to be a meaningful differentiator in the perceived effectiveness and composition of technology management within the various cases included within the research. The characteristic was derived directly from the case characteristics without first being derived into 2nd order characteristics.

The body of cases again divided along similar groupings as with previous themes, with Sellafield and IBM having the highest overall capability and perceived effectiveness in terms technological systems coherence and architecture, NHS showing capability but to a lesser extent or in a less coherent form, and with the local government and Encirc showing little capability. In this case MOD was significantly the least coherent in terms of its information systems with over 200 systems used and only partially integrated, heavily dependent on manual inputs and retrievals. Sellafield and IBM, as has been discussed extensively within other themes, have mostly centralised, single access point systems that service the various information system requirements of the procurement process. Equally, the remaining two cases of Encirc and local government group together. Within these cases, whilst there is coherence generally in the acquisition lifecycle due to centralisation of processes amongst a small organisational hierarchy. Little of this coherence can be attributed to information systems and between those systems used there is no central access point and little coherence between the systems themselves.

5.2.7.5 Extra-organisational Systems

Extra organisational systems refers to the case organisation's interaction with suppliers or third party organisation I.C.T systems, or any interconnectivity that was observed between these external organisations systems and the case organisation's systems. This theme was derived directly from analysis of the case characteristics without first being derived through second order themes.

Of the organisation investigated, IBM demonstrated the highest interoperability and interconnectivity with extra organisational systems. This is because of the nature of the cognitive capabilities suite's ability to scour unstructured as well as structured data. In essence the system scours the internet through a very diverse range of sources, the input from which

empowers the decision making process of the procurement professionals. MOD and Sellafield showed some interactivity with extra organisational systems. In the case of MOD there is some evidence to suggest that this is due to the nature of the oligopolistic marketplace, as MOD's suppliers are very large organisations. It was observed that these systems were interfaced with by the project team members at Abbeywood. However there was no formalised central link. In the case of Sellafield there was some evidence of interactions with suppliers' systems, specifically monitoring systems regarding the availability of spares etc., the focus here was for risk assessment. However, there was dedicated, shared GUI or formalised integration. These organisations expressed that these arrangements were fit for purpose. The NHS interacted with shared hosted space for handling of the RFQ, PQQ and other formal procurement related documentation however there was little integration outside of this. Local government and Encirc were only observed to interact through non-bespoke technologies such as e-mail. There was a general acknowledgement that while this could be improved, the interactions were fit for purpose.

5.2.8 Applying the theoretical lenses to technology management

5.2.8.1 Agency theory as applied to technology management

The application of agency theory towards technology management considers how the application of technology observed within the cases serves to mitigate the self-interested behaviours and different organisational goals of the agent for the protection and benefit of the principal. Eisenhardt (1989) describes the five fundamental assumptions of agency theory as self-interest, bounded rationality, risk aversion, information exchange, utility of information and goal conflict. In considering these factors across the cases it is clear that information exchange, utility of information and goal conflict are areas pertinent to the way in which the body of cases employs technology within the acquisition lifecycle.

The identified categories of cases broadly hold in considering these factors across the body of cases. Within MOD there was a low utilisation of technological systems towards solving the principal-agent dilemma. However there was some examples of information exchange between principal and agent. Within the NHS case there was a similar situation where there was some usage of information exchange also. The key areas of interest with these two cases was twofold. Firstly the degree of information that was being exchanged, and secondly the 'utility of the information'. Due to the lack of coherent and cohesive integrated enterprise systems the quality and speed of dissemination of the information led to a condition where technology was not being used optimally to redress the informational asymmetries embedded within the

relationship. It must however be noted that utility of information was far better used to address information asymmetries in the servitized components of the contract, where the agent often took the initiative in co-creating value. IBM and Sellafield again addressed these concerns by having integrated I.C.T systems that pull data from a wide variety of sources and disseminate to the relevant parties in the principal agent dyad. The capabilities to track past performance along a wide spectrum of metrics is a significant benefit in addressing the information asymmetry of the agent. This is particularly true within the PCP context as the organisations often engage in iterative contracting with the same body of suppliers, and therefore patterns of self-interested action can be observed over time. The lack of information exchange within local government and Encirc general makes interpreting through an agency theoretic lens non-appropriate.

5.2.8.2 Institutional theory as applied to technology management

Institutional theory is extremely useful in interpreting the results of the application of technology within acquisition lifecycles of organisations procuring complex performance. The various pressures can be applied and considered in regard to each of the technological interventions that was recorded along the acquisition lifecycle. The most atypical or divergent of the cases was MOD. Within MOD the wide variety of systems and information systems initiatives are emergent through to coercive, mimetic and normative pressures. Given the cited over 200 disparate ICT systems used within the organisation it is clear the coercive pressure has again played a significant role in I.C.T systems adoption. MOD has a remit to provide detailed requirements specification of highly technical briefs to suppliers, as well as communicate effective operational data to suppliers in possession of servitized in-use phase service contracts. As such the coercive pressure to adopt the supplying organisation systems or create systems capable of providing this required capability. In addition to this, the pressure to become more efficient from central government creates an innate mimetic pressure within the context as the organisation seeks to become more effective though benchmarking external organisations. Lastly there is likely normative pressures embedded in a prestigious, and highly scrutinised context such as MOD. The NHS is under similar pressures as a public sector organisation, however the coercive pressures from suppliers is of a different nature as there is significantly less exchange of highly technical requirements embedded within the normative procurement process. Within local government the coercive pressure of regulatory compliance prompts the usage of publicly available e-tendering tools such as e-chest, however systems adoption is limited outside of these basic tools. It seems that a minimum of basic tendering

tools are a procurement profession wide isomorphism as they are apparent in each case. In addition, Encirc also adopted a number of maintenance monitoring systems, in part due to coercive pressures of their supply chain partners. Sellafield, like MOD, are subject to the highest levels of public scrutiny These coercive pressures to monitor each part of the granular detail would seem to have led to an adoption of highly integrative systems across the organisation.

5.3 Revisiting the Literature

In this section the researcher revisits the prevailing concepts that were identified in the literature review in order to discuss how the findings and implications derived from the discussion aligns or contrasts with these areas.

5.3.1 Revisiting the core literature.

Procuring complex performance is the central focus of this research area. As described within the literature review, the research seeks to examine practice across the lifecycle of procurers of complex performance by selecting cases that are in or around the complex domains. These domains and are distinct from tradition procurement that exhibit a low contractual focus.

In exploring the normative practice in procuring organisations undertaking PCP arrangements, the insights within this research broadly support much of the existing perspective on the PCP dimension.

Howard and Caldwell (2010) in there book “Procuring Complex Performance: Studies in Innovation in Product-service Management” the authors outline an initial problem space for defining the PCP domain which was instrumental in this research. The authors posit a four dimensional model with associated sub areas. These were Complexity (Lifecycle management, through life capability, temporal dynamics, complex products and services) Managing markets (performance measurement, supplier management, risk, public-private governance), Innovation management (Knowledge & Learning, sustainability, product-service innovation, discontinuity) and Procurement (Alliances, outsourcing, relationships and contracts). This model outlines a comprehensive set of the core elements of the PCP problem space at a high level.

Arguably all of the points raised within Howard and Caldwell's initial problem space were related to characteristics identified within the cases, or related to the emergent cross-case themes. To give a few examples; the knowledge and learning sub category proves to be a critical factor in differentiating the cases with high perceived effectiveness of their performance management practice and those with low perceived effectiveness of their performance management. While this was underutilised and disaggregated within MOD, Sellafield's LFE was centralised, coherent and integrated with external suppliers. The implication of this congruence is that the model is broadly applicable, and that the results are in keeping with the existing conceptual understanding of the domain. The research expands on this work by

identifying the specific ways in which these factors manifest in the empirical reality, and comparing the ways in which organisations vary within these dimensions.

Roehrich & Lewis (2014) in their paper entitled ‘Procuring complex performance: implications for exchange governance complexity’ discuss the relationship between the complexity of an organisation’s business activities and the exchange governance required to successfully execute those activities. The conclusion of the paper stressed that the increase in complexity required an increase in contractual and relational exchange governance in order to effectively execute projects. A particular focus was given to the requirement of mechanisms that encouraged the development of inter-personal relationships as opposed to mechanistic non-personal approaches.

The research has shown this to be broadly true. Organisations such as Sellafield that made significant use of long term contract alliances, supplier integrated project teams and sophisticated information exchange systems to support value co creation reported higher levels of perceived effectiveness with their systems. More generally, the thematic reduction of case characteristics revealed numerous themes that related to the concept of exchange governance such as supplier engagement, coherence and holistic control and extra organisational systems interaction.

Spring & Araujo (2014) in their paper entitled ‘Indirect capabilities and complex performance’, the authors stress the importance of indirect capabilities to the procuring organisation engaging in PCP arrangements. The authors pose four key basic elements affecting the procuring organisation’s indirect capabilities, those being: Interface artefacts, contracting, and boundary management practice and I.C.T infrastructure. Although the authors stress the point that this is a step in building up a set of emergent competencies that apply to the PCP context, and have not yet arrived at a cohesive list.

This work furthers the goal of Spring & Araujo (2014) by adding empirical insights into how a range of cases that are practically coping with the challenges of the PCP environment. Specifically, this work demonstrates the validity of Spring & Araujo’s indirect capabilities model by confirming the importance of their four categories. Each of these categories was widely represented within the list of case characteristics, showing that organisations are reacting to these indirect capabilities development requirements. More importantly the work builds upon this attempt to expand understanding of what constitutes the range of PCP strategies by providing empirical insights into specific initiatives being undertaken within each

category. This work has highlighted themes that when applied can provide understanding into ‘how’ the challenge of PCP is being addressed in more granular detail than was attempted by Spring & Araujo (2014). For example, Spring & Araujo provide insight into how I.C.T capabilities provides the means through which indirectly capabilities can be generated. This work extends this further and provides specific insights into how I.C.T systems are enabling this in the empirical setting and how this manifests different between distinct categories of the PCP case.

Caldwell et al (2009) in their paper entitled “Procuring complex performance in construction: London Heathrow Terminal 5 and a Private Finance Initiative hospital” was one of the earlier papers discussing the concept of procuring complex performance. In this early paper, the authors help define the PCP space by fusing the CoPS literature with the procurement literature. In doing so the authors were some of the earliest to highlight that typical risk averse behaviours (such as PFI contracting in defence) are not the ideal means by which to maximise the effectiveness of the interaction, and incentivised risk sharing mechanisms are more appropriate within complex domains.

This research arrives at the same conclusion, with the Sellafield case reporting high perceived effectiveness when compared with the MOD case in terms of their overall risk sharing and contracting strategies. The work furthers this view by comparing the alternative contracting forms and risk sharing mechanisms as alternatives to risk averse contracting types. Furthermore, the research also highlights the set of operating conditions that have allowed these techniques to work well in the empirical world, e.g. coherence across the organisation, high levels of interaction with extra organisational systems, closely related interaction with suppliers.

Of the papers reviewed in the literature review, Hartmann et al’s (2014) is a critical paper in making the connection between co-creation of value and its increased importance in the domain of PCP as compared with traditional procurement. In this paper, the authors use a longitudinal case study to develop a three stage classification of organisations in transition from single use procurement through to becoming procurers of complex performance. Hartmann et al (2014) indicate that a public buyer is motivated by political pressure in the first instance and begins adopting practice that co-create value as a result. The three stages of the transition process are contractual and relational capability building, contractual integration of assets and services, and collaborative interaction and value co-creation.

Interestingly, these three characteristics are near synonyms for the characteristics of acquisition lifecycle practice identified within this work. The contractual integration of assets and services is an embedded component that was included in the case selection criteria. However, of the other stages: collaborative interaction and value-co creation strongly aligns with this work's 3rd order themes of 'supplier engagement' 'knowledge management' 'extra-organisational systems use' and 'collaborative practice', while the phase of 'contractual and relational capability building' strongly aligns with this works themes of 'contractual techniques, quality filters and KPI's and 'collaborative practice'.

These findings therefore confirm the validity of these transitional stages, and they have been reached, in part, by some of the case study organisations . Whereas Hartman et al., (2014) produced a model describing what the necessary steps to transition into effective PCP, the contribution of this research is in articulating a thematic architecture that can be used to assess the relative maturity of those organisations already operating with the PCP space, thus building on the contributions of Hartman et al. (2014). This architecture in its increased detail also allows the more acute pinpoints of what mechanisms for value co-creation are currently omitted from an enterprise in transition towards effective management of complex product and service procurement.

Caldwell & Howard (2014), in their paper "Contracting for complex performance in markets of few buyers and sellers: The case of military procurement" the authors review the challenges in adopting emergent contract arrangements in the case of defence. The authors conclude with three challenges, loosely summarised as: the innate complexity of the procurement, the retention of skills to procure well whilst outsourcing heavily and lastly how to foster innovation.

The authors conclude that a number of factors defence must engage in to address these challenges, not least of which is to understand their role as a highly engaged supply chain actor rather than an organisation 'passing the book', as is arguably the case in the risk averse contractor managed strategies such as CFA and CFC This research directly complements Caldwell & Howard's paper. Whilst the authors identify the challenges this work identifies specific modes of operating in a thematic hierarchy of case descriptors. This allows a prospective defence practitioner to identify the points of difference in acquisition lifecycle strategy and composition and use those sets of characteristic differences as a road map around which to consider implementing change.

Roehrich et al, (2014) in their book chapter entitled: “Procuring Complex Performance (PCP) in the UK Defence Sector” the authors use a case study, again examining the UK defence sector to develop further understanding into PCP. The work discussed the need for inter-organisational collaboration in complex supply relationships, and describes the uniqueness of the PCP context and the unsuitability of traditional academic and practice-based approaches in providing effective performance in that context. This research is therefore addressing the call for additional understanding into the still emergent and uniquely constructed context of PCP that is made within the work by Roehrich et al, (2014).

5.3.2 Revisiting the wider literature

Whilst the PCP literature is the area to which this work contributes most directly, there are other areas of thematic interest to which the work makes a contribution. Discussed below are some of the key areas to which the research has relevance beyond the canon of procuring complex performance research:

A stream of work running in parallel to PCP is the work regarding product-service systems. In a key paper consulted early in this research, Smith et al. (2014) produced a paper entitled “Servitization and operations management: a service dominant-logic approach”. Within this work the authors concentrate more on the value proposition of the model from a supplier perspective more so than is often done in the PCP concept. Within this wider perspective the findings are still recognisable as similar to the outputs of the core PCP literature as well as this research. The authors conclude that a complex systems perspective is required to effectively handle the transition to a servitized product-service system, and identify four key value propositions for the PSS organisation. These value propositions are ‘asset value’ ‘recovery value’ ‘availability value’ and ‘outcome value’. In essence, these value propositions are somewhat synonymous with the activity types performed across an acquisition lifecycle. The asset value is akin to requirement setting and procurement in the earlier stages, whereas the recovery, and availability is synonymous with the effectiveness of the practices embedded within the in-use phase and contract type.

The contribution of this work to the paper by Smith et, al (2014) demonstrates the literature is moving forward towards a more comprehensive understanding of each side of the PCP relationship. In moving forward, this research has to qualify the thematic characteristics that can describe a PCP system from the procurers’ perspective. In order to fully develop a framework for understanding the strategic options available these findings would first require validating in a wider empirical setting, possibly through a quantitative confirmatory study, and

then expanded to include success and failure modes of each strategic option from the suppliers' perspective.

Datta et al (2010), in their paper entitled "Operations strategy for the effective delivery of integrated industrial product-service offerings: Two exploratory defence industry case studies" explore the importance of performance-based contracting in successfully extracting value from PSS arrangements. As is the case with much of the PCP research the defence sector is the focus of the paper. Specifically the authors examine how the change towards availability contracting in the defence and aerospace industries has prompted the emergence of new firm capabilities.

This work sits alongside the work by Datta (2010) in identifying a means of describing specific strategic options available in order to address the changing requirements. As with Datta's work, this research identified a range of strategic options of how organisations operating in complex servitized environments are addressing the requirements to effectively monitor and manage the performance-based contracts. The work provides several alternatives to defence's current risk averse approaches as seen in other cases and highlights that this risk- averse, availability-contracting approach is perceived to be ineffective within MOD whilst the alternatives seen in Sellafield are perceived to be highly effective.

5.3.3 Summary of work in relation to existing knowledge

This work does not contradict or significantly reconceptualise any of the fundamental work undertaken within the PCP domain. Instead the findings of this research have shown to corroborate that which has been written before and expand on the requirements for further understanding around organisations operating in the PCP domain. Through extensive in-depth engagement with a wide range of PCP or 'near-PCP' organisations, this research has provided a thematic architecture capable of interrogating the strategically pertinent concepts embedded within complex acquisition lifecycles. This list has derived groupings of common practices across these range of themes. This grouping suggests that there is a range of capabilities and maturity within the body of cases explored. Much of the previous literature focused on transition modes towards PCP, or in better defining PCP from traditional procurement (*Roehrich et al, 2014; Caldwell & Howard, 2014; Hartmann et al 2014*). This research builds on these works by positing that there is a range of acquisition lifecycle sophistication manifest within PCP contexts, and that there is not yet an established set of isomorphisms. This work begins the process of defining value adding organisational practice within PCP firms and provides the thematic architecture by which this can be undertaken.

5.4 Categorising complex procurement organisations

After having derived a thematic architecture that seeks to explain practice within the acquisition lifecycle of procurers of complex products and services, the cases were compared and contrasted based on this architecture. A set of distinct groupings emerged from the case-set. The work then applied agency and institutional theory (*Eisenhardt, 1989*) in order to incorporate these emergent results in the discussion chapter. This process noted that the means by which these organisational process differences were emerging from an agency and institutional theory perspective were again distinct within the emergent groups. As an example, whilst one group of organisations was highly professionalised (normative pressure), other groups were amassing processes around the legal framework imposed by central government (coercive pressure). In consideration of these distinct categories of complex procurer, Figure 54 was created in order to summarise this finding and theorise as to the wider academic implications.

A matrix view of the emergent categories of complex procurer type

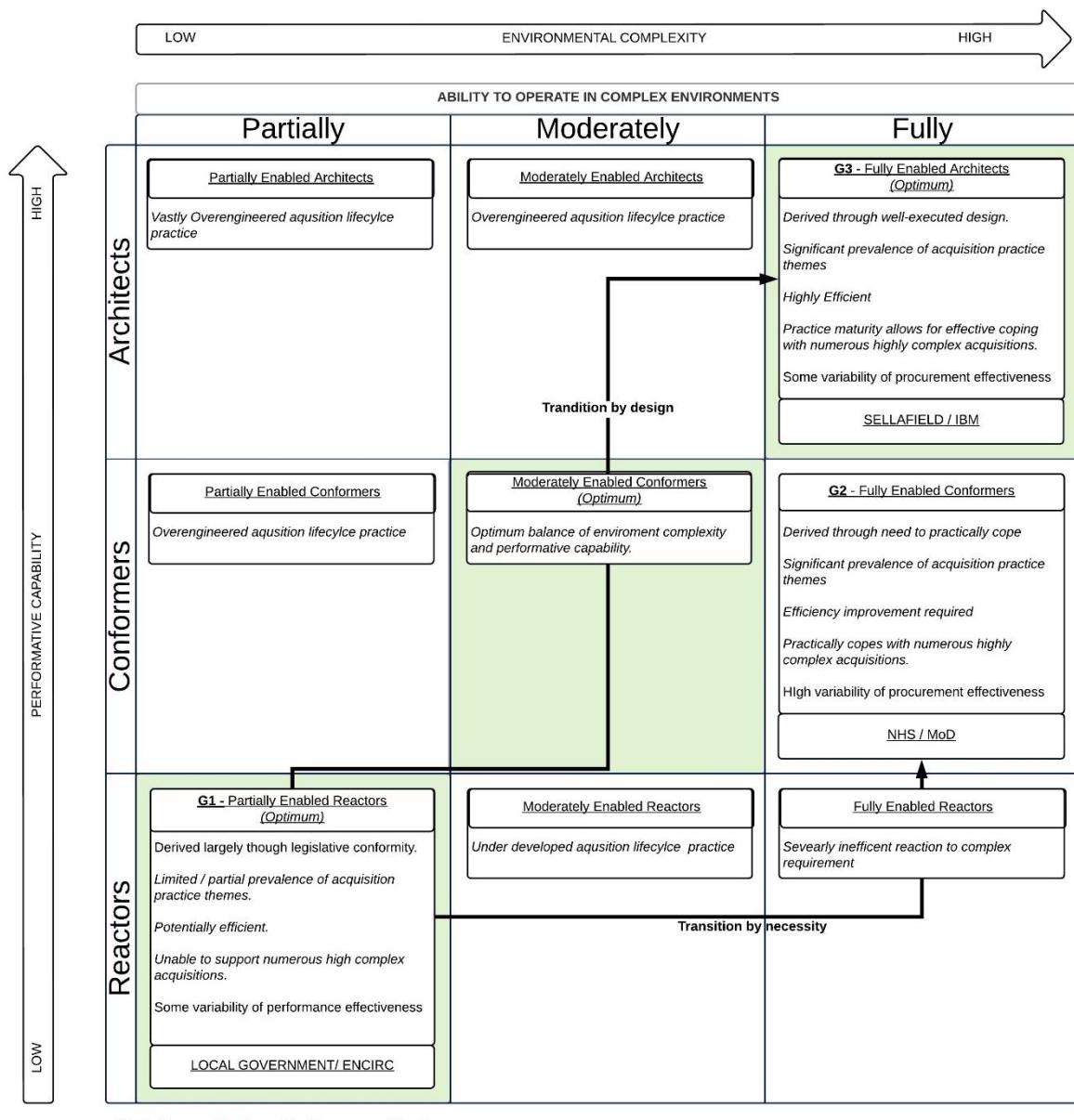


Figure 54 - Matrix of Complex Procurer Categories

Figure 54 is intended not as a single figure summary of the implications or theoretical contributions of this work, but rather as a visualisation to aid the reader in understanding. The top axis refers to the organisations overall ability to operate when provided with complex requirements. These classifications therefore scale with environmental complexity, organisations operating in the most complex contexts are therefore labelled 'fully enabled'.

The left axis refers to the performative capability of the organisations practices, this scale was derived in considering the different ways in which organisations capabilities manifest. Those on the top row have the greatest capability, thus make the greatest use of performance

management tools, technological solutions etc. The purpose of juxtaposing these two positioning is to make the point that the highest level of sophistication is not necessarily optimal, instead organisations should seek to balance their performance capability with the requirements placed upon them by the complexity of the environment in which they operate.

The labels on the left axis are in place to illuminate key differences between the groups of cases. Whereas the first two rows of ‘reactors’ and ‘conformers’ are responding to the pressure of requirements, the top row describes organisations that are ‘designing’ performative capability to meet the pressure of requirements.

The left axis was derived directly from the discussion section of this research, an intimate knowledge of the composition of process and strategies along each acquisition lifecycle enables the researcher to state the relative performative capability of each organisations. The application of institutional and agency theory to these processes helped reveal the categories of reactors, conformers and architects. The top axis was derived by revisiting the classification of CoPS organisations by Ren & Yeo (2006) used for case selection. With an in depth knowledge of each of the organisations now having been acquired, these classifications could be more thoroughly considered and used to extrapolate relative positioning in terms of the environmental complexity.

The groups of case organisations are plotted on the matrix and their prominent characteristics are stated underneath. Lastly, the arrows between the boxes dictate the proposed paths by which organisations could transition from one group to another. If the requirements on G1 are set to increase they will necessarily have to move right across the matrix, the optimum path is to move diagonally, designing performative capability appropriate to the level of environmental complexity.

5.4.1.1 Partially enabled reactors:

The partially enabled reactors group consist of the Local Government and Encirc cases. This grouping has been labelled ‘partially enabled reactors’ to express two fundamental points regarding the organisations’ acquisition lifecycle capability. Firstly, that the organisations are offering partial ability to cope with the challenges posed by complex acquisitions and secondly, that the organisations are ‘reacting’ to coercive demands of external forces rather than designing ‘ideal’ solutions to address the challenges of complex acquisition. This group is typified by a number of descriptors that cannot be applied to the organisations in the other two groups. Specifically, the processes featured along the acquisition lifecycle were formed in

reaction to comply with legislation in the case of the Local Government case (a coercive pressure). Similarly, whilst Encirc were not operating in the public sphere, the organisation's acquisition lifecycle was derived from conformity to basic procurement standards such as the use of PQQ's, evaluating tender bids, and consistency of information provided to prospective suppliers. There was far less attention paid to the more sophisticated PCP capabilities described within the literature, such as value-co creation and management proficiency through-life (*Howard & Caldwell, 2010; Roehrich & Lewis 2014, Spring & Araujo 2014*). Generally, these capabilities, if utilised, were in a form far less sophisticated than observed within the other organisations. For example, in discussing the emergent themes from the cross-case analysis, the variety of I.C.T application was lower, and the type of systems providing information to, or collecting information from, the procurement process, were simplistic e-procurement-style tools. The spread of organisational control was also generally lower, as was the geographical spread of stakeholders. This is all suggestive of proportionally lower relational complexity amongst this initial emergent group of cases. A key point here, is that whilst the variety of tools and complexity of processes brought to bear in addressing the challenges (performative capability) was lesser than observed in the other cases, the ability to be able to enact effective acquisition of complex products and services was not necessarily lesser in efficiency than observed within other case. This was due to the lower overall operational requirements and relational complexity of this group (environmental complexity). Thus, whilst the capability and sophistication of the normative process in place within these organisations would require development to support more numerous or complex procurement practice, they are currently adequate to cope with the requirements of the organisations.

5.4.1.2 Fully enabled conformers

The fully enabled conformers group is the middle grouping in the proposed acquisition matrix, consisting of both the NHS and the MOD. The distinguishing characteristic of this grouping in comparison with the previous 'partially enabled reactors' group is the significantly higher degree of organisational complexity and capability (environmental complexity). In terms of the cross-case themes, there are significant differences between these organisations and those included in G1. Specifically, there is a far greater density of processes used, systems utilised along the acquisition lifecycle, a greater density of organisational units and organisational functions. If we take the performance management category as an example, these two organisations often showed a high or moderate prevalence of each of the thematic dimensions (e.g. Use of quality filters, KPIs, contractual techniques). However, the perceived effectiveness

of these dimensions is generally either low or moderate. This pattern is, with some exception, by and large repeated across the other areas of interest (risk management, technology management, and organisational alignment). Thus, group two is typified by a far higher degree of relational complexity, as well as overall capability. A higher number, or more complex procurement can be undertaken and managed ‘through life’ by these acquisition practices, however, they are not necessarily more efficient in the management of these acquisitions than those seen in group 1.

5.4.1.3 Fully enabled architects

The fully enabled architects is the top-rightmost group on the acquisition matrix, consisting of Sellafield and IBM. This group demonstrates similar density of organisational processes and outright acquisition capability featured in G2, and occupies the same column in term of environmental complexity. However, this group also had a high perceived effectiveness associated with the relevant themes. From an institutional theory perspective, the observed processes within these organisations showed far less evidence of having been reactionary to coercive and mimetic pressures. The rationale for the use of any particular process or technique was well articulated and this justification was consistent across the range of processes observed within the two cases. Therefore, group 2 is described as ‘fully enabled conformers’ in that the organisations provide sophisticated capability to practically cope with expansive requirements placed upon them. Group 3 are described as ‘fully enabled architects’ in that the organisations provide sophisticated capability as a consequence of having designed a robust and consistent set of procurement practices. This group of cases is capable of coping with sophisticated complexity, without the continuous redesign or insertion of new processes. This suggests that procurers of complex performance in a complex domain are not inherently inefficient, and that design choice made within the organisation structure and acquisition lifecycle can overcome the challenges of the context with profound effect. Furthermore, particular points appear to be highly effective in making the distinction between G3 and G2, specifically: Widely integrated knowledge management systems, robust risk management practice that invite rather than reject risk, uniformity of risk practices and enforced standard processes.

5.5 Chapter Summary

This chapter has discussed the findings and used agency theory and institutional theory to interoperate and explain these emergent insights. The core literature is then revisited and the implications of this work discussed. The following chapter will now solidify these insights by providing explicit detail as to how the research question has been addressed and what contributions have been made.

6 CHAPTER 6: CONCLUSION

6.1 Introduction

The final chapter of the thesis draws out the research conclusions by explicitly articulating how the research question has been addressed and by presenting the key findings and the original contributions to knowledge that have emerged from addressing this question. A reflection on the research process and a description of the study limitations and the avenues for future research are also provided.

6.2 Contribution overview

This research makes three categories of contribution: a methodological contribution, a theoretical contribution and a practical contribution. These contributions are identified and summarised within this overview. Further detail on how these contributions serve to address the research questions is then provided in the subsequent section.

Methodological Contributions

- The research details a replicable means of investigating complex acquisition lifecycle management through a qualitative, abductive research design.

The methodology employed here has a number of elements, the combination of which creates a novel approach to the investigation of complex acquisition lifecycles. The Zachman approach works in tandem with the abductive research design to allow broad data collection strategies that narrow the field of interest over time. The Zachman framework allows the researcher to identify gaps in knowledge, as processes are aligned chronologically and logical omissions can be observed, and corrected in later data collection. As the case profile is expanded the emergent areas of interest act as exclusion criteria and allow for a focused introspection, excluding the significant quantity of non-useful data available within the case.

Theoretical contributions

- Provided a congruent and relevant thematic lens for interpreting procurement lifecycle analysis through the combination of institutional and agency theory.

The application of both institutional and agency theory towards the analysis of acquisition lifecycles is both novel within the wider literature and necessary in order to adequately comprehend the emergent results of this case. An acquisition lifecycle covers a number of chronologically ordered phases with distinct actors, stakeholders, processes and strategies embedded within each. In order to assess each of these sections under one common framework

there is a requirement to interpret results through both theoretical lenses. Agency theory for example offers the greater explanatory power when dealing with the processes around the contract setting, as there is a distinct principal-agent relationship. The processes in the concept phase are better explained through the institutional theory lens, as there is no principal agent relationship, but a multiplicity of influencers on process adoption. The necessity and capability of this approach is discussed at length in section 2.9.4 of the literature review.

As discussed, this combination of theories is particularly applicable when applied to the assessment of lifecycle. This is because the distinct phase of the lifecycle has unique stakeholders applied to it. Thus the shortcomings in explanatory power of one theory is compensated for by the alternative theory that better fits the contexts endemic to that particular phase. In later phases that have a fundamentally different context the effect is reversed. In the phases, and sub-phases where the two theoretical lenses are equally suitable then the perspectives can be applied complementarily allowing for a deeper exploration of the phenomena. This lifecycle approach can be used as a platform for future studies looking to investigate complex acquisition lifecycles.

- An evaluative categorisation of complex procuring organisation types (MATRIX in section 5.4).

A primary theoretical contribution is the categorisation of complex procuring organisations. This matrix provides the framework by which future researchers can make relative assessments of the suitability of organisations' acquisition lifecycle practice relative to their context. The matrix positions the complexity of the case organisations' environment against the performative capability of the systems. This suggests an optimum position of an organisation's performative capability relative to the complexity of its environment avoiding having an overly-engineered process for a relatively non-complex environment and as well as an inadequate process for the challenges endemic to the context. Within the case set explored in this research three classifications were derived, each of these classifications were interpreted through the coupled theoretical lenses of agency and institutional theory so as to interpret how this combination of environmental complexity of process capability came into play empirically.

Practical contributions

- Provided a hierarchical, thematic architecture for use in comprehending the acquisition lifecycle practices of an organisation procuring complex products and services.

The thematic architecture is a tool that provides criteria against which to compare the relative capabilities of complex acquisition lifecycles where no set existed previously. This is elaborated upon in section 6.3.3. This practical contribution is extended when considering that the matrix classification of complex systems can be used to provide a tool for interpreting the outputs of the thematic architecture with reference to the in-context suitability of the combinations of factors identified in a given case.

- Insights into the empirical reality of 'how' and 'what' complex procuring organisations are doing in acquisition lifecycle processes.

The research has provided insights into the practices of the participating case organisations. Each of the organisations has been offered a report for participating in the study. This has had an as yet un-measured practical benefit for these organisations.

- Provided actionable insights to industry partners, as well as tools for use in the industry setting.

The conclusions drawn within this research fed into an industry facing report to be delivered to the project sponsor, the MOD. This report specifically recommended process, technologies, tools and general strategies observed in other cases that had proved beneficial in the native case and was comparable to the MOD case. The recommendations were presented at the 1* general level and the impact case results are ongoing at the time of writing. This is a direct practical benefit.

6.3 Relating contributions to the research questions and objectives

In the following section, the research questions are re-visited and the concomitant research findings and contributions are presented.

6.3.1 Research Question:

“How are organisations addressing the challenges of managing acquisition lifecycles in the context of procuring complex products and services?”

The research has provided a broad range of categorised characteristics for each case that has allowed the researcher to deduce a set of core cross-case themes that are able to articulate the 'what' and 'how' of acquisition lifecycle practice. A comparison of these key themes provided meaningful insights into the strategically significant variance at play within the case organisations' acquisition lifecycles. This, in turn, has allowed the researcher to categorise organisations in accordance with these thematic variances. As a result, the research has

provided theoretical insights into how challenges are being met by a range of procurers of complex performance, and in so doing has addressed the research question.

6.3.2 Categorising complex procurement organisations

The categorisation of complex procuring organisations discussed in section 5.4 is a primary contribution of the research. This matrix categorisation provides the fundamental tools for future research to organise, assess and compare the strategies, processes, tools and techniques used within complex organisations. This factors has been discussed at length in the discussion chapter and will therefore not be repeated here.

6.3.2.1 Addressing Objective 3

In making this contribution the research satisfied the research objective 1:

“To identify the substantive differences in how case organisations approach complex procurement, so as to propose theory regarding the significant process patterns in complex procurement.”

This contribution directly addresses this research question, as the substantive difference are identified by following the underlying methodologies, then the classification allows the consideration of the whole set of cases, by enabling relativistic comparisons.

6.3.3 Thematic Architecture

The hierarchical architecture of themes featured within this work is a distinct contribution in itself, functioning both as a necessary step in deriving a theoretical contribution but also being a tool to be utilised by future research and practitioners. The literature review identified a set of core areas of concern that are pertinent to strategic practice within areas of complex procurement and through-life management. These areas were then used as a filter to identify relevant processes as each of the acquisition lifecycles were mapped out chronologically. Following on from this, these highlighted areas were then investigated in greater detail, resulting in a comprehensive set of characteristics for each case. Lastly, these characteristics were compared cross-case to identify a thematic architecture for use in examining meaningful strategic practice within acquisition lifecycles of complex products and services.

This is a contribution to the relevant literature on PCP, as it builds on previous efforts to understand the makeup and key areas of concern associated around organisations procuring complex performance (*Howard and Caldwell, 2010; Roehrich & Lewis 2014, Spring & Araujo, 2014*). While previous literature has sought to define the area and focused in on particular factors such as ‘indirect capabilities’ or ‘exchange governance’, this work takes a more

inclusive and broader approach towards understanding complex procurement of products and services. This work's abductive design has placed the emphasis on allowing the empirical world to in part define the requirements of the inquiry, and in doing so has provided a framework that allows future research to articulate meaningful differences amongst the acquisition lifecycle practice of complex procurers without being bounded by one or few particular conceptual factors.

6.3.3.1 Thematic architecture as an applicable tool

The themes featured within the architecture are the output from having undertaken the cross case analysis and reduced the whole sum of themes to this final set. Therefore, the list of factors feature in the thematic architecture can be thought of as a comprehensive set of descriptors of the strategic and practical position of the procedural, technical and operational structures surrounding a complex acquisition lifecycle. By investigating these factors, this and other research can determine the readiness and capability of a complex acquisition lifecycle strategy, and make useful comparisons between organisations. This is also of benefit to practitioners wishing to undertake internal audits, or comparative assessments of organisations that undertake long-term complex acquisitions.

6.3.4 Contribution to the existing literature regarding Procuring Complex Performance.

Following on from the previous section, this work does not contradict that which has come before it, instead it stands parallel to the existing literature in assisting to develop a more robust understanding the strategic options available to generate greater value for organisations procuring complex products and services. The benefit of the abductive design and thus allowing the empirical world partially define the inquiry is that the explanatory power is not limited to a niche and specific conceptual area of interest. Such specificity may be problematic in attempting to impose meaning on such an inherently complex phenomenon, as the interplay between systems, people and context is difficult to conceptually navigate. This work sidesteps this problem by asking what is empirically occurring within broad a-priori areas, as opposed to asking what 'X' is doing in relation to 'Y'.

The specific findings and thus, the specific ways in which this work has added to the existing literature has been discussed extensively within the "Revisiting the Literature Section" and thus will not be repeated within this summary.

6.3.4.1 Addressing Objective 2

In making this contribution the research satisfied the research objective 2:

"To identify strategically significant acquisition lifecycles characteristics of organisations operating within the PCP domain."

The objective here is presented within the findings section. Each case was examined thoroughly and strategically significant characteristics have been presented and discussed. The application of these characteristics was used to derive the final thematic architecture and insights into the cases and case set. This objective has thus been achieved.

6.3.5 Abductive research design into procurers of complex products and services

This research design concluded by providing categories of complex procurers, as well as the thematic framework for understanding complex procurers. In addition to these two tangible outputs, the method itself is a distinct and novel contribution, the benefits of which have been discussed in the previous section. The model combines a number of established elements in a novel research design. These elements are the Zachman enterprise mapping technique as a guide for conceptualising a sequence of processes within a lifecycle, an abductive research design, the cross-case thematic reduction, and the combination of agency and institutional theory. The output of such a combination provides a method capable of exploring complex phenomena in expansive linear processes within the qualitative research tradition.

6.3.5.1 Addressing Objective 1

In making this contribution the research satisfied the research objective 1:

"To propose a method for comprehending the strategic activities undertaken in an acquisition lifecycle."

The novel methodology developed combines a number of different elements and moves towards creating an abductive, qualitative research design. Whilst further work is required to ensure the validity of theoretical insights generated from case studies to validate the method comprehensively, this thesis has succeeded in proposing the method and thus this objective has been achieved.

6.4 Reflections on research limitations

6.4.1 Addressing Generalisability

As is the issue with case-based qualitative research, there is difficulty in generalising the results outside of the bounds of the case or case studies as the findings may be idiosyncratic to that

given case context or sample of case contexts (*Eisenhardt, 1989*). The objective of this research however, was to first generate actionable insights that are valid in that case-specific context. It is the researcher's intent to follow on from this work with a confirmatory study to test the validity of the thematic architecture and propositions derived from this in future work. Whilst acknowledging this fact, it is however relevant to state that care was taken to increase generalisability within this study. In line with Eisenhardt (*1989*) summary of effective theory building from case research, this work undertook the following measure: Extensive crafting of instruments and protocols, used multiple collection methods, focused on theoretically useful cases, extensively overlapped data collection and analysis, separated the within-case and cross-case analysis, iteratively built conclusions and compared with existing literature.

6.4.2 Case suitability

As has been stated at numerous points throughout the literature, whilst the research adopted PCP as the central construct during the literature review the case selection borrowed from Spring & Araujo (*2014*). This work softened the rigorous definition of PCP when selecting the empirical setting so that the work can extend beyond the highly focused view of "High value capital goods" (*Davies and Hobday, 2005, p.4*). The rationale for this was to broaden the range of practice that can be viewed beyond the most typical PCP settings. Thus, the research took a PCP-centric view rather than a rigid COPS exclusive view. Therefore, acknowledging that non-complex, non-servitized procurement organisations are likely unsuitable for selection (Lewis & Roehrich, *2009*) but without the limitation of assuming that PCP settings are inherently impenetrable to insights generated from any divergence from the COPS definition. With this having been stated, it of course remains a possibility that this assumption of the absolute and complete uniqueness of the PCP setting is a correct one, although this seems more plausibly a case of degrees rather than an absolute fact.

6.4.3 Further case data (public – private juxtaposition)

Of the six cases explored, only five were explored until the point of theoretical saturation. IBM, due to their being unwilling to expand and share particular details (for intellectual property reasons), were not explored until the point of theoretically saturation. Furthermore, given that the organisation, and key contact person, were based within the United States there were some data accessibility issues. Despite there being a number of high quality interviews with senior personnel, significant documentation analysis from both contact persons and that which is publicly available, it was still felt that theoretical saturation had not been reached with the IBM

case, and that additional insights could have been derived if not for the aforementioned challenges.

Additionally, the inclusion of a wider body of cases would have provided a greater number of characteristics to reduce into the final themes, providing wider reference points for the final thematic architecture. Of particular interest would have been the inclusion of additional cases from the private sector, as the current sample skewed towards the public sector. Whilst PCP as an academic concept has generally centred on large public sector procurers, the purpose of this work was to expand the line of inquiry beyond that which has already been researched and thus, a stronger weighting towards the private sector would have been an appropriate means of furthering this goal.

6.4.4 Subjectivity of prevalence and perceived effectiveness

As is the case with qualitative research generally, whilst the researcher can take steps to minimise the subjective bias through the use of rigorous applications of case methodologies and triangulation of data source (*Eisenhardt, 1989*), subjectivity remains a challenge. Within this work the cases were compared across themes as is typical, however, the perceived effectiveness of the organisations' current operations within these themes was encoded as an additional theme. This means that the effectiveness of current practice within the organisation has been defined in accordance with the perception of interview participants who took part in the work. Again, steps were taken to address this potential source of bias. In encoding the 'perceived effectiveness', the opinions of multiple participants were used along with document analysis where possible. If, for example, the participants were generally dissatisfied with the variety of I.C.T systems then this would be a pertinent data point. Secondly, if the official strategy documentation suggesting the I.C.T system amalgamation was an area of necessary improvement for the organisation then this would be a secondary data point. Each of these would be encoded at 'perceived effectiveness' and used to inform the allocation of high, moderate or low for that theme within that case.

6.5 Future research

6.5.1 Verification of results

The proposed sophistication spectrum, as well as the thematic architecture for investigating practice within acquisition lifecycles both lend themselves naturally to a confirmatory follow-on study. Whilst this research has made a humble and necessary beginning in positing this framework, a second confirmatory study of a wider sample would be required in order to

establish generalisability and move towards providing a coherent tool for procuring organisations to adopt. This qualitative component has done the necessary in depth case research to provide a step forward in insights into acquisition lifecycles. Follow-on research would likely take the form of a quantitative component that generates hypotheses and tests these in a wider sample. An example of such a hypothesis that follows on directly from this work: “Centralisation of knowledge management practice has a positive effect on overall acquisition lifecycle performance”. This quantitative follow-on would also address a weakness in the subjectivity of qualitative work discussed above.

6.5.2 Expansion of case set

The inclusion of another case would potentially add more emergent characteristics, and in turn this broader range of characteristics could be used to either more accurately confirm the thematic architecture proposed, or provide new dimensions by expanding the number of themes featured. Additionally, including more cases along the maturing spectrum would provide a better understanding of the range of differences between each grouping or perhaps expand the taxonomy with additional groups.

6.5.3 Further lines of inquiry

In addition to the expansion of research through validation and case expansions the area can be explored along a number of different lines. This section lays out some future research questions that are related to, but have been left unanswered by this PhD thesis. These questions have been organised within two potential future studies.

Further study 1:

“What characteristics of complex acquisition lifecycles positively correlate with increased organisational performance, and to what degree?”

“What characteristics of complex acquisition lifecycles correlate with employee satisfaction amongst procurement and project professionals?

“What organisational characteristics correlate with the successful adoption of the most beneficial complex acquisition lifecycle characteristics? What can current theory explain regarding the coalescence of these characteristics?”

Further study 2:

The creation of complex contracting for product and services has been explored through the examination of the lifecycle analysis within this PhD. In this context, this has been applied specifically to the complex products and service arrangements.

“What other areas of complex contracting can be explored with the methodology X”

“How can this analysis contribute to an understanding of these given phenomena in a way that provides a novel and original contribution to the area?”

“What adaptions to the methodology are necessary?”

“What are the results of applying methodology X to contexts A, B, C?”

6.6 Concluding Remarks

The central purpose of this research has been to uncover how organisations are addressing the challenges of managing acquisition lifecycles within the domain of complex product and service procurement. The work has utilised an expansive abductive research design to plot and interpret the acquisition lifecycle processes of MOD, NHS, Sellafield, Encirc, Local Government and IBM. The processes in each of these acquisition lifecycles were highlighted in accordance to their relevance with key a-priori areas of interest derived from the literature and refined within the empirical world (Organisational Alignment, Performance Management, Technology Management and Risk Management). The processes relevant to these categories were then explored in an abductive method to derive a comprehensive set of case characteristics, which in turn were used to derive a thematic architecture applicable to the case set in describing how complex acquisition lifecycles are being managed. This in turn led the research to the conclusion that there is a distinct types of complex procurers within the case set: Partially Enabled Reactors, Fully Enabled Conformers and Fully Enabled Architects. The central conclusion of this research is that these groupings are non-trivial, and that the empirical world of complex products and systems procurement has not yet derived a set of coherent isomorphisms. This work has added to previous efforts to understand the PCP domain by providing the conceptual model and thematic architecture for use in further exploring the phenomena, and for industry to utilise in designing procedural change into their complex acquisition lifecycles.

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8 APPENDIX 1

ARTICLE REFERENCE	REASON FOR REJECTION
H-J Uhlemann, T., Lehmann, C., & Steinhilper, R. (2017). The Digital Twin: Realizing the Cyber-Physical Production System for Industry 4.0. <i>Procedia CIRP</i> , 61, 335–340.	Articles describes the acquisition of data with the specific domain of production and industry 4.0 and is thus not pertinent to the research question.
Turken, N., Carrillo, J., & Verter, V. (2017). Facility location and capacity acquisition under carbon tax and emissions limits: To centralize or to decentralize. <i>Intern. Journal of Production Economics</i> , 187, 126–141.	The article is concerned with the legislation surrounding carbon emissions in broad acquisition policy and is thus not pertinent in address of the research question
Tahmasebi, P., Javadpour, F., & Sahimi, M. (2017). Data mining and machine learning for identifying sweet spots in shale reservoirs. <i>Expert Systems With Applications</i> , 88, 435–447.	The article is centred around data mining and machine learning within the context of better extraction of oil reserves and is thus is entirely unsuitable for use in address of the research question.
Kang, X., & Miao, D. (2016). Knowledge-Based Systems A study on information granularity in formal concept analysis based on concept-bases. <i>Knowledge-Based Systems</i> , 105, 147–159. http://doi.org/10.1016/j.knosys.2016.05.005	A computer science paper that address big data analytics, entirely non relevant to the research question.
Kamsu-Foguem, B. (2016). Information structuring and risk-based inspection for the marine oil	The paper is concerned with the monitoring of complex production systems from the

pipelines. <i>Applied Ocean Research</i> , 56, 132–142.	perspective of oil extraction systems, entirely non relevant.
Senthil, S., Srirangacharyulu, B., & Ramesh, A. (2014). A robust hybrid multi-criteria decision making methodology for contractor evaluation and selection in third-party reverse logistics. <i>Expert Systems With Applications</i> , 41, 50–58. http://doi.org/10.1016/j.eswa.2013.07.010	The paper focuses upon green legislation and the applicability of reverse logistics model and is not centrally related to procurement of products complex or otherwise. Thus is rejected at the abstract analysis stage.
Jung, J., Hong, S., Jeong, S., Kim, S., Cho, H., Hong, S., & Heo, J. (2014). Productive modeling for development of as-built BIM of existing indoor structures. http://doi.org/10.1016/j.autcon.2014.02.021	The paper is too specific for inclusion within the full review, as it centres are the use of specific new hardware in the creation and maintenance of buildings.
Groves, W., Collins, J., Gini, M., & Ketter, W. (2014). Agent-assisted supply chain management: Analysis and lessons learned. <i>Decision Support Systems</i> , 57, 274–284. http://doi.org/10.1016/j.dss.2013.09.006	The paper focuses on simulation in assess of wider supply chain issues and is thus not centrally concerned with the question or procurement of acquisition and is thus non-relevant in address of the research question.
Golhar, D. Y., & Banerjee, S. (n.d.). An optimal ordering strategy for a third-party managed supply chain.	The article is concerned exclusively with modelling high throughput demand patterns. So whilst there is a relevance in terms of purchasing and procurement the context is not within the wider areas of complex acquisitions that the research question explores.

<p>Webel, S., Bockholt, U., Engelke, T., Gavish, N., Olbrich, M., & Preusche, C. (2013). An augmented reality training platform for assembly and maintenance skills. <i>Robotics and Autonomous Systems</i>, 61, 398–403.</p>	<p>The research focuses on a micro example of maintenance of complex assets. Leveraging virtual reality tools towards training and maintenance execution. Thus is not useful in direct address of the research question</p>
<p>Smunt, T. L., & Ghose, S. (2016). An Entropy Measure of Flow Dominance for Predicting Operations Performance. <i>Production and Operations Management</i>, 25(10), 1638–1657.</p>	<p>The work is related to simulating the flow of production in the context of fast throughput operations and is thus too narrow a focus and too specific an operation</p>
<p>http://doi.org/10.1111/poms.12575</p> <p>Reimann, F., Kosmol, T., & Kaufmann, L. (2017). Responses to Supplier-Induced Disruptions: A Fuzzy-Set Analysis. <i>Journal of Supply Chain Management</i>, 53(4), 37–66.</p>	<p>The article takes an event systems theory approach towards evaluating disruptions between buyer and supplier. The focus is too narrow to be of critical relevance in addressing the research question.</p>
<p>http://doi.org/10.1111/JSCM.12141</p> <p>Seidman, G., & Atun, R. (2017). Do changes to supply chains and procurement processes yield cost savings and improve availability of pharmaceuticals, vaccines or health products? A systematic review of evidence from low-income and middle-income countries. <i>BMJ Global Health</i>, 21136, 2016–243.</p> <p>http://doi.org/10.1136/bmjgh-2016-000243</p>	<p>The article is entirely based in the health domain and is therefore not relevant in address of the research question.</p>

<p>Johnson, G. A., & Vindrola-Padros, C. (2017). Rapid qualitative research methods during complex health emergencies: A systematic review of the literature.</p> <p>http://doi.org/10.1016/j.socscimed.2017.07.029</p>	<p>The article is a systematic literature review from the health domain, and thus is entirely non-relevant in address of the research question.</p>
<p>Cabigiosu, A., & Camuffo, A. (2017). Measuring Modularity: Engineering and Management Effects of Different Approaches. <i>IEEE Transactions on Engineering Management</i>, 64(1), 103–114.</p> <p>http://doi.org/10.1109/TEM.2016.2614881</p>	<p>The article investigates modularity from an engineering standpoint, and is not directly concerned with the strategy. This article was highlighted for potential improvement but later discarded as the full review of the 184 article had been conducted</p>
<p>Mizgier, K. J., Jüttner, M. P., & Wagner, S. M. (2013). Bottleneck identification in supply chain networks. <i>International Journal of Production Research</i>, 51(5), 1477–1490.</p> <p>http://doi.org/10.1080/00207543.2012.695878</p>	<p>In this article the authors use network theory to establish a technique for detecting bottlenecks emergent in the extend network. While there is some relvence of this it is clearly more applicable to the specific operational challenges faced within n</p>
<p>Khalili-Damghani, K., Tavana, M. & Najmodin, M (2015). Reverse logistics and supply chains: A Structural equation modelling investigation. <i>International Journal of Industrial Engineering : Theory Applications and Practice</i>, 22(3), 354–368. Retrieved from http://www.scopus.com/inward/recor</p>	<p>The article discusses the role of reverse logistics in supply chain management. The focus is upon fast-moving throughput with a strong logistics focus that omits the article from being non-useful in address of the research question.</p>

d.url?eid=2-s2.0-84957006608&partnerID=40&md5=44871c56d1dba804f9b856ca2eddf98f	
Troisi, E. M., Caelers, H. J. M., & Peters, G. W. M. (2017). Full Characterization of Multiphase, Multimorphological Kinetics in Flow-Induced Crystallization of IPP at Elevated Pressure. <i>Macromolecules</i> , 50(10), 3868–3882. http://doi.org/10.1021/acs.macromol.7b00595	The article is from a physical science domain.
Urbanic, R. J. (2015). A design and inspection based methodology for form-function reverse engineering of mechanical components. <i>The International Journal of Advanced Manufacturing Technology</i> , 81(9-12), 1539–1562. http://doi.org/10.1007/s00170-015-7180-5	This article is from a engineering perspective, exploring reverse engineering of mechanical components. Non-relevant to domain of study.
South African Institute of Mining and Metallurgy. (1956). <i>Journal of the South African Institute of Mining and Metallurgy</i> . South African Institute of Mining and Metallurgy. Retrieved from http://library.liv.ac.uk.liverpool.idm.oclc.org/search/i?SEARCH=0038-223X&searchscope=2	An erroneous search return – The is a book returned from 1956 and has no bearing on the research topic.

<p>Simpson, D. (2010). Use of supply relationships to recycle secondary materials. <i>International Journal of Production Research</i>, 48(1), 227–249.</p> <p>http://doi.org/10.1080/00207540802415584</p>	<p>The article is of surface level relevance, with the focus being specifically on the recycling of materials amongst complex supply chains.</p>
<p>Iyengar, S., Hedman, L., Forte, G., & Hill, S. (2016). Medicine shortages: a commentary on causes and mitigation strategies.: BMC Medicine, 14(121).</p>	<p>The article is based within the medicine literature, entirely non relevant.</p>
<p>Collins, J., Kette, W., & Gini, M. (2009). Flexible decision control in an autonomous trading agent. <i>Electronic Commerce Research and Applications</i>, 8(2), 91–105.</p> <p>http://doi.org/10.1016/J.ELERAP.2008.09.004</p>	<p>The article is specifically focused upon the effectiveness of taking a particular approach with automated trading agents. While there is substantial overlap there is a radically different set of interest having been employed within this paper in comparison with those of the research question.</p>
<p>Wong, T. N., & Fang, F. (2010). A multi-agent protocol for multilateral negotiations in supply chain management. <i>International Journal of Production Research</i>, 48(1), 271–299.</p> <p>http://doi.org/10.1080/00207540802425393</p>	<p>The paper is concerned with the application of smart agents towards multilateral bargaining and is therefore of potential benefit to the current study but takes an overly specific view of one small aspect for inclusion in the full review.</p>
<p>Fathi Aghdam, F., & Liao, H. (2014). Prognostics-Based Two-Operator Competition in Proactive Replacement and Service Parts Procurement. <i>The Engineering Economist</i>, 59(4), 282–306.</p>	<p>The article takes a mathematical modelling approach towards service parts procurement from an engineering perspective. Thus while the concepts overlap the engineering focus excludes this</p>

<p>http://doi.org/10.1080/0013791X.2014.940563</p>	<p>from being included in the full paper review.</p>
<p>Dems, A., Rousseau, L.-M., & Frayret J.-M. (2013). Effects of different cut-to-length harvesting structures on the economic value of a wood procurement planning problem. <i>Annals of Operations Research.</i></p>	<p>A highly specific example of procurement research in that is it applied exclusively to wood-cutting and thus not suitable for inclusion in this research.</p>
<p>Yain, W. S., & Sio, F. Lou. (2009). Fuzzy adaptive agent for supply chain management. <i>Web Intelligence & Agent Systems</i>, 7(2), p173–194.</p>	<p>The article focuses upon supply chain management operationalisation in a fast throughput environment and does not pertain to complex areas and has thus been rejected at review stage.</p>
<p>Jaipuria, S., & Mahapatra, S. S. (n.d.). Performance improvement of manufacturing supply chain using back-up supply strategy. <i>Benchmarking: An International Journal Supply Chain Management</i> An International Journal An International Journal, 22(1), 446–464.</p>	<p>The study focuses on non-complex supply chain dynamics outside of a PSS context and is thus not directly pertinent in address of the research question</p>
<p>Merzifonluoglu Yesemin. (2017). Integrated demand and procurement portfolio management with spot market volatility and option contracts. <i>European Journal of Operational Research</i>, 258(1), 181–192.</p>	<p>The study focuses upon the fast-moving procurement supply chains and characterising purchase capability. The study takes too narrow a focus upon the area.</p>
<p>Zhou, S. X., & Yu, Y. (2011). Optimal Product Acquisition, Pricing, and Inventory Management for</p>	<p>The article is to do with remanufacturing and the purchase of used good towards this process and has thus been discounted.</p>

Systems with Remanufacturing. Operations Research, 59(2), 514–521.	
Kesner, R., & Ressell, B. (2009). Enabling Business Processes through Information Management and IT Systems: The FastFit and Winter Gear Distributor. <i>Journal of Information Systems Education</i> , 20(4), 401–405.	The paper is an examination of a pedagogical exercise of a simplistic case and is thus entirely unsuitable for review.
Simangunsong, E., Hendry, L. C., & Stevenson, M. (2012). Supply-chain uncertainty: a review and theoretical foundation for future research. <i>International Journal of Production Research</i> , 50(16), 4493–4523. http://doi.org/10.1080/00207543.2011.613864	The article pertains to supply chain uncertainty. Whilst this is a component of the research areas the narrow focus upon this concept alone precludes it's inclusion in the full review.
Mishra, N., Kumar, V., & Chan, F. T. S. (2012). A multi-agent architecture for reverse logistics in a green supply chain. <i>International Journal of Production Research</i> , 50(9), 2396–2406. http://doi.org/10.1080/00207543.2011.581003	The article focuses upon green logistics and reverse supply chains and is thus too narrowly focused on these specific SCM topics to be pertinent in address of the research question.
Devalkar, S., Anupindi, R., & Sinha, A. (2011). Integrated Optimization of Procurement, Processing, and Trade of Commodities. <i>Operations Research</i> , 59(6), p1369–1381.	The article pertains to the assessment of fast throughput procurement, and does not focus upon complex commodities
Skoglund, K., Svensson, G., Thilén, U., Dellborg, M., & Eriksson, P.	Immediately rejected, article is from a different discipline.

(2017). Long-term outcome after right ventricle to pulmonary artery conduit surgery and reintervention. Scandinavian Cardiovascular Journal, 51(5), 284–291.	
Hsing Ho, C., & Pedro, R. (2013). Evaluating the removal performance and friction characteristics of runway contaminants. Journal of Airport Management, 7(2).	Immediately rejected, article is from a different discipline.
Creazza, A., Dallari, F., & Rossi, T. (2012). An integrated model for designing and optimising an international logistics network. International Journal of Production Research, 50(11), 2925–2939. http://doi.org/10.1080/00207543.2011.578157	The article is focused upon physical distribution and logistics, whilst this is a key elements of the complex acquisitions process. It is too narrow a focus to be pertinent to this research.
Grzenda, M., Bustillo, A., Quintana, G., & Ciurana, J. (2012). Improvement of surface roughness models for face milling operations through dimensionality reduction. Integrated Computer-Aided Engineering, 19(2), p179–197.	Immediately rejected, article is from a different discipline.
Isik, F. (2010). An entropy-based approach for measuring complexity in supply chains. International Journal of Production Research, 48(12), 3681–3696	The paper is partially relevant in that it specifically deals with the emergent importance of complexity within competing supply chains. However the focus is upon defining and measuring complexity within these environments and therefore centres more on the mechanics on

	supply than the practical operational capabilities embedded within procurement practice.
Merzifonluoglu, Y., & Feng, Y. (2014). Newsvendor problem with multiple unreliable suppliers. <i>International Journal of Production Research</i> , 52(1), 221–242.	The article mathematically models the condition of newsvendor suppliers in the context of numerous unreliable supplier options. The article is not describing complex acquisitions and was thus rejected.
Laidler, G. J., Hirose, T., Kapfer, M., Ikummaq, T., Joamie, E., & Elee, P. (2011). Evaluating the Floe Edge Service: how well can SAR imagery address Inuit community concerns around sea ice change and travel safety? <i>Canadian Geographer / Le Géographe Canadien</i> , 55(1), 91–107.	Immediately rejected, article is from a different discipline.
Santos, J., Garcia, M.-P., Arcelus, M., Viles, E., & Uranga, J. (2011). Development of a wireless Plug: Lean system for improving manufacturing equipment diagnosis. <i>International Journal of Computer Integrated Manufacturing</i> , 24(4), 338–351.	Article is based around data exchange within lean manufacturing systems. It is not related to procurement of complex procurement and has so been rejected at abstract review.
Bazydło, P., Szewczyk, R., & Urbański, M. (2015). An integrated dynamic weighing system based on SCADA.	The article pertains to systems integration in a field unrelated to the research question and has therefore been rejected from full review.
Schulte, P., & Spencer, D. (2016). Development of an integrated spacecraft Guidance, Navigation, & Control subsystem for	Immediately rejected, article is from a different discipline.

automated proximity operations. <i>Acta Astronautica</i> , 118, 168–186.	
Wong, C., Kee-hung, L., & Cheng, T. c. (2011). Value of Information Integration to Supply Chain Management: Roles of Internal and External Contingencies. <i>Journal of Management Information Systems</i> , 28(3), 161–200.	Partially relevant article however the focus is generically on supply chain management and the issue does not focus upon any of the critical themes of complexity or procurement.
Nakao, M., Takemoto, S., Sugiura, T., Sawada, K., Kawakami, R., Nemoto, T., & Matsuda, T. (2014). Interactive visual exploration of overlapping similar structures for three-dimensional microscope images. <i>BMC Bioinformatics</i> , 15(1), 415.	Immediately rejected, article is from a different discipline.
Kallestrup, K., Hadberg, L., & Akkerman, R. (2014). Decision support in hierarchical planning systems: The case of procurement planning in oil refining industries. <i>Decision Support Systems</i> , 68, 49–63.	Partially relevant article, although the focus is upon fast throughput context of oil procurement and thus has been discounted from full paper review.
Mevi, R. K., Kazemi, S., Najafabadi, A. F., & Mousaabadi, H. B. (2013). Identification and Assessment of Logistical Factors to Evaluate a Green Supplier Using the Fuzzy Logic DEMATEL Method. <i>Polish Journal of Environmental Studies</i> , 22(2).	Immediately rejected, article is from a different discipline.

<p>Hexley, P., Smith, V., & Wall, S. (2016). Operational Changes in a Shared Resource Laboratory with the Use of a Product Lifecycle Management Approach: A Case Study. <i>Journal of Biomolecular Techniques</i> : JBT, 27(1), 18–24.</p>	<p>Immediately rejected, article is from a different discipline.</p>
<p>Fang, X., Ru, J., & Wang, Y. (2014). Optimal Procurement Design of an Assembly Supply Chain with Information Asymmetry. <i>Production and Operations Management</i>, 23(12), 2075–2088.</p>	<p>The research mathematically models assembly supply chains and does not include the core elements of complexity and procurement of complex systems that is act as inclusion criteria for articles in the systematic review</p>
<p>Hu, S., Wan, Z., Ye, Q., & Chi, W. (2017). Supplier Behavior in Capacity Investment Competition: An Experimental Study. <i>Production and Operations Management</i>, 26(2), 273–291</p>	<p>A game theoretic assessment of the of capacity in a traditional supply chian. The omission f core concepts like servitization, complexity and complex procurement exclude this article from full review.</p>
<p>Wu, J.-Z., Chien, C.-F., & Gen, M. (2012). Coordinating strategic outsourcing decisions for semiconductor assembly using a bi-objective genetic algorithm. <i>International Journal of Production Research</i>, 50(1), 235–260.</p>	<p>The study uses mathematical algorythems in exploration of the case of semiconductroy example. The specificity and lack of service component associated with the context cause this paper to be exploded at the abstract review stage.</p>
<p>Grabowski, M., Rizzo, C., & Graig, T. (2016). Data challenges in dynamic, large-scale resource allocation in remote regions.</p>	<p>Immediately rejected, article is from a different discipline.</p>

<p>Kirezieva, K., Bijman, J., Jacxsens, L., & Luning, P. A. (2015). The role of cooperatives in food safety management of fresh produce chains: Case studies in four strawberry cooperatives. <i>Food Control</i>, 62, 299–308.</p>	<p>Immediately rejected, article is from a different discipline.</p>
<p>Zhou, Z., Xiao, Z., Liu, Q., & Ai, Q. (2013). An analytical approach to customer requirement information processing. <i>Enterprise Information Systems</i>, 7(4), 543–557.</p>	<p>The article pertains the use of customer management systems but exclude the key areas of interest focused upon by the research question such as servitization environments, or procurements. Rejected at abstract stage.</p>
<p>Panda, T., & Mohanty, P. (2012). Supply Chain Management Practices and Scope for Bullwhip Effect in Indian Dry Grocery Business. <i>Journal of Supply Chain Management</i>, 9(3), 63–85.</p>	<p>The article pertains exclusively to fast throughput, non-complex environments. Without a strong servitization component and has thus been discounted from full review.</p>
<p>Enfield, R. (2010). Reviewing your organisation's approach to data management. <i>Journal of Securities Operations & Custody</i>, 3(2).</p>	<p>Immediately rejected, article is from a different discipline.</p>
<p>Kumar, A., Heide, J. B., & Wathne, K. H. (2011). Performance Implications of Mismatched Governance Regimes Across External and Internal Relationships. <i>Journal of Marketing</i>, 75(2), 1–17.</p>	<p>Article is from a marketing field and why there are a number of overlaps the absence of core themes discounts this article from full review.</p>
<p>Lilleborg, M., Hauge, R., & Eidsvik, J. (2016). Information Gathering in</p>	<p>Immediately rejected, article is from a different discipline.</p>

Bayesian Networks Applied to Petroleum Prospecting. Mathematical Geosciences, 48(3), 233–257.	
Beer, S., & Lemmer, C. (2012). A critical review of “green” procurement: Life cycle analysis of food products within the supply chain. Worldwide Hospitality and Tourism Themes, 3(2), 229–244.	The hospitality tourism focus of the research makes it unsuitable for inclusion in the full paper review
Harmon, K., & Moriarty, G. (2010). Making web development and e-servicing investments pay off. Journal of Securities Operations & Custody , 3(2).	Immediately rejected, article is from a different discipline.
Xiao, L., Liao, G., Deng, F., Liu, H., Song, G., & Li, M. (2015). Development of an NMR system for down-hole porous rocks. Microporous and Mesoporous Materials, 205, 16–20.	Immediately rejected, article is from a different discipline.
Kim, S., & Shon, E. (2011). Effects of regulation changes in seoul bus system: private bus operation under non-competitive fixed price contract. Journal of Advanced Transportation, 45(2), 107–116.	The article has some relevance owing to the focus upon fixed price contracting and its outcomes however other key considerations of the research are omitted making it unsuitable for inclusion in full paper review.
Behera, P., Mohanty, R. P., & Prakash, A. (2015). Understanding Construction Supply Chain Management. Production Planning & Control, 26(16), 1332–1350.	There is partial relevance to the research question. However numerous key themes are omitted and thus the paper has not been carried through to full review.

<p>Kinzli, K.-D., Gensler, D., Oad, R., & Shafike, N. (2015). Implementation of a Decision Support System for Improving Irrigation Water Delivery: Case Study. <i>Journal of Irrigation and Drainage Engineering</i>, 141(11), 1–10.</p>	<p>Immediately rejected, article is from a different discipline.</p>
<p>Ross, A. D., & Jayaraman, V. (2009). Strategic Purchases of Bundled Products in a Health Care Supply Chain Environment. <i>Decision Sciences</i>, 40(2), 269–293.</p>	<p>Immediately rejected, article is from a different discipline.</p>
<p>Gonzalez, H., Han, J., Cheng, H., Li, X., Klabjan, D, & Wu, T. (2010). Modeling Massive RFID Data Sets: A Gateway-Based Movement Graph Approach. <i>IEEE Transactions On Knowledge And Data Engineering</i>, 22(1).</p>	<p>The article focuses upon the use of RFID technologies in warehousing and supply chain management and does not touch upon the key areas under investigation by this research question.</p>
<p>Ming-Kuen, C., Shih-Ching, W., & Choyou-Huey, C. (2009). The E-Business Policy Of Global Logistics Management For Manufacturing. <i>International Journal of Electronic Business Management</i>, 7(2).</p>	<p>The article precludes a focus on procurement of complex assets nor does it discuss any form of complex-product system procurement. Therefore the article has been discounted at abstract review.</p>
<p>Feng, Q., Dai, Y., & Hwang, K. (2009). Rainbow Product Ranking for Upgrading E-Commerce. <i>IEEE Internet Computing</i>.</p>	<p>The article discusses electronic networks and has a strong e-commerce focus. Thus the article has been rejected at abstract review.</p>
<p>Klampfl, E., Fradkin, Y., McDaniel, C., & Wolcott, M. (2009). Ford Uses OR to Make Urgent Sourcing</p>	<p>This paper specifically pertains to particularly fast-throughput supply chains of the mass production automotive</p>

Decisions in a Distressed Supplier Environment. <i>Interfaces</i> , 39(5).	industry. Thus the article has been excluded at abstract review.
Sadananda Upadhyaya, K., Srinivasan, N. K., & Upadhyaya, K. S. (2012). Availability estimation using simulation for military systems. <i>International Journal of Quality & Reliability Management</i> , 29(1), 937–952.	Pertains to the availability of military systems, and conducts a simulation in assessment of this. Does not pertain to procurement of complex assets and has thus been discounted from full review.
Susarla, A., Barua, A., & Whinston, A. (2010). Multitask Agency, Modular Architecture, and Task Disaggregation in SaaS. <i>Journal of Management Information Systems</i> , 26(4), 87–117.	Immediately rejected, article is from a different discipline.
Bahinipati, B. K., & Deshmukh, S. G. (2012). Vertical collaboration in the semiconductor industry: A decision framework for supply chain relationships. <i>Computers & Industrial Engineering</i> , 62(2), 504–526.	The article pertains to vertical integration collaboration within an e-marketplace. The focus is therefore on fast throughput and fails to discuss sufficient items of complexity to make this pertinent in address of the research question.
Adamides, E. D., & Pomonis, N. (2009). The co-evolution of product, production and supply chain decisions, and the emergence of manufacturing strategy. <i>Int. J. Production Economics</i> , 121, 301–312.	The article is partially relevant in that it address a number of the core issues that the research question is concerned with. However the economic viewpoint taken to exclusively manufacturing makes the article unsuitable for continuation into full review.
Tachizawa, E. M., Gimenez, C., & Sierra, V. (2015). Green supply chain management approaches: drivers and	The article focuses upon the green supply chain practice within non-complex

<p>performance implications. International Journal of Operations & Production Management Industrial Management & Data Systems International Journal, 35(1), 1546–1566.</p>	<p>environments and so is not directly pertinent and is excluded from the study.</p>
<p>Gibert, K., García-Alonso, C., & Salvador-Carulla, L. (2010). Integrating clinicians, knowledge and data: expert-based cooperative analysis in healthcare decision support</p>	<p>Immediately rejected, article is from a different discipline.</p>
<p>Zhao, X., Liu, C., & Lin, T. (2010). Incorporating business process management into RFID-enabled application systems. Business Process Management Journal, 16(2), 932–953.</p>	<p>Immediately rejected, article is from a different discipline.</p>
<p>Kreller, D. I., Young, S. P., Mendez, E. A., & Mcgunigale, S. L. (2012). Chromatogram Handler: A unique computer program that efficiently processes data generated in liquid chromatographic investigations of organic ligand adsorption on mineral surfaces.</p>	<p>Immediately rejected, article is from a different discipline.</p>
<p>Agarwal, R., Anand, J., Bercovitz, J., & Croson, R. (2012). Spillovers across organizational architectures: The role of prior resource allocation and communication in post-acquisition coordination outcomes.</p>	<p>The article is using a non-relevant definition of acquisition, meaning to acquire another organisation and is separate from the issue of complex asset procurement.</p>

Strategic Management Journal, 33(6), 710–733.	
Chen, W., Feng, Q., & Seshadri, S. (2013). Sourcing from suppliers with random yield for price-dependent demand. <i>Annals of Operations Research</i> , 208(1), 557–579.	The article pertains to price setting in high-throughput procurement and does not pertain to complex produce service systems and is fundamentally commodities based. Therefore the paper has been discounted from full review.
Prince, M., Smith, J. C., & Geunes, J. (2013). A three-stage procurement optimization problem under uncertainty. <i>Naval Research Logistics (NRL)</i> , 60(5), 395–412.	The article investigates non-complex procurement of commodities through theoretical simulation. The lack of focus on complex product service systems precludes that article from inclusion into the full review.
Schoenherr, T. (2010). Outsourcing decisions in global supply chains: an exploratory multi-country survey. <i>International Journal of Production Research</i> , 48(2), 343–378.	While a useful contribution in understanding the generic outsourcing decision across numerous countries, this article's lack of focus on UK institutions and the lack of specificity in terms of outsourcing type has precluded it from being directly relevant in addressing the research question.
Geunes, J., Merzifonluoglu, Y., & Romeijn, H. E. (2008). Capacitated procurement planning with price-sensitive demand and general concave-revenue functions. <i>European Journal of Operational Research</i> , 194, 390–405.	As is similar with a number of the articles that have been rejected from inclusion in the full review the paper's focus is on simulating purchasing dynamics. Importantly purchasing of fast-throughput commodities or products as opposed to procurement of complex product service systems.

<p>Choo, A. S. (2014). Defining Problems Fast and Slow: The U-shaped Effect of Problem Definition Time on Project Duration. <i>Production and Operations Management</i>, 23(8), 1462–1479.</p>	<p>The article does not pertain to any of the core themes that are pertinent in address of the research question.</p>
<p>Zheng, S., & Negenborn, R. R. (2015). Price negotiation between supplier and buyer under uncertainty with fixed demand and elastic demand. <i>Int. J. Production Economics</i>, 167, 35–44.</p>	<p>While there is relevant focus on uncertainty and negotiations between supplier and buyer, the focus is on fast throughput purchasing and not complex procurement.</p>
<p>Chen, Y.-J., & Chen, Y.-M. (2009). An XML-based modular system analysis and design for supply chain simulation. <i>Robotics and Computer-Integrated Manufacturing</i>, 25, 289–302.</p>	<p>The simulation focus and lack of inclusion of core concepts excludes this article from full paper review.</p>
<p>Brintrup, A. (2010). Behaviour adaptation in the multi-agent, multi-objective and multi-role supply chain. <i>Computers in Industry</i>, 61, 636–645.</p>	<p>The article is focused on the automation of decision making processes within supply chains. The article excludes consideration of complex acquisitions and has been excluded at abstract review.</p>
<p>Sokolova, M. G., Akimova, G., Vaishlya, O., & Vedernikova, A. (2010). Physiological research of efficiency of biologically safe bacterial fertilizers. <i>Journal of Manufacturing Technology Management</i>, 21(1), 956–970.</p> <p>Retrieved from</p>	<p>Immediately rejected, article is from a different discipline.</p>

<p>Adhitya, A., & Srinivasan, R. (2010). Dynamic Simulation and Decision Support for Multisite Specialty Chemicals Supply Chain. <i>Industrial & Engineering Chemistry Research</i>, 49(20), 9917–9931.</p>	<p>Specific focus on the chemical supply chain excludes this article immediately.</p>
<p>Li, J., Xiong, N., Park, J. H., Liu, C., MA, S., & Cho, S. (2012). Intelligent model design of cluster supply chain with horizontal cooperation. <i>Journal of Intelligent Manufacturing</i>, 23(4), 917–931.</p>	<p>The focus of the article on horizon communication is a potentially relevant one to the research. Although the absence of any of the core themes of the research being discussed explicitly causes the paper to be rejected at the abstract review stage.</p>
<p>Banerjee, A. (2009). Simultaneous determination of multiproduct batch and full truckload shipment schedules. <i>Int. J. Production Economics</i>, 118(1).</p>	<p>The paper uses simulation in exploring a specific application of logistics management principals and is not relevant to the study.</p>
<p>Yu, Y., Chen, X., & Zhang, F. (2015). Dynamic Capacity Management with General Upgrading. <i>Operations Research</i>, 63(6).</p>	<p>The article covers the specific topic of capacity planning and general upgrading and is thus not pertinent in addressing the research question.</p>
<p>He, Z., Hu, W., & Dong, W. (2010). Petroleum Electromagnetic Prospecting Advances and Case Studies in China. <i>Surveys in Geophysics</i>, 31(2), 207–224.</p>	<p>Immediately rejected, article is from a different discipline.</p>
<p>Bai, C., & Sarkis, J. (2009). Integrating sustainability into supplier selection with grey system and rough set methodologies. <i>Int. J. Production Economics</i>, 124(1)</p>	<p>The focus on sustainability excludes the article from inclusion in the full paper review.</p>

<p>Chung, W., Talluri, S., & Narasimhan, R. (2010). Flexibility or Cost Saving? Sourcing Decisions with Two Suppliers. <i>Decision Sciences</i>, 41(3), 623–650.</p>	<p>Operationalises the problem of optimizing cost efficiency in different contract arrangements in fast throughput supply chain. Whilst generally pertinent the lack of focus on complex system of product-service systems precludes this from inclusion in the full review.</p>
<p>Palander, T., & Vesa, L. (2011). Potential methods of adjustment to declining imports of Russian roundwood for the Finnish pulp and paper industry. <i>The International Journal of Logistics Management</i>, 22(2), 222–241</p>	<p>As with numerous other paper excluded the article focuses upon the context of wood-procurement and is thus not pertinent for inclusion in the full paper review.</p>
<p>Su, S. I., Gammelgaard, B., & Yang, S. (2010). Logistics innovation process revisited: insights from a hospital case study. <i>International Journal of Physical Distribution & Logistics Management</i>, 41(3), 577–600</p>	<p>The article pertains directly to logistics in both a hospital, and within Thailand. The article is excluded from full review as it is thematically and contextually irrelevant.</p>
<p>Mckelvey, B., Wycisk, C., & Hü Lsmann, M. (2009). Designing an electronic auction market for complex “smart parts” logistics: Options based on LeBaron’s computational stock market. <i>Intern. Journal of Production Economics</i>, 120, 476–494</p>	<p>The paper focuses upon the application of novel technology towards logistics and therefore does not attend to the central themes of the research.</p>
<p>Guercini, S., & Runfola, A. (2009). The integration between marketing and purchasing in the tractability</p>	<p>Whilst the idea of supply chain transparency is of almost universal applicability in addressing questions related</p>

process. Industrial Marketing Management, 38, 883–891	to complex supply chains, the focus on the fashion industry and non-complex products excludes this article from being carried forward to full review.
Li, S., Murat, A., & Huang, W. (2008). Stochastics and Statistics Selection of contract suppliers under price and demand uncertainty in a dynamic market. European Journal of Operational Research, 198 (3)	In spite of numerous relevant cross overs of contexts the explicit focus on fast-throughput purchasing excludes this article from inclusion within full review.
Mahnam, M., Reza Yadollahpour, M., Famil-Dardashti, V., & Reza Hejazi, S. (2008). Supply chain modeling in uncertain environment with bi-objective approach. Computers & Industrial Engineering, 56, 1535–1544.	The papers focus upon assembly line supply chains and is thus discounted from inclusion in the full review as this is not directly pertinent.
Bradt, D. A. (2009). Evidence-Based Decision-Making (Part II): Applications in Disaster Relief Operations. Prehospital and Disaster Medicine, 24(06), 479–492.	Immediately rejected, article is from a different discipline.
Nollet J., Rebolledo, C., & Popel, V. (2012). Becoming a preferred customer one step at a time. Industrial Marketing Management, 41, 1186–1193.	The markets that are involved with the procurement of long term complex assets, and that the research question is addressing are often oligopolistic ones. The subject matter here presumes a highly competitive market-place and thus does not fit with the context of the research question.
Wang, X. (2010). The buyer's procuring mechanism under	As with a number of the article on this rejected list, the paper focuses upon

operating cost sharing in supply chain. <i>J Syst Sci Complex</i> , 23, 1102–1117.	acquisition in the sense of fast-throughput purchasing, and the relationship between the buyer-supplier within this context.
Barchi, M. R., & Mirabella, F. (2008). The 1997–98 Umbria–Marche earthquake sequence: “Geological” vs. “seismological” faults.	Immediately rejected, article is from a different discipline.
Stevenson, M., Huang, Y., Hendry, L. C., & Soopenberg, E. (2011). The theory and practice of workload control: A research agenda and implementation strategy. <i>Intern. Journal of Production Economics</i> , 131, 689–700.	The focus of this research is at the operational as opposed to the strategic level. Thus the focuses does not align with answering the broader questions that are pertinent to the research.
Böhme, T., Williams, S. J., Childerhouse, P., Deakins, E., & Towill, D. (2013). Methodology challenges associated with benchmarking healthcare supply chains. <i>Production Planning & Control</i> , 24(10-11), 1002–1014.	The article, as with many other returns from the search string, is excluded from full review as it pertains exclusively to traditional fast moving supply chains and not towards the context of long term complex acquisitions of major capital products and services.
Fritz, M., & Hausen, T. (2009). Electronic supply network coordination in agrifood networks Barriers, potentials, and path dependencies. <i>Intern. Journal of Production Economics</i> , 121, 441–453.	The specificity of the empirical context and lack of inclusion of core themes pertinent to the research excludes this article.
Drechsel, J., & Kimms, A. (2010). Computing core allocations in cooperative games with an	Immediately rejected, article is from a different discipline.

application to cooperative procurement. Intern. Journal of Production Economics, 128, 310–321	
Delsate, N. (2011). Analytical and numerical study of the ground-track resonances of Dawn orbiting Vesta. Planetary and Space Science, 59, 1372–1383.	Immediately rejected, article is from a different discipline.
Munson, C. L., & Hu, J. (2009). Incorporating quantity discounts and their inventory impacts into the centralized purchasing decision. European Journal of Operational Research, 201, 581–592	The article overtly concentrates on the advantages derived from economies of scale in fast-moving high-throughput supply chains and is therefore discounted from full review on this basis.

9 APPENDIX 2

Interview Summary

This work invoked an abductive research design which is characterised by repeated reengagement with the empirical world. This has the following two significant affects: Firstly, numerous interview participants were reengaged for follow up interviews after subsequent analysis of new data both within that particular case and across the range of cases. Secondly, supplementary data was collected via e-mail and on the phone with these participants without them having undertaken a formal interview.

Furthermore, owing to the diversity of the cases explored, the relevant knowledge was distributed over an uneven number of departments and participants. Whilst some of the smaller organisations processes could be detailed cradle to grave by one individual, the larger organisations often had the same knowledge spread over numerous people, departments and geographical locations. This lead to an uneven number of interviews across the case study range as demonstrated within the table. Lastly, the interview data fails to capture the extent of the data required for this PhD, as the document analysis and additional communication with participants were necessarily extensive.

The following table describes the interview participants. The majority of participants requested to be anonymised to the level of job role.

Participant Code	Organisation	Job Role	Number of Formal interviews	Additional Communication	Interview Length
A1	MOD	1 Star General equivalent (Commercial)	2	N/A	• 1h • 45m
A2	MOD	Group Captain (Head of suite of projects)	2	• Email	• 1h
A3	MOD	Colonel (Project Team Head)	1	N/A	• 2h

A4	MOD	Project Team Head	1	N/A	• 1h
A5	MOD	Project Team Head	1	N/A	• 1h
A6	MOD	I.C.T Systems specialist	1	N/A	• 1h
A7	MOD	Head of Assurance	1	N/A	• 1h
A8	MOD	Head of Scrutiny	1	N/A	• 1h
A9	MOD	Wing Commander (Concepts & Doctrine)	3	• E-mail • Telephone	• 2h • 1h • 1h
B1	NHS	Procurement Officer	5	• e-mail • telephone	• 1h • 2h • 3h • 1h • 1h
B2	NHS	I.C.T Specialist	1	N/A	• 1.5h
B3	NHS	I.C.T Specialist/ Quality Control	1	• e-mail	• 1h
B4	NHS	Head of CCG	1	• e-mail	• 2h
B5	NHS	Head of Contracting	1	• e-mail	• 1h
C1	Sellafield	Head of Programme	1	• e-mail	• 2h
C2	Sellafield	Head of Programme	1	• e-mail	• 2h
C3	Sellafield	High level executive	3	• Telephone • E-mail	• 2h • 1h • 1.5h
D1	Governme nt	Head of Procurement	2	• e-mail	• 3h • 2h
D2	Governme nt	Head of Procurement	1	N/A	• 1.5h
D3	Governme nt	Head of procurement consortium	1	• e-mail	• 2h

E1	Encirc	Operations Director	2	<ul style="list-style-type: none"> • e-mail • telephone 	<ul style="list-style-type: none"> • 2h • 1h
E2	Encirc	Purchasing manager	1	N/A	<ul style="list-style-type: none"> • 1h
F1	IBM	High level executive (telephone interview)	3	<ul style="list-style-type: none"> • e-mail 	<ul style="list-style-type: none"> • 1h • 1h • 1h