School of Management

Understanding why Complex Projects Overrun: Developing a Framework for Identifying and Managing Risks

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DECLARATION

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

The research presented and reported in this thesis was conducted in accordance with the National Health and Medical Research Council National Statement on Ethical Conduct in Human Research (2007) – updated March 2014. The proposed research study received human research ethics approval from the Curtin University Human Research Ethics Committee (EC00262), Approval Number #SoM-05-2013

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ABSTRACT

Projects are a ubiquitous feature of today's global economy, penetrating almost every sector to a greater or lesser extent. There is also a burgeoning knowledge base concerning their management encapsulated in research journals, innumerable text books, international standards of practice, and professional qualifications.

Yet despite all the knowledge and experience gained from projects, the review of literature in this thesis finds frequent reports of projects having overrun in terms of time and/or cost. The conclusion is drawn that further research is needed if overruns are to be mitigated or avoided. The review also finds calls from leading academics for project management research to move beyond the traditional positivist perspective on projects and adopt alternatives that might provide fresh insights. With critical realism as its methodological foundation, this research study answers this call by adopting a systemic modelling perspective to researching the phenomenon of overruns.

Empirical investigation of two large health care Private Finance Initiative (PFI) construction projects was conducted using a qualitative case study design coupled with a causal mapping technique. The projects were examined from the perspective of the construction company who was contracted to design, build, finance, and operate the facilities. One project was heralded by the company to be a success while the other experienced significant cost overruns during the operational phase.

With the operational phase of both projects as the locus of investigation, the findings of this study suggest that feedback dynamics involving loss of client trust; delay triggers such as design changes; and contextual conditions such as human resource policies, can form a complex system that can induce cost overruns during the operating phase of projects. Using the case study findings, a model offering an explanation of the pathology of project operating cost overruns is developed.

It is argued that the thesis makes two main contributions to theory. Firstly, it identifies a system of factors that can induce cost overrun in the operational phase of PFI projects and encapsulates this system in a model. The model offers a broad appreciation of the pathology of operational cost overrun and, while aligning with existing models in the extant literature, it also extends them in key ways. Secondly, the thesis makes a methodological contribution to knowledge by providing a detailed exposition of a critical realist approach to researching projects which offers an alternative to traditional positivist based approaches.

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CHAPTER 1:   INTRODUCTION

1.0   RATIONALE FOR RESEARCHING PROJECTS

Fuelled by frequent reports of projects being late, over budget or having failed meet other expectations (Flyvbjerg et al., 2002, Love et al., 2012), projects have a rather unenviable reputation. Yet despite their reputation, projects proliferate. Indeed Winch et al. (2012, p.141) suggest there is 'a general trend towards project forms of organising'.

Such is the strength of this trend that today projects can be found in almost every nook and cranny of the global economy, their propagation cultivated by changes to market conditions in the late 20th century (Kerzner, 2009). Growing consumer wealth saw the static, mass, homogenous markets of the earlier part of the century give way to a much more sophisticated group of consumers who sought product differentiation, variety, innovation and whose demands were subject to frequent change (Wheelwright and Clark, 1992). Another feature of this new landscape was the globalisation of firms which further enabled consumer choice and, at the same time, increased competition to satisfy that choice. The organisational forms that had obediently served the needs of consumers in the earlier part of the 20th century were not designed to cope with this new landscape. Honed by the likes of Ford (and Taylor in Europe) these forms of organising were designed for the production mass goods with low variation (Cicmil et al., 2009). Seeking an alternative, firms turned to projects.

Projects provide the ability to integrate different permutations of knowledge, disciplines and technologies in a way that can be reconfigured quickly (Meredith and Mantel, 2010). These features enable uniqueness and variety in products as well as the ability to respond to fast changing market demands. Presumably lured by these exciting features, the 'projectification' (Midler, 1995) of organisations has been prolific. Originally the preserve of construction and engineering sectors, projects are now used in a wide variety of applications with some $16 trillion per year being spent globally on project based activities (Turner et al., 2010).

The practice and profession of project management (PM) has also burgeoned. Early techniques such as Gantt and PERT have been complemented by computer software packages specifically designed to support the management of projects (Kidd, 1990). More sophisticated (and expensive) systems have seen project

management move from the level of an individual project to the enterprise level where programs and portfolios of projects can be managed (Meredith and Mantel, 2010). Membership of professional organisations such as the Project Management Institute and the Association for Project Management continues to grow year on year. These organisations also offer internationally recognised standards of project management practice captured in 'bodies of knowledge' as well as offering a suite of industry recognised qualifications. Governments have also developed standards such as PRINCE2 and the OGC gateway procedure with industries such as software having developed their own specific methodologies (i.e. AGILE) to guide practice.

Organisations and practitioners clearly have at their disposal a wide variety of armaments with which to support the practice of project management. Yet in spite of this, many organisations are left defeated by projects that experience overruns of cost and time. Looking at cost alone, the magnitude of overruns that can be experienced is significant with values of 13% (Love et al., 2009), 14% (Winch, 1996), and as high as 44.7 % (Flyvbjerg et al., 2002) being reported in the literature.

Specific projects are identified within the literature as exemplars of the phenomenon of overrun at work. For example, Denver airport in the United States experienced a 200% cost overrun (Szyliowicz and Goetz, 1995) and the Scottish Parliament in the UK which experienced cost overrun of almost 900% and was more than three years late (White and Sidhu, 2005). It seems reasonable to assume that the organisations tasked with delivery of these projects were reputable and had significant prior experience of similar projects. Yet still, they encountered failure.

The phenomenon of overruns is not 'breaking news' to the community of practitioners and researchers involved in project management. Overruns have been an enduring theme within the literature dating back at least to the 1960's with Avots (1969, p.77) asking 'What are the reasons for failure?' Yet it seems the basic line of inquiry is still as relevant today as it was over 45 years ago.

In summary, despite their prevalence in a growing number of organisations and the availability of research, standards, and techniques, projects are still regularly reported as having overrun in terms of time and/or cost. Thus it appears work still needs to be done to improve our understanding of projects such that they might be managed in ways that mitigate the behaviour of overrun.

1.1   UNDERSTANDING OVERRUNS USING SYSTEMIC MODELLING

Traditionally projects have been conceived as rationalistic, deterministic and predictive which Turner et al. (2010) describes as treating projects as though they are 'machines'. Researchers have contended that this conventional perspective on projects does not adequately match their actuality. Morris (1997, p.2), for example, noted that 'the successful accomplishment of a project may well require attention to range of factors not treated by the traditional project management literature'. Bredillet (2004, p.3) argues that project management deals with a 'complex reality' but that current theory is underpinned by assumptions that can lead to 'oversimplification'. Cicmil et al. (2009, p.83) points to the 'paradox of project management'. The paradox is that project management identifies projects as unique, innovative, uncertain and changing but conventional theory and practice is underpinned by assumptions of rationality, determinism and standardisation where command and control are the order of the day. Williams (2005) suggested that rationalistic assumptions are inadequate because contrary to being 'machines' projects involve people and thus comprise 'soft' factors such as human nature, politics and relationships.

From a practice point of view, Engwall (2003) for example demonstrated through research of two case studies that rigorous adherence to conventional project management theory did not guarantee success. The mismatch between conventional theory and the actual practice of project management is also visible with respect to issues such as stakeholder management. A number of researchers have pointed out the importance of stakeholders in the practice of project management (Morris and Hough, 1987, Winch, 2004, Cleland, 2008) yet it is only recently that subject has received exclusive attention in one of the most influential practitioner oriented texts, the PMI's Guide to the Project Management Body of Knowledge (PMBOK Guide) (PMI, 2013)

The limitations of a conventional perspective on projects have fuelled calls by leading researchers (Morris and Hough, 1987, Williams, 1999, Turner et al., 2010, Bredillet, 2013) for academics and practitioners alike to explore and adopt alternative perspectives that might better reflect their actuality. However, although new perspectives have emerged (see Turner et al., (2010) for an overview), in the main, PM research like PM practice remains stubbornly welded to what Bredillet (2013) observes as hegemony of approach. This observation is supported by

empirical research by Smyth and Morris (2007). The authors report that much project management research is dominated by a single orientation characterised by a positivist (and associated empiricist) paradigm; a paradigm that speaks to a conventional conceptualisation of projects (Bredillet, 2004). Thus, while some researchers have proposed new perspectives (Ackermann et al., 1997, Bredillet, 2013, Winch, 2015) they are much less prevalent in the literature than the dominant approach.

Consequently, opportunity remains for fresh insights into project behaviour by using alternative perspectives on projects. Taking advantage of this opportunity, this thesis adopts a systemic modelling perspective (Williams et al., 1997, Eden et al., 2000, Ackermann and Eden, 2005) for inquiry into overruns in projects in order to improve understanding of the phenomenon. A systemic modelling approach facilitates fine grained insight into the actuality of projects (Williams et al., 2003, Howick et al., 2008), insight that can be used to develop theory that can resemble the 'complex reality' (Bredillet, 2004) of projects and can thus offer enhanced value to practitioners following Lewin's (1945) axiom that 'nothing is so practical as a good theory'. Thus, the overarching ambition of this thesis was to achieve research that is both academically rigorous and of practical relevance (Pettigrew, 2001).

1.2   RESEARCH CONTEXT

The research was undertaken in partnership with a large construction company, referred to hereon as BuildIt. The relationship with BuildIt in relation to the PhD research stemmed from the author's prior involvement with the business which is described in more detail next.

The author's entry into researching project overruns was, to coin a phrase of Andrew Pettigrew's, one of planned opportunism. The initial step was enrolment in a post graduate Masters (MSc) in Business Analysis, the award of which depended upon completion of a dissertation project. Exploring options for the dissertation topic, an opportunity emerged from the author's then MSc supervisor (now PhD supervisor) to explore the issue of project overruns with a construction company (BuildIt).

The combination of topic and opportunity to work with an organisation sparked the author's immediate interest. Prior to joining the MSc, the author had been

involved in and led projects of various sizes and, therefore, had lived experience of the challenges associated with managing projects. Furthermore, the opportunity to work within a 'real life' setting spoke to the same interest that had spurred the author's enrolment in the MSc in the first place – the opportunity to help organisations improve.

During the course of the three month MSc dissertation, the author's supervisor broached the subject of pursuing a PhD in the topic (of project overruns). The proposal was initially met with the same scepticism that had twice led the author to decline PhD opportunities in the past. The scepticism was fuelled by a misconception about the nature of research and thus the author's 'fit' as a researcher. The misconception was that research comprised only of theory[1] which marginalised the author's ambitions of helping to improve practice. However, regular discussions between the author and his supervisor regarding examples of research which had supported practice, coupled with Lewin's (1945) axiom that 'nothing is so practical as a good theory', dispelled the misconception and the PhD journey began.

A couple of events along the PhD journey are also worthy of a few words to help the reader contextualise the research. The PhD was started in Glasgow (UK) however at the end of the first year an opportunity arose (and was pursued) to move to Perth, Western Australia. While the relationship with BuildIt (which was based in the UK) was retained, the geographic distance meant field visits were naturally time bound opportunities. Furthermore, during the remainder of the PhD, BuildIt underwent a number of significant organisational changes. These changes, understandably, caused distraction from the research study within BuildIt and consequently access to data proved challenging. Despite the back drop of frequent change and the turbulence it brought with it, research on two case studies was completed. This thesis document describes that research and is structured as follows.

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[1] It is somewhat ironic that during the Phd journey theory gripped the focus of the author, as reflected in particular within the research methodology section.

1.3 STRUCTURE OF THE THESIS

Exploring the Extant Literature

The review of literature is split into three sections. The first section frames this study by establishing why projects, and in particular project overruns, should be the subject of further research. The main findings are that projects are economically and socially important. Furthermore, despite much knowledge and experience having been gained about projects, there has been an enduring theme in the project management literature of project overruns. The conclusion drawn is that more needs to be done to understand the phenomenon of project overruns.

The second section seeks to explore what has already been done to advance understanding of project overruns. It is found that extant research, although extensive, has tended toward explaining the influence a single factor has on overruns (for example, cost estimation or design changes) or identifying collections of discrete factors that are needed to secure project success and thus avoid outcomes such as overruns. However, the review also finds that individual factors do not operate in isolation from one another but rather they interact to bring about project behaviour such as overruns. The conclusion drawn is that to gain a fuller appreciation of project overruns an approach that identifies the factors that affect this behaviour and the relationships between those factors is needed. It is subsequently found that a systemic modelling approach offers a way forward in this regard.

The aims of this study are to contribute to both project management theory and practice. The final section of the review attends specifically to the latter aim by exploring what approaches are available to aid practitioners in mitigating or avoiding the risk of project overruns. It is found that the conventional project risk management techniques while valuable have inherent limitations which could be offset by complementing these techniques with those using a systemic modelling approach to risk management. However, it is also found that development and application of systemic approaches to project risk are still relatively rare. The conclusion drawn is that the findings gained from this study be used to develop a model that offers description of a pathology of project overruns that can be used to inform the practice of practitioners.

Research Methodology

Chapter 3 provides a comprehensive explanation of the research approach used in this study. The chapter is split into two parts. Part A focuses on explaining the theory of methods (methodology) that underpins the approach, examining the aspects of research philosophy, research procedure (strategy), research design, research method and research techniques. Of particular note is the adoption of a critical realist philosophy of research which is a departure from the traditionally positivist orientation of project management research. It is argued that this departure offers the possibility of new perspectives on project overruns which can complement the existing body of largely positivist based project management research.

Through transparent and rigorous consideration of each of the methodological choices that comprise the research approach it is argued that the choices of a critical realist philosophy, a case study design, qualitative interviews, and a causal mapping technique interlock to provide a coherent approach to researching overruns in projects.

Part B of the chapter concerns the practical application of the approach to research, focusing on data collection and data analysis. In summary, empirical investigation of two large health care construction projects was conducted using a qualitative case study design coupled with a causal mapping technique. The projects were examined from the perspective of the construction company who was contracted to design, build, finance, and operate the facilities. One project was heralded by the company to be a success while the other experienced significant cost overruns during the operational phase. For each case study five participants with a range of roles were interviewed.

Case Study Findings

Chapter 4 presents the case study findings based upon the investigation of the two case study projects. With the operational phase of both projects as the locus of investigation, the study found that feedback dynamics involving loss of client trust; delay triggers such as design changes; and contextual conditions such as human resource policies, can form a complex system that can induce cost overruns during the operating phase of projects. Using the findings, a model offering an explanation of the pathology of project operating cost overruns is developed.

Discussion of Research Findings

Chapter 5 examines the research findings from the case studies in light of extant literature in order to establish what contributions to knowledge the findings can make. It is argued that the overarching contribution to knowledge made by the thesis is revealing a system of factors that offers a wider appreciation of how operating cost overruns can be brought about. The implications for project management practice are also examined. Contributions to methodological knowledge are also argued for, in particular attending to knowledge gaps within the literature concerning the application of a critical realism within a project management context as well as the detailed exposition of a practical application of a critical realist methodology. A second contribution is also claimed concerning the application of a causal mapping technique to researching project overruns. The limitations of the research study are subsequently examined.

Conclusions

This brief final chapter brings the thesis to a close by examining how the research aims set out at the beginning of the thesis were addressed. The specific contributions of the thesis to both theory and practice are presented before examining future avenues for research.

CHAPTER 2:   EXPLORING THE EXTANT LITERATURE

2.0   CHAPTER ABSTRACT

This chapter reports on a review of the literature concerning the topic of project overruns. Following the advice of Tranfield et al. (2003), the literature review aims to examine and evaluate existing research within the field and, subsequently, to inform the development of research questions that can further the existing knowledge base.

In order to ensure transparency and repeatability with respect to method, the chapter opens with a brief description of the method that was used to review the literature

Next, the project management literature is reviewed to establish why projects are of relevance for further research and thus establish the rationale and scene for the remainder of the thesis document. The review finds that projects are of significant economic and social importance owing to rapid growth in adoption by organisations from around the late 20th century. Similarly, the project management knowledge base is also found to have burgeoned with numerous handbooks and academic journals relating to the field. However, the review also finds that despite a growing wealth of experience and knowledge, projects are regularly reported as having been late, exceeded their budgets or failed to meet other expectations. The conclusion drawn is that more research needs to be done to better understand why projects exhibit the behaviour of overruns such that they might be managed in ways that can mitigate or avoid this behaviour.

The review proceeds by examining the literature to establish what research has already taken place to understand overruns in projects. The review finds that a variety of perspectives have been adopted. One is to explore the influence of a single aspect of projects and their management such as cost estimation. Another is to explore the influence of a collection of factors such as success or failure factors. The review finds that both these approaches offer valuable insights but that neither has specific concern for interrelationships between factors. Interrelationships are found to be important because the literature suggests that factors do not operate in isolation but rather they interact with one another making the relationships between factors as important as the factors themselves. Consequently, it is argued that a research perspective that has concern for factors *and* their interrelationships is

needed in order to gain a more comprehensive understanding of overruns in projects.

The review finds that a systemic modelling attends to this need because it conceives of project behaviour as a manifestation of a system of factors rather than discrete factors operating in isolation. It is subsequently argued that a systemic modelling approach is a suitable way to proceed for further inquiry into project overruns. However, the review also reveals that adopting a systemic modelling approach is a departure from conventional project management theory. The nature of the departure is explored and it is argued that it is both warranted and in demand because it answers a call by a number of leading researchers for the adoption of alternative perspectives on projects.

Understanding why projects overrun is valuable but is, in and of itself, insufficient for the aims of this thesis which are to contribute to both theory *and* practice. To more fully attend to the latter aim, the review turns attention to the practice of project management, in particular project risk management, to examine the techniques that are available to practitioners to help them manage the risk of overruns in projects. Of particular note is the finding that managing risk using conventional project management techniques marginalises the role of 'soft' human factors as well as the possibility of risks interacting with one another, both of which are identified in the literature review as having an important influence on project behaviour. Consequently, it is argued that using a conventional approach to project risk management leaves projects vulnerable to soft risks and systemicity of risk (the interaction of risks).

The review finds that a systemic approach to risk management offers a way forward to attend to this vulnerability but that the development and adoption of systemic risk management tools within project management remains novel. Findings from the literature suggest that existing tools can be highly sophisticated, require specialist expertise to use, can be costly, and time consuming which creates barriers to adoption. On the basis of these findings two conclusions are drawn. First, that the rarity of available tools offers a fruitful avenue for the development of a new tool to support practitioners in taking a systemic approach to risk and its management and second that the new tool should attend to the barriers described earlier in order to facilitate its adoption.

As discussed earlier, the research in this thesis took place with a construction company (BuildIt) and thus the study focuses upon construction projects. In particular, the thesis' focuses upon Private Finance Initiative (PFI) projects and therefore the penultimate section of the review examines literature surrounding PFI's. With reference to the work of Pettigrew on conducting research in organisational settings, the section begins with some context as to the reasoning behind the thesis' particular focus on PFI's. Reviewing the PFI literature reveals four significant findings that provide opportunities for this thesis' to contribute to knowledge on PFI projects. First, although time and cost performance of PFI projects is good in the majority of cases, the concept of project overrun is none the less relevant in PFI's as a significant proportion of projects still overrun. Second, there have been few fine grained studies of PFI projects presenting opportunity for the sort of detailed inquiry offered by a systemic approach (described earlier in the literature review). Third, because PFI projects include the operational phase as part of the project lifecycle, they are in tension with the conventional project lifecycle model espoused in the project management literature. Findings emerging from the extant literature suggest that, when conducting research in the context of PFI projects, the project lifecycle needs extending to include the operational phase. If not, the conceptual basis of the research will be inconsistent with the actuality of the projects being studied. Reviewing the PFI literature in light of a project lifecycle that includes the operational phase reveals a fourth and final finding. It was found that despite extensive and growing research on PFI projects, there remains significant gap in the literature which is that there have been no empirical studies of cost overruns in the operating phase of PFI projects.

2.1   METHOD OF REVIEWING THE EXTANT LITERATURE

Silverman (2013, p.343) provides the following questions as guidance for what the researcher should be aiming to examine as part of their review of the literature:

- What do we already know about the topic?
- What do you have to say critically about what is already known?
- Has anyone else ever done anything exactly the same?
- Has anyone else done anything that is related?
- Why is your research worth doing in the light of what has already been done?
- Where does your work fit in with what has done before?

Jorgensen and Bozeman (2007, p.358) suggest that in any literature review 'the analysis is more one of interpretion than science'. While the analysis of literatures might be subject to interpretation, systemising the search for literature improves repeatability, a central tenet of academic research (Johnson and Harris, 2002).

Observing the advice of Easterby-Smith et al. (2008) that literature reviews progressively zone in on the focal research topic, the review of literature followed a process of logical progression as a means of systematically searching for literature that attended to Silverman's(2013) questions above. The process of logical progression began by selecting a set of 'seed' publications, chosen on the basis of their relevance to the broad topic of project management. These comprised the two leading project management journals *International Journal of Project Management* and *Project Management Journal* as well as the more recent *International Journal of Managing Projects in Business.* Journal publications were complemented by 'classic' (Söderlund and Geraldi, 2012) project management texts including Morris and Hough (1987). The combination of texts and journals formed the 'seed' publications with which to begin the review of literature.

Journals were mined using the search terms below:

- Project fail*
- Project success
- Project overrun*
- Project delay*
- Project cost*

Asterisk denote the use of wild cards to search for variants of the search term. For example 'Project fail*' will return results for 'project failure', 'project failures'. The application of search terms also followed a process of logical progression by starting with the broad topic of 'project failure' and then progressively zoning in on literature relating to the focal research topic of project overruns before zoning in still further to the particulars of project delay and project cost.

Reflecting the dispersed nature of project management research (Kwak and Anbari, 2009), literature from the 'seed' publications revealed publications in other disciplines including operational research, engineering management, and construction that contained research relevant to project overruns. The search terms above were applied within these new search spaces revealing yet further publications and so the literature review also followed a process of snowballing on 'discipline' beginning with project management then moving in to related fields.

The results of the literature review are organised under three headings. The first heading, Contextualising Projects, frames the proposed research study by establishing why project overruns should be the subject of further research. The second heading, Understanding the Behaviour of Projects, sets out to understand what research has already been done to understand the behaviour of overruns in projects. The final heading, Mitigating Project Overruns, examines the extant literature to establish the state of the art with respect to tools and techniques for mitigating the risk of undesirable project behaviour such as overruns reflecting the aims of the study to contribute to both theory *and* practice.

2.2 CONTEXTUALISING PROJECTS

2.2.1 Definition of a Project

Within the literature there is no universally accepted definition of what constitutes a project. One definition put forward by the Project Management Body of Knowledge (PMBOK) (PMI, 2013, p.5), and referred to regularly within the literature, is that a project is 'a temporary endeavour undertaken to create a unique product, service, or result'.

The PMBOK definition offers a foundational understanding of what a project is but it lacks sufficient richness to apprehend a comprehensive appreciation of what is

meant by 'a project'. For example, the meaning of 'temporary endeavour' gives no sense of what the nature the 'endeavour' is. Researchers however have provided elaboration suggesting that the endeavour be viewed as an enterprise and thus that a project be conceptualised as a 'temporary organisation' (Lundin and Söderholm, 1995, Turner and Müller, 2003). The organisation brings together resources to achieve a specific outcome and by its temporary nature is time bound in its existence.

The PMBOK definition also asserts that individual projects are 'unique' which implies that projects share no common ground and, consequently, practices and research findings are not applicable outside of those projects within which they are developed. The assertion is, however, contradictory to the many handbooks, training packages and BOKs that capture practices of project management that are believed to be applicable to all projects. This apparent contradiction can be explained by elaborating on the meaning of uniqueness with respect to projects. Turner and Müller (2003, p.1) for example suggest that 'no project before or after will be *exactly* the same' (emphasis added). For example, the construction of two schools will bring together similar stakeholders although the specific composition of those stakeholders might differ. The construction processes and techniques used to create the schools will be similar but might also involve particularities, for example due to ground conditions. The construction project will also result in the production of two similar facilities although their layouts may differ. The point being made here is that projects are not unique in every respect but rather as Maylor (2010, p.5) asserted 'something like it has almost certainly been done by someone somewhere before. For this reason, projects are said to have *aspects of uniqueness'.*

Based upon the foregoing, projects can be conceived as being temporary organisations (Turner and Muller, 2003) that comprise both elements of uniqueness and elements of repetition. However the review of literature revealed a further concept that is relevant in relation to projects – complexity, in particular structural complexity (Williams, 1997). Structural complexity concerns the interrelatedness of the components of a project (Kharbanda and Pinto, 1996) that might include technologies, production processes, teams, stakeholders and skill sets but to name just a few. Indeed projects can involve many and varied components each in some way related to others, creating a large number of interrelationships and structural complexity in the project (Baccarini, 1996, Cooke-Davies et al., 2011). Moreover, parallel working used to meet demanding project time scales, can create yet further

interdependence between components and thus increased structural complexity of the project (Williams, 1997). Finally, uniqueness in projects means the details of the entire project are rarely known at the outset and, therefore, uncertainty can exist concerning tasks and goals. As clarity of tasks and goals emerge through progressive elaboration (PMI, 2004), Williams (1997) suggests it may become necessary to add new elements to the project leading to yet more interrelationships and structural complexity.

Turner (1999) suggests that structural complexity as characterised by the three dimensions of uncertainty, integration and urgency, distinguish projects from routine operations management. Consequently, structural complexity is relevant to a comprehensive understanding of what is meant by a project.

In summary, while the literature review found no definitive definition of a project, based upon the foregoing findings from project management literature this research conceives a project as being:

- A temporary organisation that comprises aspects of uniqueness and repetition and that exhibits characteristics of structural complexity.

2.2.2   The Ubiquity of Projects

Although projects are without a definitive definition, this has not prevented their wide spread adoption by organisations. Historically the preserve of engineering and construction sectors, the project organisational form now pervades large portions of economic activity. The proliferation of projects can be explained by a change in market conditions over the course of the late 20th century (Kerzner, 2009). Historically, markets had been characterised as homogenous, mass, and relatively static in terms of change and thus low costs and high volumes were the order of the day (Wheelwright and Clark, 1992). These were conditions that were well suited to organisational forms typical of that era and characterised by 'Fordism' (and Taylorism in Europe) (Cicmil et al., 2009).

By the late 20th century however new market conditions had begun to emerge. Increasing consumer wealth created markets of customers whose needs changed frequently and who demanded variety, innovation and brand rather than simply low cost. Moreover, internationalisation of firms meant there was increased competition

in the market place to satisfy those demands. The organisational forms of Fordism were suited to 'high volume throughputs of standardised products and services and for making decisions in a relatively stable technological and market environment' (Maylor et al., 2006, p.664). These forms of organising, that had obediently served the needs of masses over the earlier part of the century, were no longer fit for purpose in these new market conditions. Consequently, organisations had come to realise that to compete and prosper in these new conditions, they 'must be dynamic in nature; that is, they must be capable of rapid restructuring should environmental conditions dictate' (Kerzner, 2009, p.92).

Seeking an alternative form of organising that could cope with these new conditions, organisations turned to projects which are 'ideally suited for managing increasing product complexity, fast changing markets, cross-functional business expertise, customer-focused innovation, and market and technological uncertainty' (Hobday, 2000, p.871). The strength of projects in dealing with the market conditions described above saw organisations undergoing what Midler (1995) refers to as 'projectification' whereby they made the transition from the mass production efficiencies and hierarchical organization structures (Daft and Lewin, 1993) of a classical functional form toward project based forms.

So aggressive has been the 'projectification' of organisations that projects are now of central economic and social importance as evidenced by Turner et al. (2010) who estimated that world expenditure on projects is in the region of $16 trillion or 1/3 of global spend. Although these figures are recent, the literature suggests that organisations have long been dependent upon projects for success. For example, more than two decades ago Pinto and Covin (1989, p.50) were of the view that it had 'long been acknowledged that the effectiveness of an organization depends, in large part, upon the successful management of its projects'.

Given that projects proliferate in today's economy and that they have been important to organisational success for some time, it seems reasonable to assume that many organisations have developed experience in the use of projects. Yet, as introduced earlier, projects are regularly reported as having failed to meet their expectations. The implication for this research is that work remains to be done to understand why organisations, despite having gained experience, continue to encounter project failure. Furthermore, it seems reasonable to assume that the conditions that cultivated proliferation of projects (such as increasing consumer wealth) will endure and, consequently, project based activity which already occupies

a large portion of global economic activity will continue to grow. Therefore it is argued here that improved understanding and thus performance of projects is of organisational, economic and social importance and, consequently, is worthy of further research.

2.2.3   The Growing Complexity of Projects

As well as growing in popularity, the literature suggests that projects are growing in complexity (Baccarini, 1996, Williams, 1997, Cooke-Davies et al., 2011). To compete in the market conditions described earlier, organisations continually strive to provide consumers with ever more sophisticated products (and services) in ever tightening time scales. Increasing sophistication means the projects used to deliver products must bring together and integrate wide ranges of expertise and technologies. As a consequence the number of project elements increase and so too do the interconnections between them increasing the project's structural complexity. To achieve tight time scales the need for concurrent working increases 'which by definition increases project complexity further' (Williams, 1997, p.15) because it creates yet further interconnections between elements.

A second aspect of project complexity is uncertainty. As noted earlier, uniqueness in projects means the details of the entire project are rarely known at the outset and, therefore, uncertainty exists concerning project objectives and the methods to achieve those objectives (Turner and Cochrane, 1993). As clarity of methods and objectives emerge through progressive elaboration (PMI, 2003) it may become necessary to add new elements to the project leading to yet more interrelationships and increasing structural complexity (Williams, 1997).

Cooke-Davies et al. (2011, p.2) point out that uncertainty also concerns how the various elements of a project can change, noting that in complex projects particularly each element 'can change in ways that are not totally predictable, and which can then have unpredictable impacts on other elements that are themselves capable of change'. The authors also point out that structural complexity is more than a large number of interrelated elements, it is the 'woven togetherness' of the elements (Cook-Davies et al, 2011, p.2). In other words, structural complexity refers to the intricacy of the relationships between elements.

Increasing project complexity increases the difficulty of managing projects. This is because complexity, as characterised above, makes project behaviour 'difficult to predict intuitively' (Williams, 2005, p.502) due to the intricacy of relationships between elements. Furthermore, change in one element can have 'major effects' across the whole project, effects that can be difficult to understand because of the aforementioned intricacy of relationships.

As will be discussed later (section 2.2.5), there have been regular reports of past projects experiencing overruns. The review of literature above suggests that projects of the future will be more difficult to manage than past projects due to increasing complexity. It seems reasonable to assume, therefore, that the issue of project overruns will remain of concern into the future. The implication for this research is that more needs to be done to understand and cope with project complexity in order to mitigate or avoid project overruns in the future.

2.2.4   The Growing Knowledge Base of Project Management

Allied to the growth in adoption of projects by organisations the knowledge base concerning projects and their management has also burgeoned. The evolution of modern project management began between the 1930's and 1950's (Morris, 1997) with early developments in terms of standardised tools and techniques attributed to Operational Research within, for example, the U.S. defence sector in the 1950's (Turner et al., 2010).

Kerzner (2009, p.2) suggests that the practice of managing projects using standardised techniques is 'relatively modern'. However, the field has undergone rapid growth with techniques such as Gantt and PERT now complemented by computer software packages to support the management of projects (Kidd, 1989, Kidd, 1990). More sophisticated systems have enabled the management of projects to move from the project level to the enterprise level were individual projects can be viewed as programs or portfolios of projects (Meredith and Mantel, 2010).

Methodologies such as PRINCE2 (AXELOS, 2015) and Agile (Agile Manifesto, 2015)) have also emerged to support effective project management and there has been rapid growth in professional membership organisations (Meredith and Mantel, 2010) such as the Project Management Institute(PMI), Association for Project Management (APM) and International Centre for Complex Project Management

(ICCPM). These organisations offer standards, guidance and training for project management. PMI and APM both provide 'bodies of knowledge', texts reflecting the evolving understanding and practice of project management and capturing core elements of standard practices. For practitioners, a range of qualifications is on offer to help them develop and demonstrate their project management competence. Similarly for organisations there are means of assessing and developing competence using, for example, project management maturity models (PMI, 2003). These models capture a collection of organisational best practices which organisations can assess themselves against and aspire toward to improve competence.

Research interest in the field of project management also continues to expand. The domain has two well established and internationally recognised journals, the International Journal of Project Management (IJPM) and Project Management Journal (PMJ) which have more recently been joined by a third journal, the International Journal of Managing Projects in Business (IJMPB). Texts and handbooks are in abundance with most major publishing houses (e.g. Oxford, Wiley, Sage and Gower publishing) having published a guide or text relating to the subject of project management.

The above findings suggest that the knowledge base, what is understood about projects and the practice of project management is significant and growing. Furthermore, the literature suggests that the various tools, techniques and methodologies are being put to use by practitioners and organisations (White and Fortune, 2002, Besner and Hobbs, 2008, Fortune et al., 2011) though their application can differ depending upon project type (Shenhar, 1998, Payne and Rodney Turner, 1999, Crawford et al., 2006)

Yet, as will be shown in the next section, the literature also suggests that many projects are reported as having failed to meet their expectations. Therefore, despite the availability and use of a growing body of knowledge, organisations still face the spectre of project failure. This tentatively suggests that there may be limitations with current available tools for managing projects, a suggestion that is supported by research by White and Fortune (2002). The authors surveyed practitioners' views on the practice of project management, finding that the most frequently mentioned limitations of existing tools were an inadequacy for managing complex projects and difficulty in modelling the 'real world'.

The implication for this thesis is that if current tools and techniques cannot adequately cope with complexity (identified earlier as growing in projects) and actuality of projects then more work needs to be done to develop tools and techniques that can cope in order to augment existing tools. Furthermore, to facilitate practitioner's adoption of the tools, it is posited that they should attend to the limitations of existing tools identified by White and Fortune.

2.2.5   An Enduring Theme of Project Failure

The findings of the literature reviewed have suggested the variety and number of organisations adopting projects has grown dramatically and, consequently, many organisations have experience in managing projects. Furthermore, it was found that the knowledge base of project management has burgeoned with tools, techniques and methodologies, and that these are being put to use by organisations and practitioners.

Yet despite all the experience and knowledge that has been gained concerning projects they are still regularly reported as being late and/or having exceeded their budgets. Although not restricted to construction projects (Standish Group, 2009) this field appears to receive the lion's share of attention in the literature with respect to overruns, perhaps owing to the magnitudes which can be significant. For example, Winch (1996) reported an average of 14% cost overruns and 11% time overruns in the UK for public sector procured construction projects such as roads and hospitals. Flyvbjerg et al. (2002) suggests that average cost overruns for infrastructure projects such as roads, bridges and rail can be upwards of 20%. Love et al. (2013) in an analysis of 276 construction and engineering projects in Australia revealed an average cost overrun to be 12.22%.

Love et al. (2014) stress that the concept of 'overrun', particularly in relation to cost, should not be confused with the concept of 'escalation'. Cost overrun is concerned with an unanticipated increase in cost due to changes within the project whereas cost escalation is concerned with an anticipated growth in budget due to market forces such as inflation (Love et al, 2012).

The literature suggests that the phenomenon of overruns is immune to geographic and economic boundaries with reports of project overruns from countries such as the UK (White and Sidhu, 2005), USA (Szyliowicz and Goetz, 1995), India

(Doloi et al., 2011), Hong Kong (Chan and Kumaraswamy, 1996), Saudi Arabia (Assaf and Al-Hejji, 2006), Ghana (Frimpong et al., 2003) and Nigeria (Mansfield et al., 1994) but to name a few.

Furthermore, it appears experience offers little defence. Denver International Airport (Szyliowicz and Goetz, 1995) and the Scottish Parliament (White and Sidhu, 2005), for example, both experienced extensive overruns but were presumably delivered reputable companies with significant prior experience in delivering similar types of projects and still they encountered failure.

Such has been the performance and reputation of projects, that Hodgson and Cicmil (2006, p.7) are of the view that frequent cost overruns, delays and underperformance 'seem to have become the rule and the reality of contemporary projects'.

Although the literature discussed thus far is contemporary, projects failing to meet their cost and schedule expectations are not a recent development. In fact the review of literature finds that the phenomenon has been an enduring theme in the literature with mention as far back as the 1960's (Avots, 1969) and in almost every decade thereafter (Morris and Hough, 1987, Atkinson, 1999, Eden et al., 2005, Turner et al., 2010).

In considering the theme of project overruns in light of the foregoing discussion it seems that, despite being equipped with the armaments of experience and knowledge, organisations are still struggling with projects that fail to deliver against expectations. Furthermore, it seems the battle against project failure has been a campaign that spans many decades. The implication for this thesis is that work needs to be done to better understand why projects overrun and to use this understanding to develop tools and techniques that can support practitioners to mitigate or avoid this behaviour.

The preceding discussion has centred on the concepts of cost and time overruns as the criteria for defining 'project failure'. However it is recognised that there are other criterion against which project failure (or success) can be judged. Indeed defining such criterion has become a research topic of its own (Wateridge, 1995, Atkinson, 1999, Shenhar et al., 2001). While a variety of different criteria have been put forward there is growing consensus within the literature that success (or failure) of a project is dependent upon the perspective from which it is viewed (De Wit, 1988, Yu et al., 2005, Bryde and Robinson, 2005, Turner, 2009). Therefore,

selection of criteria will differ depending upon which perspective is adopted. As will be discussed in more depth later, the research presented in this thesis was undertaken from the perspective a commercial construction organisation 'BuildIt' whose criteria centred upon cost and time. Therefore, while it is recognised that there are other criteria against which project success (or failure) can be measured, the focus in this study was cost and time overruns.

2.2.6   Summary

The review of the literature has revealed an enduring theme of project failure with projects regularly being reported as having been late, exceeded their budgets or failed to meet other expectations. Cultivated by changes in market conditions over the late 20th century, a large and growing proportion of organisations have turned to projects to deliver their products and services. Consequently the topic of project failure is of wide spread economic relevance. Allied to the growth in adoption, the review also found that the project management knowledge base is burgeoning with handbooks, training course and standards. Yet despite the armaments of knowledge and experience, the literature review finds that organisations are still frequently defeated by projects that overrun in terms of time and/or cost, so much so that some researchers suggest this behaviour has become a reality of contemporary project management.

Looking forward in time, the review suggested that the market conditions that have cultivated the proliferation of projects are likely to endure therefore projects will remain an important feature of the future economic landscape. Furthermore, and as a consequence of aforementioned market conditions, the review suggested that projects of the future are likely to be more complex and thus more difficult to manage than those of today or the past.

The main conclusion drawn from the literature reviewed thus far is most succinctly captured by paraphrasing an observation made by Avots (1983, p.145) more than 30 years ago which is that it is still not known with any confidence what causes project failure, and without such knowledge, it will be difficult to manage a project so as to avoid it. Thus, two broad initial research questions are set:

- What causes overruns in complex projects? and consequently
- How can this knowledge be put to use to mitigate or prevent overruns?

To make progress on this agenda the literature review continues by exploring how prior research has gone about understanding the behaviour of overruns in projects.

2.3   UNDERSTANDING THE BEHAVIOUR OF PROJECTS

Project overruns have been examined from a wide variety of perspectives and thus the literature on the subject is extensive. Consequently, rather than attempt to provide an exhaustive list of literatures, the aim of this section is to provide a synthesised account of the main strands of research that have taken place. To this end, the literature on project overruns is arranged and reviewed around three foci: research that has focused attention on a single aspect of projects and their management (for example, cost estimation), research that has explored the influence of collections of factors (for example critical success factors), and research that has examined overruns as the manifestation of a system of factors (for example exploring the role of feedback dynamics).

The section begins by presenting a synopsis of the first two foci followed by a short critique of both, using the literature to reveal their strengths and limitations. The third focus (a systemic perspective) is then examined which is found to attend to the limitations of the previous two foci. It is subsequently argued that a systemic perspective offers a valuable approach for future research into project overruns.

2.3.1   Focusing on a single Aspect of Projects

One approach that has been adopted to examine project overruns has been to focus on the role and influence of a single aspect of projects and their management. Flyvbjerg et al. (2002, 2005) after Wachs (1989) for example, focused on the issue of cost estimating. Examining 258 transportation infrastructure projects valuing USD$90 billion, Flyvbjerg et al (2002) found that nine out of ten projects experienced cost overrun with an average overrun of 28%. Based upon their analysis of these projects, the authors conclude that the overruns are 'best explained by strategic misrepresentation i.e. lying' Flyvbjerg et al (2002, p. 290) by decision makers about the true cost of the projects in order that their projects be approved.

Later Flyvbjerg (2008) added the influence of optimism bias in underestimation of project costs drawing upon the seminal work of Tversky and Kahneman (1974). While optimism bias can lead to underestimation of project costs, the error is not driven by an intention to deceive as it is with strategic misrepresentation. Rather, optimism bias is 'a cognitive predisposition found with most people to judge future events in a more positive light than is warranted by actual experience' (Flyvbjerg, 2008, p.6) leading to underestimation of project costs.

Akintoye and Fitzgerald (2000) explored cost estimation from the perspective of construction contractors finding that the causes of inaccuracy in cost estimating included a lack of adoption of estimating tools and techniques, time constraints to prepare cost estimates and those responsible for cost estimation lacking practical knowledge of the construction process.

A further line of inquiry has been to focus on project change as a cause of overruns in projects. Love et al. (2002) looked at change and how it causes rework. Wu et al. (2004) focused on the causes of change. Sun and Meng (2009) conducted a review of existing lists of changes and effects to create two taxonomies which synthesised and listed potential changes and effects drawn from the literature. Related, others have looked at the process of how changes in projects are managed (Hwang and Low, 2012).

Other researchers still have focused upon the influence of more qualitative aspects of projects. Olander and Landin (2005) looked at the influence of stakeholders on projects and how their negative attitudes toward a project can cause overruns. Meng (2012) examined the influence of relationship management as factor in project cost and time performance suggesting that the deterioration of relationships between project participants, in particular supply chain partners, might increase the likelihood of poor project performance. Turner and Müller (2005) focused on the role of the project manager, in particular their leadership style, competence, and emotional intelligence suggesting that these qualities could play an influential role in project success.

Cutting across all of the foregoing topics is research focusing on the subject of risk management. Risk management has been a focus of attention for some time within the literature as a central cause of overruns in projects (Franke, 1987, Williams, 1995). Akintoye and MacLeod (1997) shed light on the nature of this cause. Based upon a survey of the construction industry in the UK, the authors

found that formal risk analysis techniques such as decision trees and Monte Carlo simulation were rarely applied because of a lack of knowledge and doubts about their suitability.

The individual aspects of projects discussed thus far operate at the level of the project. However, researchers have also sought to examine individual factors that exist at the organisational level. For example, Keegan and Turner (2001) focused on the value of organisational learning between projects exploring current learning practices and found that the time pressures which are common in project based organisations reduces the quality of learning practices and in turn could affect the performance of future projects.

2.3.2   Focusing on Collections of Factors

As well as focusing upon the influence of an individual factor such as risk management process or project manager competence, research has also examined the influence of collections of factors on project outcomes. In particular, literature in this space has sought to understand what factors are important to achieving the outcome of project success by defining collections of critical success factors (Pinto and Slevin, 1987, Bing et al., 2005b, Müller and Jugdev, 2012). Success factors are defined as 'the things we can influence to increase the likelihood of achieving a successful outcome' (Turner et al., 2010, p.81) and the aim of research has been to reveal the collections of factors that can influence project success.

Revealing critical success factors has been a long standing area of focus within project management research (Baker et al., 1983) and is still important today although Fortune and White (2006) suggest that publications identifying new factors are in decline. Although contemporary research focuses on success factors, a retrospective look at research in this space uncovers that avoiding project failure was the original frame of reference. For example, Turner (2009) suggests early publications listed a collection of 'pitfalls' to be avoided to improve the likelihood of project success. Though as early as the 1960's, academics such as Avots (1969) had begun to list reasons why projects exhibit behaviour such as cost and schedule overruns albeit he did not specifically term them 'factors'. Success and failure factors are, in essence, the same criteria looked at from two different points of reference, indeed some researchers such as Belassi and Tukel (1996) examine

factors from both failure and success perspectives. On the basis of the foregoing points, success as well as failure factor research is relevant to this thesis document.

Although not the first to tackle the issue of success factors, one of the most cited lists according to Turner et al. (2010, p.93) is that by Pinto and Slevin (1987) in which 10 factors of success were identified. In the prevailing 25 years since Pinto and Slevin's seminal work, investigation into the factors affecting project success and associated failure has continued apace.

Research has explored critical success factors for project types, project types such as R&D (Pinto and Covin, 1989), construction (Sanvido et al., 1992) and I.T. (Wateridge, 1995). Other researchers have looked at the issue of success factors exploring the applicability of particular factors within specific geographic contexts (Mansfield et al., 1994, Doloi et al., 2011). Other researchers still have taken steps to try to consolidate factors and move toward a more definitive list that might be applicable across project types (Cooke-Davies, 2002).

2.3.3 Critique of Approaches

Whether exploring collections of success factors or focusing on a single aspect of a project both approaches are valuable in their own respects for understanding project overruns. Knowledge of success factors gives broad insight into the variety of factors that can have influence over project outcomes. Focusing on a single aspect of projects offers the possibility of revealing the particularities of how that individual factor might affect project outcomes.

However, one aspect that neither of the approaches has explicit concern for is relationships between factors. By its very nature, examining an individual aspect of a project omits the possibility of relations to other factors. Although critical success factor research reveals collections of factors it has no facility to attend to interrelationships between them (Fortune and White, 2006).

Yet the critical success factor literature has recognised that the interrelationships between factors are 'at least as important' as the individual factors themselves (Fortune and White, 2006, p.54). Cooke-Davies et al. (2011) suggest that the approach of breaking a project down into its constituent parts and examining each separately is a common practice in dealing with complicated situations in project

management but that the practice ignores the important relationships between the parts. This is, in effect, the practice being conducted in success/failure factor research.

Belassi and Tukel (1996, p.142) suggest that many of the success/failure factors 'do not, in practice, directly affect project success or failure. Usually a combination of many factors….result in project success or failure'. The authors illustrate their point by suggesting that the availability of project resources may be a consequence of other organisational factors. The authors suggest that without understanding the relationships between factors managerial action might be misplaced in that action might attend to the symptom (e.g. availability of resources) rather than the cause (other organisational factors). Without attending to the cause, the symptoms may subside but are likely to return. Thus Belassi and Tukel (1996) suggest that knowledge of relationships between factors can focus managerial action where it is most needed. This view is echoed by Nandhakumar (1996) who suggests that if success factors are to offer guidance to practitioners then improved understanding of the relationships between the factors is needed.

To summarise thus far, the literature suggests that individual factors (elements) of a project do not exist in isolation from one another, each making its own discrete contribution to project behaviour free from interference by others. Rather, they interact with one another to bring about project behaviours. The notion of interrelations is likely to be particularly important in understanding the behaviour of complex projects given, as outlined earlier; one of their key features is interrelatedness. The implication for this thesis is that taking a discrete approach to understanding projects whereby the influence of a single element or collection of discrete elements is examined risks a partial understanding of overruns being achieved because concern for the relationships between factors have been marginalised. Consequently, understanding the individual elements *and* the relationships between them is needed to gain a comprehensive understanding of project behaviour such as project overruns. One approach to researching projects that attends to this need is that of systemic modelling. The following discussion examines the features of this approach

2.3.4 Focusing on Systems of Factors

<u>Attending to the Whole</u>

A fundamental feature of a systemic modelling approach is systems thinking (Senge, 1990, Checkland, 1999) whereby understanding of project behaviour is arrived at through comprehension of how the system of factors operates as a whole. To gain this comprehension, a systemic modelling approach has explicit concern for individual factors, *and* the particular relationships between them, that can influence project behaviour. Knowledge of elements *and* the particular relationships that hold the whole edifice of factors together to form a particular combination unlocks understanding by uncovering the system of factors that are interacting to bring about project behaviour as illustrated in the example below which is excerpt from Eden et al's (2000) disruption and delay model
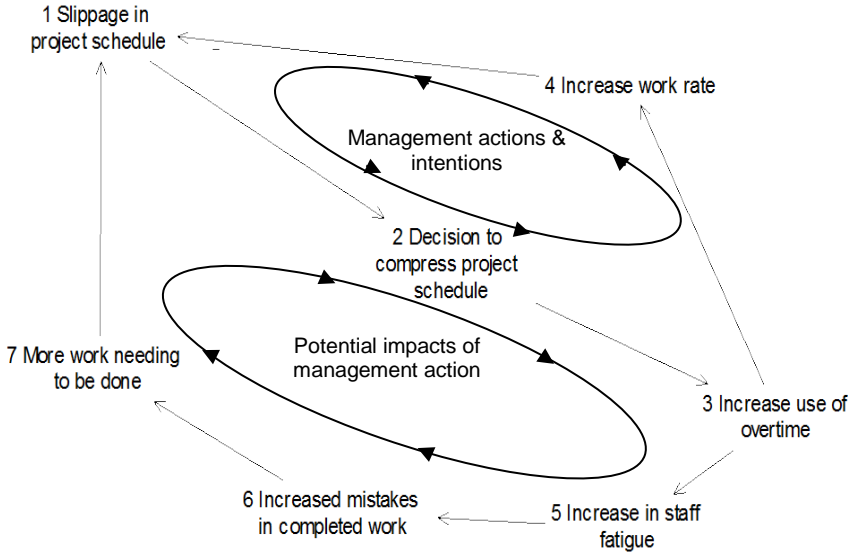
Figure 1 Causal map of project response to increased use of overtime.

The example above also illustrates how comprehension of how the whole system of factors operates can offer enhanced understanding of project behaviour. In the situation above, continued use of overtime is found to result in further slippage in project schedule. By understanding what factors are at work, and the relationships between them, a systemic modelling approach reveals the system of factors

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underlying this phenomenon and in doing so offers explanation of why continued use of overtime can result in the counter-intuitive outcome of increased slippage in a project. In short a systemic modelling approach can offer more comprehensive understanding of project behaviour by seeing project behaviour as the manifestation of structurally related factors that form a system of factors. In essence factors interact forming structures that are deep within the project and manifest in project outcomes such as overruns.

Attending to 'hard' and 'soft' factors

A second feature of a systemic modelling approach is the attention paid to 'hard' and 'soft' factors (Williams, 2005, Ackermann et al., 2007, Ackermann et al., 2014). This is illustrated in the example above which identified 'hard' factors such as 'expected delivery date' and 'soft' human factors such as 'morale' or 'fatigue'. As can be seen from the example, attending to both types of factors is important to explaining project behaviour. However attendance to 'soft' factors is of particular note because they 'often appear to dominate feedback structures' which are discussed next (Rodrigues and Bowers, 1996, p.215).

Attending to Feedback Dynamics

A third feature is the ability of a systemic modelling approach is the capability to reveal dynamic behaviour such as the feedback loops which have been found to play a powerful role in project behaviour (Eden et al., 2005). For example, in the illustration above, Eden et al. (2000) show the feedback loops that can derive from managerial action in response to disruptions. Howick and Eden (2001) revealed the effects that feedback can have when projects are compressed to meet tightened time scales. The concept of feedback also features highly in Cooper's (1993a) description of the rework cycle. As can be seen from the example above, understanding this dynamic behaviour can enhance comprehension of project behaviour.

Use of Modelling Techniques

A final feature of a systemic modelling approach is the use of models to support understanding. While the example shown above is a simple model of project behaviour, the multitude of factors and relations that could be present within a project, particularly a complex project, could mean factors and relationships are many in number. Reflecting Simon's (1972) theories of bounded rationality,

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understanding of the whole is, therefore, likely to be cognitively challenging. A systemic modelling approach adopts modelling as a means of easing the cognitive load and thus improving understanding of project behaviour (Edkins et al., 2007). Models that have been used include causal modelling (Ackermann et al., 2014), soft systems methodology (Winter and Checkland, 2003), influence diagramming (Howick et al., 2008) as well as computer models such a system dynamics (Rodrigues and Bowers, 1996, Lyneis et al., 2001, Taylor and Ford, 2006, Lyneis and Ford, 2007, Rahmandad and Hu, 2010).

Although the features of a systemic modelling approach have been presented individually, the features are not mutually exclusive (as has been alluded to above). For instance, the ability to attend to dynamic project behaviour is in part reliant upon an ability to attend to soft human factors since these often form important nodes in feedback loops (Ackermann et al., 2007). Similarly, the ability to attend to the whole is underpinned by the use of modelling in order to support comprehension (Ackermann and Eden, 2005).

Using the qualities of a systemic perspective and modelling tools, a systemic modelling approach has revealed valuable insights concerning project behaviour. For example, one of the earliest examples from Cooper (1980) was used as a diagnostic tool in a $500m litigation claim against the US Navy. Ackermann et al. (1997) also applied the technique in litigation revealing the causes of disruptions and delays to complex projects and Williams (2004) applied the technique to post-hoc analysis of projects to reveal hard to expose 'non-intuitive' lessons.

To summarise thus far, the literature suggests that knowledge of the various factors is, in and of itself, not enough to build comprehensive understanding of projects. This is because factors do not exist in isolation from one another, each making its own discrete contribution to project behaviour free from interference from others. Instead factors interact with one another forming intricate structures deep within the project and it is these structures that manifest in project behaviour.

The implication for this thesis is that the behaviour of overruns might be better conceptualised, not as the direct consequence of individual or collections of discrete factors, but as a manifestation of structurally related factors. With this conceptualisation, to gain understanding of project overruns concern is needed for revealing both content (what are the 'hard' and 'soft' factors involved in project behaviour) and structure (how do these factors interact with one another).

Knowledge of both content and structure allows the project to be examined as 'an integrated whole to obtain a full view of the total system' (Turner et al., 2010, p.62) enabling understanding of how the system of factors can bring about the behaviour of overruns. The implication for this thesis is that a research design that adopts a systemic modelling perspective would appear to offer a nuanced understanding of overruns in projects.

Furthermore, on the basis of the foregoing review of literature, the two initial broad research questions set out in section 2.2.6. are revised to

- What are the factors, and the relationships between them, that describe systems of factors that can bring about overruns in complex projects?
- How can knowledge about systems of factors that can influence overruns in projects be put to use to by practitioners to mitigate overruns in current and prospective projects?

2.3.5 Contextualising a Systemic Perspective with Extant PM Theory

While a systemic modelling has provided valuable insights into project behaviour, Williams (2005) suggests that adoption of the approach is a departure from conventional project management theory in a number of ways. Conventional theory has informed much of the project management knowledge base of research and associated practice (Bredillet, 2004). Therefore, if a systemic modelling approach to researching overruns is to be pursued, some brief attention is needed to expose the ways in which the approach departs from conventional project management theory and to understand how this departure fits with the extant knowledge base.

A systemic modelling approach makes three departures from conventional project management theory each of which has been touched upon above. Firstly, understanding of project behaviour is arrived at by taking a holistic perspective (Eden et al., 2005). That is, comprehension of how the system of factors and relations that comprise a project operate as a whole is central to unlocking understanding of project behaviour. Conventional project management theory however, advocates that understanding of the whole be achieved by breaking the project down, analysing its components, then rebuilding it to provide explanation (Turner et al., 2010, Cooke-Davies et al., 2011). In short, project management

theory is based upon an engineering/science paradigm which initiated project management and which proffers a reductionist approach, whereas, a systemic modelling approach proffers a holistic approach.

Secondly, a systemic modelling approach explicitly attends to 'soft' human factors (Williams, 2005, Ackermann et al., 2014). As discussed above, these have been found through empirical research to play a crucial role in explaining project behaviour. If projects are conceived as temporary organisations (Lundin and Söderholm, 1995), then the importance of soft human factors come as little surprise. Indeed, Cooke-Davies (2002, p.189)   asserts that 'it is fast becoming accepted wisdom that it is people who deliver projects, not processes and systems'. There has been awareness of soft factors within the project management research literature for time. Pinto and Slevin (1987) for example, recognised almost 30 years ago that while 'hard' factors were important soft 'organisational and behavioural' factors needed much greater attention and were 'essential' for project managers to understand. However, despite these observations conventional project management theory as espoused in the various BOK's remains based upon a 'hard' systems perspective where a project is analogous to a 'machine' (Turner et al., 2010). With projects conceived as machines, the focus in developing understanding is largely for things that are tangible or quantifiable in nature, for example finance, time and numbers of human resources. 'Soft' human factors such as social relations, politics (small 'p' and large 'P') and culture but to name just a few have no place in machines and thus are marginalised(Ackermann et al., 2007). Furthermore, the metaphor of projects as machines underpins the earlier assumption of reductionism. Machines comprise components that are deterministic in nature and thus understanding of their operation can be arrived at through reductionism. Thus in considering projects more as soft systems rather than hard systems, a systemic modelling approach departs from conventional theory.

A third departure of systemic modelling is its attendance and concern for dynamic project behaviours, in particular feedback loops (Cooper, 1993a, Eden et al., 2000). Convention theory, based upon 'hard' system thinking, assumes linearity of relationships and therefore cannot adequately account for complex feedback behaviour (Williams, 1999). As noted earlier, the ability to attend to dynamic behaviour is in part dependent upon the ability to attend to soft human factors as these often form important nodes in feedback loops. Williams (2005, p.502) notes that since conventional project theory 'rarely' considers these soft variables, even if

feedback was 'allowed' to be identified it could not be achieved since without acknowledgement of soft variables the reciprocal dependence is no longer visible.

2.3.6   Summary

To summarise, a systemic modelling approach departs from a conventional view of projects in a number of ways. Conventional project management theory takes a 'hard' systems perspective whereby the system (project) is characterised largely by elements that are rationalistic, deterministic and tangible in nature (Cicmil et al., 2009) and thus the project can be conceptualised as a machine(Turner et al., 2010). A systemic approach on the other hand views projects as 'soft' systems wherein the project can comprise both 'hard' and 'soft' factors (Ackermann et al., 1997).

Using a conventional conception of projects as 'machines', understanding of project behaviour can be arrived at through reductionist techniques and management of projects achieved through command and control with predictive results. Treating projects as 'soft' systems on the other hand, systemic modelling seeks understanding by comprehension of the whole system and recognises that results of managing projects do not always follow intuitive logic because of the presence of human factors within the system that are not deterministic in nature (as illustrated above).

While the conception of a project adopted by a systemic modelling approach departs from that of the conventional project management theory, the review of literature suggests that the departure is both warranted and in demand. A growing body of research has challenged the conventional conception of projects because the conception does not comprehensively match the actuality of projects (Williams, 2005, Cicmil et al., 2009, Turner et al., 2010, Bredillet, 2013). This was recognised as far back as the late 80's (Morris and Hough, 1987) with Morris (1997, p.2) Morris (1996) later commenting that 'the successful accomplishment of a project may well require attention to range of factors not treated by the traditional project management literature'. These other factors included 'soft' issues such as stakeholders and their management and led Morris (1997) to consider the notion of 'management of projects' rather than project management. The latter encapsulating the conventional view of projects and the former a much wider perspective on projects.

Research has also pointed to the deficiencies of a conventional approach to project management at a practical level. Engwall (2003, p.797), for example, describes the findings of an empirical study of two projects, one that closely follows conventional PM practice and 'fails', the other 'deviated from several of the most basic principles of project management......However this project was a tremendous success'. Similarly, Howick and Eden (2001) showed how management responses guided by conventional thinking (such as the use of overtime) to accelerate projects can in fact have the opposite effect of increasing delay.

While the paradox between conventional project management theory and the actuality of projects has been recognised for some time, project management research and associated practice has remained welded to what Bredillet (2013) refers to as a hegemony of approach underpinned by the conventional conception.

There is evidence that researchers have ventured outside of conventional theory (Winch, 2002, Ackermann et al., 1997, Bredillet, 2013) however research by (Smyth and Morris, 2007) suggests that the adoption of alternative perspectives is still very much in the minority in the project management landscape. The authors found that much of research is still of a single persuasion that is characterised by a positivist philosophy and the use of associated quantitative methods which, as will be discussed in more detail later, correspond with a traditional conception of projects. This has perhaps fuelled fresh calls by leading academics in the field for researchers (and practitioners) to adopt new perspectives that might help extend understanding and thus improve management of projects.

In summary, there is a growing view within the literature that the conventional conception of projects does not comprehensively reflect project actualities. Consequently, researchers have called for new perspectives on projects in order to extend and develop knowledge within the field that better reflects project realities. While contributions have been made toward this agenda, they are in the margins by comparison to the dominant approach.

Earlier, it was suggested that further research into project behaviour could benefit from taking a systemic approach, and, that this approach offered an alternative perspective on projects. In light of the foregoing review of literature concerning the challenges to conventional project management theory a number of implications for this research are revealed:

- Adopting a systemic modelling perspective on projects could be fruitful in terms of generating new insights into the behaviour of projects because research remains largely of a single persuasion.
- Making use of qualitative research strategies within a systemic perspective could complement the existing knowledge base by providing a more nuanced understanding of project realities. Using this fine grained understanding to inform theory development could then yield theory that more closely resembles the actuality of projects and thus can inform improved management of projects. Such an approach would satisfy the aims of this research set out in the introduction of developing knowledge that is academically rigorous and of practical relevance.

One final item is worthy of note. As discussed earlier, adopting a systemic modelling approach is a departure from conventional project management theory. A concern for the author of this thesis, that has also been raised by other researchers such as Cicmil et al. (2009, p.86), is that using an alternative perspective might result in research that is disengaged from 'the project management mainstream'. However, through careful consideration of the philosophy of research used to underpin this thesis the author argues that outputs from research with an alternative on projects can complement instead of compete with existing knowledge that has been driven by a more conventional perspective. This issue is discussed in greater depth in Chapter 3:.

2.4   MITIGATING PROJECT OVERRUNS

The aims of this research are to contribute to both project management theory and project management practice. The previous section focused on the former of these aims by examining how existing research has gone about gaining knowledge about project overruns and thus informed theories of overrun. It was concluded that adopting a systemic modelling approach in future research could offer new insights because the approach can give a comprehensive account of complex project actualities and, by comparison to the dominant approach, has received much less attention within the literature.

An aim of this thesis is to use the insights gained from research to improve project management practice with a view to mitigating the phenomenon of overruns

in projects. In other words, the aim is to mitigate the risk of overruns in projects. Consequently, the topic of discussion in this section of the literature review is project risk management.

By exploring the literature on project risk management, the aim of this section is to understand the state of the art within the field, determine whether more should be done and, if so, what could be done to improve project risk management using knowledge gained from a systemic approach. The discussion is prefaced with some brief context on the topic of project risk management providing a definition of 'project risk', discussing the process of project risk management, and revealing the organisational importance of managing project risks. As discussed earlier, much of project management practice is underpinned by conventional project management theory therefore the section begins by exploring conventional project management risk practices. Two principal limitations of current practice are revealed – the comprehensiveness of risks considered and the systemic nature of risks. A brief review of systemic modelling approaches to risk management is then conducted which reveals that such approaches can attend to the need for more comprehensive risk consideration and systemicity of risk. Finally, a critical review of existing systemic modelling approaches to risk management is conducted which suggest that a conceptual model could offer value.

2.4.1   Context on Project Risk and its Management

Royer (2000, p.6) suggests that 'unmanaged or unmitigated risks are one of the primary causes for project failure'. The Project Risk Analysis and Management guide (APM, 2004, P.17) defines project risk as 'an uncertain event or set of circumstances that, should it occur, will have an effect on achievement of one or more of the project's objectives', going on to say that such an event 'can be identified, assessed and managed through the project risk management process...'. PMBOK Guide (PMI, p. 237) defines Project Risk Management(PRM) as: 'PRM includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project; most of these processes are updated throughout the project. The objectives of PRM are to increase the probability and impact of positive events and decrease the probability and impact of events adverse to the project'.

The temptation in PRM might be to aspire to tackling every source of uncertainty in order to completely eradicate risk, however researchers council against this for two reasons. First, Flyvbjerg et al. (2003, p.11) suggest that project risk can never be 'completely eliminated; but it can be moderated' therefore aspiration of complete eradication is somewhat futile. The second reason is of a practical nature. Chapman and Ward (2003, p.277) note that 'any RMP [risk management process] is not without costs' therefore it is important that the 'process is efficient as well as effective'. The point here is that, while it might be desirable to ascertain and manage every possible risk, the cost of doing so could render a project unviable. It would seem then, that in developing project risk management techniques some balance needs to be struck between the ideal of identifying every possible risk to the nth degree and the need for risk management to be an efficient process. In short there is a need to follow Ashby's (1958) law of requisite variety.

The concern for project risk extends beyond the level of the project itself upward to the organisational level. Project risks can have important implications for overall organisational performance. Hartman (1997, p.15) for example points out that pro-active risk management by mitigating risk before they happen means resources are not needed to recover from the impacts of a risk event, improving overall organisational profitability. Chapman and Ward (2003) point to a related issue of opportunity cost. As part of risk management strategies at the project level, contingencies will be made at the organisational level (such as the provision of a contingency fund) as a precaution in case risk events occur. This means some additional fraction of the organisations finite resources are being committed to the project (at least temporarily since the risk event might never occur) and therefore cannot be used for other purposes and thus a potential opportunity cost is incurred. Robust management of project risks then, not only plays a role in project success but also organisational success.

As discussed earlier, there is a view and supporting rationale within the project management literature that the complexity of projects is increasing. As a consequence, Hartman (1997, p.21) suggests that 'This means that risk management is not only more complex, but more important than ever'. Moreover, researchers suggest that PRM is still in its infancy Raz et al. (2002) and there is a need for more tools to support the management of risks (Maytorena et al., 2004) . The next section examines the conventional approach to project risk management

through the lens of a commonly adopted tool (the project risk register) to establish why new tools might be needed.

2.4.2   Conventional Techniques for Project Risk Management

Williams (1993, p.7) suggests that the Project Risk Register (PRR) is 'the most common administrative device' for identifying, assessing, attributing ownership of and managing risks'. The importance of the PRR is also emphasised by the PMBOK Guide (PMI, 2004) which identifies the PRR having a role in 8 of the 9 steps involved in the project risk management process.

A project risk register contains a list of potential risk events associated with a project, an example of which is presented below. For each risk event an assessment is made as to the level of risk exposure which is calculated as the product of likelihood and consequence. In each case mitigating actions are identified.

Reflecting upon the PRR as a tool for risk management, reveals a series of benefits. First, the PRR appears to be low in sophistication making it accessible for use by a broad range of project participants. Second, the PRR follows a relatively standardised template. Standardisation aids familiarity with the tool further contributing to its accessibility but also aids efficient analysis of risks across multiple projects. Third, and on the basis of the previous two benefits, the PRR appears to meet Chapman and Ward's (2003) call for project risk management to be efficient. The PRR's simplicity, standardisation and familiarity across project settings is likely to contribute to an efficient PRM process. However, despite these benefits the PRR has limitations.

The limitations are borne out of the theory which underpins the PRR, that is, conventional project management theory. The previous section highlighted issues with conventional theory in particular that concern for 'soft' human factors is marginalised and that there is a tendency to achieve understanding of project behaviour by breaking the project down into its constituent parts (Cooke-Davies et al., 2011). Both these issues manifest in the project risk register (Ackermann et al. 2007).

Conventional theory and associate techniques, such as the risk registers, tend to focus largely on 'hard' risks, such as technical and financial risks with less emphasis

placed on other sources of risk such as 'soft' human risks (Ackermann et al, 2007). As discussed earlier, projects are inherently human structures and human activity can have significant influence over project behaviour. Consequently, if a comprehensive view of project risk is to be achieved, it is essential that risk management 'include not only the technical factors but also a realistic assessment of environmental and social risks' (De Lemos et al., 2004, p.63). Despite the importance of 'soft' risks, Thevendran and Mawdesley (2004, p.137) in their study of the construction industry observed that 'there is a dearth of formal procedures available to identify and control human risk factors'. This suggests that projects are currently vulnerable to 'soft' risks and, coupled with the comments from Raz (2002) above, that more needs to be done in terms of the development of techniques and processes to support risk management in projects. An implication for this research is that tools are needed for the management of project risk and that tools which can provide an integrated view of both 'hard' and 'soft' risks would be highly valuable.

Kwan and Leung (2011, p.635) suggest that 'a common practice of current risk management approaches is to consider risks as independent events'. The PRR is an example of this approach in action where each risk is treated as a contained unit and is thus assessed as though insulated from other risks (Morris and Pinto, 2004). As noted earlier, the tendency to examine project elements as discrete units is a feature of conventional project management theory. However, while the theory suggests that project risks can be conceieved as independent of one another in practice this is often not the case (Williams et al., 1997). Instead risks can interact within one another such that 'The impacts that some risks have might compound the impact of others – so the effect of two risks might be more than the sum of the two individual effects thus reflecting systemicity' (Williams et al., 1997, p.345). These impacts can result in non-linear growth in project costs which Eden et al (2005) describe as 'amoebic' growth. Coupling this issue with the rising complexity of projects the need to attend to interrelationships between risks becomes even more apparent. Indeed Williams (1999) suggests that as projects become more complex, conventional project management approaches become less adequate.

A conclusion drawn for this research is that, if comprehensive understanding project risks is to be achieved, revealing interrelationships between risks that give rise to systemicity of risk is necessary. However, in the main, current project risk management practices are without a facility to attend to interrelationships between risks and therefore opportunities exist to develop techniques in this space.

Finally, Maytorena et al. (2004, p.467) point out one further limitation of the project risk register which is that 'its development is typically ad hoc'. The authors do not expand on the meaning of ad hoc development but it seems reasonable to deduce that the development of the project risk register is without a systematic approach and, therefore, potentially a less comprehensive consideration of risks is being achieved. The implication for this research is that, in future, any techniques developed in should attempt to encourage a systematic approach to risk consideration.

In summary, the project risk register clearly has benefits of accessibility due to its simplicity, standardisation and efficiency. However, approaches to risk management that are founded upon conventional project management theory, as the PRR is, are likely to leave projects vulnerable to two forms of risk - 'soft' risks and systemicity of risk. This is because the underlying theory has an inability to account for human risks and interrelationships between risks. Moreover, it appears that the PRR in particular has no systematic means of development thus wide consideration of risk is perhaps not taking place.

Based upon a review of the literature, the following section explores the use of a systemic modelling perspective to project risk management as a means of attending to the limitations of the typical conventional approach of using a PRR and thus enhancing the management of project risks. Furthermore, the section attends to the second research question identified earlier in this chapter of

- How can knowledge about systems of factors that can influence overruns in projects be put to use to by practitioners to mitigate overruns in current and prospective projects?

2.4.3   Systemic Modelling Techniques for Project Risk Management

As well as being used for developing understanding of the behaviour of project overruns, systemic modelling approaches have been shown to offer value in the management of risk in projects. Although the systemic modelling approach has been applied within project management, the application of approach to risk management is still novel (Maytorena et al., 2004, Ackermann et al., 2014) thus presenting a fruitful area of development for this study.

Williams (2004) attributes much of the work in the systemic modelling space to two teams of researchers, one team originated from the University of Strathclyde, and the other from PA Consulting. Thus work by these two teams would seem to offer a good start point for consideration. Williams (2004) however observed that in comparison to the University of Strathclyde approach, the PA Consulting method to systemic modelling was sparsely described within the research literature. None the less, sufficient literature exists to provide a brief overview of recent developments from both teams, as well as others, which is then followed by a critical review of the approaches in order to reveal where new techniques might best focus attention.

In the main, the approaches used for systemic modelling of project risk revolve around the use of qualitative modelling (Ackermann et al., 2014), quantitative modelling in particular system dynamics (SD) (Cooper, 1993b, Lyneis and Ford, 2007) or a combination of the two Howick et al. (2008). The approach used by the PA consulting team focuses largely on the use of quantitative modelling using system dynamics (Cooper, 1993c)) (albeit that qualitative modelling through influencing diagramming is a precursory step to the development of the SD model). An example of this approach is Godlewski et al. (2012) which describes the development of a system dynamics (SD) model at the Fluor corporation and was used to foresee the cost and time implications of changes to projects, as well as to simulate the effects of management actions in response to these changes. The model is reported as having added significant value, with suggested savings having been achieved that exceed $800m over 100 projects.

Use of qualitative modelling techniques has also begun to demonstrate significant value for the management of project risks. For example, Ackermann et al. (2014) recently reported on their development and application of a risk management workshop using causal mapping to explore the risks associated with the development of a new power station to supply a remote island in Scotland. On the basis of feedback canvassed from participants, perceived benefits of the approach included the ability to reveal and illustrate a comprehensive suite of risks that was thought not possible by participants using conventional approaches. Furthermore, participants suggested that the causal mapping technique encouraged consideration of interrelationships between risks (systemicity of risk) rather than treating risks as insulated from one another as might be the case with traditional approaches. Finally, and related to the previous two points, participants of the workshops noted that the

approach offered the ability to see the bigger picture view i.e. to see the individual risks within the context of the whole system of risks.

A further approach to systemic risk modelling is to mix qualitative and quantitative modelling techniques such as the use influence diagrams as a first step toward quantitative modelling techniques (Huseby and Skogen, 1992, Dikmen et al., 2007). For example, Tah and Carr (2001, p.174) develop what they refer to as a 'risk structure map' which is used to support identification of sources of risk and the relationships between them as a precursor to quantitative modelling using fuzzy logic. An excerpt from a qualitative model used by Dikmen et al. (2007) is presented below:
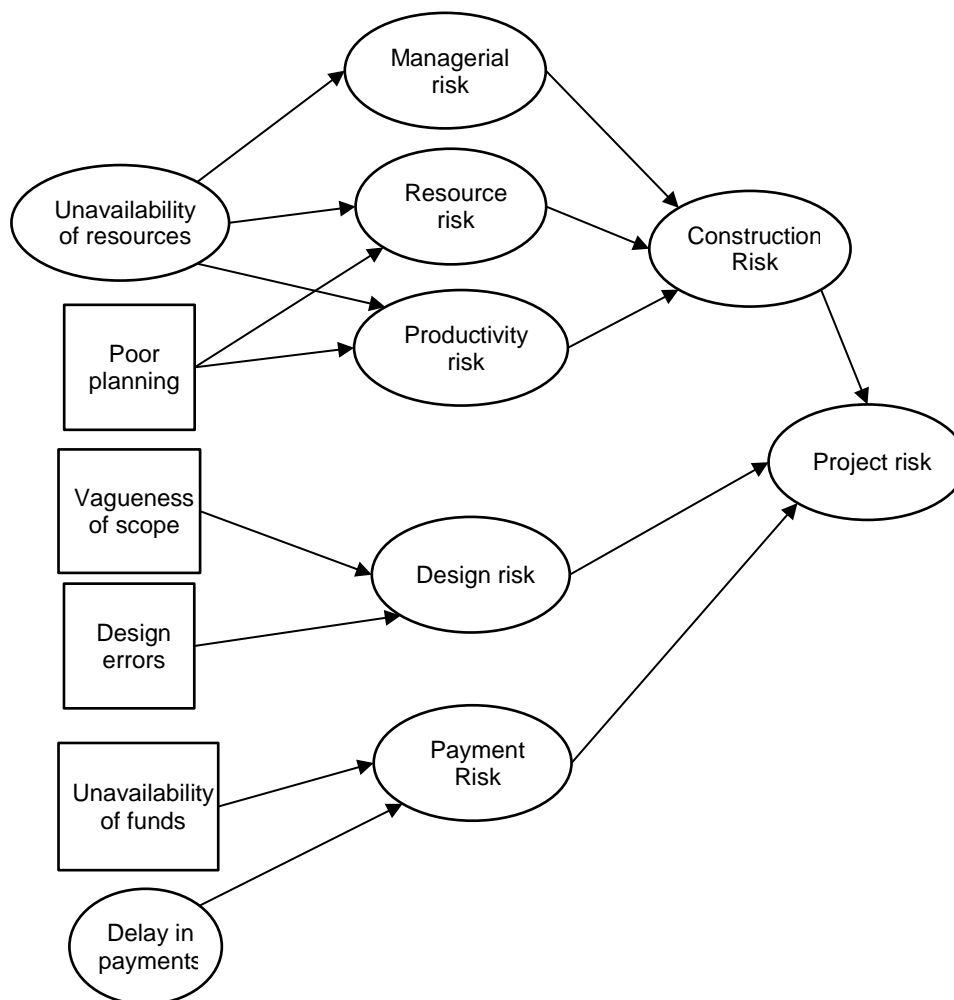
Figure 2 Example of qualitative model (except from Dikmen et al. (2007))

Neither, Dikmen et al. (2007) or Tah and Carr (2001) indicate how influence diagrams that are used to identify risks and their relationships is arrived at. However, Dikmen et al's (p.497) comments that the qualitative risk models are

'basic assumptions' of the process' which suggests that the influence diagrams are defined a priori rather reflecting the actuality of projects.

Ackermann et al. (2007) also use a form of influence diagram, causal mapping, as a step in the development of their risk filter tool. The authors explain that the risk filter is a questionnaire that offers assessment of project risk at the beginning and during the life of a project, the analysis of which is achieved through quantitative modelling (Monte Carlo method). Unlike the approach of Dikmen et al. (2007) and Tah and Carr (2001), however, the causal model that forms the basis of the risk filter is not a standard a priori model but rather is developed from in depth interviews with project participants. The consequence of using causal mapping and in depth interviews is maps that are far richer in detail and thus give a more nuanced understanding of risk. Moreover, developing the maps from the ground up, as it were, does not restrict thinking to those areas of risk identified by a framework that has been defined a priori.

A further example of using causal mapping with quantiative modelling is described in Howick et al (2008). The authors provide insight into their 'modelling cascade', an integrated methodology for transitioning in an auditable manner from qualitative data that is first captured in causal maps to quantitative system dynamics models.

It is also worthy of note that critical success/failure factor research has also sought to convey the relationships between factors that can influence project outcomes (Fortune and White (2006), Belassi and Tukel (1996)). The approach used by Belassi and Tukel (1996) was to gather factors into similar types whereas Fortune and White (2006) grafted the success and failure factors on to a pre-existing conceptual framework. While both frameworks are valuable, the identified relationships between factors are not based upon the actuality of projects leading back to the issue of whether theory is representative of complex project reality.

2.4.3.1   Critical Review of Systemic Approaches to Risk Management

There are clearly a number of options available for the management of project risk using a systemic modelling approach however they largely boil down to a choice of quantitative and qualitative modelling techniques. While quantitative techniques like system dynamics have added much value to project management, Rodriguez

and Bowers (1996, p.219) conclude that application of the technique is 'still relatively rare'. This rarity is perhaps a consequence of three interrelated barriers that the authors make reference to – sophistication, skills and cost. SD models are far more sophisticated than conventional approaches to the management of project risk such as the project risk register. Sophistication of the models means they are not as readily accessible to project staff because of the need for specialist skills for construction and management of SD models. With specialist skills, comes additional costs and thus impacting on the cost efficiency of the risk management process. A further barrier was identified by Loosemore and Cheung (2015) who found that a systems approach challenges conventional thinking and practices which are deeply embedded within the practitioner community.

The implication for this thesis is that, while quantitative modelling using the likes of SD might be valuable, wide spread application of quantitative models to projects is likely to be problematic due to the sophistication of the technique, the specialist skills and associated cost of application.

The use of qualitative modelling through, for example risk workshops also has barriers to access. While the approach might appear less sophisticated than the development of quantitative models, risk workshops require significant specialist facilitation skill as well as expert ability in the associated causal mapping technique. Indeed, beyond the developers of the systemic risk workshop approach (Ackermann and Eden, 2005, Ackermann et al., 2014) there are no examples within the literature of practitioner driven applications which is perhaps a reflection of the challenges.

Reflecting upon the research question below (set out earlier in this chapter) in light of the foregoing discussion:

- How can knowledge about systems of factors that can influence overruns in projects be put to use to by practitioners to mitigate overruns in current and prospective projects?

The literature suggests that there are a number of tools and techniques available to support a systemic approach to risk management. However, it also appears that there stands a chasm between these techniques and adoption by the wider project management practitioner population because they (techniques) require significant specialist skill and associated investment to implement. Moreover, the foregoing review of literature suggests that systemic modelling challenges current custom and practice of project risk management which perhaps further obstructs the adoption of

systemic modelling techniques. Thus the final element of this chapter is to consider how the research reported in this thesis document aims to attend to the research question above.

2.4.3.2 Next Steps for the Development of Systemic Risk Modelling

Given the context above is seems that the development of a technique or tool that can draw upon the characteristics of current approaches to project risk management *and* that of a systemic modelling approach could offer a first step in making systemic modelling more accessible to a wider practitioner population. In essence achieving a 'light touch' approach to systemic modelling of project risk, one that has the benefits of a conventional approach, in terms of simplicity, accessibility, cost and efficiency but also brings to bear the benefits of systemic modelling in terms of comprehensiveness of risk consideration and systemicity of risk.

What is proposed by this author is that the factors, and the relationships between them, that are revealed from the investigation of project overrun in this research be used to develop a qualitative causal model of project risks. Consequently, the model will be based upon empirical analysis of actual projects and should, therefore, be a more closer resemblance of project actualities than the deployment of an a priori model (used by the likes of Dkimen et al. (2007)).

It is proposed here, that the development of a qualitative causal model of project risks could attend to the issues concerning the adoption of systemic modelling techniques by practitioners in the following ways:

Attending to Cost and Skill Associated with Systemic Risk Modelling

As noted earlier, specialist knowledge and associated costs of implementing current systemic modelling techniques can be a barrier to practitioner use. Exploring risks in a conceptual form would keep the level of sophistication and consequently minimise the need for specialist knowledge and associated costs making the tool accessible to a broad base of project participants.

Attending to Comprehensive Coverage of Risks

A model that reveals potential sources of risk at a conceptual level could be used to support PM's (and other project participants) in a simple but effective way to open their mental antenna to the multitude of risks that can face a project.

Attending to the Systemicity of Risk

Using a systemic modelling approach to construct the model would reveal *potential* interrelationships between risk sources. Representing these relationships might help practitioners see through the complexity of interrelated risks (Williams et al., 2012) but more generally might encourage the behaviour of considering risk systemicity and, consequently, reveal new sources of risk and relationships that are particular to their specific context.

A Segue to other Systemic ModellingTechniques

A conceptual model could provide a segue forward into the adoption of more sophisticated techniques. The simplicity of a conceptual model might serve to encourage the adoption of systemic modelling techniques thus introducing practitioners to the basic ideas and benefits associated with a systemic modelling approach. Consequently this might encourage the pursuit of more sophisticated tools such as risk workshops or system dynamic models.

A conceptual model could also provide a segue back from a systemic view of project risk to the use of more conventional tools such as the project risk register (PRR). For example, a model of project risks could be used to elicit, understand, and assess project risks in light of their relationships with one another and then be deconstructed into a PRR. Thus the assessment of risk in the PRR would be informed by risk systemicity, albeit that the risks would be presented in a typical PRR format and the visibility of risk systemicity, therefore hidden. Nevertheless, the PRR is a conventional and thus more accepted practice than systemic modelling. Presenting risks in a PRR format would allow for the gradual introduction of a systemic approach.

2.5   PROJECT OVERRUNS AND THE PRIVATE FINANCE INITIATIVE (PFI)

2.5.1   Introduction

As discussed in section 2.1, the research presented in this thesis was conducted with an organisation - a construction company called BuildIt. Pettigrew (1997, p.343) stresses that when researchers conduct studies in organisational settings they must be aware that they have 'no god given right to expect other people's organisations to be their laboratories'. The researcher therefore cannot expect to design their study *a priori* and then simply demand their host organisation to provide access to particular data, departments or people that meet the needs of their study. Instead, Pettigrew (1997, p.286) advises researchers to engage in a 'reciprocal relationship' with the organisation whereby the researcher gives something back to the organisation (for example research findings or running workshops) in return for access to parts of the organisation and its data. In this arrangement the two parties work together to shape and focus the research in ways that can meet their respective needs.

Following Pettigrew's advice, the author of this thesis worked closely with his host organisation (BuildIt), shaping the research in a way that could meet the needs of the study but also those of BuiltIt. This process is discussed in greater detail in chapter 3 but in summary it led the study to centre upon the investigation of a particular type of project – the Private Finance Initiative (PFI). Consequently, this penultimate section of the literature review focuses specifically on the extant literature concerning PFI projects so as to accurately frame the research questions and corresponding research findings.

To set the scene and provide background, the section opens with context to the Private Finance Initiative as a form of contracting to deliver public services. Academic interest in PFI projects is then examined, revealing the types of research that have already taken place and identifying gaps in the literature to which this thesis might attend. Attention is then turned to the PFI project lifecycle which is found to include the operational phase, a feature that puts PFI projects in tension with the conventional view of the project lifecycle as espoused in the project management literature. Supported by extant literature, the section then goes on to argue that the conventional life cycle model must be extended to include the operational phase when working in the context of PFI projects. If not, the conceptual basis of research will be inconsistent with the actuality of the projects being studied. Finally, literature concerning the phenomenon of project overruns in PFI projects in

particular is examined. It is found that although the performance of PFI projects concerning overruns is generally reported as good, PFI's are in no way immune to the phenomenon. Most significantly, it is found that there are currently no empirical studies of cost overrun in the operational phase of PFI projects, presenting a fruitful avenue for this thesis to make a significant contribution to knowledge.

2.5.2   Context to the Private Finance Initiative

The Private Finance Initiative (PFI) is a form of contract that has been used by governments around the world as a means of investing in public services (Bing et al., 2005a). Many different types of public services have been delivered using the PFI approach including hospitals, schools, roads and bridges (Bing et al., 2005b). Such projects are of central concern to governments because of the important contribution they make to a country's social and economic welfare. However, they are also incredibly expensive to deliver which presents a challenge to budget constrained governments. To overcome this challenge, governments have turned to Private Finance Initiative contracts as a means of engaging the private sector to deliver these important projects (Osborne, 2000).

In a PFI contract government 'delegates responsibility to the private sector to design, construct, finance, operate and maintain infrastructure projects that would normally be the responsibility of national government working on its own' (Turner, 2004, p.350). Thus in a PFI project it is the private sector not the public sector that finances, designs, builds and operates facilities. The private sector then uses the facilities to provide public services in return for a charge to the public sector (Ball and King). Although each PFI project will have its own contractual nuances, typically the project will involve a public sector client (e.g. NHS, education department or roads department) engaging a consortium of private organisations (also referred to as 'the service provider' or the 'concessionaire') for a period of around 25-30 years. Akintoye suggests that the private sector consortium is likely to comprise of a main contractor, finance institutions, specialist consultants (e.g. health planners), and a maintenance company. As discussed above, a number of important public projects have been delivered using this approach.

2.5.3   Academic Interest in PFI Projects

PFI projects have received growing interest from the academic community. In their review of PFI literature between 1998 and 2003 Ke et al. (2009) found that early research focused largely on just three topics (risk, procurement and finance). However, a more recent review by Tang et al. (2010) suggests a significant broadening of research topics to include innovation (Barlow and Köberle-Gaiser, 2008), project success factors (Zou et al., 2014), transaction costs (Reeves, 2008), concession periods (Xu et al., 2012) performance assessment (Love et al., 2015, Akbiyikli, 2013, Hodge and Greve, 2007) and value for money (Gaffney et al., 1999, Akintoye et al., 2003, Cuthbert and Cuthbert, 2010).

However, despite growing research on PFI projects, Yuan et al. (2009) point out that there remains a significant gap in the literature. Yuan et al.'s (2009, p.256) review of PFI literature revealed that the majority of extant research was conducted at a macro-level of analysis, examining PFI's 'at a broad social or organisational level'. Research at this level of analysis has examined for example finance structuring (Turner, 2004), the rationale for the PFI model (Hodge and Greve, 2005, Roehrich et al., 2014), the costs of the PFI procurement process (Tang et al., 2010) as well as risk allocation/sharing between public and private sectors (Grimsey and Lewis, 2002, McDowall, 2003, Bing et al. 2005a). Yuan et al (2009) points out that the emphasis on macro-level research has left a 'significant gap' in current understanding of PFI's concerning the 'micro-level' processes of managing these projects. The authors suggest that all factors, not just the macro ones 'must be considered if they may affect the process, implementation and success' of PFI projects (Yuan et al., 2009, p.256).

Examining literature in the prevailing period since Yuan et al's (2009) finding, a small number of studies have emerged that take a more fine grained approach to research. For example, El-Gohary et al. (2006) examined the management of project stakeholders using an in-depth case study, Holmes et al. (2006) conducted a qualitative fine grained study of health care projects from bid stage through to construction, De Lemos et al. (2004) conducted a case study of the Lusoponte bridge project in Portugal, and Edelenbos and Teisman (2008) conducted an in-depth study of a road infrastructure project. However, despite these contributions to fine grained understanding of PFI projects, research at the macro-level remains the

dominant approach and so the 'significant gap' identified by Yuan et al. (2009) largely remains.

Cuthbert and Cuthbert (2010) offer an explanation for the lack of fine grained studies of PFI projects. The authors suggest that commercial confidentialities surrounding PFI projects are so significant that PFI's are almost impregnable by researchers, hampering access to the detailed data needed for fine grained studies. Consequently, PFI research tends to be based upon publically available data which is usually reported at the macro-level.

The lack of fine grained studies of PFI projects presents a gap in the literature to which this thesis can attend. This is because the research adopts a systemic modelling perspective on projects (as discussed in section 2.3), a perspective that is concerned with gaining nuanced understanding of project realities through fine grained study. Furthermore, the research is conducted by working directly with a construction company (BuildIt), mitigating the barrier identified by Cuthbert and Cuthbert concerning accessing the detailed data needed for in-depth study of PFI projects. Based upon the foregoing points therefore, this thesis has the potential to attend to the current gap in literature for fine-grained study of PFI projects and contribute new insights that offer nuanced understanding of these projects.

2.5.4   Reconceptualising the Project Lifecycle for Researching PFI's

One of the distinguishing features of PFI contracts touched upon above is the inclusion of the operational phase as part of the project lifecycle (Ive 2004). In a traditional design and build contract, for example, the operational phase does not form part of the project. The private sector is contracted to deliver physical infrastructure which is then handed over to the client to operate. In a PFI contract however the project is not transferred to the client after construction because the private sector is contracted to provide the physical infrastructure *and* manage its ongoing operation. Thus for a consortium delivering a PFI project, the build phase (including design and financing) is only part of the project's lifecycle as they continue to be responsible for the project during its operation,. This can include providing services such as cleaning, catering and security as well as the ongoing maintenance and repair of the physical infrastructure.

The inclusion of the operational phase in the PFI project lifecycle puts PFI's in tension with conventional wisdom espoused in the project management literature concerning the project lifecycle. For example, Turner (2009, p.10) asserts that there is 'growing agreement' within the literature that projects comprise 5 phases of 'concept; feasibility; design; execution (construction); and close', a view that is echoed by other academics (Morris, 1994, Kerzner, 2009, Meredith and Mantel, 2010) as well as practitioner texts such as the PMBOK Guide (PMI, 2004). The conventional lifecycle model therefore defines the project as coming to a close following the execution (construction) phase. However, as described earlier, completion of the build phase in a PFI project does not herald the end of the project but rather a key milestone in the project's lifecycle. Furthermore, the inclusion of the operating phase means PFI's can be 25 – 30 years in duration, challenging the conventional wisdom that projects are 'temporary' in nature (Lundin and Söderholm, 1995, Turner and Müller, 2003, PMI, 2004)

PFI's are not the only type of project to challenge the conventional wisdom concerning the project lifecycle. Projects delivered using other forms of contract such as Design-Build-Operate-Maintain (DBOM) and contracts used in defence that must adhere to the Concept-Assessment-Development-Manufacture-In service-Disposal (CADMID) project life cycle (UK Ministry of Defence, 2012) will present a similar challenge. This is because these contracts also define the operational phase as being part of the project. What the foregoing suggests is that, when research takes place in the context of projects whose contracts define them as including the operating phase, there is a need to extend the conceptualisation of the project lifecycle to include the operating phase. If not, the conceptual basis of the research will be inconsistent with the actuality of the projects being studied.

Calls to extend the project lifecycle to include the operating phase in project contexts such as PFI are beginning to emerge in the literature particularly in relation to performance assessment. For example Love et al. (2015) and Liu et al. (2015) call for the lifecycle to be extended when assessing the performance of PFI projects so as to provide a more accurate reflection of the project's whole life performance. Similarly, Artto et al. (2015) points out that project's continue to provide value-add well beyond completion of construction and therefore there is a need to connect the construction phase with the operational phase to gain a sense of overall value add. Outside of academic research, Turner (2009) cites organisations such as the World

Bank who have also adopted alternative models of the project lifecycle for performance assessment.

On the basis of the foregoing points, this thesis adopts a conceptualisation of PFI projects that includes the operational phase as part of the project lifecycle. Using an alternative conceptualisation of the project lifecycle is consistent with the assumption made earlier in this chapter which is that projects are context specific. In the context of PFI projects, the contract defines that the project comprises the elements of design, build, *and* operate. Thus, it is necessary to include the operating phase in our theoretical conceptualisation of PFI projects such that it accurately reflects the actuality of the projects being studied.

2.5.5 Overruns in PFI Projects

Ive (2004, p.366) suggests that PFI projects 'have achieved an excellent track record of becoming operational at or before contracted date'. On first inspection the most recent report from the UK government's National Audit Office (NAO) on PFI project performance appears to substantiate Ive's (2004) observation, reporting that time and cost objectives were met in 'the majority of PFI projects (NAO, 2009, p.17). However, closer examination of the data underlying this statement reveals a different perspective - 31% of PFI projects were delivered late and 35% exceeded their contract costs. Thus, while it is fair to say that the majority of PFI projects are indeed delivered to time and cost, there are a significant proportion that are not. Furthermore, the situation with respect to time and cost overrun in PFI projects seems to be worsening. The earlier National Audit Office report (NAO, 2003) found that 24% of projects overran in time and 22% overran in cost as compared with 31% and 35% respectively reported in the 2009 report.

The figures reported by the NAO suggest that the phenomenon of overruns is clearly relevant in the context of PFI projects. As discussed in the previous section, this thesis adopts a conceptualisation of PFI projects that sees the operating phase as an inherent part of the project lifecycle. Reviewing the PFI literature through this conceptual lens reveals that a number of researchers have identified cost overrun during the operational phase as a central risk to PFI projects (Bing et al., 2005, Kwak et al., 2009, Ke et al., 2010). Yet despite this recognition, to date, there have been no empirical research studies of cost overrun during the operational phase of

PFI projects. Again, this absence might be explained by Cuthbert and Cuthbert's (2010) observation that strict commercial confidentialities surrounding PFI projects act as a barrier to accessing data. However, as discussed earlier, this barrier is mitigated in the context of this thesis as a consequence of working with an organisation. The implication for this thesis is that any insights gained from empirical study of overruns in the operating phase of PFI projects would represent a significant contribution to knowledge.

In summary, the literature reviewed in this section has revealed that there is a lack of fine grained studies of PFI projects. Moreover, there is an absence of studies examining the phenomenon of overrun during the operating phase of PFI's even though the literature has identified cost overrun in the operating phase is known as a critical risk in PFI projects. The conclusion drawn is that the landscape of existing PFI research presents an opportunity for this thesis to make a significant contribution to knowledge if the findings generated through fine grained study of PFI projects reveal insights into the phenomenon of overruns in the operating phase of PFI projects.

Based upon the preceding review of the literature the aims of the thesis are thus refined to the following:

- To identify the factors, and the relationships between them, that describe a system of factors that can bring about overruns in complex projects, in particular PFI projects, and subsequently
- To use the knowledge gained about the system of factors to develop a conceptual model that could be put to use by practitioners to mitigate overruns in current and prospective PFI projects.

2.6 CONCLUSIONS

The focus of this study is the phenomenon of overrun in projects. In order to inform the development of research questions that could further the existing knowledge base on the phenomenon, a critical review of the extant literature was conducted.

The review revealed that despite growing experience with projects and a burgeoning knowledge base, organisations are frequently left defeated by projects

that are late, exceed their budgets or fail to meet other expectations. The conclusion drawn was that more research needs to be done to better understand why projects exhibit the behaviour of overruns such that they might be managed in a way that mitigates this behaviour.

The review found that the topic of overruns has already been the subject of research but it was revealed that the tendency has been toward exploring collections of discrete factors or individual factors with less emphasis on the relationships between factors. The literature suggested that the relationships between factors are of equal importance as the factors themselves because, in practice, factors do no operate in isolation from one another. Instead, they interact with one another. A conclusion was thus drawn that if further understanding of project overruns was to be gained, then future research would benefit from adopting a perspective that attends to both factors and their relationships. The review revealed that one such perspective was that of systemic modelling.

Systemic modelling conceives of project behaviour as the manifestation of factors that are interlinked with one another to form a system of factors. The review found that by understanding how the whole system of factors operates, systemic modelling has been able to unlock understanding of complex project behaviours such as overruns. Despite these valuable insights, however, the literature suggests that this perspective is a departure from conventional project management theory. The nature of the departure was explored and it was found that leading researchers have called for the adoption of alternative perspectives on projects due to perceived inadequacies of the conventional view. Consequently, it was concluded that the adoption of a systemic modelling perspective is both warranted and in demand.

The review then turned attention to the practice of project risk management (PRM) as a means of mitigating project overruns. Again, the literature suggested that, in and of themselves, conventional perspectives on PRM are inadequate for mitigating the behaviour of overruns in projects because they leave projects vulnerable to two types of risk that influence overruns – 'soft' risks and systemicity of risk. The review found that a systemic approach to risk management offers a way forward to attend to this vulnerability but that developments and applications of this approach were still relatively rare in project management.

Exploring literature on existing systemic risk management techniques within project management, the review posited that the rarity might be due to a number of

barriers to adoption such as the high level of sophistication, skill level and cost associated with existing tools. Two conclusions were drawn. Firstly, that the rarity of techniques offers a fruitful avenue for new developments of tools to support a systemic approach to project risk management, and secondly, that the development of new tools should attend to the identified barriers to adoption.

Finally, the review explored literature surrounding PFI projects, reflecting the thesis' particular focus on this type of project. The review found that despite a growing research base understanding and enhancing knowledge of PFI's 'continues to be a matter of significance and importance' (Kwak et al., p.51). In particular, the review revealed a gap in the literature which is that there have been no empirical studies of cost overruns in the operating phase of PFI projects, presenting this thesis with an opportunity to make a significant contribution to knowledge.

Based upon the preceding review of the literature the aims of this thesis were as follows:

- To identify the factors, and the relationships between them, that describe a system of factors that can bring about overruns in complex projects, in particular PFI projects, and subsequently
- To use the knowledge gained about the system of factors to develop a conceptual model that could be put to use by practitioners to mitigate overruns in current and prospective PFI projects.

The next section describes the research methodology that was adopted to attend to these aims.

CHAPTER 3:   RESEARCH METHODOLOGY

3.0   CHAPTER ABSTRACT

The overarching goal for this study is to make a contribution to the academic body of knowledge within the field of project management. To achieve this goal, the contribution must be assessed as being of scientific quality. The three metrics most often used to assess quality in the methodological literature are validity, reliability and replication (Johnson and Harris, 2002).

In order to attend to these metrics this chapter provides a clear and full explanation of the approach to research in this study. To explain the approach in a coherent manner, the chapter is split into two parts. Part A focuses on explaining the theory of methods (methodology) that underpins the approach, examining the aspects of research philosophy, research procedure (strategy), research design, research method and research techniques. Part B concerns the practical application of the approach to research, focusing on data collection and data analysis.

3.1   PART A – THEORY OF METHODS

This section focuses upon the theory of methods (methodology) that underpinned our approach to research. In particular, the section explains the theory that informed each of the methodological choices associated with the approach to research. The methodological choices that are examined concern research philosophy; *research procedure (strategy), research design, research method,* and *research technique*. The four terms in italics have abundance of meaning within the methodological literature, for example, what Bryman and Bell (2011) refer to as a design, Saunders (2009) calls a strategy, and Yin (2009) a method. In all three instances reference is being made to a case study.   In order to avoid misunderstandings between the researcher and reader, presented below is the author's understanding of the four terms based upon reading of methodological literature (Danermark et al., 2002, Sayer, 1992, Saunders, 2009, Easterby-Smith et al., 2008, Bryman and Bell, 2011).

- Research procedure (or strategy) –describes the dominant persuasion of the study whether qualitative or quantitative.

- Research design – describes the overall design of the study, examples of which include experiment, survey and case study.
- Research method – the data collection methods included as part of the research design such as interviews and questionnaires.
- Research technique – the techniques, included as part of the research method which focus on elicitation, capture and analysis of data.

In attending to the above aspects, a fundamental aim of this section is to instil confidence in the reader that the approach to research was developed in a rigorous and thoughtful manner. To achieve this aim the section:

- Reveals the logic underpinning each of the choices.
- Demonstrates that the choices are informed by sound reasoning and a rounded understanding of methodological issues.
- Demonstrates that, while the approach is derived from individual choices, the choices are logically compatible with one another and thus form a cohesive approach to research that will generate credible findings that can be accepted into the extant body of research
- Attempts to synchronise the reader's methodological expectations with those of this research study

3.2   RESEARCH PHILOSOPHY

3.2.1   Section Overview

This section explains the author's choice of research philosophy, critical realism (Bhaskar, 1975, 2008), in light of possible alternatives. Two main varieties of research philosophy are examined, one underpinned by relativist ontological assumptions and the other by realist ontological assumptions. It is revealed that the author's understanding of projects, as set out in the preceding chapter, is more compatible with realist assumptions than those of relativism. Consequently, the field of view is focused on realist approaches to research.

A review of methodological literature reveals that empiricism and critical realism are the two main realist approaches to research. The review of literature also finds that empiricist assumptions underpin a positivist approach to research, an approach

that has been used extensively in the study of projects (Smyth and Morris, 2007). Consequently, it is suggested that positivism is a contextually relevant alternative with which to draw comparison with critical realism.

With the field of view narrowed to a discussion of positivism and critical realism as two alternative realist approaches to research, close examination and comparison of these alternatives is conducted. The examination finds positivisms epistemic assumptions and its corresponding approach to explanation to be incompatible with the needs of this research study. Drawing comparison with a positivist approach, the alternative critical realist approach is then shown to offer epistemic assumptions and a form of explanation that is more consistent with the needs of this study.

To provide a rounded assessment of critical realism, its limitations are explored. It is revealed that knowledge claims are fallible, temporary and are, by comparison to positivism, limited in their generalizability. However, it is argued that a) these knowledge claims are consistent with the emerging understanding of projects as being contingent in nature; b) critical realist research can make a strong contribution to theories of project management; and c) that critical realist knowledge claims are logically consistent with Merton's (1968) middle range theory, a type of theory that has been called for in project management research (Packendorff, 1995, Söderlund, 2004, Bredillet, 2013) but as yet has not been unified with a critical realist methodology.

Finally, while diversity of methodologies within a field can lead to fragmentation of ideas and thus limit theoretical progress (Söderlund, 2012), it is shown that the adoption of critical realism offers the opportunity to develop new theoretical perspectives that can be convergent with the existing body of extant positivist-based research. Consequently, adopting a critical realist approach contributes to an agenda of theoretical progress rather than theoretical fragmentation and also attends calls from leading academics in the field for researchers to explore projects from new perspectives (Turner et al, 2010, Söderlund, 2012, Bredillet, 2013,).

Figure 3 provides the reader with an overview of the structure of this section as well as the underlying questions being attended to in each of its sub-sections and the intended contribution of each sub-section to the thesis.

	Sub-Section	Underlying Questions Being Attended to	Intended Contribution of Sub-Section to Thesis
3.2.2	Context	Why is examination of philosophical assumptions necessary?	Contribute to reader confidence that the approach to research is informed by a rounded knowledge of methodological issues.
		What is the methodological state of the art in project management?	Reveal the dominance of positivist-based approaches to researching projects.
		Where does critical realism feature in PM research?	Reveal the scarcity of critical realist approaches to PM research and opportunities for contributing to methodological PM knowledge
			Inform the positioning of a critical realist contribution within the project management literature in later sub-sections.
3.2.3	Realism & Relativism – Two Main Varieties of Research	What are the assumptions of these two varieties of research? & how do they compare with our understanding of project realities?	Demonstrate the logical consistency of choosing realism over relativism for our study of overruns in projects by making transparent the compatibility of realist assumptions with our understanding of projects as well as illuminate the incompatibilities of relativist assumptions.
3.2.4	Comparison of Two Particular Realist Approaches to Research	What are the particular ontological assumptions of the realist philosophies of critical realism and positivism? What is it about critical realism that makes it more compatible with the needs of this study than positivism?	Demonstrate the logical consistency of choosing critical realism over positivism for our study of overruns in projects
3.2.5	The Structure of a Critical Realist Explanation	What does a critical realist explanation look like?	Provide the reader with forward visibility of the type of explanation being aimed for by this study of overruns in projects.
3.2.6	Critical Realism – Implications for Contributing to Theory	What claims can justifiably be made about theory developed using a critical realist approach to research?	Synchronise the reader's expectations with those of the research by providing forward visibility of its ambitions with respect to contributing to theory.
		How is theory developed using a critical realist approach positioned with respect to the extant PM research, the majority of which is positivist-based?	Demonstrate that a critical realist contribution to PM knowledge is different to, but not separate from, the extant body of work because the knowledge is complementary to existing positivist generated knowledge (and vice versa).
			.

Figure 3 Structure of Research Philosophy Section

3.2.2 Context

Philosophy of research is central to inquiry. A philosophy of research encapsulates a set of assumptions concerning the nature of reality (ontological assumptions) and the nature of knowledge (epistemological assumptions) (Easterby-Smith et al., 2008). Consequently, it determines the methods that are appropriate for inquiry (Morgan and Smircich, 1980) and defines what claims can justifiably be made about knowledge produced from inquiry (Creswell, 2009).

Philosophies of research can be classified into individual paradigms (Kuhn, 1996), each having its own particular slant on ontological and epistemological issues. A number of paradigms are available to the researcher (Bryman and Bell, 2011) but none can categorically be claimed 'the best' for inquiry (Söderlund, 2012, p.42). Consequently, there is no default paradigm that readers of a research study can assume has been used to guide the inquiry.

Explanation of the research philosophy used to guide inquiry is therefore necessary to allow the reader to harmonise their expectations toward the methods and knowledge claims associated with the particular paradigm that has been adopted. However, simply stating the name of the paradigm is insufficient because available paradigms are often without a unified, static definition. For example, the long established 'scientific' paradigm of positivism is described by Bryman and Bell (2011) as difficult to pin down in terms of a precise definition. Furthermore, proponents of a particular paradigm may disagree with one another on its particularities, and over time they may even 'disagree with themselves' (Easterbury-Smith et al., 2008, p.22). Consequently, though the researcher and reader might recognise the same label of a paradigm they might diverge in their understandings of the assumptions which it constitutes. This lack of synchronisation of researcher and reader understandings could lead otherwise valid choices of method and claims about knowledge to be brought into question by the reader (Creswell, 2009), thus creating a situation whereby credibility of the research is threatened.

This section aims to avoid this situation. It provides a clear statement of the philosophy of research used to guide inquiry and a full explanation of the authors understanding of it with a view to aiding the reader to orientate their expectations toward the methods and knowledge claims associated with the philosophy of research, case critical realism.

In preparation for this philosophy of research section, a review of the project management literature was conducted to get a sense of the methodological state of the art within the domain. Two findings were made that are pertinent to this section in particular and the study more generally. First, while there might be no 'best' approach to research, within project management research there is a dominant approach – that of positivism (Williams, 2005, Smyth and Morris, 2007). Prominent researchers have drawn attention to the emergence of alternative approaches to researching projects and emphasised the value of multiple perspectives within the domain (Pollack, 2007, Winch, 2004, Turner et al, 2010, Bredillet, 2013). However, it would appear that the domain of projects remains stubbornly tied to positivist-based research and, therefore, it would seem that choosing a critical realist approach to guide this research study is a departure from the norm, further emphasising the need for explanation of the choice.

The second finding from the review of the literature is that critical realism has only been recently introduced as an approach to research in project management (Smyth and Morris, 2007). Since then, there have been no explicit instances of its application in the central journals of project management research – IJPM, PMJ. Smyth and Morris (2007, p.427) suggested their aim was to introduce critical realism as a 'possibility' and to 'stimulate consideration of this option among researchers' rather than provide a detailed exposition of the approach (which they leave to future research projects). Consequently, important gaps in contextualising critical realism within project management research remain. Gaps include elucidation of how it is that critical realism can have concern for the particular *and* the general (Smyth and Morris, 2007). Little discussion has been had in the context of project management research concerning connecting the approach with appropriate methods. Nor has it been brought to light how a critical realist contribution 'fits' with an extant PM research base that, as noted earlier, is largely positivist orientated (Williams, 2005).

By adopting a critical realist approach to research, the above gaps present potential threats to, and opportunities for, this study of overruns in projects. Threats emerge, for example, from claims that critical realism has concern for the particular *and* the general when highly regarded researchers such as McGrath (1981) have convincingly argued that the researcher can pursue the particular or the general but not both in equal measure. This apparent contradiction threatens the methodological coherence of a critical realist approach.

Opportunities are presented by the gaps in terms of potential contributions to methodological knowledge that can be made by attending to the gaps. Contributions could take the form of addressing the above apparent contradiction, illuminating methods that can be compatible with a critical realist approach, and finally establishing how findings using a critical realist approach relate to findings in the extant literature, the majority of which have been generated by an alternative realist approach of positivism.

To summarise, the aims for this and proceeding sections are firstly to reinforce the credibility of research findings by demonstrating a logically coherent approach to research, and secondly to make a methodological contribution to PM knowledge by elucidating a critical realist approach to researching overruns in projects and further demonstrating that critical realism is a logically coherent approach that 'stacks up' as appropriate for the study of projects.

Given the lack of attention to critical realism in project management and the need to ground the discussion within extant literature, the following sections necessarily make use of literature sources from other disciplines (e.g. social sciences) where critical realism has received much more attention and its features have been elucidated in depth.

The start point for discussion is to examine the underlying ontological and epistemological assumptions of the two main varieties of research philosophy - realism and relativism.

3.2.3   Realism and Relativism - Two Main Varieties of Research

Although there are many research philosophies to choose from (Morgan and Smircich, 1980) the choice can be distilled down to two opposing varieties - those philosophies underpinned by relativist ontological beliefs and those underpinned by realist ontological beliefs (Easterby-Smith et al. 2008). Ontological assumptions are concerned with the nature of reality and are therefore 'the foundation for every other assumption we make' (Danermark et al., 2002, p.18) about our research. Relativist based philosophies hold an ontological belief that reality is subjective in nature that it is 'a projection of human imagination' (Morgan and Smircich, 1980, p.493) and therefore deny that 'there is anything knowable that is independent of mind' (Collier, 1994, p.12).

Research philosophies with a realist ontology on the other hand are of the opinion that reality is in fact objective in nature. In other words, realist philosophies claim that reality exists 'out there….independently of our knowledge of it' (Danermark et al., 2002, p.17). In support of this claim, realist researchers argue that 'Reality simply does not react in accordance with our expectations, but on the contrary with considerable autonomy' (Danermark et al., 2002, p.18) and therefore reality must be external to the observer.

Various realist researchers provide propositions that support the argument for an external, autonomous reality (Sayer, 1992, Danermark et al., 2002, Fleetwood and Ackroyd, 2004). These propositions resonate strongly with this authors understanding of project realities set out in the literature review chapter. For example, one proposition is that mistakes are made. Project management research has shown that mistakes can be made, for example, during project bid development. A second proposition is that reality takes us by surprise. Project stakeholders are taken by surprise when their project is not going according to the plan. Another proposition is that wishful thinking does not work. If wishful thinking worked in projects then there would be little need to better understand the behaviour of project to improve their performance since stakeholders could simply wish their project to be better. Furthermore, project management research suggests that understanding project is not easily achieved through, for example, simple reflection (Williams, 2004, p.275). This difficulty resonates with the final realist proposition that it takes significant effort to understand reality (Sayer, 1992). The consistency of realist propositions with the author's understanding of project realities, suggests that an approach to research which is founded upon a realist ontology is an appropriate way to proceed in researching project overruns. Thus attention is focused on exploring research philosophies underpinned by realist ontology.

While there are 'several varieties of realism' (Easterby-Smith et al. 2008, p.19), Bryman and Bell (2011) suggest the two most prevalent are empirical realism and critical realism (Bhaskar, 2008). Fleetwood and Ackroyd (2004) point out that it is empirical realist ontological assumptions that underpin the positivist paradigm. Furthermore, as has been discussed, positivist based approaches are dominant within project management research (Smyth and Morris, 2007). Thus, positivism provides a contextually relevant alternative paradigm with which to draw comparisons with critical realism because it is both a realist paradigm and has been

used extensively in researching projects. Consequently, the philosophies of critical realism and positivism are the focus of the remainder of the discussion.

3.2.4   Comparison of Alternative Realist Approaches

Although the paradigms of critical realism and positivism are both based upon *a* realist ontology, they are not based upon the *same* realist ontology. In short, the two agree that there is a reality 'out there' but they differ in what they conceive that reality to be like.   Critical realism, for example, conceives of reality as being 'stratified', comprising three ontological levels illustrated in Figure 4 below.

	Pure Empiricism	Positivism	Critical Realism
Level of reality	Experiences	Events	Mechanisms/ Powers
Empirical	x	x	x
Actual		x	x
Real			x

Figure 4 Critical Realisms Conception of Reality (Adapted
from Collier, 1994, p.44)

The three levels of reality in Figure 4 are described as the *empirical* level which 'consists of what we experience, directly or indirectly'; the *actual* 'where events happen whether we experience them or not' and the level of the *real* where 'that which can produce events in the world, that which metaphorically can be called mechanisms' exist (Danermark et al., 2002, p.20).   The basic premise of critical realism is that reality comprises what we can directly observe or experience of events taking place in the *actual*, but that reality also comprises 'powers and mechanisms which we cannot observe' which operate in the *real* level and bring events into being (Danermark et al., 2002, p.20). Thus, for critical realism, reality comprises of what can *and* what cannot be directly observed or experienced.

By comparison, positivisms model of reality is restricted to what can be observed or experienced directly (Figure 4). This restriction is brought about because of positivisms epistemic assumption that 'knowledge is only significant if it is based upon scientific measurement' (Easterby-Smith et al. 2008, p.22). The belief is that the instruments of science (such as observation) can provide unmediated access to reality to reach matters of fact or 'truth' (Sayer, 1992).

However, restricting valid knowledge to scientific measurement, in turn, imposes ontological restriction, since to be 'measured' an entity must have some physical properties. Consequently, Fleetwood and Ackroyd, (2004) say the term 'real' must largely be reserved for things of a physical nature. The logic of this restriction is exposed by the authors as having committed an epistemic fallacy whereby 'ontological concerns are collapsed into epistemological concerns' (Fleetwood and Ackroyd, 2004, p.29). As Danermark et al. (2002) explain further, positivism reduces what there is to what can be known about it, thus conflating epistemic and ontological assumptions. Put simply, in a positivist paradigm, reality is *forced* to comprise of scientifically measurable entities, not because that is what reality is like but because epistemic assumptions restrict legitimate knowledge to scientific measurement.

Positivism's epistemological, and thus ontological, stance is problematic for this research study. In reviewing project overrun literature, it was revealed that human factors such as managerial pressure, politics and social issues can be instrumental in bringing about overruns in projects (section 2.3.4). Human factors do not lend themselves to the scientific measurement required by positivism and consequently a reasonable assertion is that human factors are precluded from the analytical field of view in positivist research.

This assertion might be met with opposition from claims that sophisticated scientific instrumentation *can* acquire knowledge of human factors. For example, it could be argued that a Likert scale can provide knowledge about the extent of pressure placed on project staff to meet a particular project milestone. However, it is the research participant (subject) that uses a Likert scale to convey to the researcher their feeling (a subjective phenomenon) of pressure. Therefore, the measurement is not 'scientific' in the positivist sense described above of being made in an unmediated, objective manner by the researcher. Consequently, if we are to adhere to positivist assumptions, then strictly speaking, even where sophisticated techniques like Likert scales are used, human factors are still out of analytical reach.

Restricting our view of reality to what can be scientifically measured also impacts explanation. The components of positivist explanation (data) are events taking place in the actual and consequently explanation is reduced to 'regular associations (or 'constant conjunctions') of causes and effects' (Sayer, 1992, p.108) of the sort illustrated in Figure 5.
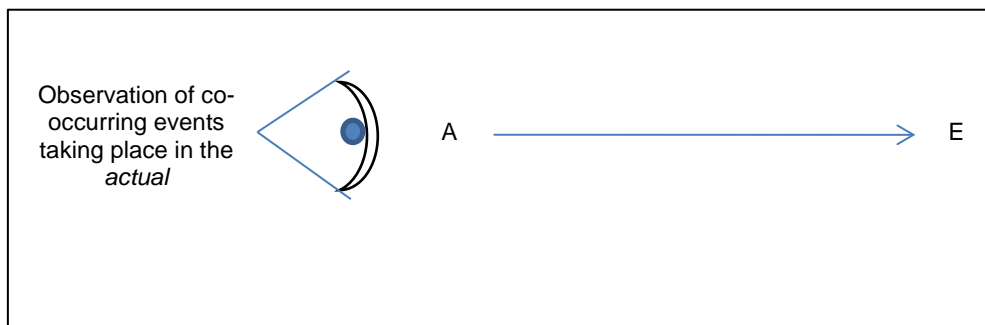
Figure 5 The Co-Occurrence of event E following event A

The aim of this research study is to explain causes of overruns in projects. Sayer (1992, p.104) suggests that to explain what causes something 'is to ask what 'makes it happen' or in other words produce a causal explanation that says something about 'why we observe what we observe' (Hedström and Bearman, 2009, p.9). A regularity model of explanation of the sort shown in Figure 5 can provide insight into 'what' causes overrun but it 'doesn't answer the question why?' (Easton, 2010, p.118) . The aim of this research study is to get beyond recognition of *what* causes project overrun to understanding *why* such causes maturate to bring about the phenomenon of overrun therefore a positivist form of explanation falls short of this research study's needs..

Critical realism, on the other hand, offers a much deeper form of explanation, one that addresses *why* and *how* events (such as overruns) can be brought into being. This form of explanation is provided by virtue of reality being conceived as having a third level, the *real*, (touched upon earlier, Figure 4) where mechanisms exist, which although 'seldom visible' (Danermark et al., 2002), bring observed events into being.

The conceptual third level of *real* is what distinguishes critical realism from other forms of realism and allows for a deeper form of explanation (Figure 6) than the regularity model of positivism (Figure 5). The reason critical realism is able to

conceive of a third level of reality is its underlying ontological assumption that something (an entity) is 'real' '*if it has an effect or makes a difference*' Fleetwood and Ackroyd (2004, p.29). This ontological statement says nothing about how knowledge is to be gained about the entity therefore ontological and epistemological concerns are kept quite separate in critical realism. This separation means the epistemic fallacy encountered by positivism is avoided and thus reality can be conceived as more than what is directly visible by scientific means, enabling a deeper form of explanation to be achieved.
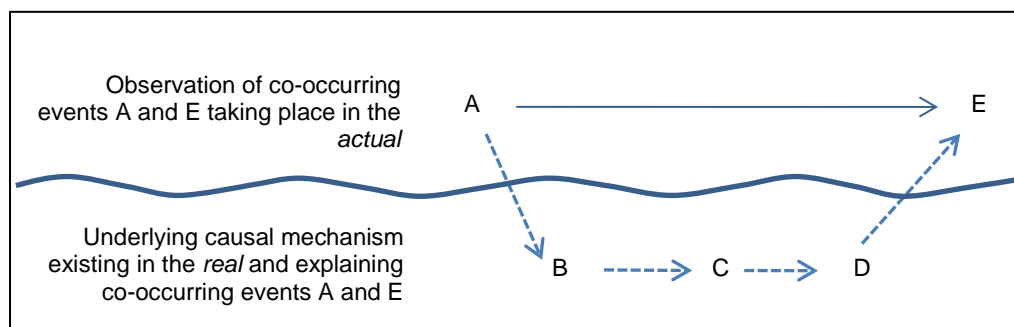
Figure 6 A Conceptual model of critical realist explanation
(adapted from Hedström and Ylikoski (2010, p.59))

When compared to a critical realist explanation, positivist explanation might be thought of as providing a shallow form of explanation that focuses on regularly observed events. For critical realism, simply knowing that event E regularly followed event A, 'is not enough' (Sayer, 1992, p.106). To attain 'usable knowledge' (Danermark et al., 2002, p. 316) a 'Deeper explanatory understanding' is needed. This deeper level explains 'the causal mechanisms that have generated the macro-level observation' that E has generally followed A. Critical realism thus recognises that scientific explanation 'necessarily involves observation of events' (Danermark et al., 2002, p.22) but posits that explanation must articulate the mechanism that brought the regularity into being. Thus explanation is about 'postulating (and identifying) mechanisms' that 'make intelligible the regularities we observe' (Sayer, 1992, p.107), a type of explanation that is referred to by Hedström and Bearman, 2009, p.4) 'a mechanism-based explanation'.

The term 'mechanism' is metaphoric in nature (Danermark et al., 2002, p.20) and is used to refer to description of 'the entities of a causal process that produce the effect of interest' describing the 'continuous and contiguous chain of causal or intentional links between the *explanans* and the *explanandum'* illustrated in Figure 6 (Hedström and Ylikoski, 2010, p.50). This mode of inference in which events are

explained by postulating (and identifying) mechanisms which are capable of producing them is called *'retroduction'* (Sayer, 1992, p.106). Hedstrome and Bearman (2009, p.3) explain that retroduction is not about guessing what mechanisms are like but rather they must be detailed in 'clear and precise ways' revealing the 'cogs and wheels of the causal process through which the outcome to be explained was brought about'.

3.2.5   The Structure of a Critical Realist Explanation

The previous section focused on making transparent the rationale for selecting a critical realist approach to researching project overruns. This section explores the requirements of a critical realist explanation to provide forward visibility of the type of explanation being aspired to.

The term 'causal process' is suggestive that the structure of a mechanism is linear and simple of the sort illustrated in Figure 6 above. In fact the structure of a mechanism, and thus critical realist explanation, is much more complex. Hedström and Ylikoski (2010, p.52) suggest mechanisms are hierarchical in structure where 'a mechanism at one level presupposes or takes for granted the existence of certain entities with characteristic properties and activities (mechanisms), it is expected that there are lower-level mechanisms that explain them'. The concept of hierarchy is illustrated conceptually by Sayer (1992) (Figure 7).
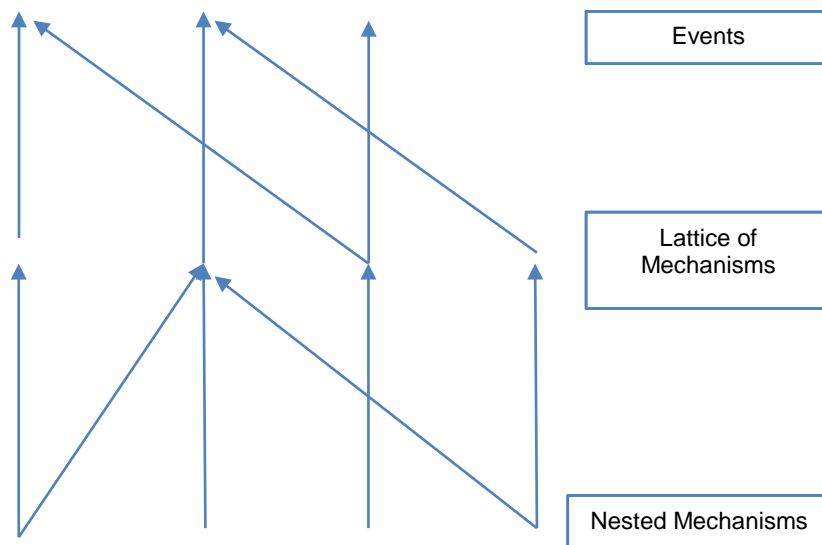
Figure 7 Conceptual model of the structure of a critical realist explanation (Sayer, 1992, p. 112)

Sayer's (1992) conceptual model (Figure 7) shows that to achieve explanation of phenomena using a critical realist methodology means describing a lattice work of mechanisms interacting with one another to produce the phenomena. The operation of each mechanism within the lattice, itself described with reference to nested mechanisms. Only by understanding the whole edifice can an explanation be achieved.

Furthermore, critical realism asserts that the relationship between identified mechanisms and their effects is 'not a given but contingent' upon the presence of appropriate contextual 'conditions'(Tsoukas, 1994, p. 291). These 'conditions' are other entities that have their own causal powers/liabilities' (mechanisms) (Sayer, 1992) and which serve to either trigger the identified mechanism or counteract its effects. Consequently, context is an integral part of the critical realist model of explanation whereby contextual conditions form part of the lattice work which, together with the identified mechanism, explains the 'causal process[es] that produce the effect of interest' (Hedström and Ylikoski, 2010, p.50) illustrated below (Figure 8).
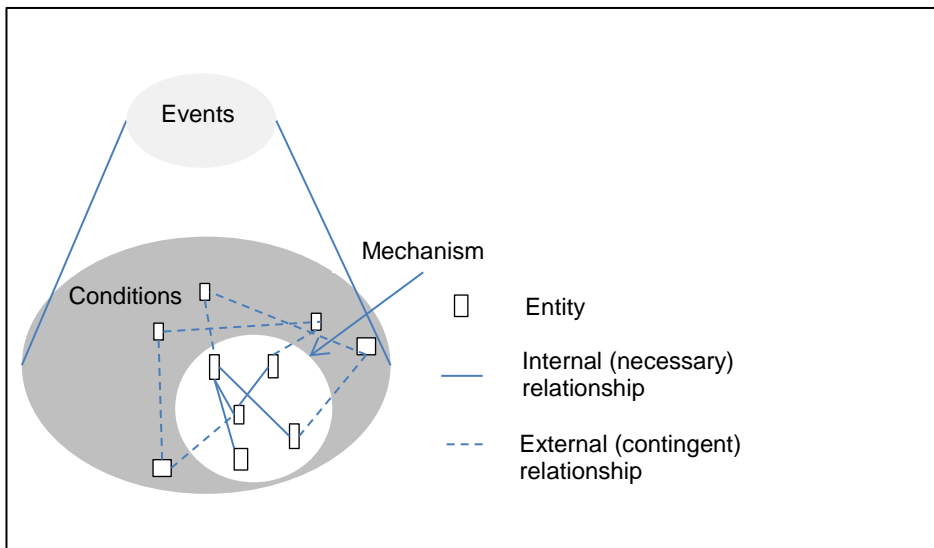
Figure 8 Illustration of critical realist explanation of events

Examining Eden et al. (2000) work on disruption and delay through the lens of Sayer's (1992) conceptual model and the language provided by Hedstrome and YLikoski, (2010), helps to illustrate the structure of a critical realist explanation in the context of project management research. (Though it should be noted that the authors do not define that their philosophical position as critical realism).
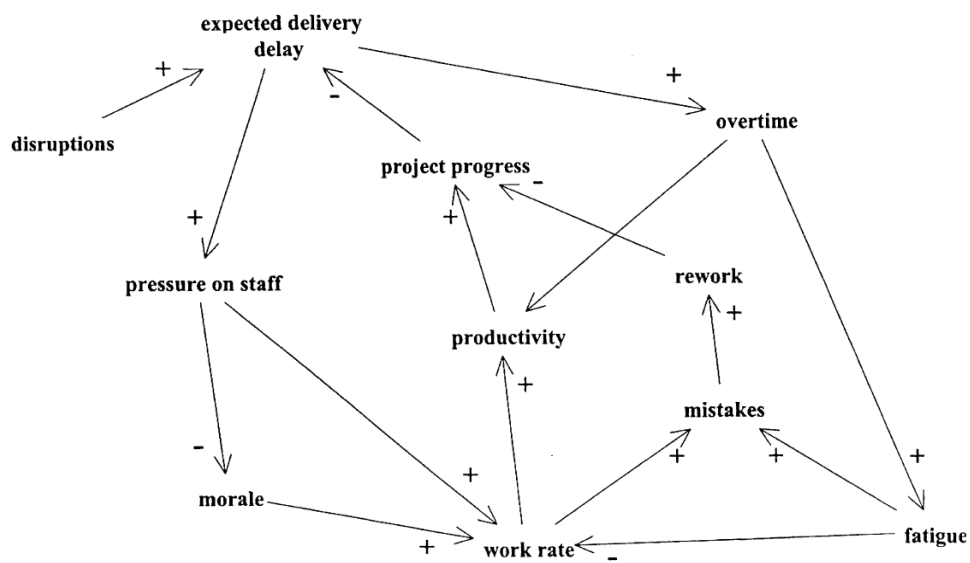
Figure 9 A disruption and delay mechanism (Eden et al. 2000, p.298)

Figure 9 illustrates a model of disruption and delay in projects – a D&D mechanism. The D&D mechanism is formed from a 'hierarchy' of mechanisms. At one level of the hierarchy there is a structure comprising a lattice work of two mechanisms. A mechanism that explains delays caused by pressure on staff (staff pressure mechanism) and the other describing delays caused by the use of overtime (overtime mechanism). These two mechanisms are themselves explained by nested mechanisms operating at a lower level in the hierarchy, such as 'staff fatigue' and 'staff morale' (which are themselves a consequence of human structure). Thus the D&D mechanism operating at one level is explained by the operation of lower level mechanisms (like overtime and pressure) which are themselves explained by still lower level mechanisms like fatigue. As touched upon above, it is only by understanding how the whole edifice operates that explanation can be achieved.

3.2.6   Critical Realism – Implications for Contributing to Theory

The previous sub-section provided forward visibility of the sort of explanation being aimed for in this study. The agenda for this sub-section is to provide the reader with forward visibility of the implications for theory of adopting a critical realist approach to investigating overruns in projects. As discussed earlier, (page. 61), such implications have received little attention in the project management literature. For example, it has not been explained how it is that critical realism can have theory concerned with both the particular *and* the general (Smyth and Morris, 2007) of projects, when others have coherently argued that pursuit of both in equal measure is futile (McGrath, 1981). Nor has it been brought to light how critical realist theories 'fit' with an extant PM research base that is largely positivist orientated (Williams, 2005, Bredillet, 2004).

These gaps could put the coherence of the critical realist approach used in this study at threat. Therefore, by attending to the gaps in literature, this sub-section aims to demonstrate that critical realism is a logical coherent paradigm suitable for the study of projects while at the same time as providing forward visibility to the reader of the type of theory being aimed for in this study. The discussion is structured around the following characteristics of theory developed using a critical realist approach to research:

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- Theory that is fallible and temporary rather than 'final'
- Theory that is generalisable but not predictive
- Theory that is of the middle range (Merton, 1968) but is strong

3.2.6.1 Theory that is Fallible and Temporary

As discussed, explanation in critical realism is about revealing the causal mechanisms that bring about phenomena. However, gaining access to these mechanisms is problematic since they are 'seldom directly visible' (Danermark et al., 2002, p.22). In fact, it is critical realism's assertion that accessing any parts of reality is not a straight forward matter 'because we cannot gain access to the world independently of the concepts we use' (Fleetwood and Ackroyd, 2004, p.3). In other words access to reality is always mediated by available concepts (e.g. language, diagrams, mental images).

Other realist paradigms argue against the notion of concept mediation. For example (as discussed above) positivism asserts that reality is *directly* accessible through application of appropriate scientific methods. Such direct, unmediated access is, however, based upon an assumption that 'thought objects' (concepts such as language, diagrams, mental images) have a one-to-one relationship with 'real objects' (Sayer, 1992, p.47). That is to say, our concepts are direct, unequivocal, representations of the real objects being observed and therefore can be assumed to be matters of 'fact' or 'truth'.

Critical realism lays down a simple assertion that rules out the possibility of claims for 'facts' and 'truths' which is that 'No one can step out of their conceptual world and see if reality 'really exists' or what it 'essentially is'' (Danermark et al., 2002, p.18). Consequently, claims of a one-to-one relationship between knowledge objects and the real object can never be validated. The argument for concept mediation is most clearly made by Sayer (1992) through the use of a simple example. The author explains that the sun was once 'known' to move across the sky however the sun did not change, our conceptualisation of it changed. Thus, even the most fundamental of 'scientific' measurements, observation, is revealed to be concept mediated.

That access to reality is always concept mediated has a series of implications for the nature of critical realist theories. Since it is not possible to see if our knowledge is a direct representation of reality, the best that can be hoped for is knowledge that is practically adequate (Sayer, 1992) rather than some 'ultimate' or 'final' knowledge Danermark et al., 2002, p.23) representative of *the* 'truth' or *the* 'facts' about reality.

Consequently, knowledge (concepts) and theory that articulates this knowledge, is better treated as metaphoric in nature. These metaphors can be improved (as illustrated above with the example of the sun) therefore the aim for theoretical progress using a critical realist approach is for epistemic gain (Sayer, 1992) rather than reaching some 'final' theory, discussed more fully later.

In summary, theory in critical realism must always be treated as fallible and temporary in nature, and 'can only be regarded as the best truth about reality we have for the moment' (Danermark et al., 2002, p.23) and subject to improvement.

3.2.6.2   *Theory that is Generalisable but not Predictive*

To build a causal explanation in critical realism means focusing on the particular (Sayer, 1992) because the particulars reveal the details needed to specify a mechanism that brings about phenomena as well as the contextual conditions that trigger or counteract its operation.

McGrath (1981) suggests that to emphasise the particular is to marginalise the general. Yet in the context of project management research Smyth and Morris (2007, p.433) claim that critical realism 'addresses both the general and the particular'. This apparent conflict of opinion can be explained through clearer definition of the meaning of 'general', or more appropriately *generalisability*, which is not elucidated by Smyth and Morris (2007).

There are two forms of generalisation which if confused with one another may lead to claims about generalisability that are inconsistent with critical realism and thus render findings invalid. The first sort of generalisability is 'data generalizability' Johnson and Harris, 2002, p.109) where data are generalised to other similar settings, also referred to as statistical generalizability. This is the type of generalisation associated with positivist approached where the aim is to identify

some empirically observed pattern in data that can be statistically inferred to be representative of the wider population from which the data was drawn.

With a focus on the particulars of a situation (small 'n' sample) critical realism cannot justifiably claim statistical generalisation. This is because to secure statistical inference requires a large sample (large 'n') of data be explored from the target population. Instead, critical realism aims for the second sort of generalisation whereby it is theory, rather than data, that is generalised, referred to as 'theory generalizability' Johnson and Harris (2002, p.109) or analytic generalisation (Yin, 2009).

Generalisation of theory in critical realism is made possible by the assumption that mechanisms are 'relatively stable structures' which can be 'invariant under certain transformations', that is, they can continue to exist while their constituents undergo changes in attributes which are not relevant to their reproduction" (Sayer, 1992, p.94).

To transparently explain the concept of invariance in the context of project management and thus demonstrate how general claims can be made from studying the particulars of project overruns, the D&D mechanism from Eden et al. (2000) is re-examined (Figure 10 below). The D&D example has been selected because the authors explain that their model was informed by experiences of a small number of cases. Thus, although the authors did not specify their research paradigm to be critical realism, the D&D research is based upon a small 'n' study, typical of the sort needed to build causal explanations using a critical realist approach.
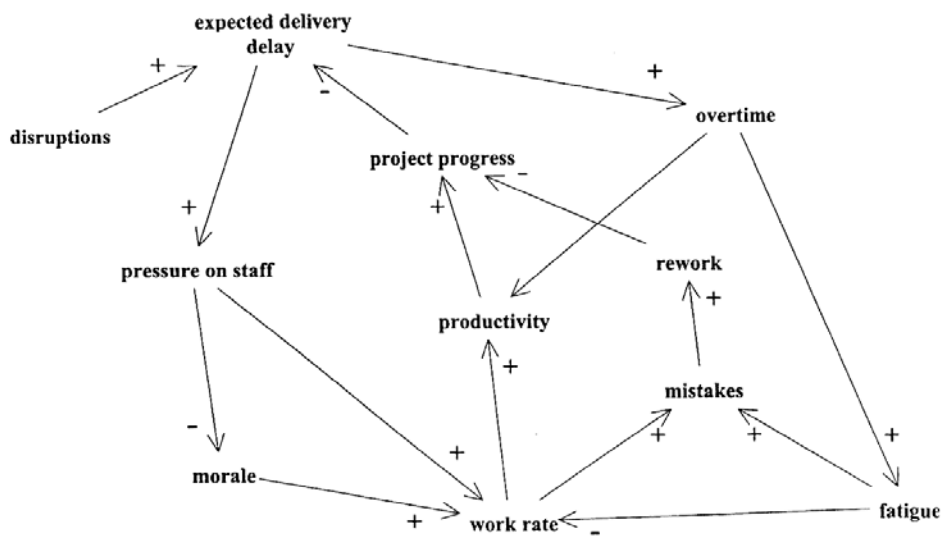
Figure 10 A disruption and delay mechanism (Eden et al. 2000)

Examining Figure 10, it is conceivable that the constituents of the D&D mechanism such as staff will be present in other project settings, albeit that they might have different attributes to those staff of the research setting from which the D&D mechanism was revealed. There may be, for example, a difference in staff age profile however this difference in attributes is not relevant to the reproduction of the D&D mechanism. Despite the different age profile, staff are still likely to become fatigued. Consequently, while the number of projects studied in order to reveal the intricate D&D mechanism was small, generalization of the mechanism (the theory) is possible to other settings due to invariance of its constituent parts.

While critical realism offers the possibility of generalisation it must be emphasised that critical realism does not offer the predictive capacity of alternative realist approaches like positivism. Positivism predicts with some probabilistic certainty that patterns, and thus events, will be observed in other settings. As noted (section 3.2.5) in critical realism the relationship between identified mechanisms and their effects is contingent upon appropriate contextual conditions of the *particular* project setting from which the mechanisms were identified. As a consequence, to predict the effects in a new setting, the contextual conditions in these new settings would need to be similar to those of the setting where the mechanism was originally identified. Similarity of project contexts is of course *possible* but it is not *predictable* because projects are open systems therefore their context has infinite variety and randomness making prediction near impossible. Consequently, the 'predictive' claims of critical realism are limited to what mechanisms *may* do and only subsequently what they will do in any given situation (Sayer, 1992).

In summary, while it can be asserted that critical realism has concern for the particular *and* the general, if methodological confusion is to be avoided it must be recognised that the type of *general* is different to the positivist sort. Instead, we need to re-orientate expectations toward a contribution to theory that is rich in terms of explanation and offers the possibility of analytic or theoretical generalisation. Such generalisation is consistent with a view of projects being context dependent (Shenhar, 2001, Engwal, 2003), a view that takes cognisance of the fact that projects, while having aspects of similarity, also contain differences and thus universality of approach cannot simply be assumed

3.2.6.3   Theory that is Strong and of the Middle Range (Merton, 1968)

The discussion thus far has revealed the characteristics of knowledge generated by a critical realist approach as well as those of an alternative realist paradigm, positivism. Reflecting upon these two paradigms it seemed to this author that the language of positivism - truth, permanence and prediction – were connotative of a strong form of knowledge. The language of critical realism on the other hand appeared more feeble in nature – fallible, impermanence and non-predictive. This distinction raised a question in this authors mind about whether a critical realist contribution to project management theory can be thought of as being as strong as that of a positivist approach.

Sutton and Staw (1995, p.387) describe that strong theory:

> *'delves into underlying processes so as to understand the systematic reasons for a particular occurrence or non-occurrence. It often burrows deeply into microprocessors, laterally into neighbouring concepts, or in an upward direction, tying itself to broader social phenomena……… It usually is laced with a set of convincing and logically interconnected arguments'.*

These are qualities that are synonymous with a critical realist explanation (described throughout this section) which suggests that critical realist contributions to theory, although less permanent and less predictive than those claimed by positivism, can be robust. Consequently, in adopting critical realism for the study of overruns in projects, it is argued that this study is in a good position to make a strong theoretical contribution to the field.

As touched upon earlier, theories in critical realism are treated as 'the best truth about reality we have for the moment' (Danermark et al., 2002, p.23) and therefore the aim is to continually improve explanation of phenomena. Improvements might include reconceptualising theory as new concepts become available or revealing the operation of a previously identified mechanism in a new setting and thus extending theory. Theoretical progress for critical realism is, therefore, an on-going endeavour whereby theory is gradually improved or extended.

This gradual progression of theory is representative of Wieck's (1995b, p.385) notion of theory development through 'interim struggles', theory development that is incremental. Wieck (1995) suggests that this sort of theoretical progress is

consistent with Merton's (1968) theories of the middle range rather than the grand theory associated with, for example, the positivist tradition.

The PM literature has voiced middle range theories as being consistent with the domain of projects (Packendorff, 1995, Söderlund, 2004, Bredillet, 2013) but has not explicitly unified middle range theory with a critical realist methodology as a means of developing such theory in project management. Consequently, two conclusions are drawn. First, that the adoption of critical realism in this study has the potential to make a theoretical contribution that is consistent with the domain of projects. Second, that in unifying critical realism with middle range theory in the context of projects, that the thesis makes a modest contribution to the methodological knowledge base of project management.

3.2.6.4   The 'fit' of a Critical Realist Contribution with Extant PM Research

Throughout, this philosophy of research section has sought to distinguish critical realism from the alternative realist position of positivism on the grounds that positivism is unsuitable for the needs this research study inquiry. However, as noted earlier, project management research remains extensively positivist in orientation and this begs the question as to how an alternative (critical realist) contribution 'fits' within this positivist dominated landscape. This sub-section briefly attends to this issue which is then explored in greater depth in the proceeding section.

It has been argued in the foregoing discussion is that the *assumptions* of positivism are unsuitable for the particular needs of this research study. This says nothing about the *findings* of positivist based research. Findings are generated from methods and, as will be shown later (page.81), the methods most often associated with positivism (such as survey) can form *part* of a critical realist approach to inquiry. The compatibility of methods is because, as noted earlier (page. 67), critical realism recognises that scientific explanation necessarily involves observation of patterns events. A reasonable deduction then is that the findings of positivist based research will also be compatible with those generated by a critical realist approach.

This compatibility is examined in greater detail in the following section however for the moment it is anticipated that extant positivist based project management research will be enfolded into this inquiry. Thus the author positions the contribution made by this research study, not as living separately from the wealth of positivist

research that has gone before it, but rather as offering theoretical progress moving forward from it. Conceptually the author sees the contribution, and those of critical realist led studies more broadly, as complementary with the existing project management knowledge base as illustrated in Figure 11 below.
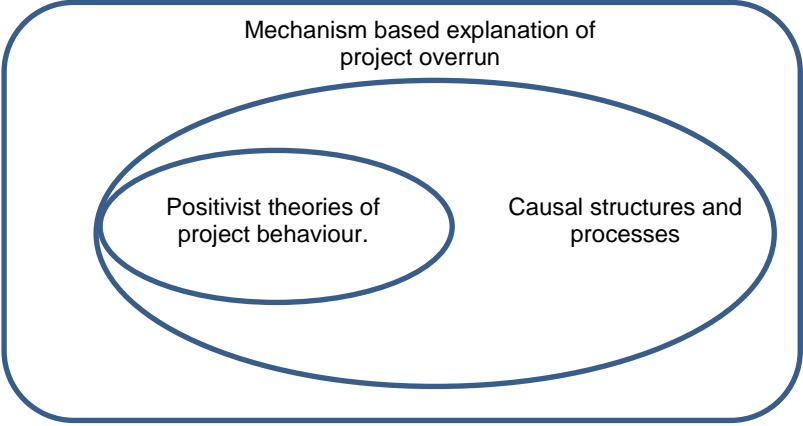
Figure 11 Complementarity of critical realist contributions with extant positivist research

3.2.7   Conclusions

The foregoing discussion has sought to explain how the author's choice of research philosophy, that of critical realism (Bhaskar, 1975, 2008), was arrived at in light of possible alternatives. The two main varieties of research philosophy were introduced, realism and relativism. Comparison of the underlying ontological assumptions of realism and relativism revealed the assumptions of realism to be more compatible with the author's understanding of projects (set out in Chapter 1) than those of relativism. Consequently, attention was focused on realist approaches to research.

Reviewing the methodological literature, empiricism and critical realism were identified as the two Principal realist approaches to research. It was also found that empiricism underpins the positivist paradigm which is the dominant approach to research in project management. As a realist paradigm used extensively in researching projects, positivism was selected as a comparator to critical realism due to its contextual relevance to this research study.

The remainder of the discussion focused on examining critical realism with comparison drawn with positivism as an alternative realist approaches to research. The examination found the epistemic assumptions and approach to explanation offered by critical realist to be more consistent with the needs of this research study than those offered by positivism.

To provide a rounded assessment of critical realism, its limitations were explored. These included knowledge claims that are fallible and temporary nature as well as claims for generalizability that are based upon theoretical rather than statistical generalisation. It was put forward that these claims are consistent with the view in project management, that projects are context sensitive (Shenhar, 2001, Engwal, 2003) and which recognises that projects while being similar have differences. Moreover, it was argued that despite its perceived weaknesses, critical realist research can make a strong contribution to theories of project management and that the aim of critical realism is for middle range theory (Merton, 1968), a form of theory that has been called for by researchers in the project management domain (Packendorff, 1995, Söderlund, 2004, Bredillet, 2013) but yet unified with a critical realist methodology in the context of project management research.

While diversity of methodologies within a field can lead to fragmentation of ideas and thus limit theoretical progress (Söderlund, 2012), it was shown that the adoption of critical realism offers the opportunity to develop new theoretical perspectives that can converge with the existing body of extant positivist-based research. Consequently, adopting a critical realist approach contributes to an agenda of theoretical progress rather than theoretical fragmentation.

Also, through explanation of the author's choice of paradigm, the section has sought to synchronise the reader's methodological and theoretical expectations with those of the authors understanding of a critical realist methodology.

In conclusion, rigorous examination of critical realism in this section has shown the paradigm to be compatible with the author's understandings of projects and with the explanatory needs of this research study. Furthermore, critical realism has been shown to offer findings that can be convergent with those of the extant project management literature, even though extant research has largely adopted an alternative realist approach of positivism. Thus, critical realism offers theoretical progress by providing an approach to research that is different to but not separate from existing project management literature.

3.3 RESEARCH PROCEDURE

The previous sub-section focused on the philosophy of research that will guide this study, that of critical realism. Selecting critical realism is the first of a number of individual methodological choices that will shape the overall approach to research for this study. Although the research approach is arrived at by making individual choices, the approach must be cohesive if the study is to be of academic standing. To achieve cohesion, the individual methodological choices must be logically compatible with one another and, therefore, a natural way to proceed in informing the next methodological choice (research design) is to revisit the critical realist literature and seek guidance on those designs that are compatible with the philosophy.

Critical realism is flexible with regard to compatible research designs (and associated methods) because the complexity and variety of research aims that can be pursued is beyond the capabilities of a single approach to research (Sayer, 1992). This need for flexibility is consistent with the study of projects, for example Söderlund (2012, p.42) stresses that there is no 'single best approach' for studying projects.

Although critical realism offers flexibility with regard to choice of research designs, the choices cannot be made 'indiscriminately' (Danermark et al., 2002, p.166). Critical realism aligns with McGrath's (1981) view that all research designs (and associated methods) have associated strengths and weaknesses therefore designs must be selected in a logical fashion whereby they are applied to the types of research inquiry to which they are best suited.

Critical realism identifies two types of research inquiry, the *intensive* procedure and the *extensive* procedure (Sayer, 1992) as illustrated in Figure 12.

	INTENSIVE	EXTENSIVE
Research question	What produces a certain outcome and how does it produce this outcome?	What are the regularities and common patterns of a particular population?
Type of account produced	Causal explanation of the production of certain events	Descriptive representative generalisations, lacking in explanatory penetration
Typical methods	Study of individual agents in their contexts, interactive interviews, ethnography. Qualitative analysis	Large-scale survey of population or representative sample, questionnaires, standardised interviews. Statistical analysis.
Limitations	Findings are unlikely to be 'representative', 'average' and thus generalisable in a statistical sense	Limited explanatory power

Figure 12 Characteristics of intensive and extensive procedures
(adapted from Sayer 1992, p.20)

The *intensive* procedure is concerned with revealing causal processes and is compatible with designs that are largely qualitative in nature (Sayer, 1992). The aim of an *extensive* procedure on the other hand is to discover 'some of the common properties and general patterns of a population as whole' (Sayer (1992, p.242) and therefore tends to adopt 'quantitative data collecting and statistical analysis' (Danermark et al., 2002, p.163).

Of the two available procedures, the *intensive* procedure is logically consistent with the aim of this research study of revealing causal processes that bring about overrun in projects therefore an *intensive* procedure is pursued in this research study. *Intensive* studies focus on a 'particular case or small number of cases' (Sayer, 1992, p.243) and so attention is naturally directed toward the case study design as a logical next step for constructing the intensive procedure to the study of overrun in projects.

Before proceeding to the case study, the *extensive* procedure is worthy of brief discussion. Earlier (page. 77), it was asserted in this thesis that a critical realist contribution can complement the existing body of largely positivist-oriented project management research. Brief examination of the *extensive* procedure and how it fits with an *intensive* procedure helps further illuminate the logic of this claim.

As shown in Figure 12, the *extensive* procedure is to reveal general patterns across a population by using quantitative data from designs such as a large scale questionnaire survey (Sayer, 1992). The aim, and associated research designs, of the *extensive* procedure are synonymous with positivist-orientated research that dominates the PM domain (Smyth and Morris, 2007). Therefore a logical deduction

is that the findings of positivist-orientated project management research, research that is reflective of an *extensive* procedure, are also compatible with critical realism.

Indeed, Danermark et al. (2002, p.166) suggests that *extensive* procedures can help researchers 'get some idea of what empirical patterns are produced by a particular mechanism'. In other words, the patterns of concepts revealed by *extensive* research provide indication of underlying mechanisms at work. Knowing the patterns that are particular to a mechanism means researchers can look for that pattern within other research settings and where the pattern is discovered, deduce that the previously identified mechanism *might* be at work. To confirm whether the previously identified mechanism *is* at work, will require further *intensive* study within the new setting.

Considering the above points in the context of this study, *extensive* procedures have been conducted in a wide variety of settings within project management research. If the *intensive* research study reported in this thesis document reveals concepts that are similar to those found in *extensive* project management research, then this *may* indicate that the identified mechanism is at work in other settings and consequently, that it *might* be generalised to these other settings. Thus, the proposed *intensive* study offers the possibility of convergence of findings with existing *extensive* project management research, 'convergence, by methods that compensate for one another's vulnerabilities' (McGrath, 1981, p.190). The proposed *intensive* research study will, therefore, be *different* from the largely *extensive* studies of project management research but it will not be *separate* from the existing (and future) body of work. Rather the proposed *intensive* study is synergistic with *extensive* studies, providing deeper explanation of previously identified patterns and thus contributing to progress in the field of project management.

In summary, the aim of this research study is to develop causal explanations of overruns in projects. The philosophy underpinning the research, critical realism, identifies two procedures for research, *intensive* and *extensive.* The *intensive* procedure is the logical choice for this study because its aim is the development of causal explanations. The *extensive* procedure on the other hand is better suited to revealing regularities in data than the deep causal explanations being sought here.

Although both procedures are suited to quite different research aims, they have a synergistic relationship. For example, *extensive* studies describe the patterns of data associated with a particular causal mechanism. *Intensive* studies reveal the

details of the mechanism. Knowledge of mechanisms and the associated patterns they generate means mechanisms described from one setting can be postulated to exist in other settings where the same patterns are discovered. This synergistic relationship suggests that, in the context of this research study, convergence of insights is anticipated between this *intensive* critical realist study and the extant project management literature which has largely adopted designs and methods associated with an *extensive* procedure.

3.4   RESEARCH DESIGN

In order to reveal underlying causal processes, the *intensive* procedure focuses on a 'particular case or small number of cases' (Sayer, 1992, p.243). Thus a logical next step for the construction of the proposed intensive procedure is to examine the case study as a design for conducting inquiry.

This section is opened with examination of the case study design before going on to examine two components that will comprise the design - research methods and research techniques. Figure 13 below is intended to provide the reader with an overview of the structure of this section as well as the underlying questions being attended to in each of its sub-sections and the intended contribution of each sub-section to the thesis.

	Sub-Section	Underlying Questions Being Attended to	Intended Contribution of Sub-Section to Thesis
3.4.1	Case Study Design	What is about the features of a case study design that make it suitable for *intensive* inquiry?	Demonstrate the logical consistency between an *intensive* research procedure and the features of a case study design.
		Why are alternative designs such as the survey or experiment unsuitable for *intensive* inquiry?	Provide the reader with confidence that selection of a case study design over alternative designs was an intentional choice and one that was informed by a rounded knowledge of methodological issues.
		What type of case study will be applied? What number of cases will be studied and why? How will specific cases be selected for study from the available pool of cases?	Provide the reader with forward visibility of details of the design as well as build confidence in the researchers understanding of applying the case study design.
3.4.2	Research Method	What available methods of data collection are suitable for case study design?	Provide the reader with confidence that the researcher's choice of methods is informed by a sophisticated understanding of methodological issues.
		Why is the interview selected as the Principal data collection method and what type of interview is being pursued?	Provide the reader with forward visibility of details of the design.
3.4.3	Limitations of a Qualitative Case Study Design	What are the limitations of the case study design and how will these be attended to within the study?	Provide the reader with confidence that the choice of research design is an informed one, taken in full view of the designs limitations. Provide the reader with forward visibility of the steps that will be taken to mitigate the designs limitations.
3.4.4	Research Technique – Causal Mapping	What is causal mapping? Which causal mapping technique in particular will be adopted and why? Why is a causal mapping technique being adopted over a traditional narrative technique? What are the limitations of the causal mapping technique being adopted and what impacts do they have on the proposed study?	Provide the reader with forward visibility of the technique being used to elicit, record and analyse data within the case study design. Provide the reader with confidence that selecting a causal mapping technique over a narrative approach is an appropriate choice for this study. Demonstrate to the reader that the choice of technique is an informed on that has been made in full view of the techniques limitations.
			.

Figure 13 Structure of Research Design Section

3.4.1 Case Study Design

In a case study design, the phenomenon being studied is examined within the context of the setting in which it is found. Furthermore, phenomena are studied in only a single or small number of settings. Focusing on a small number of settings and keeping phenomena in their context (Dul and Hak, 2008) are the features that distinguish the case study from other designs (such as the experiment or survey) and make it suitable for an *intensive* inquiry. Examining only a small number of settings creates the opportunity for an '*in-depth understanding'* Creswell, 2008, p.98), and therefore explanation, of phenomena to be achieved. Detailed explanation is central to *intensive* inquiry in order to develop a causal explanation that reveals the 'cogs and wheels' of the causal process bringing about phenomena (Hedström and Ylikoski, 2010). Moreover, a causal explanation must detail the contextual conditions that activate or counteract the identified mechanism.

The survey design also studies phenomena in their context Dul and Hak, 2008 however its reliance on quantitative data yields a cause-effect form of explanation. This sort of 'shallow' explanation was described previously as inconsistent with the needs of this research study (section 3.2.4). This is because a cause-effect explanation is not a causal explanation, one that describes the causal process bringing about phenomena.

Returning to the case study, although it can make use of quantitative data (Stake, 1995), the 'implicit companion' of the design is qualitative data (Yin, 1981, p.58). As noted above, the case study creates the opportunity for detailed explanation to be achieved. This opportunity is exploited using qualitative data which are 'particularly helpful in the generation of an intensive, detailed examination of the case' (Bryman and Bell, 2011, p.60). Qualitative data attend to questions of 'what', 'how' and 'why' (Yin, 2009). Yin, (2009, p.9) suggests questions of 'how and why' are particularly helpful for elucidating rich explanation but are not easily attended to by quantitative means.

As noted above, in a case study design phenomena are studied within the context in which they are found (Dul and Hak, 2008). No attempt is made to control the entities being studied or their environment. This is unlike other designs such as the experiment which place the phenomenon in a contrived setting and thus eliminate context.

Context is central to this research study for two reasons. The first reason has already been touched upon earlier (section 3.2.5) which is that a causal explanation must include insight into contextual conditions. The second reason is that there is growing recognition of the important role context plays in the management of projects. For example, empirical research (Engwal, 2003) has revealed projects failing' because of contextual conditions even though the projects diligently followed espoused normative project management theories. Such research supports claims that the management of projects is contingent in nature (Shenhar, 2001), or in other words is context dependent.

In summary, the case study design is concerned with asking 'why' and 'how' questions to develop rich explanations that can describe causal processes and how these processes interact with their context to bring about the phenomenon being studied. These qualities are synonymous with the research questions and underlying philosophy of this study as well as a recognition of the contingent nature of projects (Shenhar, 2001; Engwal, 2003) within the field of project management. Consequently, the case study is adopted in this research study as a design suitable for inquiry into the phenomenon of overruns in projects.

The discussion thus far has illuminated features of a case study design that are orientated toward the needs of the proposed study. However, a number of other choices concerning the design remain to be made. Choices must be made concerning what type of case study design will be implemented, the number of cases that will be examined and finally, how specific cases will be identified for study from the available pool of possible cases. For the purposes of replication it is important that the decisions arrived at are made transparent. The following discussion explores each of the foregoing choices in turn.

There are two types of case study that can be conducted. One is to study a case at a particular time (cross-sectional), and the other is to conduct a longitudinal case study 'studying the same single case at two or more different points in time.' (Yin, 2009, p.49). In theory, both types are available to the researcher. However, in practice, it is more likely that a cross sectional case study will be undertaken if the research is part of academic course work (Saunders, 2009, p.155). This is because longitudinal studies take up significant amounts of time and resource both of which are constrained during academic studies. Given the limited time and resources available to complete a PhD a cross sectional design was pursued in this study.

A second decision point concerns the number of cases to be studied. While studying a single case is justifiable (Flyvbjerg, 2011), the literature suggests that a multi-case approach improves the credibility of findings (Yin, 1981, 2009). Yin (2009, p.61) explains that analytic conclusions from two independent cases, 'as with two experiments, will be more powerful than those coming from a single case' thus improving credibility. For example, selecting (like for like cases) may help to confirm constructs and therefore strengthen theory. Whereas, selecting contrasting cases might serve to falsify (thus improve) parts of developed theory. The possibility of replication or contrast, both of which improve the credibility of findings, strongly suggest a multi-case approach as the way forward. Thus the aim of this study was to examine at least two case study projects.

As noted above, only a small number of cases (projects) are examined in an *intensive* study therefore it is likely that not all of the case study projects that might be *available* for study *will* be studied. This begs the question - of the available pool of projects that *could* be studied, what logic will determine the small sample of projects that *will* be studied and comprise the multi-case design? 'The traditional method of sampling is to identify a population then to select a random or stratified sample from that population' (Voss et al., 2002, p.203). This method is, however, geared toward identifying patterns in data that can subsequently be statistically generalised to the population. As discussed previously (section 3.2.4) pattern identification and statistical generalisation are not the aims of this research study.

The aims of this research study are to develop causal explanations (theory) and to generalise these explanations by means of theoretical generalisation rather than statistical generalisation. To pursue these aims, cases are selected on the basis of theoretical sampling. At the heart of theoretical sampling, is learning (Flyvbjerg, 2011, Bryman and Bell, 2011). The basic premise is that researchers should 'choose cases where they expect learning will be greatest.' (Bryman and Bell, 2011, p.60). Learning might take the form of developing explanation (theory) of phenomena. In this situation, the literature suggests selecting cases where the phenomenon is '*transparently observable'* as a natural way to proceed (Pettigrew, 1990, p.275) and that atypical or extreme cases in particular are a good place to start (Flybverg, 2011).

Alternatively the aim of learning might be to 'replicate or extend the emergent theory' (Eisenhardt, 1989, p.537). In this situation *replication logic* is used to drive the process of case selection where 'Each case must be carefully selected so that it

either (a) predicts similar results (a *literal replication*) or (b) predicts contrasting results but for anticipatable reasons (a *theoretical replication*)' (Yin, 2009, p. 54). Thus using replication logic, cases are selected on the basis of their similarity or contrast such as polar opposite types (Pettigrew, 1990).

Selection of polar types is of particular interest to this researcher because the emphasis in project management research has largely been 'failure' based, as Packendorff observes (1995, p. 323) 'It seems as though successful projects are in no need of evaluation'. Underpinning the focus on failure is an assumption that 'failures hold morals which successes cannot' (Kharabanda and Pinto, 1996, p.4). This assumption may have some validity. However, even if the assumption were proven 'true', then all that could be justifiably said is that opportunities to learn from success are *less* significant and not *insignificant*. Moreover, exploring success might make opportunities to learn more accessible to the researcher - as the popular saying goes 'success has many fathers while failure is an orphan'. In short, couching the research in terms of 'failure' could negatively affect field research by discouraging practitioner participation, for fear of 'blows to self-esteem or "looking bad" to others' (Miles and Huberman, 1994, p.292) when being associated with failed projects. Thus participants might be more likely to openly share success than failure. Finally, exploring success alongside failure provides an opportunity for contrast therefore potentially shedding stronger light on opportunities to learn. On the basis of the foregoing, it strikes this researcher that to focus exclusively on failure is a lost opportunity on a variety of levels and, therefore, successful case study projects were pursued as part of the research design.

To summarise thus far, the proposed research design for this study is a cross sectional case study. The design will comprise at least two case studies in order to improve the credibility of findings. The specific cases will be selected by following theoretical sampling logic. In particular, cases that have experiences extreme or atypical levels of overrun will be sought. Moreover, it is intended that one of the case studies comprising the multi-case design will be a 'successful' project and thus provide contrast to those projects studied that experienced overruns.

3.4.2   Research Method

In order to develop causal explanations from a qualitative case study, qualitative data will need to be collected. The three 'most common means of qualitative data collection' are documentation, non-participant observation, and interviews (Johnson and Harris, 2002, p.110).

Regardless of which of the three data collection methods are used, resultant data can only ever provide the researcher with a mediated view of the phenomenon being studied. This is because, as discussed previously (section 3.2.6.1), data in a critical realist paradigm are always treated as *representations* of reality rather than reality itself. Thus, each method must be thought of as providing a mediating lens through which the researcher gains visibility of phenomena (Figure 14).
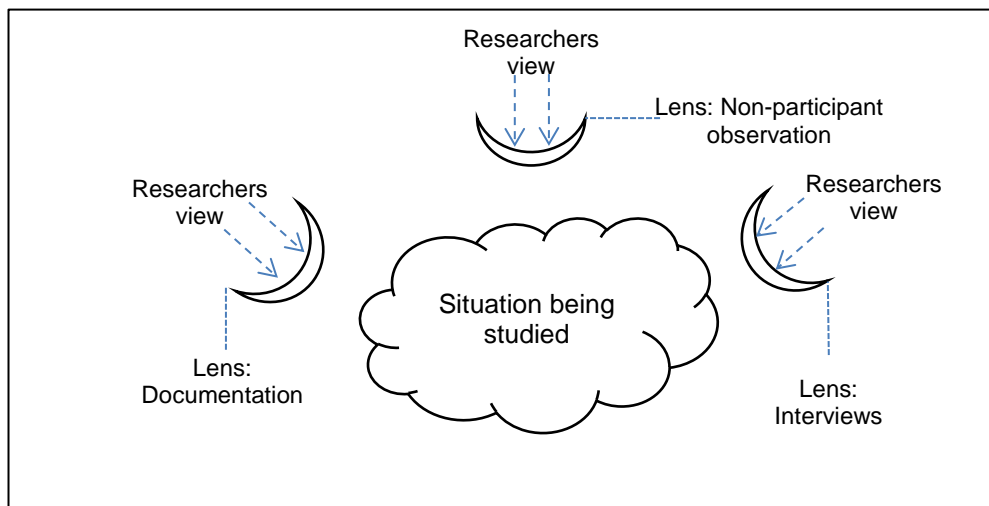
Figure 14 Conceptual model of the lenses provided by data collection methods

While all three lenses (methods) provide a mediated view of overruns, the extent of mediation is greater for some than it is for others. For those with greater mediation the view provided to the researcher is of lower fidelity, a lower degree of exactness, in its representation of the situation. Documents, for example, cannot be treated as 'literal recordings of events that have taken place' Yin (2009, p.103). Although they might be claimed to contain 'the facts', 'facts' can be subject to 'selective deposit' and bias in their presentation (Pettigrew, 1990, p.277). This is because documents are written toward a specific agenda, perhaps a particular socio-political agenda. Using documents, the researcher is thus furnished with a view of the situation that is strongly mediated by the 'selective deposits' and biases

of the document author(s). Only data deemed important to the agenda are included, masking off other data and thus impairing the researcher's view of the situation as illustrated in Figure 15.
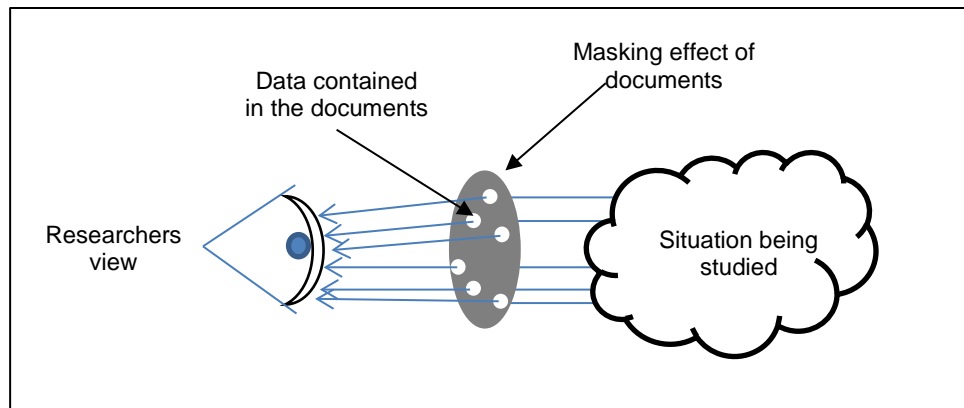
Figure 15 Potential masking effect of existing documentation

The second method, non-participant observation, is also subject to significant mediation. This is because it provides a lens that is restricted to those data that are empirically observable. Concepts (data) such as politics and history do not lend themselves to empirical observation but these have been shown in this thesis document to be central to understanding the situation of overruns. Consequently, non-participant observation provides a significantly mediated view of the situation that lacks the fidelity needed to gain a view of the situation that is comprehensive.

The final method is that of interviewing. Interviewing can provide a view of situations that is much less mediated, and therefore of higher fidelity, than that of documentation or non-participant observation. A research interview creates conditions that are more conducive to understanding the situation rather than contributing to a particular socio-political agenda as might be the case with documentary evidence. With the scene set for understanding, data need not be restricted to what is socially or politically acceptable therefore creating a platform for participants to express more sensitive and broader ranging insights. The researcher thus has the potential to view the situation 'warts and all'.

Furthermore, interviews are not restricted, as non-participant observation is, to the use of empirically observable data. The interview participant has access to non-empirical concepts (data) such as politics or social relations when articulating their understanding of the situation. Having this wide range of concepts (data) available

means the interviewer can be furnished with a view of reality that can be both wide angled, giving comprehensive coverage, and granular, providing nuanced insights.

In summary, interviews provide a vantage point from which the researcher can gain a view of the situation that is both broad ranging in coverage and detailed in its rendering. The lens provided by interviews is thus high in fidelity and so can provide the researcher with a closer portrayal of the situation than can be achieved by documentation or non-participant observation methods. Using the interview the researcher can thus gain depth and subtlety of understanding of the situation being studied (Pettigrew, 1990). Consequently, interviews are recognised as 'an essential source' of data for the qualitative case study (Yin, 2009, p.108) and therefore are selected as the Principal data collection method for this study.

As discussed above, all methods provide a mediating lens through which the researcher can view the situation being studied. While interviews can provide the best vantage point of the three methods, they too are subject to weaknesses of mediation. For example, participants may suffer recall bias or indeed present an intentionally bias point of view (Pettigrew, 1990).

The ideal research design is to use all three methods and triangulate between them to improve accuracy of our vantage point by validating findings through convergent and contextual validity (Reason and Rowan, 1993). For example, non-participant observation can allow for the researcher to observe the difference between what is said (in the interview) and what is practiced in reality. Similarly documents can provide a powerful comparator for data gathered from interviews that might serve to validate or falsify finding. Access to these other sources of data was pursued as part of the research design.

The principal data collection method being used in this study is the interview. Referring to 'the' interview is suggestive of a single type when in fact, interviews are heterogeneous in nature. Interviews can be one of three different types - structured, unstructured or semi-structured (Johnson and Harris, 2002, Easterby-Smith et al. 2008, Bryman and Bell, 2011). The following discussion examines all three types in order to clearly define which one is being used in this study.

The decision as to which type of interview to pursue is a dilemma between flexibility of topics covered and consistency of topics across interviews (postmus, 2013). For example, in a structured interview, data are elicited using a rigid question set that restrict interview data to very specific topics, characteristic of a

questionnaire survey 'where there are short answers to questions and the interviewer simply ticks boxes' (Easterby-Smith et al. 2008, p.127). Limiting the interview to specific topics maximises consistency of data between interview participants thus improving comparison between participant data. Such an approach is described by Yin (2009, p.107) as a *survey interview* and uses the statistical techniques of the survey to reveal patterns in the data.

While providing powerful comparative capability, the structured type of interview is not suited to the needs of this study. As discussed above, the reason for favouring interviews over other methods in this research study was to minimise the degree of mediation between the researcher and the situation being studied. A structured interview approach does not move the researcher toward this purpose because the structured question set acts as a mediating device, a filter.

In a structured interview, there is no flexibility to move outside of the structured question set therefore '*You only get the answers to the questions that you ask*' (Johnson and Harris, 2002, p.102). As such the interview questions act like apertures, narrow openings that only reveal parts of the situation that are 'known' to be of importance a priori, masking off other parts that do not feature in the question set (Figure 16).
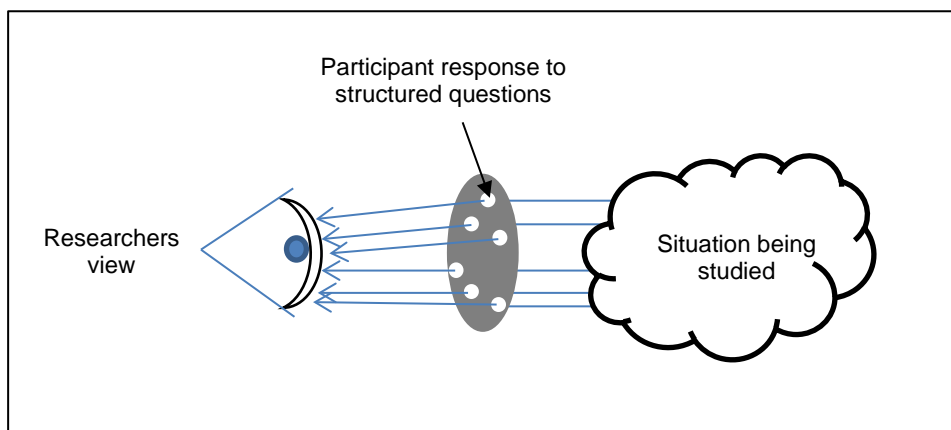
Figure 16 Masking effect of rigidly structuring of interviews

The researchers view is thus mediated, filtered, by the question set preventing them from gaining a rounded and comprehensive understanding of the situation from the participant's perspective. Moreover, the interview questions are set a priori by the researcher. Therefore, the resultant data is potentially biased toward a

portrayal of the situation that is researcher determined rather than one that is participant determined and thus perhaps a closer representation of the situation.

Postmus (2013, p.244) advises that if the researcher wants a comprehensive understanding of the participants perspective then the participant should be put 'in charge of the interview process' and encouraged to discuss 'new and uncharted territory'. Using the second type of interview, the unstructured interview, provides a way forward in this regard.

An unstructured interview has no a priori structure imposed upon it. The participant can take charge of the interview process and has complete freedom of expression and exploration. Thus in theory, resultant data could be both comprehensive and free of researcher bias since the interview has not been restricted in anyway by the researcher. This suggests a very low degree of mediation might be possible from an unstructured type of interview.

However, Easterby-Smith et al. (2008, p.128) point out that 'non-directive' (unstructured) interviews are 'likely to produce no clear picture in the mind of the interviewee of what questions or issues the interviewer is interested in, and in the mind of the interviewer, of what question the interviewee is answering!' Thus a complete lack of structure in the interview is likely to result in both confusion and large quantities of redundant data. Both consequences serve to obscure the researcher's view of the situation rather than improve it.

A third and final type of interview is the semi-structured interview. Data elicitation is initiated using a small number of open questions at the beginning of the interview (Johnson and Harris, 2002). These initial questions orientate the participant toward the topic of interest therefore avoiding the confusion that can be caused by an interview that has no structure whatsoever. As noted, the initial questions are of an 'open' style. Therefore, as well as bringing some structure to the interview, the initial questions also offer some freedom of expression by participants so that the participant is free to discuss the matter as they see it rather be restricted to the concepts made available to them in a structured type of interview (Sands, 2013) . Moreover, open ended questions can 'promote free association, which stimulates story-telling' and allows the participant to 'spontaneously proffer additional, often vital information' (Sands, 2013, p.149) opening up lines of inquiry into the situation not thought of by the researcher prior to the interview. Answers to initial questions are used to generate follow up questions and responses to those questions used to

generate further questions, and so the process continues (Kvale and Brinkmann, 2009). This approach allows the researcher to follow the participants logic of discussion rather than the other way around which is the case in a structured interview type.

To summarise, a semi-structured interview provides *some* structure thus mitigating the weaknesses of an unstructured discussion. At the same time, semi-structured interviewing also allows flexibility of topics to be covered. Flexibility allows participants to call upon wide ranging concepts (data) to explain the idiosyncrasies of their view, furnishing the researcher with a nuanced appreciation of the situation. Such an approach to interviewing is in fitting with what Yin (2009, p. 107) calls as an '*in-depth interview'*. An in-depth interview can bring the researchers understandings closer to those of the participant in a way that is not achievable through either structured or unstructured interviewing because of their mediating effects. Gaining visibility of the situation that is as close as possible to that of the participant is central to this study. Consequently, the semi-structured interview type is being adopted.

3.4.3   Limitations of the Qualitative Case Study Design

The preceding discussion focused on the rationale for adopting the qualitative case study design over other approaches to research which has naturally led to emphasis of the strengths of the design. However, Yin (2009, p.3) advises that it is just as important to 'openly acknowledge' and understand the designs weaknesses, recognising that no approach to research is without limitation.

Paying attention to the limitations of a selected research design is important in order to avoid the validity of research being brought into question. In a recent review of project management research, Smyth and Morris (2007) found that researchers, at times, made claims which were inconsistent with the underlying research design because of a lack of attention to methodological issues such as design limitations.

Reading across the methodological literature, three potential flaws of a qualitative case study design are identified each of which is explored in this section:

- A lack of rigour in the application of the design
- Weaknesses brought about by the reliance on subjective data

- Perceived limitations relating to generalizability of findings from the design

Lack of rigour in the application of the design

Flyvbjerg (2011, p.302) suggests that case study research is 'often held in low regard'. Perhaps a contributing factor in this perception is that, according to Yin (2009) the case study design is not always conducted with rigour. Empirical research by Jans and Dittrich (2008, p.27) corroborates this view and find that 'many case studies suffer from a lack of scientific rigour' suggests due to a lack of attention to the following issues:

- Case selection criteria
- Means of data collection
- Methods of data analysis

The discussion has already begun to attend to the first two these issues and it is the intention that all three will be explored in the data collection and analysis section. By making transparent the author's choices with respect to the above issues the aim is to reinforce the rigour with which the study was conducted.

Weaknesses brought about by a reliance on subjectivity

A further limitation put toward a qualitative case study design is its reliance on subjective data, in particular how personal opinions or values can influence and thus bias data toward a particular agenda rather than reflecting the objective view. Bias can be introduced for example by the researcher through verification bias, the 'tendency to confirm the researcher's preconceived notions' (Flyvbjerg, 2011, p.302) or by 'becoming 'too much identified with the perspectives of particular informants' (Allan and Skinner, 1991, p.164).

Although the discussion of bias in qualitative inquiry tends to be in relation to researcher induced bias, participants can also introduce bias. In an interview participants can be subject to 'bias, poor recall or inaccurate articulation' (Yin, 2009, p.109). Miles and Huberman (1994, p.56) encourage researchers to be as vigilant as possible for bias on the part of participants noting that "Informants themselves are selective too, sometimes deliberately, sometimes unwittingly. They may gloss over important parts of their behaviours and perceptions, and the researcher may not be aware of this.'

Researchers have pointed out that bias is not a weakness of qualitative designs per se but rather a human condition (Miles and Huberman, 1994, Flyvbjerg, 2006). As Greenberg and Baron, (2003, p.43) eloquently put it - "Computers may analyse information in an accurate, unbiased, tireless fashion, but the same cannot be said about human beings'. That bias is a human condition means other designs are just as susceptible to the condition as qualitative designs. For example, Flyvbjerg (2006) suggests that the survey can be susceptible to bias in the selection of variables chosen to be studied.

Steps can, however, be taken to mitigate bias. Conformity bias can be mitigated by the researcher stating their preconceptions early in the process and consequently looking out for, and challenge them, if they begin to resonate in the data (Corbin and Strauss, 2008). By triangulating data between participants, the researcher can confirm the convergent validity of data (Reason and Rowan, 1993) thus mitigating the effects of becoming too identified with a particular participant. Finally, matters of bias, poor recall and inaccuracy of articulation from the participant perspective can be mitigated through careful selection of data elicitation techniques. These techniques are the subject of the following section (3.4.4) which examines techniques for elicitation, recording and analysis of data from a qualitative interview.

A further issue concerning subjectivity is the issue of a double hermeneutic (Kvale and Brinkmann, 2009). In qualitative inquiry the researcher is interpreting the interpretations of the research participant. Thus, there are in effect two layers of mediation between the researcher and the 'reality' of what has taken place in the situation being studied (Figure 17).
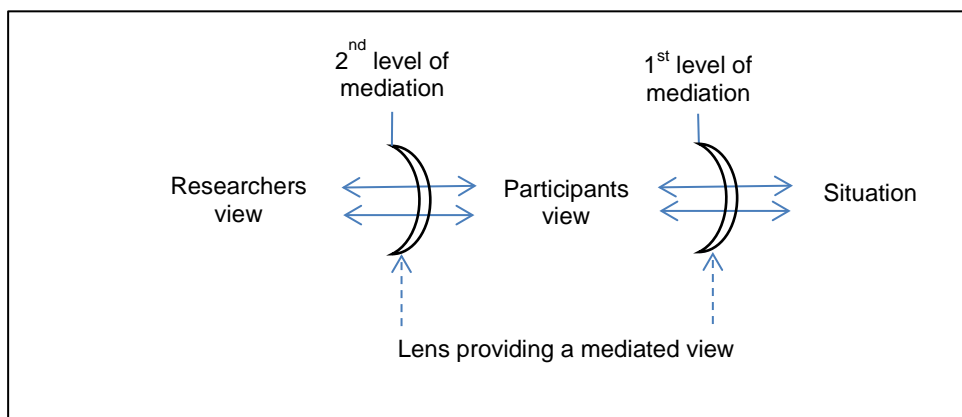
Figure 17 Conceptual model of a double hermeneutic

As Figure 17 illustrates, the participant has a mediated view of the situation and the researcher has a mediated view of the participants view. The best visibility of the

situation that the researcher can hope for is one that aligns as closely as possible to the participants view since, as discussed (section 3.2.6.1), this researcher's underlying philosophical assumption is that the researcher has no direct access to the situation.

The issue here is that the researcher might unknowingly misinterpret the meaning of the participant since there is no scientific means of the researcher getting inside the participants head to check that their views correspond to one another. Thus questions might be raised as to how accurate the researchers view of the situation being studied actually is.

Again, careful selection and application of research techniques play an important role in mitigating the double hermeneutic. Techniques that allow the researcher to validate their understandings with the participant will bring the researcher closer to the participant's view of the situation. Furthermore, sophisticated research techniques that support the participant to make sense (Weick, 1995a) of the situation will help the participant (and thus researcher) get closer to the reality of the situation. These techniques are the subject of discussion in a later section (3.4.4).

Limited generalizability of findings from the case study design

Last but by no means least is a subject 'on which a great deal of discussion has centred' (Bryman and Bell, 2011, p.61) – the limited ability to generalise findings from a case study design. The basic contention is a simple one, that generalisation from a case study design is highly questionable because the number of instances studied is so small. This contention 'is usually considered to be devastating to the case study as a scientific method' particularly for those researchers examining a single case (Flyvbjerg, 2011, p.304).

However, the contention is underpinned by two interrelated assumptions: 1) that 'case(s)' represent a statistically relevant sample of a population because 2) the aim of research is statistical generalisation. Neither of these assumptions is true of qualitative case study research (Yin, 2009).

As discussed previously (section 3.4.1), case studies are not selected on the basis of their ability to represent a wider population, they are selected on the basis of their ability to provide insight. In this way, cases are not 'samples' but rather should be treated in the same way as experiments where the aim is to 'expand and generalize theories (analytic generalization) and not to enumerate frequencies

(statistical generalization)' (Yin, 2009, p.15). Previously developed theory can be expanded through a process of replication in much the same way as repeating experiments. Through replication, the generalisation is gradually refined, providing 'not a new generalisation but a modified generalisation' (Stake, 1995, p.7). Generalisation is therefore possible using the case study design but the 'generalization is not automatic' (Tsang, 2014, p.44) in the way it is with research based upon representative samples.

The characteristics of generalisation from case study research are completely consistent with those of the underlying philosophy of research in this study of project overruns. It was noted that theory in critical realism is progressed in an incremental fashion (section 3.2.6.3) and is therefore representative of Wieck's (1995) notion of 'interim struggles' and consequently Merton's (1968) concept of middle range theory. The case study approach of gradually refining theory through replication in other settings resonates strongly with a view of theory as representing 'interim struggles'. Moreover, the process by which theory can be generated from a case study (Eiesenhardt, 1989) adopts a grounded theory approach (Corbin and Strauss, 2008). This approach is consistent with the process of retroduction used for revealing causal mechanisms in a critical realist paradigm.

In conclusion, while the case study approach may be limited in its statistical generalisation, analytical generalisation means findings can be used in other settings. Moreover, the approach of analytic generalisation is completely consistent with the underlying philosophy of research in this study of project overruns. Therefore, despite its perceived weaknesses, the case study was found to be logically consistent with the needs of this research study.

3.4.4   Research Technique - Causal Mapping

This section makes transparent the final element in the design of the proposed intensive research study of project overruns – the research technique. As discussed in the introduction to this chapter (section 3.0), research techniques are taken to mean the activities of elicitation, recording, and analysis of data. Attending to these activities, this research study adopts a casual mapping technique.

Causal mapping is a valid research technique, as evidenced by its application in domains such as OR, strategy and project management (Williams, 1997, Maytoerna et al., 2004, Eden and Ackermann, 2006, Ekins et al., 2007, Ackermann and Eden, 2011).

Approaches to causal mapping and arguments for their use have evolved over a period of more than two decades (Eden, 1988). However, despite its longevity and validity, much of the project research adopting causal mapping is the work of just a small community (Williams, 1997, Maytorena, 2004, Edkins, 2007) therefore causal mapping remains a novel technique for research. Consequently, some discussion is warranted to elucidate the technique and bring attention to what it is that makes causal mapping suitable for the needs of this research study. Moreover, approaches to causal mapping abound, therefore some discussion is needed as to which approach is being adopted here.

It is not the intention of this section to provide an exhaustive account of causal mapping techniques. There are already a number of texts that attend to this. Instead, the aim is to provide insight into the choice of causal mapping technique that has been made in this research study, the rationale underlying this choice and the implications of it. To attend to these matters this section is structured as follows:

- ***Theoretical Roots of Causal Maps*** – brief insight is provided into the theoretical underpinnings of causal mapping in order to launch the discussion.
- ***Available Approaches to Causal Mapping*** – approaches to causal mapping abound. This section provides a summary of available approaches and reveals they can be categorised as developing either idiographic or nomothetic maps. The two types are examined in light of the needs of this research study and it is argued that an idiographic

approach, in particular that of Eden et al, is the most appropriate way forward.

- ***Causal Mapping Versus Narrative Approach*** – as discussed above, causal mapping is a novel research technique therefore for the purposes of methodological rigour comparison is drawn with a more typical approach.

- ***Limitations of an Idiographic Causal Mapping*** – Outlining the limitations of an idiographic approach, this section continues a theme of this methodology chapter of providing a balanced view of the elements comprising the *intensive* approach to research.

3.4.4.1   Theoretical Roots of Causal Maps

Causal mapping is a form of cognitive map. The term 'cognitive map' is originally attributed to Tolman's (1948) work in psychology where he used the concept of field theory which 'asserts that individuals create fields or maps in order to understand and anticipate their environment' (Jenkins, 1998, p.232). The term has since taken on the meaning used by Axelrod (1976) as a *physical representation* of a person's beliefs and assertions. Cognitive maps are therefore a means of representing an individual's view of reality (Eden, 1988).

As noted earlier (section 3.4.3), this researcher's objective is to get close to the understandings of interview participants, to synchronise the researchers knowledge with that of participants. Based upon the introductory discussion above, it seems reasonable to deduce that cognitive maps can better support synchronisation than a more typical approach of a transcription of the participant's knowledge. The logic underpinning this deduction is simple. If a participant's knowledge is contained in the format of a mentally held map, then eliciting and capturing data in a similar format provides a closer portrayal of participant knowledge than that of a transcription. The researcher is thus furnished with data that is more representative of participants knowledge and thus can better support them (the researcher) in synchronising with the participants view of the situation.

Cognitive maps are constructed through the use of mapping techniques that aim 'to uncover important features of a person's internal representations and to externalize them' (Swan and Newell, 1998, p.125). A number of techniques are

available (Huff, 1990), the most common of which is probably mind mapping (Buzan and Buzan, 1993). While there are a variety of approaches to mapping they cannot be applied in an indiscriminate manner. As Fiol and Huff (1992, p.275) notes - 'as is the case with maps of the physical world, the helpfulness of a cognitive map depends on one's ability to choose the right map or set of maps'. Careful review of cognitive mapping literature suggests a causal mapping approach is the 'right' choice for this study.

A causal map is a directed graph, a network, that 'incorporates concepts tied together by causality relations' (Weick and Bougon, 1986, p.106) and therefore represents cognition 'as a set of causal interactions' (Jenkins, 1998, p.232). Figure 18 below provides a synopsis of attributes of a causal mapping approach that are aligned to the objectives of this study and thus support the choice of causal mapping over alternatives.

Study Objective	Discussion of Causal Map Attribute
To get as close as possible to the subjective understandings of participants.	Knowledge is stored by humans in the form of maps, and in particular cause maps (Bougon et al, 1977) suggesting cause maps are a closer representation of knowledge than alternative maps such as influence diagrams.
To reveal how and why overruns come about.	Ambrosini and Bowman(2002) note that 'causality provides a potentially higher level of procedural knowledge (how it works, and how to do it) than other sets of relationships'
To reveal causal relationships in participant knowledge that might be used to describe the causal processes that can bring about overruns.	Causal mapping is suited to situations where 'it is specifically the subjective, causal element in the knowledge that is most research relevant' (Laukkanen, 1998, p.171). The aim is to reveal causal processes. The graphical format of knowledge that is structured in a causal arrangement can support this aim in a way that is not possible with, for example, mind mapping where relationships between nodes are associative rather than causal.
To study overruns in complex projects.	Causal maps are 'very valuable if the studied action domain or system of knowledge is extensive' (Laukkanen, 1998, p.171). Complex projects can comprise innumerable stakeholders, social relationships, politics, and other factors. Therefore the knowledge domain is likely to be extensive. The graphical format of causal maps support understanding of this wide array of knowledge (Eden, 1992).
To understand why projects fail to reach their intended goals of cost and time performance.	Causal maps are goal orientated (Ambrosini and Bowman, 2002, p.22) therefore are aligned to the underlying hierarchical structure of a project which comprises activities in order to achieve objectives which in turn attend to achieving goals. Other approaches such as mind maps are not arranged in a hierarchical structure therefore are less representative portrayals of the situation.
To conduct research that is rigorous and repeatable.	Causal maps have formal guidelines for their development and analysis (Ackermann and Eden, 2010). The same is not true of other mapping techniques such as mind mapping. Guidelines provide a structured, documented, pathway that can support rigorous application of the technique as well as making the approach repeatable. Both rigour and repeatability are important to achieving quality research.

Figure 18 Comparison of causal map characteristics with research objectives

With the field of view narrowed on to causal mapping, the next section examines available approaches to causal mapping.

3.4.4.2   *Available Approaches to Causal Mapping*

A review of the literature reveals approaches to elicitation, construction and analysis of causal mapping abound (Figure 19). The approaches can be classified as belonging to one of two types - nomothetic or idiographic. Using this typology to classify the approaches in Figure 19 reveals that available approaches are nomothetic in nature with the single exception of Eden's (1988) idiographic approach.

In this study, an idiographic approach was chosen over nomothetic approaches. The following discussion reveals the logic that underpinned this choice. In order to set the scene, the discussion is opened with a synopsis of both nomothetic and idiographic approaches. The two approaches are then examined in detail revealing that nomothetic approaches aim for 'law' like findings and have reductionist tendencies, both of which are inconsistent with the needs of the proposed *intensive* critical realist research study of project overruns. Eden's (1988) approach is also examined which is found to be consistent with the needs of this research study because of its ability to construct causal maps that are high fidelity portrayals of participant knowledge and thus help achieve a deeper form of understanding of phenomena than the 'shallow' form of nomothetic approaches. The discussion makes use of terms that have specific meaning within the modelling domain therefore for the avoidance of confusion the terms and their meaning is presented below:

- Model - the entire causal map of a research participant.
- Construct – a 'node' of a model, comprising a portion of text
- Relationship – the links between nodes that hold the whole model together.

	Data Collection Setting	Data Elicitation Type	Data Elicitation Procedure	Model Construction	Data Preparation	Model Data	Participant Model Analysis	Comparison of Models	Extent of Practical Guidance
Nelson et al. (2000)	Interview	Semi-structured	Broad opening questions	Post data collection episode	Transcription and coding	Standardised, nomothetic	Structure Manual	-	-
Armstrong (2005)	Interview	Unstructured/ semi-structured/ structured	-	Post data collection episode	Transcription and coding	Standardised, nomothetic	Content and structure Manual	Content and structure Manual	Sufficient
Laukkanen (1988)	Interview	Semi-structured	Discussion around 'anchor points'	Post data collection episode	Transcription and coding	Standardised, nomothetic	Content and structure Computer aided	Content and structure Computer aided	Limited
Larsen and Niederman (2005)	Interview	Semi-structured	Broad & specific opening questions	Post data collection episode	Transcription and coding	Standardised, nomothetic	-	-	-
Jenkins and Johnson (2003)	Group followed by interview	Semi-structured & structured	-	Post data collection episode	Transcription and coding	Standardised, nomothetic	Content and structure Computer aided	Content and structure Computer aided	-
Bougon (1983)	Group followed by interview	Unstructured & structured	Self-Q & limited pool	During data collection episode	-	Standardised, nomothetic	-	-	-
Marcózy and Golberg (1995)	Interview	Semi-structured	Limited pool	During data collection episode	Transcription and coding	Standardised, nomothetic	Structure Manual	Structure Manual	-
Tegarden & Tegarden (2005)	Group	Semi-structured	Framing Statement	During data collection episode	Coding of statements	Standardised, nomothetic	Structure Manual	-	-
Eden 1988	Interview/ Group	Semi-structured	Broad opening questions followed by laddering	During data collection episode	-	Particular, idiosyncratic	Content and structure Computer aided	Structural and content	Extensive

Figure 19 Approaches to causal mapping

3.4.4.3   *Synopsis of Idiographic and Nomothetic Approaches*

Eden (1988) and Eden and Ackermann (1998) approach to the development of idiographic causal maps has been systematically refined over more than 25 years (Eden, 1988, Ackermann et al., 2014) and is founded upon Kelly's theory of personal constructs (Kelly, 1955). The aim of the approach is to develop a map that is a close portrayal of a participant's knowledge, experience, and views, and thus represents a participant's perception of a situation. These maps can be high fidelity and so provide the researcher with a deep understanding of the situation being studied.

Nomothetic approaches on the other hand generate maps that can be compared through statistical analysis with the aim of revealing general patterns (Laukkanan, 1998) or laws in the data that apply to a larger population (indeed the prefix nomos means 'law').

The differing aims of the two approaches naturally lead to alternative means of elicitation, construction and analysis. For example, when eliciting data using an idiographic approach, there is little *a priori* structure imposed by the researcher, only a small number of opening questions are prepared in advance of the interview (Eden, 1992, p.310). During the interview further data are elicited using a process of laddering (Baker, 2002) whereby the researcher continuously asks the participant to describe the consequences and explanations of their previous response using questions such as 'why did that come about?' or 'what impact did that have?'. Consequently, new data are elicited and the laddering process begins again. Thus laddering provides a form of scaffolding (Vygotsky, 1978) with which the researcher can surface the views of the participant in a structured manner. However, rather than the structure being imposed a priori by the researcher, the interview is being designed 'as it unfolds' (Eden, 2004, p.685),

Following the process of laddering down (to reveal explanations) or up (to reveal consequences), responses to the opening questions are continuously elaborated to reveal causal chains of argument that gradually emerge over the course of the interview, culminating to form a causal map. Revealing causal chains of argument elicits a deep form of knowledge that goes beyond superficial understandings to reveal the nuance of the situation (Spender and Eden, 1998).

Bryson et al. (2004, p.292) suggest that the choice of which initial data are explored first be 'the interviewee's choice' therefore the structure of the interview (and thus data) can, in large part, be participant determined rather than researcher determined. The participant thus has significant freedom of response and as a consequence, causal mapping 'has the capacity to produce very rich data' (Brown, 1992, p.294) that can give a comprehensive view of the situation from the participant perspective. Moreover, giving the participant control of the interview means 'the subject expresses himself in 'natural language' and organizes his thoughts around a logic that is also generally referred to as 'natural' (Cossette and Audet, 1992, p.328). Capturing language and logic (causal chains) that is 'natural' to the participant in the causal map brings the map closer to a representation of participant thinking, their knowledge of the situation. Finally, laddering gives the model a reflexive characteristic as participants are driven toward thinking about 'why' and 'how' therefore the mapping experience help the participant make sense of the situation. Through the process just described, the researcher *and* participant are brought closer to a better understanding of the situation.

By comparison, nomothetic approaches tend to adopt a more structured approach to data elicitation by using structured interview protocols of the sort described in section 3.4.2. These protocols can be as simple as 'probing around a set of anchor topics' (Laukkanan, 1998, p.176) or more sophisticated such as Larsen and Niederman's (2005) elaborate 7 topic, 35 question protocol. The intention of both these protocols is to achieve the nomothetic aim of identifying patterns in the data by restricting elicited data to particular topics thus reducing variability and improve comparability between data to make the patterns more visible.

The links in both nomothetic and idiographic maps are not deterministic (like a mathematical function), they identify what a thing 'may' do rather than what it will do and in this respect the technique is consistent with the underlying philosophy of research discussed earlier (Bryson et al. 2004).

Nomothetic and idiographic approaches both adopt data coding as a means of managing voluminous data however their approaches are quite different. In the case of nomothetic approaches, data can be coded either by the researcher (Laukkanan, 1998, Armstrong, 2005, Larsen and Niederman, 2005) or participants (Bougon, 1983, Tegarden and Tegarden, 2005). Coding of data in nomothetic approaches are

geared toward data reduction in order to enable common patterns in large scale data to be revealed.

By comparison, coding using an idiographic approach is geared toward retaining detail and thus meaning. This is because the aim of idiographic mapping is to get close to the participants understanding as possible therefore retention of details is necessary for the meaning of the participant to be accurately understood. Ackermann and Eden (2010) recommend that statements be 6-8 words in length, action oriented and may also include a contrasting pole to improve meaning. These guidelines help to manage voluminous data but at the same time retain meaning in the statements. This is in contrast to nomothetic approaches where aggressive reduction of data, sometimes to as little as one word, results in a loss of detail and thus meaning (see for example, Laukkanan, 1998).

Idiographic approaches also differ from nomothetic approaches in how the causal maps are constructed. In an idiographic approach the causal map is constructed by the researcher during the data elicitation episode (Eden, 1992) rather than away from field as is the case in some nomothetic approaches (e.g. Armstrong, 2005). Constructing the map during the episode allows for verification that the researcher has correctly understood both the content and logic (causality) of the participant as the map begins to emerge. As touched upon earlier this immediate feedback mechanism also allows the participant to check *their* understanding of the situation enabling a process of sense making (Weick, 1995) to take place, thus improving the maps representativeness of the situation being explored. (Eden and Ackermann, 1998)

Finally, idiographic and nomothetic maps are subject to different approaches to analysis. As discussed, the aim of nomothetic mapping is pattern recognition therefore analysis tends to be of a statistical nature with some approaches offering software to support the process (Laukkanan, 1998). By comparison, the aim of analysis of idiographic maps is to improve understanding of the situation being studied by exploring the properties of the map (Eden et al., 1992). For example, one property that can be explored is to reveal 'central' (or 'busy') statements, identifiable by their having a high number of causal links connected to them which in turn suggests their salience to the situation being examined (Eden and Ackermann, 1998). On identifying the structural importance of central statement, the content of the statement, as well as that of statements linking in and out of it, are examined to understand what it is about this statement that makes it so salient. Thus, analysis of

causal maps using an idiographic approach has concern for both structure (exploring the relationships between statements) and content (the statements comprising individual nodes). Idiographic models can be large, containing many hundreds of concepts. Thus while manual analysis of a model is possible, analysis is typically undertaken with the aid of computer software (Decision Explorer).

The outcome of nomothetic and idiographic approaches are distinctly different maps. Figure 20 shows a typical nomothetic map and Figure 21 and example of an idiographic map. Both maps are explored in more detail in the following discussion
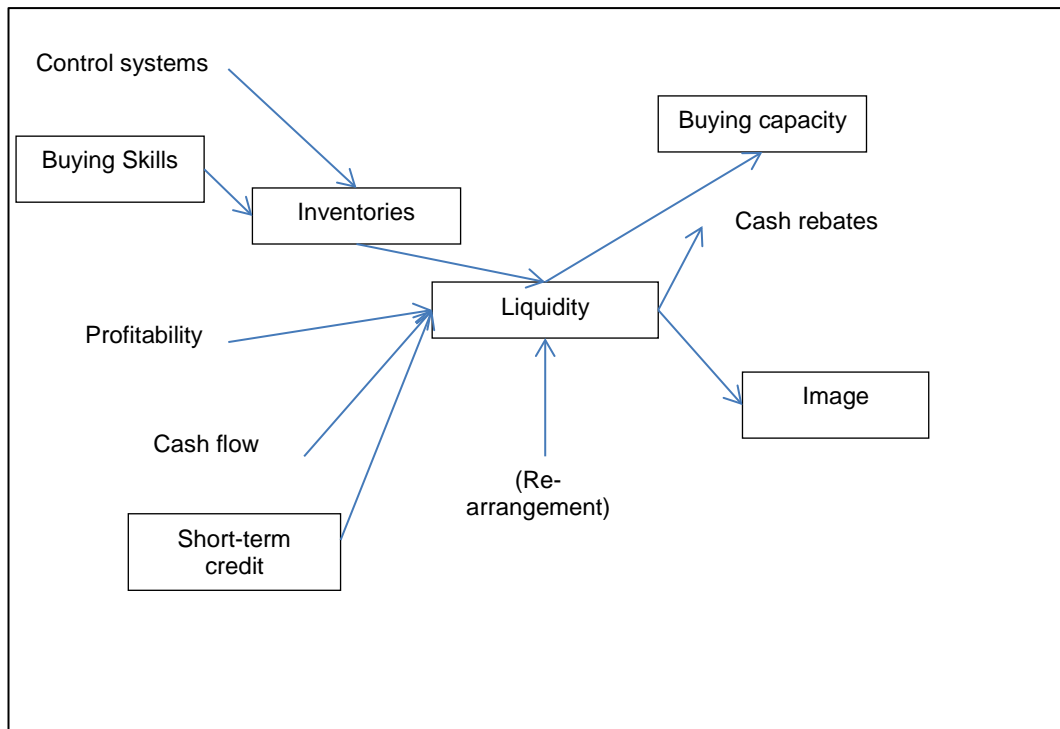
Figure 20 Example of a nomothetic map from Laukkanan (1998, p.181)
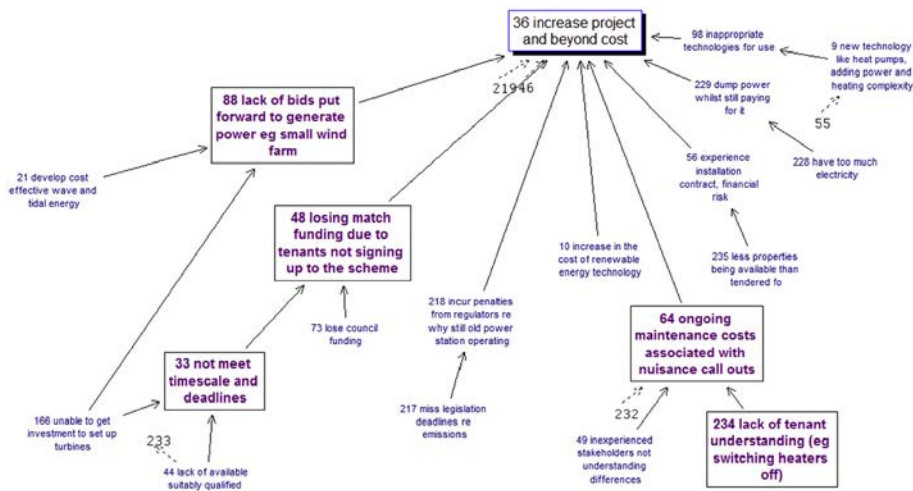
Figure 21 Example of a idiographic map (Ackermann et al, 2014)

3.4.4.4   Compatibility of Idiographic and Nomothetic Approaches with Research Needs

Both nomothetic and idiographic approaches are valuable in their own right. Nomothetic approaches offer the possibility of large scale comparison thus revealing common properties of a population. An idiographic approach on the other hand offers a nuanced understanding of situations through maps that capture the idiosyncrasies of participant knowledge and thus are close portrayals of a participants view of the situation being studied.

The aim for methods in this study is to synchronise researcher understandings with those of the participant. More specifically, the aim is to gain a nuanced appreciation of participant knowledge and thus the project overrun situation being explored. This aim leads the researcher toward the adoption of an idiographic approach over nomothetic approaches, since nomothetic approaches are concerned with pattern recognition rather than detailed understanding.

To gain a nuanced appreciation of participant knowledge maps that can articulate the idiosyncrasies of participant knowledge are beneficial because they allow the researcher to gain a subtle understanding of the situation by providing a portrayal of participant knowledge that is rich in detail.

Nomothetic approaches, however, dilute detail. Highly structured interviews constrict participant explanation to only variables determined *a priori* by the interviewer. These variables may be forcing the participant 'to work within a set of

variables which is not central to their individual cognitions of a situation' therefore preventing them from comprehensively describing *their* view of things and, importantly, preventing new insights being revealed that can 'be at the core of why the situation is perceived as problematic' (Eden, 2004, p.677). In short, restricting participant explanation pushes 'the number of constructs elicited towards an interviewer determined level' (Eden et al., 1992, p.312) rather than a level determined by the participant as necessary to explain the situation. Consequently, it is questionable whether the resultant map is a portrayal of the *participant's* view of the situation and thus impairing the comprehensiveness of the researchers understanding of the situation. .

Coding in nomothetic approaches also removes detail. As can be seen in Figure 20, the coding of data can reduce constructs to just a few words. While the resultant coded maps are valuable for comparison, the aggressive reduction dilutes detail resulting in a loss of meaning creating ambiguity over what the map is articulating. For example, in Figure 20, it is not clear what 'building capacity' means; Whose capacity?, and capacity in what? The ambiguity leaves the researcher with a less accurate comprehension of the situation. While, the researcher might deduce meaning from the map, this might not be the meaning the participant had in mind. Thus researcher has a less accurate view of the situation

The results of Eden and Ackermann's (1998) idiographic approach with its open interview style, less aggressive data coding and thus preservation of meaning, is causal maps where 'valuable richness and detail in individual cognition are not lost' (Hodgkinson and Clarkson, 2005, p.54). In other words, maps that are detailed and comprehensive representations of participants idiosyncratic knowledge of situations (Figure 21) capturing participant knowledge in all its richness and complexity. Thus, idiographic maps are much closer portrayals of participant knowledge than those of nomothetic mapping, helping us achieve the goal of getting as close to participant understandings as possible.

Construction and analysis

As discussed, construction of the causal map in many of the nomothetic approaches takes place away from data elicitation. Using an idiographic approach on the other hand, the researcher constructs the map during elicitation. This carries with it a number of benefits which, like the rest of Eden and Ackermann's (1998)

approach, contributes to maps that are accurate representations of participant knowledge. For example, maps can act as a *'guiding, orienting and regulating instrument'* (Cosset and Audet, 1992, p.330) during data elicitation helping the researcher navigate a systematic exploration of the situation being explored , thus improving the researchers understanding of the participants world. Moreover, as the map emerges during data elicitation participant validation is made possible. Bryson et al. (2004, p.292) advise that the researcher continually 'test' whether the map accurately portrays the participant's logic (and content) by regularly feeding back to them what has been captured. This allows the researcher to continually refine their understandings. These benefits are not brought to light if the map is constructed away from the field.

Finally, data analysis procedures of an idiographic approach are geared toward understanding meaning (Ackermann and Eden, 2011) whereas nomothetic approaches are geared toward revealing patterns (Laukkanan, 1998) which is not the aim of this research.

In summary, the choice of the two types of mapping (nomothetic and idiographic) boils down to much the same criteria as those presented in 'interview structuring' section. It is that there is a trade-off between 'saliency, capturing the variables and relationships which accurately reflect the cognition of the individual, and comparability, ensuring that there is sufficient commonality between maps to make them meaningful comparisons' (Jenkins, 1998, p.240). Since the aim of this research study is accurate reflection of the knowledge of individuals the author trades off the extent of comparability between maps.

3.4.4.5   *Limitations of an Idiographic Approach*

The main limitation levelled at an idiographic approach is the 'trade-off' of comparability between maps. For example, Hodgkinson and Clarkson (2005, p.54) suggest that 'a major drawback' of capturing idiographic data 'is the problems this poses for comparative analysis purposes'. The main 'problem' is that unlike nomothetic approaches, idiographic data are not standardised therefore comparison between data is not as easily achieved as it is in nomothetic approaches.

While not as easy as in nomothetic approaches, comparison of idiographic data is possible therefore to suggest idiographic data is a *major* drawback for

comparative analysis is too strong. Eden and Ackermann (1992, 1998, 2011), for example, have written extensively about comparison of idiographic maps using the Decision Explorer software to support analysis. Clearly data will not be identical across idiographic maps (as it would be using a nomothetic approach where data has been standardised). However, this does not preclude comparison. The basic principle in comparing idiographic maps is that the researcher looks for content that is synonymous across maps thus revealing similarity. This is process is not so different to nomothetic approaches, only that identifying the similarity across maps is more resource intensive because the data has been not be standardised and is more voluminous than a nomothetic map. Thus, although comparison between idiographic maps is likely to be time consuming, idiographic data cannot be claimed to be a *major* drawback with respect to comparing maps.

What is fairer to say is that, where the aim of research is statistical generalisation, idiographic approaches are perhaps not the best way to proceed. The high volume and low standardisation in data is likely to make for a very resource intensive comparative analysis. On the other hand, if the aim of research is to develop deep understandings, and from those understandings generate generalisable theory, then idiographic approaches are the way forward.

3.4.4.6 Causal Mapping Vs Narrative Approach to Qualitative Interviews

The discussion thus far has explored causal mapping as the technique being used for elicitation, capture and analysis of data from interviews. A more typical approach to interviewing revolves around data that is in a narrative format. There has been no comprehensive comparison drawn between causal mapping and narrative approaches within the methodological literature. However, reflection upon both approaches reveals a number of benefits of causal mapping, some of which have been touched upon above.

As discussed earlier, the literature suggests participant knowledge is retained in the form of causal maps. Therefore, maps are arguably closer portrayals of participant knowledge than narrative format and can bring the researcher closer to participants understandings.

A benefit of the graphical format of a causal map is that the researcher can more readily interact with the data than is the case with a narrative format. As Miles and Huberman (1994, p.91) explain:

> 'unreduced text alone is a weak and cumbersome form of display...it is *dispersed* over many pages and is not easy to see as a whole. It is *sequential* rather than simultaneous, making it difficult to look at two or three variables at once ….It is usually *poorly ordered,* and it can get very *bulky'*.

The picture painted above by Miles and Huberman (1994) is a form of data display that, while adequately capturing data, makes interaction with the captured data challenging.

A causal map by comparison is a powerful device that actively supports and encourages the researcher (and the participant) to interact with the data while it is being elicited allowing reflection (Eden, 1992). The graphical format enables data to be examined in a holistic manner allowing features such as islands of data, holes in the data or under developed data to be readily detected and thus explored (Ackermann and Eden, 2010). For example, initial opening questions of an interview might generate a series of islands of data. The concise format of a map gives the researcher a holistic view of the data and can, almost at a glance, detect features such as islands. By comparison, the voluminous data involved in narrative communication makes detecting features such as islands of data far more challenging.

Causal mapping is also a form of basic analysis of qualitative data (Miles and Huberman, 1994), revealing the causal linkages between data. Therefore constructing a causal map enables both data collection *and* some basic data analysis to take place during an interview with the participant. As discussed earlier, as the map emerges the interviewer regularly feeds back their comprehension of what the participant has told them in an aid to verify the accuracy of understanding (Bryson et al. 2004). This continual feeding back encourages two forms of analysis. Firstly, feedback encourages the participant to reflect on their initial articulation, allowing the participant to test the causal logic of their initial understandings (Eden, 1992, Cosset and Audet, 1992) through mental simulation (Jenkins, 1998) supported by the map. This reflection might challenge their initial understandings helping them to make sense of the situation (Wieck, 1995), helping mitigating issues

such as recall bias and thus bringing the map to a closer portrayal of the situation being explored.

Feedback also allows the participant to analyse, and thus validate, the researchers understanding of the causal logic (and content) they feel they have expressed. Thus a second form of analysis is provided whereby misinterpretation by the researcher can be detected and addressed thus improving the accuracy of the logic contained in the map as a reflection of the participant's understandings. This process of participant validation helps to mitigate the effects of a double hermeneutic identified earlier (page. 96) as being a weakness of a qualitative interview.

Finally, researchers (Miles and Huberman, 1994, Ackermann and Eden, 2010) suggest that revealing causality from a narrative is challenging therefore to reveal causality with the participant during the interview is advantageous.

To summarise, this thesis adopts a causal mapping approach, in particular that of Eden (1988), as part of a case study research design. Barr et al. (1992, p.20) suggest that causal mapping 'provides detailed, rigorously collected information about managerial thinking that is not typically found in case studies'.

Returning briefly to a narrative approach, it does have at least one advantage over causal mapping which is ease of learning. Learning causal mapping is far from a trivial matter (Eden, 1995, Rosenhead, 2006). The basic issue is transferring the necessary skills from experts (who are often the developers of the technique) to the learner. As Keys (2006, p.827) notes it is the problem of 'getting knowledge into novices'.

Keys (2006, p.822) suggests there has been a general 'lack of concern with the process by which individuals learn how to use such methods'. However, reading across the literature some strategies for learning causal mapping emerge. One strategy is 'consultation with an experienced practitioner' (Rosenhead and Mingers, 2001, pxiv) or perhaps better still an 'apprenticeship' (Robinson, 2007) where the expert can transfer the 'craft skills' (Morrill, 2007, p.687) of applying the technique. However, Robinson (2007) notes that a major limitation to this strategy is that 'there are so few teachers' with whom a learner might gain an apprenticeship.

The limitation of finding a mentor is not encountered in this study. This is because the researchers academic supervisor is expert in the field of causal

mapping technique in general (Ackermann, 2012), and in its application in the context of complex project behaviour in particular Ackermann et al. (2014). Thus an apprenticeship model of learning was pursued by this researcher.

A second strategy for learning is through 'practical, case-based experience, which encourages learning through reflection' (Morrill, 2007, p.688). Although the author had little direct practical experience himself, during the PhD opportunities became available to support teaching of causal mapping therefore improving familiarity with the technique and gaining vicarious experience through students' application of the technique.

The final strategy identified to support learning is through the use of literature. By comparison to other developers (Bougon, 1983, Laukkanan, 1998, Armstrong, 2005), Eden and Ackermann (1998) provide an extensive range of books and journal articles aimed directly at transferring the technique to others. While academics (Rosenhead and Mingers (2001)) and practitioners (Morrill 2007, Robinson, 2007) agree that 'reading about PSMs does not provide a sense of confidence about implementing them', reading was used to complement the two other strategies of mentoring and practice described above.

To summarise, based upon the foregoing arguments, the idiographic approach described by Eden (1988) and Ackermann and Eden (2011) was adopted favour of other causal mapping techniques because it was both theoretically desirable and practically feasible within the context of this study of overruns in projects.

3.5   SUMMARY OF PART A – METHODOLOGY SECTION

As discussed in the introduction, this section has sought to instil confidence in the reader that the approach to research was developed in a rigorous and thoughtful manner. To attend to this aim the section has made transparent the rationale underpinning the various elements of the overall approach to research.

It has explored available philosophy's revealing that the assumptions of critical realism align more closely with the needs of this study than those of alternative paradigms. In particular, critical realism's aim for causal explanation was found to resonate with the research aims of understanding why and how project overruns can be brought into being. Furthermore, the section examined the implications for theory

of adopting a critical realist approach which provided the reader with forward visibility of what they can expect in terms of the nature of the contribution to theory as well as helping synchronise the reader with the author's understanding of the paradigm. Moreover, it was argued that critical realism offers the possibility of findings that can be convergent with those of the extant project management literature, even though extant research has largely adopted an alternative realist approach of positivism.

A comprehensive examination of various research designs was conducted. It was concluded that a qualitative case study design was more compatible than alternatives for pursuing explanations that attend to questions of why? and how? Subsequently it was argued that semi-structured interviews be the primary method of data collection supported by other methods such as documentation and observation wherever possible.

Finally, the section examined causal mapping as the research technique that was adopted for the elicitation, recording, and analysis of data from interviews. It was argued that an idiographic approach to causal mapping offered the possibility of deep insights that took account of causality and that these characteristics are compatible with a critical realist aim of achieving causal explanation.

Throughout, this section has sought to demonstrate that while the approach is derived from individual choices each choice is logically compatible with the others. Consequently, they form a cohesive approach to research that can generate credible findings that can be accepted into the extant body of research. Figure 22 below illustrates how the various choices interlock to create a cohesive approach to research that attends to the research aims of this study of project overruns.

Research Aims	Understand the causes of overruns in projects
Research Technique **Causal Mapping**	Elicit and capture interview participant data in a causal format to improve visibility & understanding of causal processes that are at work
Research Methods **Interviews**	Adopt the interview as the principle data collection method to mitigate the effects of mediation — Use secondary data to triangulate with interview data, recognising the limitations of these sources.
Research Design **Qualitative Case Study**	Suited to providing an in-depth understanding of phenomena and so can reveal the 'cogs and wheels' of causal processes — Focus on a cross sectional rather than longitudinal design due to resource limitations — Examine at least 2 case studies to improve credibility of findings — Select polar types to improve likelihood of learning
Research Procedure (strategy) **Intensive**	Suited to revealing causal processes by focusing on a particular case or small number of cases
Theory of Methods **Critical Realism**	Development of causal explanations detailing the process that can bring about overruns in projects — Development of theory that is of the 'middle range' type — Development of findings that can be analytically generalised — Development of findings that can be complementary to existing PM knowledge

Figure 22 Model of research approach used in this study of overruns in projects

3.6   PART B – APPLYING THE METHODOLOGY

As discussed in the introduction to this chapter on research methodology, the chapter is split into two parts. Part A focused upon explaining the theory of methods (methodology) that underpins the approach to research in this study and examined the four aspects of research philosophy, research procedure (strategy), research design, research method, and research technique.

In this second part of the chapter the practical application of the approach to research is examined. The section opens with back ground to the study before moving on to discussing data collection and data analysis activities.

3.6.1   Background to the Research Study

The research study was conducted in partnership with the UK branch of a multi-national construction business. The name of the organisation as well as those of the case study projects and research participants have been anonymised to honour the confidentiality of those involved in the research. The organisation is hereon referred to as 'BuildIt'.

BuildIt's involvement in the research stemmed from a longer term relationship between BuildIt and the researchers academic supervisor. Facilitated by this relationship, the researcher conducted an MSc dissertation project with BuildIt which explored factors affecting project 'failure'. Failure in this instance was taken to mean projects that had not achieved their desired objectives, in particular their financial objectives. As part of its on-going business improvement activities, BuildIt conducted post-project reviews however it was felt that engaging the author of this thesis could provide the opportunity for fresh insights to be revealed.

Subsequent to completion of the MSc project, BuildIt were keen to progress with a more detailed study, recognising that the MSc study was relatively short in duration and thus limited in its extensiveness. Consequently, BuildIt agreed their continued involvement with the researcher under the auspices of PhD research, renewing their commitment to provide access to suitable case study projects (by mutual agreement).

The organisational sponsor for the research was the Managing Director (MD) of BuildIt. Working with a sponsor at such a high level within the organisation provided validity to the research. The endorsement of the MD facilitated access to case study projects and research participants.

The following section explains how data was collected from BuildIt, focusing in particular on the interview process and how case studies and participants were identified.

3.6.2   Data Collection

Strauss and Corbin (2008, p.300) suggest that for qualitative research findings to be credible it is important that there is ample detail and description of the research 'so that readers feel that they were vicariously in the field'. To attend to this requirement this section describes in detail the data collection activities of the three phases of field work which comprised this study (Figure 23).
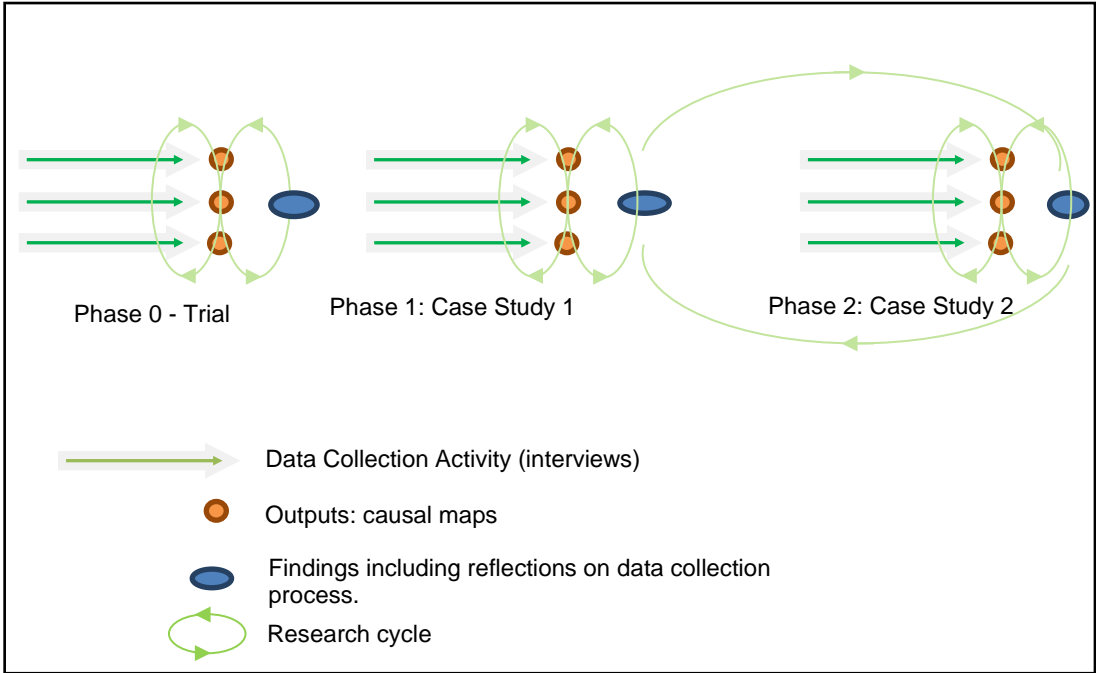
Figure 23 Conceptual model of the approach to research

The research methodology literature suggests that, rather than being developed in a one off event at the beginning of research, a qualitative research design

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emerges through a process of progressive refinement (Lincoln and Guba, 1985, Bryman and Bell, 2011). To support the process of refinement, reflective notes were made during each phase of the field work. The reflective notes captured the issues that were encountered during the field work, how these were addressed, the learning that was gained and how it informed future phases of field work. A synopsis of the reflective notes for each phase is included within this chapter, thereby providing the reader with further vicarious experience of the study (Strauss and Corbin, 2008).

3.6.2.1 Pilot Phase 0 - Trialling the Methodology and Managing Stakeholders

The reasons for conducting phase 0 of the research were twofold. The first concerned stakeholder management. In the period between the MSc project ending and PhD research beginning the Managing Director of BuildIt changed. Since the MD was the sponsor for the research this change was significant therefore it seemed to this researcher that an initial phase of work would be valuable for ensuring that the new MD and the researcher were on the 'same page' before launching in to an in-depth study of a particular case.

The second reason for phase 0 was to trial the research design laid out in section 3.4, in particular using the causal mapping technique as part of the interview element of the design. Prior to undertaking PhD field work, the researcher had gained a nuanced understanding of the theory of causal mapping but had little practical experience of applying causal mapping in an interview situation.

Given the centrality of causal mapping to the research design, the researcher believed that conducting trial interviews was a sensible way forward. It seemed to this researcher that high quality research findings from these first attempts at interviewing using causal mapping was an unlikely outcome given his lack of experience. Therefore, rather than examine a case study project (which could have led to a potentially wasted research opportunity), the locus of trail interviews was the general topic of overruns in projects. This kept the content, and thus experience, of the interview similar to that of an actual case study project. The learning gained from this experience is captured in the reflective notes associated with this phase of work (page.121).

In terms of identifying participants to interview, the researcher followed the advice of Lincoln and Guba (1985, p233) who suggest that researchers identify 'in whatever way we can' a few initial members of the group then snowball sample forward. Armstrong (2005) points out that snowball sampling is valuable in situations when access to particular domain expertise is important but the researcher cannot easily identify the experts. This was the case for this researcher.

The snowballing 'technique asserts that those individuals closest to a domain are appropriate to define the experts of that domain) because they know one another' (Armstrong, 2005, p.24. Thus having access to at least one member of the domain would provide access to other participants. Following this approach, the researcher sought advice from the MD of BuildIt on appropriate participants for phase 0. This led to the identification of a Major Projects Director (MPD), who in turn, facilitated connections with a Senior Project Manager and a Commercial Manager.

As noted above, the locus of discussion for interviews was of a general nature rather than focusing on a particular case project. To elicit data from participants the interviews were opened with the following open question 'can you tell me about what you see as the key issues that can bring about overruns in projects?' This question led to a series of data being offered by the participants which were subsequently elaborated using the process of laddering described in section 3.4.4.2.

Data was captured in the form of a hand written causal models. Reliance on hand written notes carried with it the benefits of narrative field notes over technology based data capture (such as the use of software or audio recording equipment). Benefits include being less threatening to participant than technology and not suffering from technical gremlins (Lincoln and Guba, 1985, p.241). Moreover, as described in section 3.4.4.6, capturing the maps during the interview meant they could be verified and, where necessary, adapted to improve representativeness of the participant's understandings.

Interviews took place at a local BuildIt office with each participant interviewed on two separate occasions allowing further data capture but also verification of data that had been captured at the previous interview session.

3.6.2.2   *Phase 0 Reflections*

Phase 0 provided valuable learning on a variety of fronts. For example, Lincoln and Guba (1985) advise that the researcher must pace the interview and keep it productive. Pacing during phase 0 interviews was a problem. The issue was over production of data which overwhelmed the researcher during the interview sessions. Participants were producing data so quickly, and moving around the topic area so frequently, that it became difficult for the researcher to capture the data in a coherent manner. This was evidenced in the resultant causal maps which, structurally, appeared as a series of small islands of material that had not been fully developed. These islands were indicative of the interviewee giving mention to a particular aspect then moving on to another aspect before the researcher had time to elaborate the island or understand how it fitted with other data that had already been elicited.

Reflecting upon this experience revealed that the issue of over production was caused by the structure of the interview. As noted above, the opening question of the trial interviews was 'can you tell me about what you see as the key issues that can bring about overruns in projects?' This question led participants to rhyme off a series of issues that they felt pertinent to the question. The researcher then hurriedly attempted to capture all of these points at once, meanwhile however the participant had already begun to elaborate their points. This ultimately left the researcher overloaded with data and disoriented in terms of how to elaborate each of the issue that had been identified by the participant in a coherent manner.

To tackle this data overload the opening question for the first case study project was refined to 'can you tell me about what you see as the 3 or 4 key issues that you saw as influential in the outcome of the project?' By bounding the opening question, the researcher could capture the 3 or 4 initially identified issues then elaborate upon them one by one. Once these initial issues had been explored, the researcher would then follow up by asking if there were other issues the participant felt were important. A further point of learning in this respect was the need to give visibility to the participant as to the structure of the interview and how it would unfold. For example, making clear that although the initial focus would be 3 or 4 issues, the intention was to explore all the issues that the participant felt were salient. This refined approach to opening interviews was subsequently adopted in the first case study.

A second point of learning from phase 0 concerned the matter of time allocated to each interview session. The researcher had asked participants for 1 hour of their time however more often than not interviews ran over this time. Reflecting upon phase 0, suggested that the main reason interviews ran over the allocated hour was because of what Lincoln and Guba (1985, p.270) refer to as the 'initial moves' of the interview whereby participants need time to 'warm up', 'organise their head' and get used to 'talking to the interviewer'. The time spent on initial moves could be as much as 20 minutes of the interview session. This presented three points of refinement for the interview approach.

Firstly, the interview process needed to be refined to include some 'initial moves' to support the participant in settling in to the interview session. To support this warm up Lincoln and Guba (1985) advise the use of 'grand tour' type questions such as 'what is a typical day like around here' or 'how did you happen to get into this line of work'. Secondly, the researcher would request longer time slots from participants to ensure that the interview was not cut short prematurely. However, this needed to be balanced with the third learning point from phase 0 interviews which was that by 1.5 hours into an interview researcher fatigue had set in. Based upon the foregoing points, interviews would be brought to a close when one of the following points had been reached:

- When interviewer fatigue set in
- When a point of redundancy, or saturation (Ackermann and Eden, 2010) had been reached indicated by either the participant repeating material or being satisfied they had nothing further to add.
- When the participant's available time slot ran out.

Interviewing participants twice ensured that by the end of the second interview, the point of saturation was the terminating point for the discussion rather than researcher fatigue or lack of participant time.

One final point of reflection upon phase 0 is worthy of note which concerned the identification of case study 1. During phase 0 interviews, participants regularly made reference to 'good' practice as a means of drawing contrasting comparison with the issues they saw as influencing project overruns. All three participants of phase 0 made reference to project A, when illustrating points of good practice. Thus project A emerged as a potential candidate case study that could be representative of a 'successful' case as per the intended research design (described in section 3.4).

Although it was not the intention of phase 0 interviews to reveal potential case study projects, the approach aligns to Pettigrew's (1990) strategy of using 'planned opportunism' to identify case studies whereby the researcher, with their goals in mind, keeps alert to opportunities for data collection.

3.6.2.3   Case Study 1 (Phase 1)

Pettigrew (1997, p.343) cautions that researchers 'have no god given right to expect other people's organisations to be their laboratories'. Consequently, (Pettigrew, 1990, p.279) advises that research is a 'reciprocal activity' between the researcher and the host organisation whereby researchers must give something back to their host organization in return for the time and data that they provide. Taking cognisance of the need for reciprocity, identification of case study projects needed to take place in agreement with BuildIt.

Furnished with insight from phase 0, the researcher approached the Managing Director (MD) of BuildIt with the proposal that Project A could form one of the research case studies. Discussion with the MD revealed that project A was considered within the organisation to be a 'bench mark' for other projects and that they were keen to learn why Project A had been so successful and how this success could be transferred to other projects. Project A was a Private Finance Initiative (PFI) project involving the design, build, financing, and operation of a large health care facility in the United Kingdom (UK) and was valued at over AUD$100 million[2]. Furthermore, the project had a large number of stakeholders including the client, end users, financiers and a facilities management provider. A more detailed description of the case is provided within the case study findings (page. 142).

Based on the foregoing points, project A satisfied the ambitions of the research questions and research design which were to examine complex projects, in particular PFI projects; to investigate at least one 'successful' project; and for case study projects to be extreme or atypical.

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[2] The precise value of the two case studies have been omitted in order to protect the identity of the projects

A further benefit of project A concerned trust between the researcher and participants. Lincoln and Guba (1985, p.256) suggest that 'Respondents are much more likely to be both candid and forthcoming if they respect the inquirer and believe in his or her integrity'. Some of the participants of phase 0 were involved in Project A therefore trust had already begun to form with these participants who included the Managing Director, Project Director, Commercial Manager and Project Manager.

Laukkanen (1998, p.172) advises that people's knowledge is on finite areas in the real world, in other words that no one has complete visibility of everything. This raised the question in this researchers mind as to whether the four participants already identified were sufficient to gain a rounded view of the case study project. Ultimately the question was one of achieving requisite variety Ashby (1958). Thus the researcher felt that some means was needed of establishing whether requisite variety of perspectives could be achieved with the proposed participant list.

To explore requisite variety, the participant list was examined from a variety of angles. First, the stages of the project lifecycle were examined to see what stages could be covered by the proposed participant perspectives (Figure 24). Since all participants had been involved in the project from beginning to end, the researcher felt that the proposed participant list offered good coverage in this respect. Next, the participant list was examined in terms of the hierarchy of the project (Figure 25), again the proposed list was found to provide good coverage. Lastly, the proposed list was examined in terms of the internal and external organisational perspectives. Here there was a gap because the four proposed participants were internal to BuildIt. The researcher felt there would be value in attempting to gain a perspective from outside of the organisation with which to complement the internal organisational perspectives and thus gain a comprehensive view of the project. Subsequent discussion with the Project Director facilitated access to the Director of the Special Purpose Vehicle (SPV) (a legal entity used to deliver the project) who could provide a perspective that was external to BuildIt and also spanned the organisational hierarchy as well as the project life cycle (Figure 24 Figure 26).

Project Life Cycle			
Bid	**Design**	**Construction**	**Operate**
Project Director Project Manager Managing Director Commercial Manager SPV Director			

Figure 24 Stages of project lifecycle represented by each participant

Project Organisational Hierarchy		
Executive Management	**Senior Management Team**	**Operations**
Project director Managing Director SPV Director	Project Director Managing Director	Project manager Commercial Manager

Figure 25 Levels of the organisation represented by each participant

Internal/External Organisational Views	
Internal	**External**
Project Director Project Manager Managing Director Commercial Manager	SPV Director

Figure 26 Internal and external organisational perspectives provided by participants

The researcher also attempted to gain access to the end client for the project as another data source external to BuildIt. However, this was deemed inappropriate by BuildIt due to commercial sensitivities surrounding the project. Following the revised approach to interviewing participants (discussed earlier) the following participants of project A were interviewed:

- Managing Director (BuildIt)
- Project Director (BuildIt)
- Project Manager (BuildIt)
- Commercial Manager (BuildIt)
- SPV Director (external to BuildIt)

3.6.2.4 *Case Study 1 - Reflections*

The biggest challenge encountered during the course of case study 1 was accessing data. This was brought about in part by the researcher moving from the United Kingdom to Perth (Western Australia) but also because of internal organisational change taking place at BuildIt.

The geographic distance of the researcher from the field meant there was a limited amount of time (due to costs) that could feasibly be spent on-site. Thus field interventions needed to be intensive periods of around 3 weeks in duration and forward planning was of paramount importance. Despite the researcher working with participant's months in advance to schedule interviews, upon arrival in the UK interviews were subject to last minute change. The major issue was organisational changes taking place at BuildIt which meant interviews were secondary to organisational priorities and thus were subject to change or cancellation at the last moment.

While changes to schedule are to be expected in research, the frequency of change coupled with the fact that field visits were restricted to around 3 weeks in duration, put the number of planned interviews at risk. This risk suggested that a longer duration of field trip may need to be explored for case 2 if the risk of losing interviews was to be mitigated. To mitigate the issue in the current case, the researcher made himself available to participants at their earliest convenience and kept regular contact with participants to re-schedule interviews. As a consequence of these efforts, and despite the challenges of participants availability, all participants were interviewed twice with the exception of the Managing Director who was interviewed only once due to time restrictions.

In terms of accessing other types of data, restricted access to the research site brought about by the researcher being located in Western Australia meant that opportunities for non-participant observation had to be foregone. Moreover, accessing secondary data was problematic. This may have been due to two compounding factors. Firstly, case study 1 was commercially sensitive which perhaps restricted sharing of data, and secondly, the pressures of organisational change priorities perhaps resulted in frequent requests for secondary data to be overlooked.

When making repeated requests for data, the researcher was acutely aware of a constant tension between what was theoretically desirable and what was practically feasible for the research. An incredibly fine line was being walked with respect to management of stakeholders. On the one hand secondary data would be highly valuable for the research however, on the other hand, repeatedly asking for access could have threatened the relationship that had been created between the researcher and BuildIt staff thus jeopardising access to primary sources of data which were of paramount importance.

A final point of learning from case study 1 was the importance of researcher integrity. As noted earlier Lincoln and Guba (1985, p.256) suggest that 'Respondents are much more likely to be both candid and forthcoming if they respect the inquirer and believe in his or her integrity'. However, while the methodological literature recognises the importance of integrity in collecting data, little is said about how researchers can prepare themselves to demonstrate their integrity. Experience from case study 1 suggested that the researcher underwent implicit integrity tests from participants. These tests may have been completely sub-conscious but included inquiries by participants about who the other participants were in the study, with comments like *'I don't know who else you have been speaking to'* followed by a long pause. Alternatively participants inquired *'I don't know how what I've said fits with what 'Steve' has told you'* even through the researcher never revealed that he had spoken to 'Steve'. These two forms of questions were subtle and in the 'heat of the moment' when the researcher was busy collecting data could have led to an auto-response, revealing the identity of other participants and bringing the integrity of the researcher into question. Thus it became clear that the researcher needed to be vigilant with respect to participant questions at all times.

3.6.2.5   Case Study 2 (Phase 2)

Following the completion of data collection for case study 1, a second case study was pursued with BuildIt. Lincoln and Guba, (1985, p.234) discuss the need for 'orderly emergence' of future cases rather than them being revealed in an ad hoc fashion. In order to support orderly emergence, the researcher looked to existing research participants for advice given they were all knowledgeable about the topic of overruns and were, by now, familiar with the aims of the research.

Initially, consideration was given to asking the most senior participant (the Managing Director) for candidate case study projects. However, the researcher felt that this approach might result a selection that was biased toward the interests of the MD. In order to mitigate this type of bias, all of the participants were asked to provide a list of suitable case studies. A case study selection matrix was developed to capture responses in an organised fashion and thus aid comparison between responses (Appendix A).

The matrix canvassed participants for proposals of both 'successful' and 'unsuccessful' projects. It is widely recognised within the PM literature that the term 'project success' is difficult to define and depends upon the perspective from which the project is viewed (De Wit, 1988, Yu et al., 2005, Turner, 2009). Therefore, when using the term in the case selection matrix, no definition was provided to participants in the first instance, instead leaving participants to interpret the terms. The logic of this decision was that leaving the definition open might allow for intersubjectivity among participants to be revealed regarding the status of a project. The next case study project would, therefore, be selected on the basis of unanimous agreement across participants that the project has been 'successful' or 'unsuccessful'.

Using the matrix, the responses were then triangulated across participants to reveal candidate projects. Given participants occupied various levels of organisational hierarchy, triangulated projects would offer more of an organisational view than rather than simply the view of 'management'.

Triangulating data across participant responses to the matrix revealed Project B as a potential candidate project that had experienced overruns. Again, as with case study 1, agreement was sought with the MD of BuildIt that Project B was suitable from an organisational perspective.

Like the first case study, project B was a PFI project involving the design, build and operation of a large medical facility in the UK and was valued at over AUD$100 million. The project also had a large number of stakeholders including the client, end users, financiers and a facilities management provider. However, project B was polar opposite to case study A in terms of its commercial performance – the project had experienced significant cost overrun during its operational phase. The similarity between the two projects but the contrasting outcomes offered the possibility of contrasting comparison of the two cases satisfying one of the research design requirements (section 3.4).

Based on the foregoing points, project B satisfied the ambitions of the research questions and research design which were to examine complex projects, in particular PFI projects; to investigate at least one project that had experienced overrun; and for case study projects to be extreme or atypical.

Some of the staff that had been involved in case study 1 were also involved with case study 2 therefore the researcher had pre-established relationships with some participants of case study 2. These participants were the Managing Director, Project Director and Project Manager. While this initial list of participants could provide a range of views on case 2, the researcher felt there would be value in attempting to gain other perspectives based upon the coverage that had been achieved in case study 1 and thus widen the range of perspectives gathered. For example, two aspects that were missing from case study 2 but that had been covered in case study 1 were the early stages of the project (bid and design) and also a view from outside of BuildIt.

The reason the early stages of case 2 were not covered by the Project Director (as was the situation in case 1) was because the current Project Director had not been involved in the early stages of the project. To attend to this gap, the previous Project Director was frequently pursued by the researcher to participate in the research study. However, despite several attempts to secure an interview this was not possible. Again the significant organisational changes taken place at BuildIt were identified as playing a role. As an alternative, the Bid Director for case study 2 was pursued and 2 interviews were successfully completed thus covering the early stages of the project's life.

The second aspect missing from the initial list of participants for case study 2 was a perspective that was external to BuildIt. Consequently, through careful discussion with the Project Director of case study 2, access was facilitated to the business development director of the Special Purpose Vehicle (SPV) for the project (a legal entity used to deliver the project). Thus five participants were identified for participation in case study 2:

- Managing Director (BuildIt)
- Project Director (BuildIt)
- Project Manager (BuildIt)
- Business Development Director (BuildIt)
- SPV Director (external)

The participant list ensured that the coverage of case study 2 was the same as that of case study 1 in terms of the project's life cycle (Figure 27), the project's organisational hierarchy (Figure 28), and proving views that were internal and external to BuildIt (Figure 29).

Project Life Cycle		
Bid & Design Stage	Construction	Handover
Bid Manager Project director Managing Director BD Director (SPV)	Project manager Project director Managing Director BD Director (SPV)	Project director Managing Director BD Director (SPV)

Figure 27 Stages of project lifecycle represented by each participant

Project Organistional Hierarchy		
Executive Management	Senior Management Team	Operations
Project director Managing Director BD Director (SPV)	Project director BD Director (SPV)	Bid Manager Project manager

Figure 28 Levels of the organisation represented by each participant

Internal/External Organisational Views	
Internal	External
Managing Director Project director Bid Manager Project manager	BD Director (SPV)

Figure 29 Internal and external organisational perspectives provided by participants

Despite frequent requests by the researcher for access to company data on case B no secondary data was accessed. A full account of the possible reasons for this is discussed in the reflection notes of this case contained in the next section.

Interviews for case study 2 followed the same format as those of case study 1 whereby participants were interviewed on two occasions each lasting around one hour.

3.6.2.6   Case Study 2 – Reflections

Like case study 1, the most significant challenge presented in case study 2 was accessing data however the situation had worsened significantly. Poor economic conditions coupled with significant organisational change taking place, meant staff at BuildIt were under enormous pressure attending to their 'day job', marginalising their ability to participate in the research study.

As was the case with the first case study, the researcher was based in Western Australia while BuildIt was located in the UK. Despite the researcher working with participant's months in advance to schedule interviews, upon arrival in the UK interviews were subject to last minute cancellation because of the aforementioned organisational context at BuildIt. Indeed, on at least two occasions the cancellation took place 10 minutes prior to the interview beginning. To mitigate the impact of cancellations the researcher made himself available to participants at their earliest convenience asking participants for only 24 hours' notice and keeping in regular contact with participants to re-schedule. Whereas in case study 1, interviews took place locally (to the researchers field work base) the researcher opened up the location of interviews for case study 2 to be anywhere in the UK.

Opening up availability to UK-wide carried with it its own issues. The literature emphasises the importance of a suitable meeting environment in which to conduct interviews (Ackermann and Eden, 2010, Bryman and Bell, 2011). However, on one occasion an interview needed to take place at a hotel where quiet space was limited. To mitigate the effects of meeting in a public place (in particular the lack of privacy) the researcher visited the hotel the evening prior in order to establish a suitable meeting space so as to mitigate the effects on data collection.

As a consequence of the above efforts, and despite the challenges of participants availability, all participants were interviewed twice with the exception of the Managing Director who was interviewed only once due to time restrictions.

Accessing primary data for case study 2 had proven a monumental task. To illustrate, the intended duration of the field trip was around 3 weeks but in the end was extended to almost 9 weeks in order for the researcher to pursue all the participants. Accessing secondary data sources proved even more challenging. Despite numerous requests by the researcher for company data on case B, none was forth coming. The flux of organisational change coupled with staff being under

intense pressure presumably overwhelmed requests for data. Moreover, key stakeholders of the research at BuildIt (the Managing Director and Project Director) had moved on to other organisations creating further barriers to accessing secondary data sources post-field visits.

Despite the absence of secondary data from BuildIt a rich and voluminous primary data set was collected for both case study 1 and case study 2. Thus the next step was to consider how this rich data could be analysed systematically, this is the focus of the next section.

3.7 DATA ANALYSIS

This section describes the process of analysis that was followed to examine the case studies and arrive at research findings. Figure 30 below provides an overview of the process with the remainder of the section providing more detailed discussion.

```
                    Raw causal model of a
                  participant's interview data  ◄─────┐
                              │                        │
                              ▼                        │
                     Cluster like concepts in          │
                        the causal model               │
                              │                        │
                              ▼                        │
                   Label each cluster with a theme     │
                   name describing cluster content     │
                              │                        │
                              ▼                        │
                     Review and refine theme ──────────┘
                             names
                              │
                              ▼
                     Arrive at participant models
                     presented in the form of themes
                              │
                              ▼
                  Identify a theme (theme x) that is present
                        in 'n' participant models
                              │
                              ▼
               Use the hierarchical structure of causal models to
                     reveal themes related to theme x in 'n'
                            participants models
                              │
                              ▼
                  Arrive at an insight that theme x is related to
                      theme y across 'n' participant data
                              │
                              ▼
                  Reveal raw data of theme x and theme y for 'n'
                            participants
                              │
                              ▼
                     Compare raw data of 'n' participants
                              │
                              ▼
                    Arrive at research findings that attend to
                      questions of 'why? How? and what?
```

Figure 30 Model of data analysis process

As described previously (page. 120) the raw data for each case study comprised a series of idiographic causal models, each causal model capturing the data from interviewing an individual research participant. For example, in case study 1, five participants were interviewed producing five causal models.

Comparison of individual participant models was needed in order to identify elements of data that were salient to the case study and thus enable case study findings to be arrived at. However, as discussed (section 3.4.4.5), comparing idiographic models is not a trivial matter and are typical of qualitative data in general. To recap, the two principal reasons are that idiographic models do not contain standardised data (language) and the data is voluminous. The systemic effect of both of these issues is that it is difficult for the researcher to find their way around the data to identify 'synonymous elements' of participant data (Eden and Ackermann, 1998, p.195) in an efficient and systematic way. Eden et al (1992, p.310) suggest that this challenge is particularly true of large models of between 30-120 nodes. The smallest model in this study was 90 nodes.

To overcome this challenge, and following the guidance contained in the literature (Eden et al. 1992, Eden and Ackermann (1998), Bryson et al. 2004) participant models were examined in order to identify concepts (statements of text) 'that seem[ed] to fall together' into bundles (Miles and Huberman, 1994, p.248) or clusters (Eden and Ackermann (1998). This enabled the idiographic data of each participant to be fractured into 'chunks' of similar data, each 'chunk' being assigned a label that was representative of its content. Thus the process was akin to that of coding interview transcripts. Figure 31, illustrates a 'chunk' of data concerning (and thus labelled) 'project objectives'.
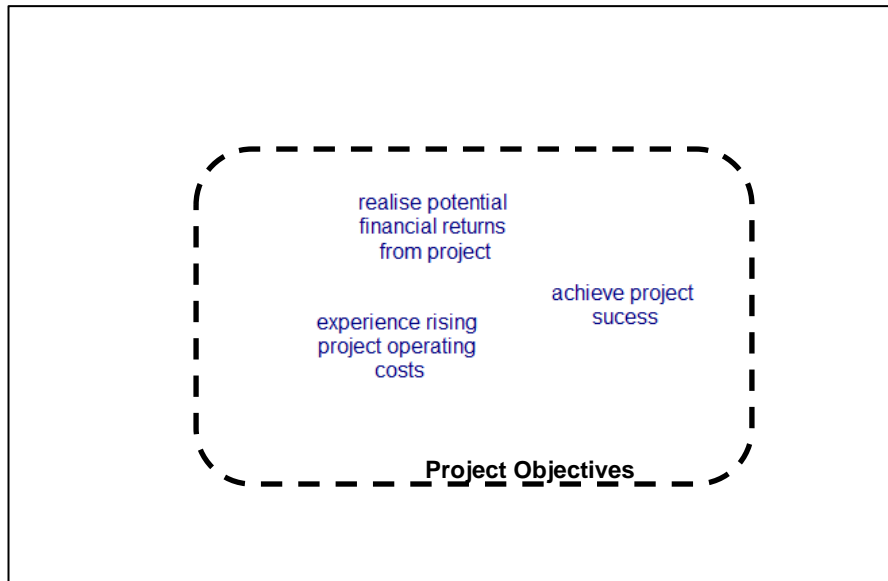
Figure 31 Project objectives

The generation of labels, hereon referred to as themes, followed a grounded theory approach (Corbin and Strauss, 2008, p.198), in that themes emerged from the content (statements) of causal models rather than being determined a priori by the researcher. This process of 'subsuming particulars into more general classes' (Miles and Huberman, 1994, p. 256) allowed the researcher to move up what Miles and Huberman (1994, p.92) call the 'abstraction ladder' by enabling the raw data to be abstracted up to the level of themes. These themes (Appendix B) could then be used as sign posts to aspects of similarity between participant data thus enabling efficient comparison.

To improve repeatability of the analytic process, themes were verified independently (in a similar way to testing for inter-coder reliability) revealing 77% level of agreement. While this score is lower than the suggested target of 90+% in some of the methodology literature (Miles and Huberman, 1994) it was felt by the author that this score was sufficient on the grounds that this research study was adopting an idiographic rather than nomothetic approach to causal mapping (section 3.4.4.4). Using an idiographic approach, the themes were not the intended end unit of analysis but rather provided a helpful device for managing and navigating the voluminous raw data (which was the end unit of analysis). Where a nomothetic approach to be adopted, on the other hand, the themes would be the end unit of analysis and consequently a higher inter-coder reliability score would be desirable.

To diverge briefly, the actual practicalities of applying theme labels to individual raw data were managed through the Decision Explorer (DE) software. DE is a bespoke tool designed to manage and analyse data in the form of causal maps. DE allows theme names to be created by the user (called 'sets') which can then be used as labels with which to tag each piece of raw data. Once the raw data has been labelled with a theme participant data can then be represented either as a causal map or as a list of themes (sets).

Returning to the analysis of participant data, at the level of themes, participant data were fewer in number and more standardised (nomothetic) than in their raw format. Consequently, the themes could be used as sign posts to aspects of similarity between participant data thus enabling more efficient comparison than would be the case had comparison been attempted at the level of raw data. So, for example, if the theme of 'project objectives' was identified in one participants model, that theme could easily be looked for in other participant models. This is illustrated conceptually in Figure 32 below.

Theme	Participant P1	Participant P2	Participant P 'n'
Project objectives	✓	✓	✓
Delays	✓	✓	✓
Project design	✓		
….			
….			

Figure 32 Identification of themes across participant data

Identifying similarity of content across participants is useful, in and of itself, if for example the aim of research is to identify patterns or frequency of the sort discussed in section 3.2.4 of the methodology chapter. However, as discussed, the aim of this research was not about patterns but rather to reveal the causal mechanisms by which the phenomenon of overruns can be brought into being or in other words develop causal explanations that offer explanation of the phenomenon.

As discussed in the methodology section, identifying relationships between concepts is a central component of explanation building. Corbin and Strauss (2008, p.198) echo this point suggesting that although 'we break data apart [and] identify concepts to stand for the data' in order to achieve explanation, 'we also have to put it back together again by relating those concepts' to one another.

Thus, what was needed to progress analysis was a means of taking the participant data, which has been fractured into themes, and identifying relationships

between the themes that would allow data to be put back together to form explanations and thus reveal insights. In the context of analysing transcripts, Corbin and Strauss (2008, p.198) suggest that 'As analysts work with data, their minds automatically make connections because, after all, the connections come from the data'.

In the case of analysing causal maps, however, the researcher does not have to rely on their minds to make the connections between concepts (in this case themes) because the causal connections are identified in the causal models. What was needed however was a means of exploring these connections. As discussed, (section 3.4.4.1), raw data represented in a causal map is hierarchically arranged. Since themes are representative of raw data, they too are in effect hierarchically arranged and so the structure of the causal models was put to use in revealing connections between themes. This was achieved by using the Decision Explorer (DE) software to reveal the themes that come 'in' to a particular theme or put another way, to reveal the themes that explain (the 'ins') another theme.

Figure 33, provides a conceptual illustration of this step of analysis by continuing on with the example of the theme 'project objectives'.
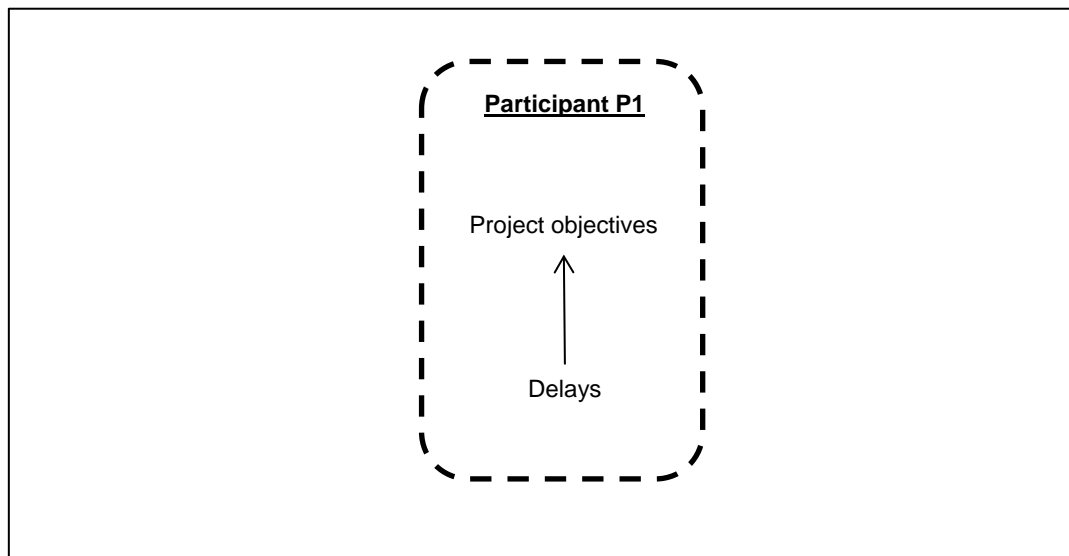
Figure 33 Conceptual illustration of relationships between themes

What Figure 33 shows is that using the hierarchical structure of causal maps, in combination with the DE software, can reveal the themes within a single participants data that are hierarchically sub-ordinate to the theme 'project objectives'. This process can be followed for each participants data to reveal a similar picture for each participant as illustrated conceptually in Figure 34 below.
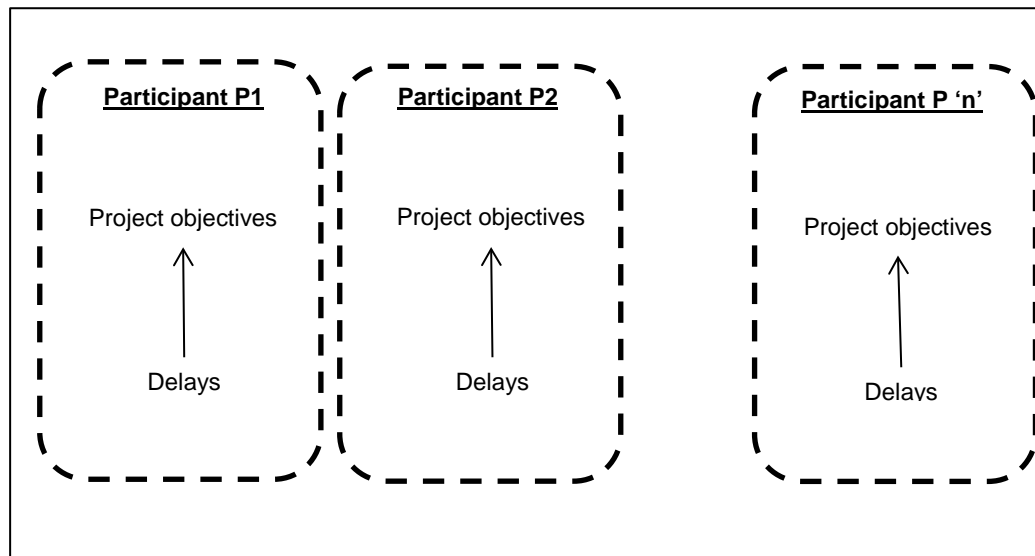
Figure 34 Cross participant analysis of themes and relationships

Although data at this stage of analysis is nomothetic in nature some insight is beginning to emerge. In the example above it is that 'delay' affects 'project objectives'. Moreover the insight appears to be salient to the case study because it is identified in models of participant 1,2, 'n'. While this is a useful insight, it is more of a description than an explanation which attends to questions of what? how? and why?. Whetten (2002, p.46) suggests that 'Descriptions, regardless of how detailed or insightful they are, may be considered conceptual contributions, but without an explanation for what is observed, they do not qualify as theoretical contributions'.

To arrive at findings that could form the basis of a theoretical contribution, that is, a contribution to knowledge, the last step of analysis was to reveal the raw data beneath the insight (illustrated below) and thus arrive at explanation. In other words, to achieve a richer explanation, it was necessary to move down from the abstracted themes to the raw data. Miles and Huberman, (1994, p. 256) highlight that it is essential that the analysis process is capable of "find[ing] the referent", the 'concrete instance' within raw data that was alluded to by a particular theme. The DE software again supports this activity since the raw data content beneath each theme can be revealed. Thus an audit trail from raw data to themes and themes to raw data is

achieved. Figure 35 below illustrates the data that would be revealed from two participant's models.

Participant P1 Model | **Participant P2 Model**

Project Objectives
- achieve project sucess
- realise potential financial returns from project
- experience rising project operating costs

Delays
- incur paymech payment deductions for the delay
- experience delay in making facility 'available'
- experience delays in resolving defects ... responding quickly

Project Objectives
- reduce operating profit on the project

Delays
- client makes payment deductions for the delay
- facilities remain 'unavailable' under terms of paymech
- encounter delays in attending to defects

Figure 35 Raw data for two participants with representative themes highlighted

By revealing the raw data which the themes represent, the level of analysis is moved down from a high level descriptive insight that delay affects project objectives, to an explanatory finding that delays in attending to defects means part of the facility is left 'unavailable'. As a consequence of unavailability, the client makes a deduction from their regular payment to BuildIt. This reduces the operating profit of the project from BuildIt's perspective. This level of explanation attends to questions of what? How? and why? and thus helps attend to Whetten's (2002) assertions above concerning the nature of a theoretical contribution to knowledge.

3.8   CHAPTER SUMMARY

The overarching goal for this study is to make a contribution to the academic body of knowledge within the field of project management. To achieve this goal, the contribution must be assessed as being of scientific quality. The three metrics most often used to assess quality in the methodological literature are validity, reliability and replication (Johnson and Harris, 2002).

In order to attend to these metrics this chapter has set out a clear and full explanation of the approach to research used in this study. The chapter has explained the theory of methods (methodology) that underpins the approach, examining the aspects of research philosophy, research procedure (strategy), research design, research method and research techniques as well as explored the practical application of the approach to research, focusing on data collection and data analysis.

The chapter which follows presents the findings drawn from the two case studies (project A and project B) examined in this study as well as a comparative analysis of the two cases.

CHAPTER 4:   CASE STUDY FINDINGS

4.0   CHAPTER ABSTRACT

The purpose of this section is to present the findings from the two case studies that were examined within the research study. The section presents the findings that were gained from each case study which are then compared in a cross case analysis to draw out overall research findings. In the next chapter the overall research findings are then examined in light of the extant literature to reveal the contributions to knowledge that they can make. Although literature is mainly examined within the next chapter, it is also called upon to support discussion within this chapter.

The first section of this chapter presents the empirical findings of the first case study, project A. To help the reader in framing the findings, the section opens with some context to project A. In order to support comprehension of the findings, included within the context is a comprehensive discussion of the contract type (PFI) that was used to procure project A. The context section is then followed by a macro level view of how interviews with participants of project A unfolded. This information is provided to further support comprehension of the findings but also to reveal the logic behind the structure used to present them. The remaining sub-sections are dedicated to presenting the findings concluding with a section containing a summary of the findings.

To summarise, the following section presents the empirical findings from the first case study (project A) and is structured as follows:

- Context to Project A
- Overview of Participant Interviews for Project A
- Empirical Findings from Project A

4.1 CASE A FINDINGS

4.1.1 Context to Project A

Project A was a large medical facility that was contracted under a Private Finance Initiative(PFI) type of contract. PFI is one of a number of public private partnership models adopted by the UK Government (Bing et al., 2005a) as a means of increasing investment in public services by engaging the private sector in the provision of those services. Turner (2004, p.350) explains 'Under this approach, a national government either works with the public sector or delegates responsibility to the private sector to design, construct, finance, operate and maintain infrastructure projects that would normally be the responsibility of national government working on its own'.

Ive (2004, p.360) explains that PFI projects come in two forms - *Concessions* and *DBFO (Design Build Finance Operate).* In both, the private sector *finances the assets* required to provide the public service. However, where the two differ is in how those services are *funded*. To explain further, in a concession PFI the provider (the PFI company) obtains most of its revenues by charging *end users* for the use of the service. An example of this type of project is a toll road or toll bridge where end users are *funding* the service through payment of a toll. In a DBFO PFI, on the other hand, 'the *funding* of the service remains public – proximately, government pays the PFI company and it is taxpayers, not users, who ultimately pay for the provision' (Ive, 2004, p.360). Ive (2004, p.361) goes on to explain that in the majority of cases, the public sector 'continues to provide *final* services to users (for example, education services, clinical services)….. while the PFI company provides *intermediate* or *support* services (some or all of the range of what can be described as facility management of FM services)'. Both of the projects examined within this thesis document were of the latter type of PFI projects - Design Build Finance Operate (DBFO).

An important point here is that although most PFI projects involve provision of capital infrastructure they are in fact designed for the provision of a service to the public. In the more common design and build contract 'the project' from the provider's perspective (i.e. the main contractor) comprises design and build activities therefore their responsibility (liability periods aside) largely comes to an end once the facility is handed over to the client. In a PFI project on the other hand 'the project' for the provider comprises not only the design and build activities but also

the operation of the facility once it is constructed. Responsibility for operation can span 25 to 40 years therefore in a PFI project the operational stage is of equal concern to the provider as the construction stage (which includes design). The concern for the operational phase is important to the case studies examined within this thesis document because the data for both cases focuses primarily on the operational phase of the projects.

Many different types of services have been delivered using a PFI model including health care, roads and education (Bing et al., 2005b) and within health care the model has been used in a variety of project settings such as hospitals, homes for the elderly, staff accommodation, office blocks and community hospitals. In some instances this involves providing new capital infrastructure and in others the renovation of existing infrastructure and in others still, both renovation and new infrastructure. In the case of project A, the PFI model was being used within a health care setting to deliver an entirely new facility.

A PFI project involves contracting of a consortium of private sector organisations to deliver a project to a public sector client. Each PFI project will have its own contractual nuances depending upon the requirements of the client however there are some common features which were also evident in Project A. Firstly, and as discussed above, the contract involved the private sector in design, build, finance and operation of the project. Thus the private sector was responsible for the design and construction of the facility but also its operation once handed over to the client (including building maintenance but also other services such as cleaning, catering and security).

Secondly, the service was provided by a consortium of private organisations brought together within a Special Purpose Vehicle (SPV). The SPV is a legal entity that unifies the consortium partners and in which they are major shareholders (Turner, 2004). Akintoye and Chinyio (2005) provides a helpful model (Figure 36 below) illustrating typical membership and arrangement of consortium partners and SPV.
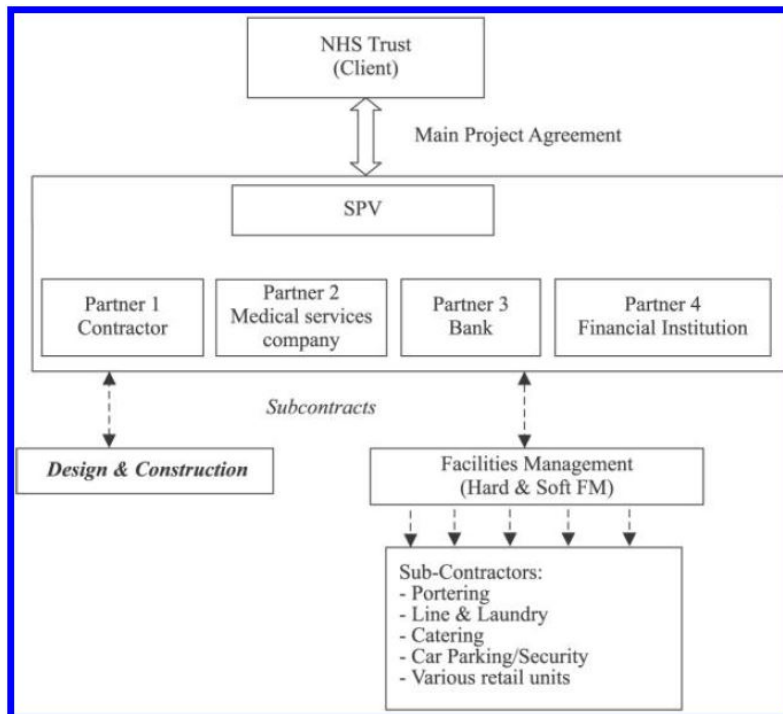
Figure 36 Model of a typical PFI project structure from Akintoye, (2005)

Similar to Akintoye's (2005) model above, Project A comprised a construction company (Partner 1 in Figure 36 above), finance institutions, specialist consultants (e.g. health planners), and an FM company. Project A is examined from the perspective of the construction company referred to here on as BuildIt.

A slight divergence is necessary at this point of the discussion to clarify terms that are used within this and remaining sections of the thesis document. During data collection for both case studies, the terms 'BuildIt', 'provider' and 'service provider' were used interchangeably by participants and, consequently, so too does this thesis document. The explanation for the synonymous use of the three terms is provided in the foregoing discussion which is that, although Figure 36 indicates it is the SPV who provides the service to the client, the members of the SPV (including BuildIt) are its major shareholders and, therefore, they are ostensibly providers of the service.

Returning to the discussion of PFI projects, a third feature of PFI contracts is their long duration, 25 years in the case of project A. The duration reflects the point made earlier that PFI contracts are designed to deliver public services rather than public infrastructure only. Allied to the duration of the contract, is the duration of the liability period particularly for the construction company. For defects, and in

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particular latent defects (those not discovered at completion), the liability period for the construction company can be many years in length and consequently, the construction company's potential involvement in a project is far from finished at hand over to the client. The liability of the construction company in a PFI project is salient to both the case studies examined in this thesis document. This is because the two cases are examined from the perspective of the construction company and the focus of data (as discussed above) is largely the operational phase of the projects within which the liability period is pertinent.

Lastly, and as touched upon earlier, within a PFI contract the service provider receives a regular (e.g. monthly) unitary payment from the client for providing the service. However, full payment is only made if the service is available and maintained at the agreed standard of service set out in the contract. For example, if in Project A part of a facility were to experience a lack of water supply then that part of the facility would be rendered 'unavailable'. Consequently, the client could penalise the provider for unavailability by withholding part or all of the payment for that unit of service. Similarly, if the client experiences poor quality, for example lower than specified ambient temperatures, then a similar process of deduction can be take place (Ive, 2004).

Payments to the provider are managed through a payment mechanism which is a central component of a PFI contract. The payment mechanism (paymech) defines all of the details associated with payment of the provider, in particular expected availability and quality standards and associated penalties. The payment mechanism is thus the clients central management instrument of the service provider during the operational phase of the project in that penalties provide incentive to the provider to ensure that the service is available and to the specified standards and ensures that failure to meet those standards (defects) are remedied promptly (Ive, 2004). Payment of the provider during the operational phase of a PFI project is of central concern to this thesis document. This is because, as noted previously, the data of both projects focus on the phenomenon of cost overruns during the operational phase of the project's. As will be discussed in detail later, paymech deductions are central to understanding operational cost overruns in both projects.

In order to incentivise the provider, paymech deductions can be hugely punitive. For example, if an issue such as a faulty elevator is discovered within the facility (by the client or end user) this would be reported to the provider as a service failure or

defect. For every type of defect, the paymech system identifies associated conditions such as the window of time within which the service provider must resolve the defect. As shown below, beyond this window of time the provider would be incurring unaccounted for time (i.e. delay). For every unit of unaccounted for time, the payment mechanism defines a proportion of the payment that should be deducted (a paymech deduction) from the payment made to the provider. Since a deduction is made for *every unit* of unaccounted for time, paymech deductions accumulate the longer the defect remains unresolved thus the provider is incentivised to remedy the defect promptly. Furthermore, to ensure the provider's response to reported failures is commensurate with the service needs of the client, the severity of deduction is linked to the service needs of the client. For example, the loss of lighting in a hospital surgical theatre would incur a far higher level of deduction than loss of lighting in a corridor.

To summarise, project A was a large medical facility delivered under the auspices of a Private Finance Initiative(PFI) type contract which are designed to provide public services. The particular type of PFI was a Design Build Finance Operate (DBFO) contract whereby the private sector provider financed the capital assets of the facility and provided facilities management services. In return, the provider received a regular unitary payment from the public sector client for provision of the service, the payment being managed through a payment mechanism.

In the case of project A, the private sector 'provider' comprised a fairly typical consortium of organisations including a construction company (BuildIt), finance institutions, specialist consultants and a facilities management company, all which were unified within a Special Purpose Vehicle (SPV). Also typical of PFI projects, project A involved the provider in both its construction (including design) phase and operational phase.

4.1.2   Overview of Participant Interviews for Project A

The following discussion provides a macro level view of how interviews with participants of Project A unfolded before examining the interview in detail. This information is provided to the reader to give further context to Project A but also to

reveal the framework that has been used to structure the presentation of insights drawn from the case study which are presented in the next section.

Project A had been heralded by participants as a success. As one participant put it the team 'achieved one of the most perfect jobs we've ever done' with another participant suggesting that the project had become the 'by-word for good delivery' within BuildIt. Consequently, a natural locus of discussion by participants was explaining what, in their opinion, made Project A a success.

To explain how success was achieved, participants described what actions were taken by the project team and why these actions were necessary. The latter revealed that the actions of the project team were aimed at mitigating a number of factors that they felt posed a risk to project success, in particular financial success.

Participants of both the projects examined in this thesis highlighted that neither of the two projects suffered time or cost overruns during their construction phase. Consequently, the locus of discussion for cost overruns in this thesis is the operational phase of the projects. The project management literature suggests that success during the construction phase of a PFI project, at least in relation to schedule, is not unusual. Ive (2004, p.366), for example suggests that PFI projects 'have achieved an excellent track record of becoming operational at or before contracted date'.

Focusing on the operational phase of the project, a particular concern of participants was the risk of delay in attending to defects reported by the client. As discussed above, in the event of a defect arising in the facility, the facility (or part thereof) could be deemed 'unavailable' under the terms of the payment mechanism. The provider has a set window of opportunity within which a defect must be remedied and the facility made available again. For each unit of time taken by the provider beyond this window, the client can deduct a proportion of the service payment to the provider and thus the project can begin to suffer operational cost overrun.

Experiencing a high volume of reported defects was seen as an important cause of delay in attending to defects. Participants provided a fine grained explanation of the issue of reported defects which revealed a variety of factors that could 'trigger' defects to be reported and thus contribute to there being high numbers of defects being reported. It is important to emphasise that in the context of Project A, the

triggers put forward by interview participants were *potential* triggers since they were not realised within project A.

Further explaining the issue of high volumes of defects, participants revealed a variety of factors that they believed could have compounded the volume of reported defects. These compounding factors do not generate a defect but rather serve to worsen the number of defects that are reported and recorded.

Within the context of project A, reported defects can be thought of as the trigger of delay. In short, if there was no defect to be remedied then no delay can be incurred in making the facility available (since without a defect it was presumably operating at specification and thus 'available'). While reported defects cause delay, participants also identified a number of factors that can compound delay. Like the compounding factors discussed above, these factors do not trigger delay but rather serve to worsen the extent of delay.

As discussed above, deductions from the regular payment made to the provider by the client is the immediate consequence of experiencing high volumes of defects and attendant delays in remedying those defects. However, discussion with participants also revealed that there were other potential consequences that could emerge as a result of high volumes of reported defects and attendant delays. Again it is important to note these were *potential* consequences since they were never actualised in the context of Project A.

As noted throughout the foregoing discussion, the risks of high volumes of reported defects, delays and emergent consequences were never actualised in the context of Project A. Participants believed this was because of the counteractions taken by the project team to mitigate these risks.

To summarise, in explaining the success of Project A participants touched upon the following aspects:

- That a principal objective for the project's success was to achieve its financial objectives
- That a variety of factors could 'trigger' defects to be reported and that a high number of reported defects could result in delays in remedying defects thus putting project financial objectives at risk
- That a variety of factors could compound the volume of defects which serve to worsen the number of defects that are recorded.

- That there are a number of factors that can compound delays in remedying reported defects. These compounding factors do not trigger delay but rather serve to worsen the extent of delay.

- That there were other potential consequences, over and above the immediate deduction of payment that could emerge as a result of high volumes of reported defects and attendant delays.

- Finally, that a number of actions were taken to counteract the risks of reported defects, delays, and emergent consequences.

Using the points above provides a helpful structure for reporting of the empirical insights gained from Project A. Thus individual insights are presented under the following headings:

- On project objectives
- On triggering and compounding of defect reports
- On factors compounding delays
- Emergent consequences of experiencing high numbers of reports defects and attendant delays
- Counteractions to undesirable project behaviour

Prior to presenting the insights and findings their presentational format is briefly discussed in order to give the reader foresight of what they should expect in terms of their structure and content.

4.1.3 Format of Individual Sections

Each insight comprises the following three components - a label, a narrative, and an accompanying causal map with which to support the narrative. The format of the insight label is presented below:

Insight A3	(Map A2)	Lack of end user knowledge about how to operate the building can trigger reported defects
1	2	3
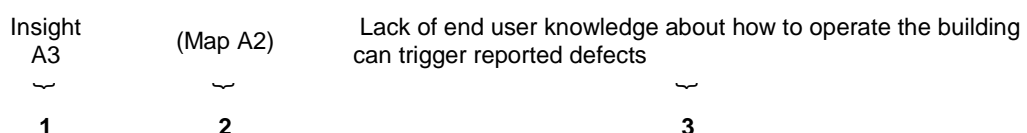
The first element of the label is a unique reference number (e.g. Insight A3). This identifies which case the insight belongs to (in the above example case A) and also

the number of the insight. The purpose of the reference number is to ease cross referencing during discussion of findings. This is because the section presents the insights (and their resultant findings) individually. However, as alluded to in the introduction, and will become apparent during the following discussion, insights while offering their own unique contribution to understanding, are not mutually exclusive. Consequently, it is necessary to discuss insights in relation to one another so as to gain a holistic view and comprehensive understanding. The reference number aids this cross referencing process.

The second element of the insight label is a map reference (e.g. Map A2). As noted above, each insight will be accompanied by a causal map. The map is used to support the narrative discussion of each insight by providing an illustration of the insight at work using data drawn from the case study. The map reference in the insight label identifies which map the reader should refer to when reading the narrative of the insight.

 In some cases, a single causal map is used to illustrate more than one insight. The purpose of presenting insights on a single map is (a) to avoid repeating material but more importantly (b) to provide the reader with a sense of the systemic nature of insights. Illustrating the systemicity of insights in a graphical form will provide the reader with an appreciation of how insights interact with one another to form systems that influence project behaviour.

The final element of an insight label is the title of the insight, for example 'design changes can trigger reported defects', which identifies the focus of the insight.

The narrative for each insight will provide some context to help support the reader in framing the insight. For example, in the insight above concerning reported defects and design changes, brief discussion will be given as to what is meant by 'reported defects' and why they are relevant to exploring operational cost overruns in the project. The narrative will then go on to reveal *how* reported defects can be a consequence of design changes before proceeding to offer explanation from the data as to *why* design changes were necessary in the project. As discussed earlier, by answering *how* and *why* questions the analytic process moves toward findings that form the basis of a contribution to knowledge.

To help make transparent the logic which supports the findings, reference is drawn to the content and structure of the causal map drawn out from the empirical data of the case. To support the reader in referring to the map, each statement on

the map is numbered. These numbers are then used within the narrative to guide the reader's attention toward particular areas of the map. For example, in the following pieces of text - 'design changes [1234]' 'reported defects [5678]', the reader's attention is drawn to concepts 1234 and 5678 on the accompanying causal model. In some cases, to gain comprehensive understanding, it is necessary to discuss many concepts and how they impact upon one another. Where this is the case, the narrative will contain this type of reference [1234→ 5678→1357→2468] which draws the reader's attention toward a particular causal chain of concepts being discussed. Furthermore, since the causal map is drawn from the empirical data, the map gives line of sight from the findings back to the empirical data thus providing an audit trail for findings.

As discussed in the introduction, the findings are used as the basis of contributions to knowledge through critical comparison with the extant literature in the following chapter. Although literature is mainly examined within the next chapter, it is also called upon to support discussion of the findings in this section.

To conclude the presentation of the case findings of each case study a summary is presented in which key terms formatted in bold to highlight the findings drawn out from the case study and thus aid cross referencing later in the thesis document.

4.1.4   A Systemic View of Project A

As discussed in the methodology chapter, this thesis adopts a systemic modelling perspective of projects. One of the tenets of this approach is that to gain a full appreciation of project behaviour a holistic rather than a discrete view of projects is needed. In short, one must gain a view of the whole system that explains project behaviour, as well as its parts.

As described earlier, the sections that follow report individual insights gained from project A. While each insight makes its own unique contribution to explaining the behaviour of the project, it focuses only on a 'part' of the system that explains project A's behaviour. Focusing on the 'parts' is necessary so that they can be more fully explored and understood. However, focusing on the 'parts' means the reader is without a full appreciation of the whole system to which the 'parts' belong and which explains the behaviour of project A.

In order to attend to this gap, a model of the system that explains the behaviour of project A is presented (Map A1). It is not the intention that the reader be able to interrogate this model since, as discussed, each of its component parts will be examined in the forthcoming sections. Rather, the model is offered to provide the reader with a holistic view of the system, giving a fuller appreciation how the 'parts' of the system discussed in the following sections interlock to create a complex system that explains the behaviour of project A.
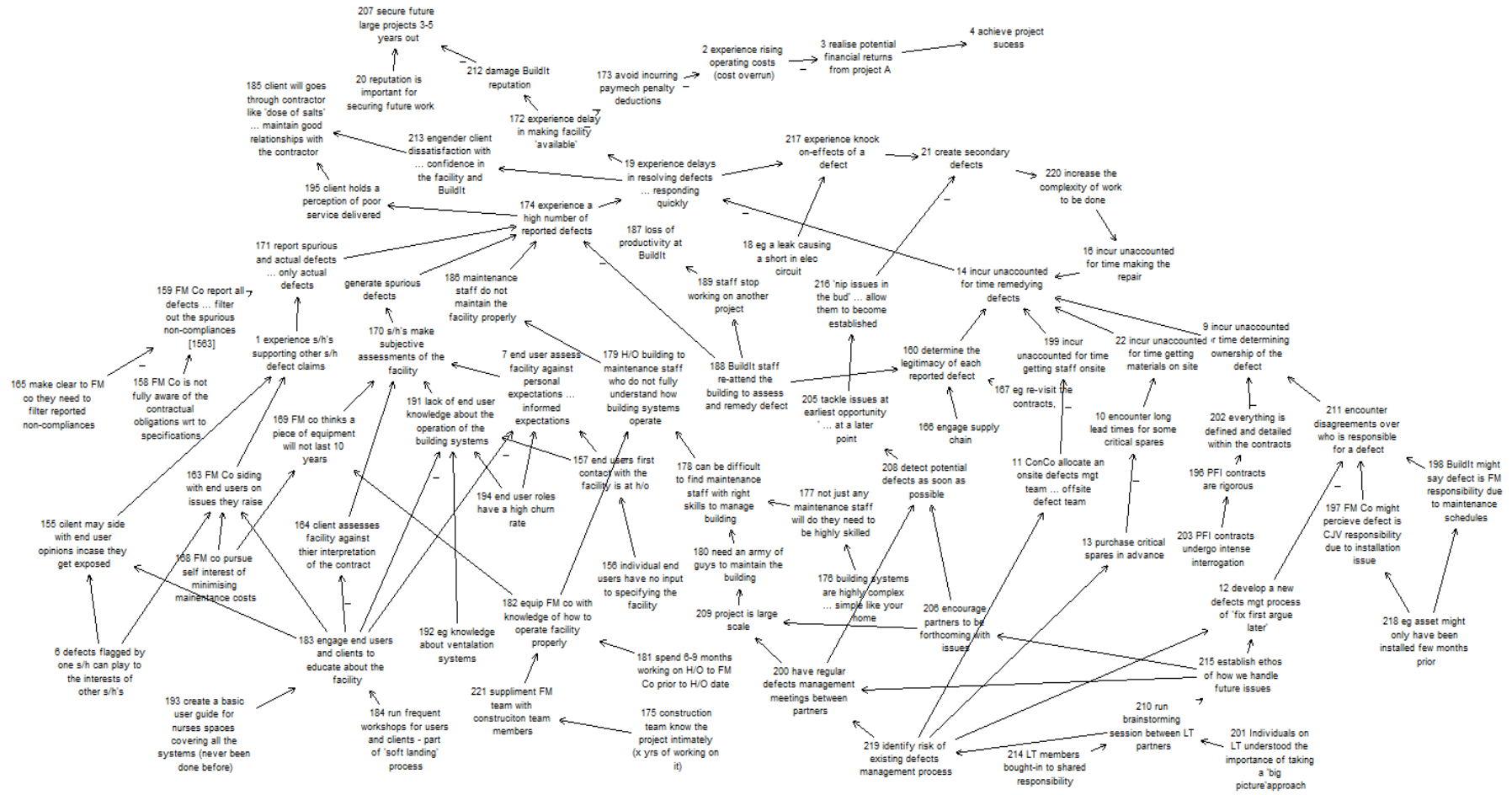
Map A1 A systemic view of project A

4.1.5 On Project Objectives

Insight A1 (Map A2) Negative Project Objectives can Guide Project Actions

Project A had been heralded by Built Right as a 'success' thus the aim of exploring project A was to understand the system of factors, including actions by the project team, that contributed to the project's success.

To gain some understanding of what actions contributed to success and why those actions were taken, the objectives of project A were examined. The project management literature suggests that project objectives play an important role in achieving project success because objectives help define what success is and, consequently, guide 'appropriate courses of action' toward the attainment of success (Ward et al, 1991, p.345). The literature also suggests that project objectives differ according to which stakeholder perspective the project is examined from (Bryde and Robinson, 2005, Turner, 2009f). Consequently, gaining insight into what interview participants saw as the objectives of project A could help in understanding of the actions that contributed to success and why those actions were taken.

All five of the participants made reference to the profitability of the project suggesting that financial objectives were of central concern to the team. As one participant put it, avoiding paymech penalties was 'the teams absolute focus'. As discussed previously, paymech penalties reduce the regular payment made to the provider during the project's operational phase and consequently reduce the profitability of the project (from the provider's perspective).

Data from project A, illustrated in Map A1, suggests that a focus on avoiding the undesirable outcome (paymech deductions) at least, in part, framed the actions of the project team in project A. Within the project management literature concerning project objectives, the tendency is to focus on aspirations to be achieved rather than those to be avoided. Expanding the search for literature concerning objectives to organisational strategy making revealed the concept of negative objectives which Ackermann and Eden (2011, p.118) described as 'aspirations to be avoided'. The authors suggest, in the context of organisational strategy making, negative objectives can have just as strong an influence on organisational action as those of positive objectives (desirable outcomes). The insight above suggests that negative objectives can have a similar strong influence in a project management context. The tentative finding drawn from this insight is that when considering projects,

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objectives (positive and negative) and their ramifications need to be fully explored in order to gain a broader appreciation of the actions that might be necessary to successfully delivery the project. Considering positive *and* negative objectives would enable actions to be considered in light of both types of objectives such that conflicts could be identified (e.g. an action which attends to a negative objective having an undesirable consequence on a positive objective).

4 achieve project
sucess

3 realise potential
financial returns
from project A

2 experience rising
operating costs
(cost overrun)

173 avoid incurring
paymech penalty
deductions
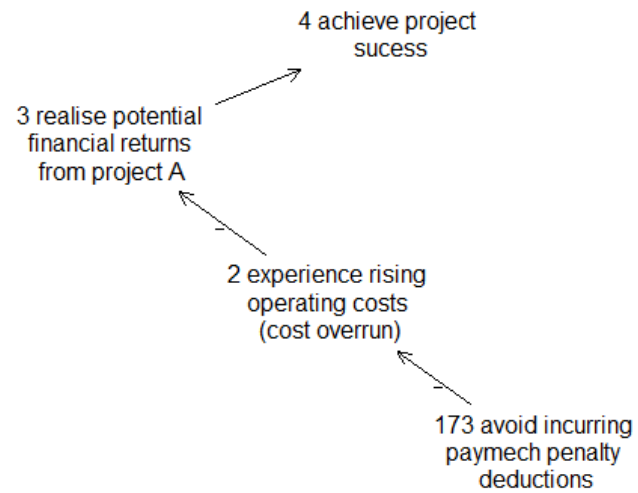
Map A2 Negative objectives revealed by project A data

Note : the negative symbol indicates a negative link and should be read as 'A leads to [not] B'. For example, in the map above 'avoid incurring paymech penalty deductions' may lead to *not* 'experience rising operating costs'.

4.1.6 On Triggering and Compounding of Defect Reports

As discussed in the overview of participant interviews (section 4.1.2), participants described what, in their opinion, led to the success of Project A. The previous section revealed that the objective of avoiding paymech deductions was believed by participants to be of importance in relation to project success. In explaining how success was achieved, participants focused on two issues. Firstly, they revealed the factors that they felt posed a risk to the objective of avoiding paymech deductions. Secondly, participants described the actions they took and believed mitigated the risks to the objective of avoiding paymech deductions. This section focuses on findings concerning the first issue – the factors participants felt posed a risk to the objective of avoiding paymech deductions.

A fundamental risk which all of the participants touched upon was experiencing delay in resolving reported defects. As discussed (section 4.1.1), in a PFI project, if part of the facility experiences a defect then this can render that part 'unavailable' under the terms of the paymech system and the client can make deductions from the providers regular payment until such point as the facility is brought back up to specification making it 'available' again. Thus, as Map A3 shows, experiencing delays in resolving defects [19] can result in delays in making the facility 'available' (following a defect) and thus cause paymech deductions to be incurred [173] by the project. In short, the longer BuildIt took to attend to a defect the greater the deductions to their regular payment. As Ives (20xx) explains, the risk to the provider 'becomes a matter of preventing complete and minimizing partial nonavailability' of the facility.

Three of the participants suggested that a *potential* contributing factor of delay was experiencing a high number of reported defects [174]. The participants suggested that reported defects can comprise 'actual' and 'spurious' defects and provided insights into the *potential* triggers of both types. 'Spurious' defects were explained as issues reported as being below specification but upon investigation by BuildIt were in fact within the boundaries of contractual obligations. 'Actual' defects, on the other hand, were reported issues that were indeed non-compliant with the contractual obligations. The *potential* triggers of defects are discussed in more depth next. Before doing so however it is important to clarify that the word *potential* is highlighted to emphasise that these triggers were not actually experienced in project A but rather were perceived risks that the project team took actions to mitigate

(discussed later in section 4.1.9). Throughout this section the word *potential* is emphasised where content is based upon what *could* have happened rather than what *did* happen.

Insight A2 (Map A3) Subjective stakeholder assessments can trigger the generation of 'spurious' defects

As Map A3 shows, a *potential* factor that can trigger or generate a spurious defect to be reported [8] is stakeholders making subjective assessments of the facility [170]. Participants provided a series of examples that gave a more fine grained understanding of the nature of this *potential* trigger by revealing who these stakeholders might be and also why they might be making subjective assessments.

One stakeholder is end users[7]. For example, end users might perceive the facility to be too hot or too cold and therefore report a defect when in fact upon investigation by BuildIt the facility is found to be operating at the specified temperature. As shown in Map A3, one of the causes of this issue is that end users are not typically involved in the specification of the facility [157]. Consequently, in the case of the temperature example, they are potentially unaware of the temperatures that have been contractually specified and therefore base their assessment of the facility upon personal preference rather than what is specified contractually. A further factor that can compound this situation, and on its own cause end users to raise spurious defects, is end users lack of knowledge about the operation of the facilities systems [191].

Modern buildings can be highly complex and comprise sophisticated systems to support their operation. A lack of knowledge concerning how these systems operate can also lead to perceptions that there is a fault within the facility. To illustrate this point, one participant drew upon a previous experience which focused upon cooling and ventilation systems. Within modern buildings ventilation and cooling systems can be provided through sophisticated design of the building structure to create natural airflow within the building and/or by using technologies such as 'chill beams' (ceiling mounted devices that use pipes of water to cool areas of a facility using a process of convection). In both approaches there might be little or no physical indication to end users that ventilation and cooling is taking place. For example will be no air vents or ducts and perhaps no draughts to be felt therefore creating perceptions that there is no ventilation within the facility and thus causing a defect to be reported when in fact the system is operating as specified. This example,

perhaps compounds the earlier example concerning end users subjective assessments of the facility being too hot or cold. That is, the lack of visible indication that cooling is taking place might serve to support end user perceptions that the facility is indeed too hot and thus that there is a fault with the ventilation within the facility.

A second stakeholder who might raise spurious defect reports is the FM provider. As shown in Map A3, the FM provider's interest/objective is in minimising the maintenance cost of the facility [168]. Thus if the FM provider perceives that, for example, a piece of equipment will not last the specified time period [169] then they might claim that the equipment does not meet specification and thus raise a defect report.

Finally, the third stakeholder who might raise spurious defects is the client. Similar to the FM provider, the client is making subjective assessments in terms of how the facility stands up against their understanding of the contract [164]. For example, the colour finish of walls might not match the client's understanding of the colour specified in the contracts and therefore result in a defect report. An example provided by one participant suggests these defects, however, can be much less trivial in nature. They relayed one experience where the client perceived their facility to be too hot and thus pursued BuildIt to resolve the matter (by submitting a defect report). However, due to affordability issues at the design stage, the client had removed the cooling system opting instead to rely on natural air flow (i.e. opening the windows). Consequently, there was no defect to be remedied.

The tentative findings that can be drawn from the insights above are that **stakeholder interests** and **gaps in stakeholder knowledge** can lead to stakeholder judgements about the facility that are subjective in nature causing spurious defects to be generated. Key stakeholders in this regard are end users, the FM company and the client.

173 avoid incurring paymech penalty deductions

2 experience rising operating costs (cost overrun)

3 realise potential financial returns from project A

4 achieve project sucess

172 experience delay in making facility 'available'

19 experience delays in resolving defects ... responding quickly

174 experience a high number of reported defects

8 generate spurious defects

170 s/h's make subjective assessments of the facility

7 end user assess facility against personal expectations ... informed expectations

169 FM co thinks a piece of equipment will not last 10 years

164 client assesses facility against thier interpretation of the contract

191 lack of end user knowledge about the operation of the building systems

168 FM co pursue self interest of minimising mainentance costs

192 eg knowledge about ventalation systems

157 end users first contact with the facility is at h/o

156 individual end users have no input to specifying the facility

Map A3 Subjective stakeholder assessments of the facility

Insight A3 (Map A4): Changes to stakeholder personnel can trigger the generation of 'spurious' defects

A further *potential* factor that can trigger or generate a spurious defect to be reported is changes to stakeholders, in particular changes to end user staff. As shown on Map A4, there was a high rate of turnover in the end user population of project A [194] and therefore project A might experience a regular flow of new staff into the facility who had no prior experience of it and thus no familiarity with its systems, operation and specification. Consequently, even if the gaps in end user knowledge discussed in the previous section were attended to with an existing cohort of end users, the arrival of new staff could cause these gaps to re-emerge and thus trigger further reporting of spurious defects [for example 191→170→8].

Contextual conditions were found to play a role with regard to a high rate of turnover of personnel. As one participant noted, in other types of projects such as schools the stakeholders (teachers and clients) are more stable than health care projects.

The tentative finding drawn from the above insight is that **changes of the client's end user personnel** can cause defects to be generated and that consideration of **personnel change within other stakeholder groups** (outside of BuildIt) might be valuable. Ilustrated in Figure 37 below.
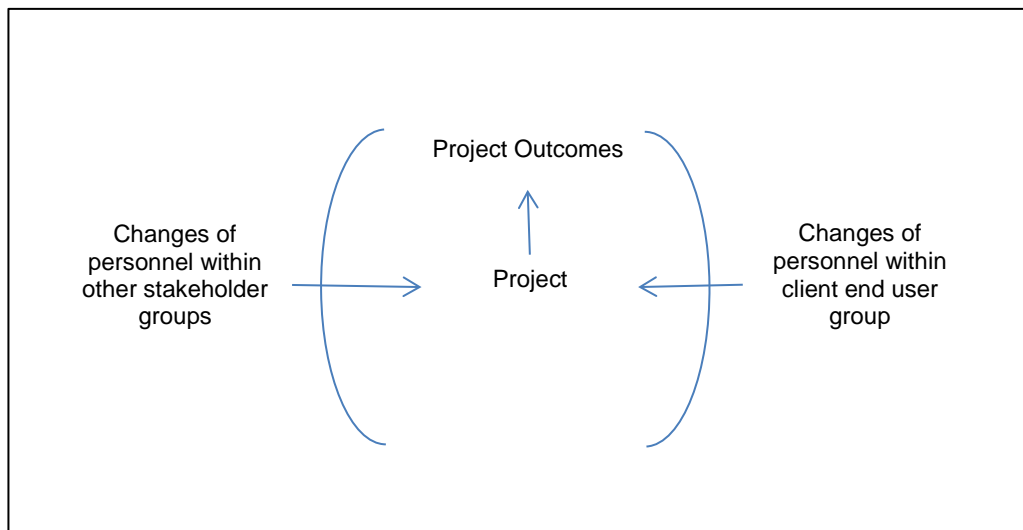
Figure 37 Conceptual model of changes to personnel across project stakeholder groups

173 avoid incurring
paymech penalty _ →
deductions

2 experience rising
operating costs
(cost overrun)

3 realise potential
financial returns
from project A

4 achieve project
sucess

172 experience delay
in making facility
'available'

19 experience delays
in resolving defects
... responding
quickly

174 experience a
high number of
reported defects

8 generate spurious
defects

170 s/h's make
subjective
assessments of the
facility

169 FM co thinks a
piece of equipment
will not last 10
years

191 lack of end user
knowledge about the
operation of the
building systems

164 client assesses
facility against
thier interpretation
of the contract

7 end user assess
facility against
personal
expectations ...
informed
expectations

192 eg knowledge
about ventalation
systems

168 FM co pursue
self interest of
minimising
mainentance costs

157 end users first
contact with the
facility is at h/o

194 end user roles
have a high churn
rate

156 individual end
users have no input
to specifying the
facility

Map A4 Changes to stakeholder personnel

Insight A4 (Map A5) Inadequate maintenance of the facility can trigger the generation of 'actual' defects

A further *potential* factor that can trigger or generate defects, this time 'actual' defects, is poor maintenance of the facility [186] caused by a gap in the skills of the team tasked with maintenance [179]. Intuitively, it would seem that this is a simple matter of acquiring appropriately skilled members for the maintenance team from the market place.

However, Map A5 suggests that the reality could be much more challenging. What the data suggests is that acquiring skilled maintenance staff could be problematic [178] in relation to project A for two compounding reasons. Firstly, that the facility required such a high skill level [177]. To paraphrase one participant 'you need much more than a janitor or caretaker to operate a facility like project A'. The point being made here, and as shown on Map A5, was that project A comprised very sophisticated systems [176] and so required a group of highly skilled maintenance staff to support its operation. Secondly project A was a very large project [209] and consequently staff were required in very large numbers [180]. The compound effects of both these factors appears to be difficulty in finding maintenance staff with the right skills [178] in the numbers required for project A. This 'difficulty' implies a further factor is at work – a skills shortage in the market place.

The tentative finding drawn from this insight is that the ability **to maintain and re-commission** the project can be affected by **contextual conditions** in particular those in the **external environment** (Figure 38) and consequently gaining understanding of the conditions surrounding a project is important because, as the example provided indicates, these can have significant influence over project outcomes.
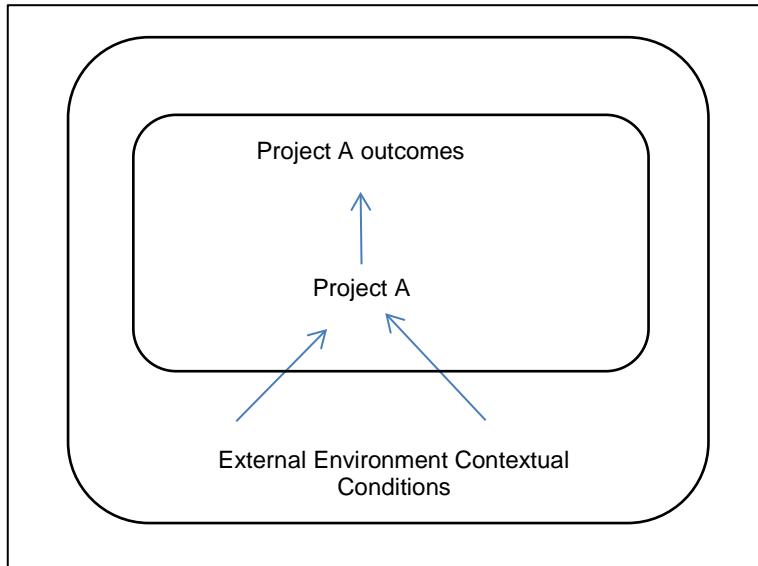
Figure 38 Conceptual model of interaction between external environment conditions, the project and its outcomes

Moreover, given the gestation period of PFI projects in particular (which can be years in length), understanding the context that might surround the project in future, and the implications of it, would be valuable such that actions might be taken in the present to tackle those implications. For example, in the case of a skills shortage in the market place is not quickly remedied and might require partnering with other organisations (such as local government skills agencies) to tackle the shortage.

2 experience rising operating costs (cost overrun)

3 realise potential financial returns from project A

4 achieve project sucess

173 avoid incurring paymech penalty deductions

172 experience delay in making facility 'available'

19 experience delays in resolving defects ... responding quickly

174 experience a high number of reported defects

186 maintenance staff do not maintain the facility properly

8 generate spurious defects

179 H/O building to maintenance staff who do not fully understand how building systems operate

170 s/h's make subjective assessments of the facility

7 end user assess facility against personal expectations ... informed expectations

178 can be difficult to find maintenance staff with right skills to manage building

164 client assesse facility against thier interpretation of the contract

191 lack of end user knowledge about the operation of the building systems

157 end users first contact with the facility is at h/o

177 not just any maintenance staff will do they need to be highly skilled

192 eg knowledge about ventalation systems

194 end user roles have a high churn rate

180 need an army of guys to maintain the building

156 individual end users have no input to specifying the facility

209 project is large scale

176 building systems are highly complex ... simple like your home

Map A5 Deficiencies in facility maintenance

Insight A5 (Map A6) Reporting of spurious defects can compound high numbers of reported defects

A further factor that could contribute to experiencing a high number of reported defects and resultant delays concerned the *reporting* of defects, in other words the administrative process of recording defects and subsequently alerting the relevant stakeholders. (This is as opposed to the previous section which focused upon the factors that could *generate* defects or in other words bring a defect into being).

Map A6 shows that the scenario of experiencing a high number of defect reports [174] is compounded by *reporting* of both actual and spurious defects [171] (rather than only actual defects i.e. those defects that are legitimate breaches of contract). By recording spurious defects as well as actual defects, the number of defects to manage is inflated thus making the number worse than it otherwise could be had only the actual defects been recorded.

As Map A6 shows, two reasons that spurious defects might be recorded are the FM Co not filtering out the spurious defects [159] and secondly stakeholders supporting one another's claims about defects [1].

In relation to the FM Co one *potential* reason they might not filter out spurious defects is that they are not fully aware of the contractual obligations associated with the facility. As a consequence, the FM Co might wrongly categorise some defects to be legitimate when in fact they are spurious. Recording rather than filtering these spurious defects [159] in turn contributes to inflating the number of defect reports to manage [174].

A second *potential* factor that could attribute to the inclusion of spurious defects in defect reports is stakeholders supporting one another's claims[1], adding to the validity of the defect and thus its perceived legitimacy by stakeholders. For example, defects reported by end users might be supported (rather than opposed) by the client or FM provider. As illustrated on Map A6, the rationale for this support is that the defect might play to the Client or FM Co particular interests [155, 168]. To explain further, a defect reported by end users might require the replacement of an element of the facility (e.g. a piece of equipment or part of the building fabric) and thus increase the life span of that element. This outcome could be in the FM provider's interests since they are responsible for the maintenance of the facility and therefore increasing the lifespan of an element might decrease the cost to the FM provider of maintaining the facility. If this is the case, the FM provider might support

the claim made by end users contributing to reporting of spurious and actual defects rather than only actual defects [171]. A further example comes from the client side who might side with end user opinions [155] so as to avoid exposure (e.g. having made poor design decisions). In both examples, the inclusion of spurious defects is driven by the fact that some stakeholders (FM Co or Client in the examples) stand to gain from their inclusion thus it is simply not in their interests to oppose end user claims about defects.

The tentative findings drawn from this insight are that **gaps in stakeholder knowledge,** for example concerning contractual obligations, can compound the number of defects that are recorded and thus need to be managed. It also suggests that a further compounding factor's is **coalitions that form between stakeholders** because of **overlapping stakeholder interests**. Consequently, the insight suggests that potential gaps in stakeholder knowledge need to be identified and managed and that the interests of individual stakeholders be understood so as to reveal potential coalitions that might form and impact upon the project.

173 avoid incurring paymech penalty deductions

2 experience rising operating costs (cost overrun)

3 realise potential financial returns from project A

4 achieve project sucess

172 experience delay in making facility 'available'

19 experience delays in resolving defects ... responding quickly

174 experience a high number of reported defects

171 report spurious and actual defects ... only actual defects

8 generate spurious defects

186 maintenance staff do not maintain the facility properly

159 FM Co report all defects ... filter out the spurious non-compliances [1563]

170 s/h's make subjective assessments of the facility

7 end user assess facility against personal expectations ... informed expectations

1 experience s/h's supporting other s/h defect claims

169 FM co thinks a piece of equipment will not last 10 years

191 lack of end user knowledge about the operation of the building systems

158 FM Co is not fully aware of the contractual obligations wrt to specifications

155 cilent may side with end user opinions incase they get exposed

163 FM Co siding with end users on issues they raise

164 client assesses facility against thier interpretation of the contract

157 end users first contact with the facility is at h/o

168 FM co pursue self interest of minimising mainentance costs

192 eg knowledge about ventalation systems

194 end user roles have a high churn rate

156 individual end users have no input to specifying the facility

6 defects flagged by one s/h can play to the interests of other s/h's

Map A6 Defects reporting process

4.1.7 On Factors Compounding Delays

To summarise thus far, there are a variety of *potential* factors that can cause defect reports to be generated. The multiplicity of factors can, in turn, contribute to a scenario of having a high number of defects to manage and thus experiencing resultant delay in making parts of the facility affected by defects available again.

Reflecting upon the foregoing, defects can be thought of as a 'trigger' of delay in making the facility, or part thereof, available. To explain further, the absence of a reported defect signifies the absence of deterioration in the facility and, therefore, the facility can be assumed to be operating at specification and thus available. Consequently, no delay can be incurred in making the facility available.

While reported defects might be a trigger of delay, three of the participants of project A identified that unaccounted for time in remedying (i.e. actually fixing a defect) could further compound the delay. This compounding effect does not trigger delay but rather serves to worsen the extent of delay. Participants provided a series of examples of factors that could attribute to the time spent remedying defects, these are discussed below.

Insight A6 (Map A7) Unaccounted for time remedying defects can compound delays.

Before any action can be taken to remedy a defect it must be examined in order to determine its legitimacy in relation to the contract [161]. PFI contracts are very detailed [202] in their content, undergoing intense interrogation [207] by the project's stakeholders and thus consume a significant amount of stakeholders time. Given the level of detail contained in the contracts, in theory they should offer a rationalistic means of determining the legitimacy of a defect. In other words it should be a relatively simple matter of re-visiting the contract [167] to examine the specifications and determine if the defect is legitimate or not. However, what Map A7 suggests is that, in practice, the matter of determining the legitimacy of a defect can be much more involved and demanding. For example, as [166] suggests, it might be necessary to engage the supply chain for the supplier of the element of the facility that has experienced the defect to make an assessment of it. This assessment could introduce subjectivity and interpretation into the decision of whether the defect is legitimate or not, particularly if it is not in the interests of the supplier to take liability for the defect. This could then lead to a far more messy situation than the theory suggests which is to revisit the contracts and examine the specifications.

A further *potential* factor that could contribute to delay is determining the 'owner' of the defect. In order for remedial action to be taken, it must be identified who 'owns' the defect [9] or in other words who is responsible for its resolution. Again in theory determining ownership should be a simple matter of re-visiting the contract to identify the responsible owner. However, like the situation described above, Map A6 suggests that in practice determining ownership can be a much more untidy and less clean cut affair. The reason is contextual conditions surrounding the defect can introduce subjectivity into the assessment of responsibility making identification of a responsible owner a challenge. The example shown in Map A7 illustrates this point which is that if an asset experiences a defect and that asset has only recently been installed [218] then disagreement might ensue over who is responsible for resolving the defect [211]. For example, BuildIt (who is ultimately responsible for installation) might suggest that the defect is the responsibility of FM Co because the asset has not been maintained properly [198]. FM Co on the other hand might oppose this view, suggesting that, because the asset has only recently been installed, that the defect must belong to BuildIt [197].

The final collection of factors that can contribute to delay in remedying reported defects concern the physical activities of conducting the remedy. These include time taken to get materials [22] and staff [199] on site as well as the time to actually conduct the repair [31].

The tentative findings drawn from this insight are that delay in remedying defects can be the combined effect of simple **logistical** matters such as getting materials and more complex **socio-political** matters such as disagreement between stakeholders over defect ownership. The insight also suggests that, despite the level of detail contained within **PFI contracts** and the rigour with which they are developed, **contextual conditions** can mean that contracts are unable to provide a rationalistic means of determining legitimacy and ownership of defects. Consequently, contracts are not able to fully displace the need for **social processes** such as reaching agreements between stakeholders.

173 avoid incurring
paymech penalty
deductions

172 experience delay
in making facility
'available'

–

19 experience delays
in resolving defects
... responding
quickly

199 incur
unaccounted for time
getting staff onsite

14 incur unaccounted
for time remedying
defects

–

174 experience a
high number of
reported defects

16 incur unaccounted
for time making the
repair

22 incur unaccounted
for time getting
materials on site

161 spend time
determining the
legitamacy of
defects

9 incur unaccounted
for time determining
ownership of the
defect

211 encounter
disagreements over
who is responsible
for a defect

160 determine the
legitimacy of each
reported defect

202 everything is
defined and detailed
within the contracts

–

197 FM Co might
percieve defect is
CJV responsibility
due to installation
issue

198 Build Right
might say defect is
FM responsibility
due to maintenance
schedules

167 eg re-visit the
contracts,

166 engage supply
chain

203 PFI contracts
undergo intense
interrogation

196 PFI contracts
are rigorous

218 eg asset might
only have been
installed few months
prior

Map A7 Unaccounted for time in remedying defects can compound delays.

4.1.8 Emergent Consequences of High Numbers of Reported Defects and Attendant Delays

Thus far the findings have focused upon the scenario of experiencing a high number of reported defects and has revealed the factors that can trigger and compound this scenario. It has been shown that experiencing a high number of reported defects can contribute to delay in making the facility (or part thereof) available and that as a consequence the client can make a deduction from the provider's regular payment. However, all of the participants of project A suggested that there are other *potential* consequences that could emerge, over and above incurring paymech deductions, that can emerge as a result of experiencing high numbers of reported defects and attendant delays. This section examines these emergent consequences.

Insight A7 (Map A8) high numbers of reported defects and attendant delays can induce changes in client behaviour

As shown in Map A8 one of the *potential* consequences of the compound effects of high numbers of reported defects [174] and attendant delays [19] is that it can have influence over the behaviour of the client toward BuildIt [185]. To explain further, the high numbers of reported defects *coupled with* experiencing delays in resolving those defects can cause the client to feel dissatisfied with the quality of service being delivered by BuildIt [213, 195] causing the client to become more adversarial rather than cooperative in its attitude toward BuildIt [185].

That the cause of the clients dissatisfaction is the systemic effects of both the volume of defects [174] *and* attendant delays [19] is of interest because what it suggests is that attending to defects as soon as possible might help to offset the feelings of dissatisfaction by the client with the quality of the service. A comment from one participant takes the potency of this suggestion a step further. They suggested that 'the client will think you are brilliant if you respond to issues quickly because the client feels they are receiving a good service'. What this observation suggests is that if the provider resolves defects expediently then the client is likely to perceive that the service provided is good, even though the project might have experienced a number of defects.

The tentative finding drawn from the above insight is that **defects and resultant delays can cause the client to become adversarial** toward BuildIt due to their

dissatisfaction with the quality of service. Moreover, while map A4 suggests that it is the number of defects *and* speed of response that can cause client dissatisfaction with quality, the client might use speed of response as a **proxy measurement** for quality. Therefore, quick response times could be used as a means of **influencing the clients perceptions** of quality toward 'good quality service' and thus mitigate the likelihood of them becoming adversarial in their attitude toward BuildIt.

173 avoid incurring paymech penalty deductions

172 experience delay in making facility 'available'

185 client will goes through contractor like 'dose of salts' ... maintain good relationships with the contractor

213 engender client dissatisfaction with ... confidence in the facility and BuildIt

19 experience delays in resolving defects ... responding quickly

195 client holds a perception of poor service delivered

174 experience a high number of reported defects

171 report spurious and actual defects ... only actual defects

8 generate spurious defects

Map A8 Changing client behaviour due to defect and delay situation

Insight A8 (Map A9) high numbers of reported defects and attendant delays can lead to a Loss of productivity at BuildIt

As discussed previously, and illustrated on Map A9 one of the steps toward resolving a defect is to determine its legitimacy [160] in terms of contractual obligations. This process might involve BuildIt staff attending the location of the defect [188] to make an assessment of it and, as discussed previously, might also require staff to re-visit the contract as well as engage the supply chain.

However, typical of project management organisations once project A is in its operational phase (i.e. 'complete') BuildIt project staff are moved on to new assignments and are, therefore, no longer actively working on project A. To complete the activities mentioned above in relation to a defect experienced on project A, staff must stop working on their current assignments and turn their attention back to project A [189] resulting in a loss of productivity at BuildIt [187] because their projects are not being progressed. Furthermore, since staff will still be responsible for their current assignment as well as the defects of project A, project staff will be stretched across multiple projects. Consequently, they might be unable to attend to their current assignment as comprehensively as they would otherwise do potentially leading to issues on their current assignment now or in the future.

The tentative finding drawn from this insight is that the consequences of experiencing defects on one project are not necessarily isolated to that project. Instead the **effects of defects can be systemic, propagating across to other projects** within the BuildIt organisation (as illustrated conceptually in Figure 39 below).
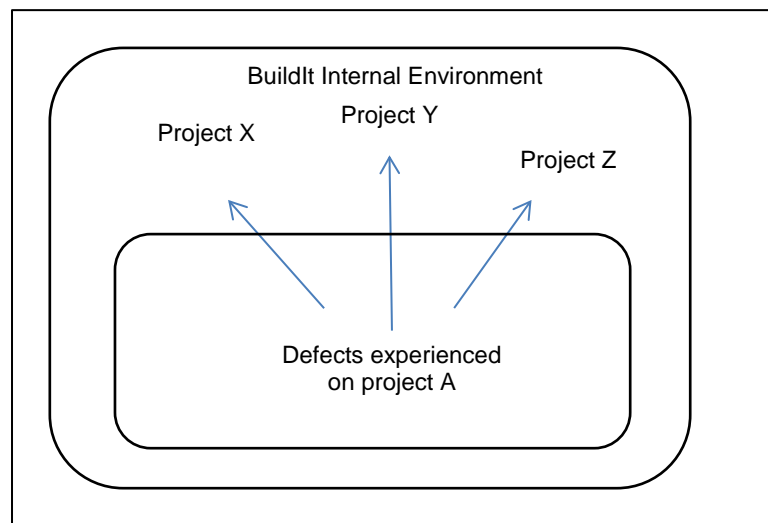
Figure 39 Systemic effect of poor project performance on the wider organisation

173 avoid incurring paymech penalty deductions

172 experience delay in making facility 'available'

185 client will goes through contractor like 'dose of salts' ... maintain good relationships with the contractor

213 engender client dissatisfaction with ... confidence in the facility and BuildIt

19 experience delays in resolving defects ... responding quickly

187 loss of productivity at BuildIt

14 incur unaccounted for time remedying defects

195 client holds a perception of poor service delivered

189 staff stop working on another project

160 determine the legitimacy of each reported defect

174 experience a high number of reported defects

188 BuildIt staff re-attend the building to assess and remedy defect

166 engage supply chain

171 report spurious and actual defects ... only actual defects

8 generate spurious defects

Map A9 The effect of project defects on the wider BuildIt organisation

Insight A9 (Map A10) high numbers of reported defects and attendant delays can Increase complexity of rework

A further knock on effect of experiencing delays in attending to reported defects is that it can increase the complexity of rework that needs to take place. To explain further, the occurrence of a defect which results in a water leak (the primary defect) could have the knock of effect of causing an electrical system to short circuit [217, 18] thus creating a secondary defect [21]. The combination of these two defects increases the complexity of rework to be done [220] in tackling the primary defect.

The increase in complexity of rework, could result in further systemic effects as highlighted by the feedback loop on Map A10 [220→ 16→ 14→ 19→ 217→ 21 → 220]. To describe these effects further, the increase in complexity [5914] of rework means more time will be needed to remedy the defect situation [16, 14] than would be the case if it were only the primary defect to be resolved. This additional time might then cause delay in attending to other defects that have been reported [19] which, while unattended, might be causing secondary defects and so the loop could continue. Moreover, the occurrence of a secondary defect might only be discovered once the team tasked with remedying the primary defect arrive at the location. Thus the team may or may not be equipped to manage the secondary defect and if not then further delay might ensue.

To explore the example above still further, a leak in one element of the facility might render that element unavailable and a deduction might be made from BuildIts regular payment. However, the occurrence of a secondary defect, such as a an electrical fault, could mean that other parts of the facility are without electrical power thus rendering multiple elements of the facility unavailable and creating a dramatic increase in the extent of the deduction to BuildIts regular payment. Thus, because of systemic effects, the cost associated with a primary defect can escalate dramatically.

The tentative finding drawn from this insight is that delay in attending to reported defects can **induce dynamic behaviour** in the form of a **vicious feedback loop involving re-work** within the project and that behaviour can have significant consequences in terms of **further delays** and **increasing operational** costs to BuildIt.

173 avoid incurring paymech penalty deductions

185 client will goes through contractor like 'dose of salts' ... maintain good relationships with the contractor

172 experience delay in making facility 'available'

213 engender client dissatisfaction with ... confidence in the facility and BuildIt

19 experience delays in resolving defects ... responding quickly

195 client holds a perception of poor service delivered

14 incur unaccounted for time remedying defects

187 loss of productivity at BuildIt

217 experience knock on-effects of a defect

174 experience a high number of reported defects

160 determine the legitimacy of each reported defect

18 eg a leak causing a short in elec circuit

189 staff stop working on another project

16 incur unaccounted for time making the repair

166 engage supply chain

171 report spurious and actual defects ... only actual defects

188 BuildIt staff re-attend the building to assess and remedy defect

220 increase the complexity of work to be done

21 create secondary defects

8 generate spurious defects

Map A10 Increasing complexity of rework due to secondary defects

Insight A10 (Map A11) Defects and Attendant Delays can translate into long term business risk

A further *potential* consequence of experiencing defects and attendant delays is that they can translate into long term business risk to BuildIt. In short, project A was a large public medical facility being funded by tax payers and as such would attract significant media and public interest. News of issues (such as defects and delays) could, therefore, travel fast and reach a wide audience damaging BuildIts reputation for delivery of these types of projects [212]. Within the audience might be potential future clients of BuildIt. Map A4 suggests that having a good reputation is important for securing future work with clients [20], a point supported by the literature (Watt, 2009, 2010). Therefore, damage to reputation could have the consequence of impairing BuildIts ability to secure future projects [207]..

The above discussion further supports the finding of *Insight A8* which is that the effects of defects and attendant delays are not isolated to within the boundaries of the project but rather they have systemic effects that can be felt at the organisation level. However, unlike *Insight A8*, the systemic effects described above are not contained within the boundaries of the organisation. In *Insight A8* the effect of defects and attendant delays in project A was to reduce the productivity of BuiltIt. Reduced productivity is an issue that is internal to BuildIt and which it presumably could have significant influence over. However, the systemic effect of damaged reputation described in this Insight A10 extend beyond the boundaries of BuildIt into the external environment and, consequently, BuildIt would have much less influence over the management of these effects.

Furthermore, map A4 suggests that the effect of damage to reputation can be enduring, indicated to be some 3 to 5 years in length [207]. Perhaps the foregoing discussion concerning the influence BuildIt has in repairing its reputation once it is damaged goes some way toward explaining why the duration is so long. (literature?). Regardless of the reasoning for the duration, it's length warrants significant attention because the inability to secure a future pipelines of work could pose a risk to the entire business enterprise.

The tentative findings drawn from this insight are that the consequences of experiencing defects on a project are not contained within the boundaries of the project nor are they necessarily contained to within the boundaries of the organisation tasked with managing it. Instead the **effects of defects and attendant delays can be systemic,** propagating out into the **external environment**

(illustrated conceptually in Figure 40) **damaging, for example, reputation**
negatively affecting BuildIt from securing future projects like project A**.** Furthermore,
once consequences such as damage to reputation are experienced they can take a
long time to repair potentially meaning that **poor performance on a project can be**
business affecting in terms of the long term performance, and perhaps survival, of
the business.
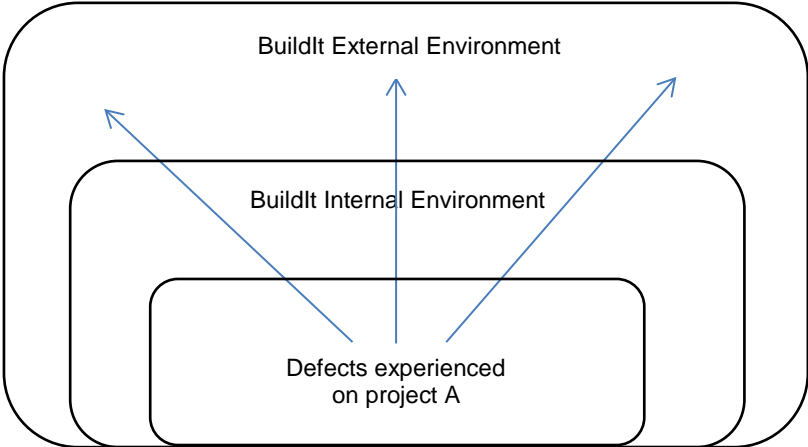
Figure 40 Systemic effects of poor project performance propagate up to the organisational
environment and out to the external environment
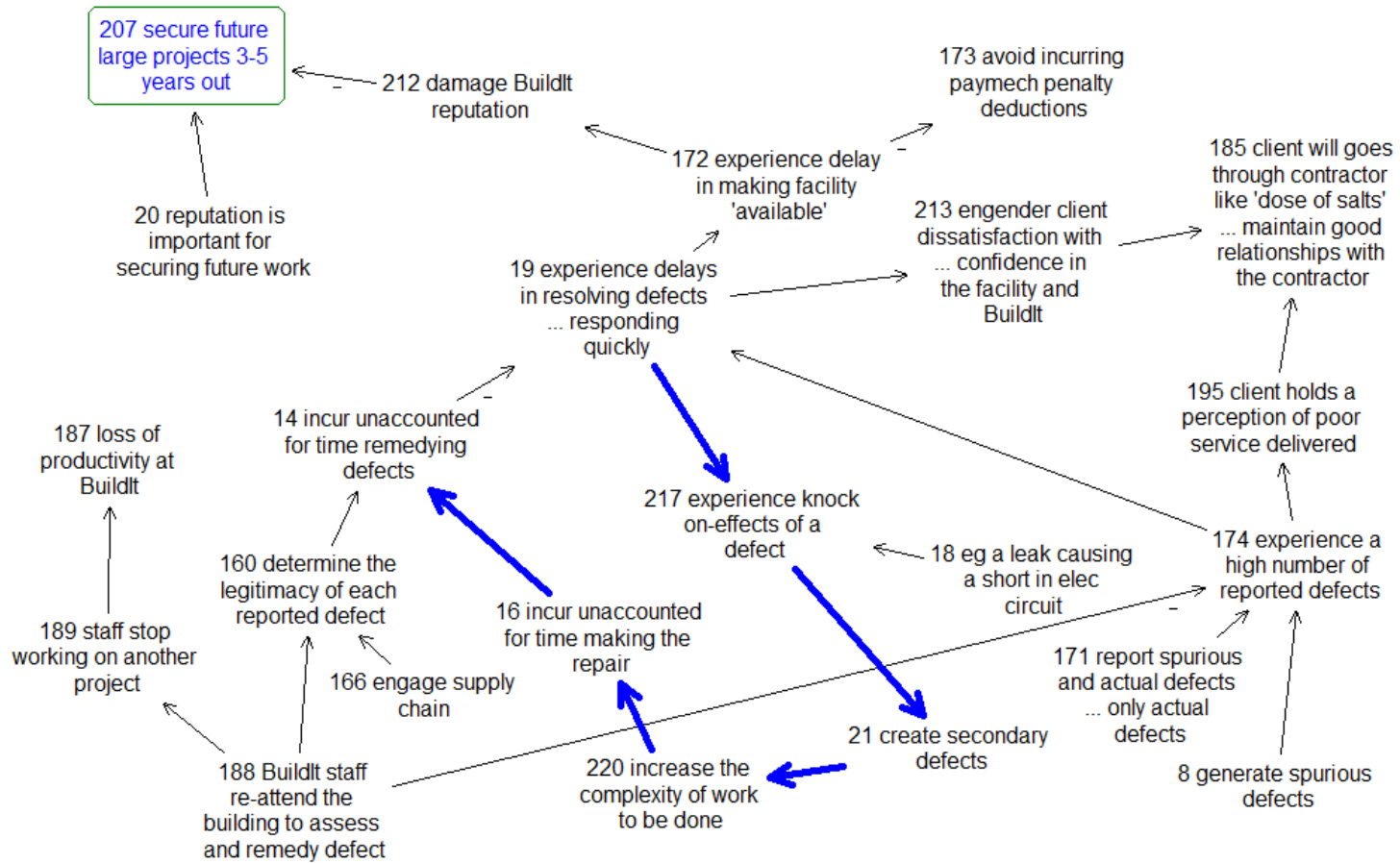
Map A11 Long term business risk of poor project performance

4.1.9 Counteractions to Undesirable Project Behaviour

The previous sections revealed the following:

- Experiencing delays in attending to reported defects can result in the client making deductions from BuildIts regular payment (referred to as paymech deductions). Consequently this increases BuildIt's operating costs for the facility beyond the estimated value and so the project would experience a cost overrun.

- Experiencing a high number of reported defects could contribute to experiencing delays in attending to defects.

- There are a variety of **factors that can trigger and compound high numbers of defect reports** and thus contribute to experiencing a high number of reported defects.

- There are also **factors that can compound delay** in attending to reported defects.

- Finally, there are a series of other *potential* consequences, over and above incurring paymech deductions, that *could* emerge as a result of experiencing high numbers of reported defects and attendant delays.

As discussed in the introduction (and emphasised throughout the preceding sections) the triggers, compounding factors and emergent consequences that have been discussed thus far were *potential* factors that *could* have affected project A. That is to say, these factors were not actually experienced in project A but rather were perceived risks that the project team took counteractions actions to mitigate. This section examines those counteractions.

Insight A11 (Map A12) Attending to gaps in stakeholder knowledge can mitigate factors affecting a high number of reported defects.

Map A11 illustrates the factors affecting a high number of reported defects (highlighted) as well as the counteractions the project team employed to mitigate these factors. The triggers are captured below (underlined) along with accompanying discussion of the counteractions taken by the project team and references to map A6 to illustrate the effects of counter actions.

To counter act this issue the project team had frequent discussions with FM Co in order to ensure that they (FM Co) were aware of the contractual obligations and, consequently, their responsibilities in terms of filtering spurious defects from the reported defects. [165]

[164] assessment of the facility by the client against their understanding of the contract.

To counteract this trigger, the project team set about educating the client about the operation of the building thus furnishing the client with more fine grained knowledge about the facility rather than leaving them only with the contract to work from [183]. This involved running workshops [184] to explain the operation of the facility as well as to describe how the facility attended to contractual requirements set out by the client.

[7] end users assess the facility against their personal expectations

Similar to the previous counteraction, workshops [184] were run to furnish end users with more information about the facility and thus aid their understanding of it. The findings revealed that the project team were aware that one risk was that end users might find the facility too hot/cold and that this might generate a defect report. Having the workshop allowed BuildIt to tackle this risk by informing end users what temperature the facility would operate at and why this temperature was selected (because it was stipulated in the service contract).

Workshops also allowed end users to feedback immediately to BuildIt aspects which they considered to be flaws in the facility. These perceptions of flaws could then be dealt with immediately by BuildIt either by explaining why a particular element of the facility was designed as it was or, if in fact it was a defect, resolve it before it became a reported defect.

[191] end users are not knowledgeable about how to operate the facility

Again, the counteraction to this trigger was to engage and educate end users [183] about the facility. Yet again, workshops [184] played an important role in furnishing end users with information about how the facility operated. The findings revealed that the project team were aware that one risk was that end users might perceive there to be a lack of ventilation within the facility due to the absence of

physical indicators associated with mechanised ventilation (e.g. ventilation ducts) and that this might generate a defect report. Workshops provided means for BuildIt to explain how the ventilation system differed from traditional systems that users might be more familiar with and also explain how the system operated and perhaps even reasons why the system was selected (for example, one system may be cheaper to operate thus lowering the cost to the client).

Recognising the complexity of the facility and thus the amount of information end users would need to take on board during the workshop setting, BuildIt complemented the workshop with other means of sharing information about the facility with end users. For example, a basic user guide was created for staff covering all of the essential systems that they might come into contact with and need to use. [193].

The consequence of the workshops and user guides was that end users were far more informed about the facility thus helping to mitigate the reporting of spurious defects.

[179] maintenance staff who do not fully understand how the building systems operate

To counteract this trigger, the project team set about sharing their knowledge and experience of the facility [221, 81] with the FM Co [182]. The rationale was simple and was that, in constructing the facility and installing and commissioning its systems the BuildIt team had an intimate knowledge of the facility [175] that FM Co would not initially have the benefit of. Thus to address this gap in knowledge the project team partnered with members of the FM Co team [221] for a period of 6-9 months to help ensure that the FM Co was equipped with the knowledge it needed to operate and maintain the facility within the obligations of the contract.

Looking across all of the counteractions reveals that they have in common a concern for knowledge sharing among project stakeholders, in particular, BuildIt sharing knowledge with the other stakeholders involved within the project including the FM Co, end users and the client. Since all of these counteractions worked to good effect on project A, the tentative finding drawn from the above is that **knowledge sharing** among project stakeholders makes an important contribution to mitigating reported defects.

19 experience delays in resolving defects ... responding quickly → 172 experience delay in making facility 'available' → 173 avoid incurring paymech penalty deductions

174 experience a high number of reported defects

171 report spurious and actual defects ... only actual defects

8 generate spurious defects

186 maintenance staff do not maintain the facility properly

158 FM Co is not fully aware of the contractual obligations wrt to specifications

159 FM Co report all defects ... filter out the spurious non-compliances [1563]

179 H/O building to maintenance staff who do not fully understand how building systems operate

165 make clear to FM co they need to filter reported non-compliances

1 experience s/h's supporting other s/h defect claims

...0 s/h's make subjective assessments of the facility

7 end user assess facility against personal expectations ... informed expectations

191 lack of end user knowledge about the operation of the building systems

164 client assesses facility against thier interpretation of the contract

182 equip FM co with knowledge of how to operate facility properly

155 cilent may side with end user opinions incase they get exposed

169 FM co thinks a piece of equipment will not last 10 years

163 FM Co siding with end users on issues they raise

183 engage end users and clients to educate about the facility

221 suppliment FM team with construciton team members

81 spend 6-9 months working on H/O to FM Co prior to H/O date

6 defects flagged by one s/h can play to the interests of other s/h's

168 FM co pursue self interest of minimising mainentance costs

193 create a basic user guide for nurses spaces covering all the systems (never been done before)

184 run frequent workshops for users and clients - part of 'soft landing' process

175 construction team know the project intimately (x yrs of working on it)

Map A12 Counter actions (green) to attend to gaps in stakeholder knowledge (boxes0 to mitigate high numbers of reported defects

185

Insight A12 (Map A13) Attending to gaps in stakeholder knowledge can mitigate factors that can compound high numbers of reported defects.

As discussed earlier (*Insight A5*), reporting of both spurious and actual defects could serve to compound a scenario of experiencing a high number of reported defects. This was because inclusion of spurious defects made the number of reported defects worse than it otherwise could be (had it only included actual defects). Two contributing factors were identified.

- [159] the possibility of FM Co not filtering out spurious defects and
- [1] experiencing stakeholders supporting one another's claims because they play to particular stakeholder interests.

As Map A12 above shows, only one counteraction was explicitly identified within project A data concerning the above factors [165] and this was to attend to the first of the factors [159] the possibility of FM Co not filtering out spurious defects. The counteraction taken by the project team was to share their understanding of contractual obligations with FM Co in order to ensure that they (FM Co) were aware of the contractual obligations concerning the facility and, consequently, their responsibilities in terms of filtering spurious defects from the reported defects.

However, reflecting upon the counteractions of *Insight A11* it is conceivable that these too could have had an effect on the compounding factors described above. Their potential points of influence are illustrated on Map A13 using bold causal links (to distinguish these links as researcher additions) and described in more detail below:

- As noted above, the data suggests that educating end users about the facility can mitigate the possibility of spurious defects being reported. However, this action also, in part, mitigates the need to filter spurious defects [159] as show by the links: 183 → 155 and 183 → 163. For example, if end users raise fewer spurious defects by virtue of being better informed then there will be less occasions when stakeholders side with one another's opinions [155, 163] and thus less likelihood of spurious defects being reported.
- It was revealed earlier in this section that the FM Co, in pursuing its business interest of minimising maintenance costs [168], *might* perceive elements of the facility to be below specification and thus *might* generate spurious defects being reported. However, if the project team shared knowledge with

the FM Co about the facility [182] as discussed in the table above, then it is conceivable that FM Co would be better informed about the durability of equipment installed and thus perhaps negate their perceptions about the equipment [169] and so prevent a spurious defect report.

What this insight suggests is that the effects of counteractions can be systemic. That is, they can have influence on multiple parts of the system (rather than simply an individual aspect). For example, as discussed above and illustrated on Map A13 it can be seen that actions designed to mitigate the triggers of defect reports such as engaging and educating end users [183] could also conceivably mitigate factors that can compound a high number of reported defects (such as [155] and [163]) since the compounding factors depend upon defects being raised in the first place. Moreover, on Map A13 it can be seen that the action [183] potentially attends to 5 of the factors that can contribute to experiencing a high number of reported defects [191, 7, 164, 163, 155] suggesting that this is a potent action.

Given counteractions can affect more than one factor within the system, a tentative finding drawn from this insight is that **a systemic view of counteractions could be valuable**. A systemic view would **allow the effects of counteractions on the parts as well as the whole to be examined** and **enable identification of those actions that might be most potent (i.e. influence multiple aspects of the system)** so that resources can be directed toward these. Furthermore, a systemic view of counteractions would **allow potentially unwanted consequences to be identified**.

188

19 experience delays in resolving defects ... responding quickly

172 experience delay in making facility 'available'

173 avoid incurring paymech penalty deductions

174 experience a high number of reported defects

186 maintenance staff do not maintain the facility properly

8 generate spurious defects

171 report spurious and actual defects ... only actual defects

158 FM Co is not fully aware of the contractual obligations wrt to specifications

159 FM Co report all defects ... filter out the spurious non-compliances [1563]

.. 0 s/h's make subjective assessments of the facility

179 H/O building to maintenance staff who do not fully understand how building systems operate

165 make clear to FM co they need to filter reported non-compliances

1 experience s/h's supporting other s/h defect claims

164 client assesses facility against thier interpretation of the contract

7 end user assess facility against personal expectations ... informed expectations

191 lack of end user knowledge about the operation of the building systems

182 equip FM co with knowledge of how to operate facility properly

155 cilent may side with end user opinions incase they get exposed

169 FM co thinks a piece of equipment will not last 10 years

183 engage end users and clients to educate about the facility

221 suppliment FM team with construciton team members

81 spend 6-9 months working on H/O to FM Co prior to H/O date

163 FM Co siding with end users on issues they raise

6 defects flagged by one s/h can play to the interests of other s/h's

168 FM co pursue self interest of minimising mainentance costs

193 create a basic user guide for nurses spaces covering all the systems (never been done before)

184 run frequent workshops for users and clients - part of 'soft landing' process

175 construction team know the project intimately (x yrs of working on it)

Map A13 Further implicit influences (bold arrows) of knowledge sharing with stakeholders

Insight A13 (Map A14) Minimising response times to help mitigate delay in attending to reported defects.

As well as taking actions to mitigate the triggers of reported defects, the project team also identified a series of counteractions to mitigate factors that could compound delays in attending to those defects (shown in Map A14). A brief description of how the counteractions attended to the factors (underlined) is provided below.

Encounter disagreements over who is responsible for a defect [211]

One of the causes of delay that was discussed earlier was that there could be disagreement between the project partners (for example BuildIt and the FM Co) surrounding who was actually responsible for resolving the defect. Rather than manage this dispute while the defect lay unattended (and contributed to paymech deductions) a policy of 'fix first argue later was adopted' [12]. In essence, the policy was that the defect would be resolved by whomever was best placed to tackle it the time it was reported following which the discussion over who *should* have be responsible for it (and the cost of repair) would take place and costs settled.

Incur unaccounted for time getting staff onsite [199]

The standard practice within BuildIt was that staff responsible for tackling reported defects were based off-site of the project (project A). Consequently, when a defect was reported, time would be needed simply to get staff to the location of project A. During this time delays in attending to the defect would be accruing and thus paymech deductions rising. In order to attend to this issue, BuildIt placed staff members on site so that they would be on hand as soon as a defect was reported [11] thus avoiding delay in their arrival to the defect location [199].

Incur unaccounted for time getting materials on site [22]

As discussed earlier, a further potential source of delay in attending to defects was delay in getting materials on site to remedy a reported defect [22]. One of the issue that could compound this situation was that some components needed for repairs had long lead times [10] therefore creating a risk of delay in repairing defects that needed those types of components. To mitigate this risk, critical spares were purchased in advance [13]. 'Critical' was assessed based upon how important that spare was to the operation of the facility. For example, a spare component for an elevator would be 'critical'.

Creating secondary defects [21]

The counteractions described above were aimed at minimising the time needed to actually remedy a defect i.e. the process of resolving a defect. A further step the team took was to have regular defects management meetings [200]. These meetings helped the team with early detection of defects and discussing how those defects might be resolved. For example, as noted earlier BuildIt undertook workshops with end users and clients design to share information with those stakeholders about the facility. However, the workshops also provided BuildIt with early visibility of potential defects through feedback from end users and clients. These early warning signs could then be fed back into the defects management meeting for discussion and remedial action to be taken.

Vicious feedback loop [14→ 19→ 217→ 21→ 220→ 16→ 14]

The counteractions above help to break the vicious feedback loop that can come about due to delay in attending to defects. They break the chain of concepts that comprise the feedback loop in two ways. Firstly, they mitigate the time needed to attend (remedy) the defect [14] *and* secondly they reduce the amount of time defects go undetected therefore reducing the possibility of secondary defects being created [21].

19 experience delays in resolving defects ... responding quickly

172 experience delay in making facility 'available'

173 avoid incurring paymech penalty deductions

14 incur unaccounted for time remedying defects

217 experience knock on-effects of a defect

9 incur unaccounted for time determining ownership of the defect

199 incur unaccounted for time getting staff onsite

22 incur unaccounted for time getting materials on site

16 incur unaccounted for time making the repair

211 encounter disagreements over who is responsible for a defect

11 ConCo allocate an onsite defects mgt team ... offsite defect team

10 encounter long lead times for some critical spares

220 increase the complexity of work to be done

21 create secondary defects

12 develop a new defects mgt process of 'fix first argue later'

13 purchase critical spares in advance

205 tackle issues at earliest opportunity ' ... at a later point

216 'nip issues in the bud' ... allow them to become established

208 detect potential defects as soon as possible

200 have regular defects management meetings between partners

Map A14 Minimising response times to mitigate delay in attending to defects

Insight A14 (Map A15) Joint problem solving among project stakeholders to help mitigate delays

As well as revealing the counteractions that were taken on project A, the process that underpinned the identification and operationalising of these counteractions was also revealed – a process of joint problem solving among project stakeholders, in particular BuildIt, FM Co and members of the SPV senior staff – through a brain storming session [210]

What the brain storming session did was provide a forum for stakeholders to surface potential risks as well as jointly explore and agree potential mitigating actions. Consequently, as illustrated in Map A15, the session played a central role in identifying and operationalising the counteractions taken by the project team. For example, it was through this brain storming process that the risks associated with the existing defects management process [219] was identified and as a result the counteractions [12, 11, 13, 200] described previously were undertaken.

The counteractions that emanated from the brain storming session are its most noticeable consequences. However, Map A15 suggests that the session also appears to have had more subtle effects concerning the social processes taking place between the stakeholders involved in it. These subtle effects manifest themselves most obviously in concept [215] which concerns the establishment of the 'ethos' of the project team in terms of how they would work to manage defects. This concept suggests that the brain storming session was an enabler for, and helped engender, common values, beliefs and understandings among the stakeholders – a willingness to work together.

The effects of this ethos are important and systemic. For example, while the brain storming session revealed the risk of disagreement between stakeholders over defect ownership, without ethos of working together the policy of 'fix first argue later' might not have been agreed to [215→12]. Equally while it might have been valuable to have regular defects management meetings [219], without the ethos partners might have been less likely to have been open about issues [206] therefore making the meetings less potent in their ability to detect potential defects [208].

The construction industry is well documented within the literature as being notoriously adversarial in nature. Moreover, because the paymech system in PFI is designed to incentivise the provider to resolve defects quickly, there is tremendous emphasis on *urgency* when defects do occur. In effect there is a paymech clock

ticking while defects are unresolved and consequently managers are under significant pressure to make quick decisions. Nutt's (1999) research on decision making shows, that putting managers under pressure engenders behaviours that focus on 'who is responsible' and invoke 'defensiveness'. Thus it seems the inherent behaviours within the industry and the conditions created by a paymech system the scene in project A was pre-set to adversary. However, it appears that the ethos of working together generated by the brain storming session mitigated potential tendencies for partners to be adversarial in their relationship with one another and yielded benefits to the project.

In summary, it seems that while the primary purpose of the brain storming session was to elicit and manage risks, the session also played a role in managing the social processes among the partners in a way that changed the way partners behaved toward risks (and perhaps toward one another) in a way that had lasting positive effects on the project.

The previous paragraph begs the question – how was the social process of arriving at agreements and shared understandings managed during the brain storming session? There was no formal process of managing these processes within the brain storming session and nor was there a formal process of risk elicitation. In essence, the structure of the session was very fluid and involved staff simply 'pitching in' their thoughts.

Furthermore, there was already a foundational level of shared values and understandings between some of the participants of the brain storming session prior to its inception in particular the values of 'shared responsibility' [214] and taking a 'bigger picture approach' [201]. Thus, project A perhaps benefited from sheer serendipity of bringing a particular collection of stakeholders together who already held at least a basic set of common beliefs. However, as noted above, the project management literature suggests that serendipity cannot be relied upon as the likelihood is that adversary will be more common.

The tentative findings drawn from the above insight is that joint problem solving sessions such as **brain storming** can provide two important functions. Firstly they can provide means of revealing and mitigating risks to the project and secondly, they can help to support **social processes** taking place within the project, processes **that change the way people behave toward risks (and perhaps toward one another)** in a way that can have lasting positive effects on the project.

Furthermore, given the importance of both these functions to the project, **bringing formal structure to sessions** such as brain storming could help in proactively managing these functions increase their performance.

19 experience delays in resolving defects ... responding quickly

172 experience delay in making facility 'available'

173 avoid incurring paymech penalty deductions

14 incur unaccounted for time remedying defects

16 incur unaccounted for time making the repair

217 experience knock on-effects of a defect

9 incur unaccounted for time determining ownership of the defect

22 incur unaccounted for time getting materials on site

199 incur unaccounted for time getting staff onsite

220 increase the complexity of work to be done

211 encounter disagreements over who is responsible for a defect

10 encounter long lead times for some critical spares

21 create secondary defects

12 develop a new defects mgt process of 'fix first argue later'

11 ConCo allocate an onsite defects mgt team ... offsite defect team

13 purchase critical spares in advance

205 tackle issues at earliest opportunity ' ... at a later point

216 'nip issues in the bud' ... allow them to become established

208 detect potential defects as soon as possible

219 identify risk of existing defects management process

200 have regular defects management meetings between partners

206 encourage partners to be forthcoming with issues

215 establish ethos of how we handle future issues

210 run brainstorming session between LT partners

201 Individuals on LT understood the importance of taking a 'big picture' approach

214 LT members bought-in to shared responsibility

Map A15 Brainstorming and its impacts (green). Counteractions (bordered)

195

4.1.10 Summary of Findings from Case A

Chapter 2 (page. 55) set out the following research aim for this study:

- To identify the factors, and the relationships between them, that describe a system of factors that can bring about overruns in complex projects, in particular PFI projects.

Insights gleaned from analysis of case study A, described in the preceding sections, have taken steps toward tentative findings that attend to the above aim as well as revealing actions that can mitigate overruns. This section provides a summary of those findings.

Data from project A revealed that, from BuildIt's perspective, the **project's financial objectives** were of central concern. It was found that the literature suggests objectives play a fundamental role in guiding actions for their attainment (Ward et al 1991) and that in project A actions were being guided by **attention to a 'negative objective'** (Ackermann and Eden, 2011) of avoiding paymech deductions. The tentative finding that was drawn was that when considering projects, **objectives (positive and negative) and their ramifications need to be fully explored in order to gain a broader appreciation of the actions that might be necessary to successfully delivery the project.** Considering positive *and* negative objectives would also enable actions to be considered in light of both types of objectives such that conflicts could be identified (e.g. an action which attends to a negative objective having an undesirable consequence on a positive objective).

It was also found that **delay in making the facility available** following a defect report was the main risk of incurring payment deductions and, consequently, to the project experiencing overrun in operating costs. The nature of 'delay' in project A was found to be different to the typical use of the term in the project management literature. Typically delay is concerned with delay to project completion whereas in project A the term referred to delay in bringing the facility back up to specification following the occurrence of a defect during the project's operational phase.

Data from project A provided means of unpacking the delay risk, revealing that reported defects can trigger delay in making the facility 'available', in particular experiencing a high number of defects.

It was found that defects can comprise **'spurious'** and **'actual'** defects, and that there were a number of **factors that can generate or compound reports of defects.** One factor was **stakeholders making subjective judgements** about the facility which can generate **spurious defects**. The cause of subjective judgments was found to be **gaps in stakeholder knowledge**. For example, gaps in end user knowledge concerning the temperature specifications or technical operation of the facility could cause **end users** to report defects that were in fact spurious. Similarly the **client** might report a defect that is spurious because of a gap in their knowledge concerning their understanding of the specifications contained in the contracts.

A second factor that could generate spurious defects was found to be **changes in end user staff.** These changes were found to be frequent in the context of project A and could **cause knowledge gaps (discussed above) to re-emerge** resulting in further defects being reported. Due to the frequency of staff changes it was also suggested that attending to end user knowledge gaps would require on going attention.

Stakeholder interests were also found to play a role in reporting of defects. For example, it is in the interest of the FM Co to minimise ongoing operating costs therefore if the FM Co perceives a piece of equipment will not last the specified time period then they may claim that the equipment does not meet specification and thus raise a defect report. A similar situation was revealed in the case of the client and suggested that it was important to be aware of the coalitions that can occur among stakeholders and their interests. Furthermore, the FM Co example alludes to systemic interaction of factors. If it is assumed that the piece of equipment installed is designed to specification then the reporting of a spurious defect by the FM Co can be thought of as the **systemic effect of both the stakeholder's interests** *and* **a gap in the stakeholder's knowledge.** Thus, if the gap in knowledge was attended to i.e. the FM Co was made aware of the technical specifications this would mitigate the defect report being raised.

A final factor in relation to spurious defects concerned the process of recording defects. It was found that **gaps in stakeholder knowledge,** for example in FM Co concerning contractual obligations, can compound the number of spurious defects that are recorded and thus need to be managed. It was also found that **coalitions can form between stakeholders** because of **overlapping stakeholder interests** can compound the number of spurious defects reported. Consequently, it was suggested that gaps in stakeholder knowledge need to be identified and managed

and that the interests of individual stakeholders be understood so as to reveal potential coalitions that might form and impact upon the project.

The discussion thus far has focused on 'spurious' defects. However, project A data suggests that a factor that could trigger 'actual' defects was **inadequate maintenance of the facility**. It was found that **conditions in the external environment** were a potential risk in this regard, in particular **skills shortages in the market place**. The importance of contextual conditions is discussed in greater detail below.

Although the trigger of delay was defects, data from project A suggested that there were factors that could compound delay. In particular these were time taken to determine the legitimacy of defects; and time spent determining the ownership of defects both of which could lead to incurring unaccounted for time in remedying defects.

As touched upon above, **contextual conditions were found to be important** with respect to **defects and delays** (illustrated in Figure 41 below). For example, a *potential* risk factor that could generate defects was inadequate resourcing of the FM team tasked with managing defects. The data tentatively suggests that an **external environmental condition** of skills shortages in the market place could make it *potentially* difficult for the FM Co to find highly trained FM staff in the numbers needed for a project the scale of project A. however with regard to skills shortages it was suggested that understanding of the conditions surrounding a project is important because, as the preceding example indicates, these can have significant influence over project outcomes. Moreover, given the gestation period of PFI projects (which can be years in length), understanding the context that might surround the project in future, and the implications of it, would be valuable such that actions might be taken in the present to tackle those implications. For example, in the case of a skills shortage in the market place this is not quickly remedied and might require partnering with other organisations (such as local government skills agencies) to tackle the shortage.

A further finding was that determining the legitimacy of defects could lead to a **drop in productivity at BuildIt** because construction staff needed to return to the project. The reason staff needed to 'return' was an **internal environmental condition** of **human resource policies** within BuildIt (and norms of project based organisations more generally) whereby staff are moved on to new projects following

the completion of a project. Also, determining ownership of defects was identified above to be another *potential* risk factor that could compound delays. Determining ownership of defects, in theory, should be a matter of referring to the contracts but this approach was found to be made problematic by the **contextual conditions surrounding the occurrence of the defect**. Changes to end user staff (discussed above) were found to be the consequence of an **internal environmental condition** within the client organisation whereby there was high rate of turnover in the end user staff population. Moreover data from project A also suggests that **the consequences of reported defects and delays** does not end at the boundaries of the organisation but rather they can propagate into the **organisations external environment**. For example, it was found that one of the consequences of experiencing defects and attendant delays on project A is that it might damage BuildIts reputation within the market place for delivery of projects of this type. It was found that the effects of this damage can be significant by limiting thier ability to secure future work and that this outcome can have a long lasting effect (many years in length) on the business.
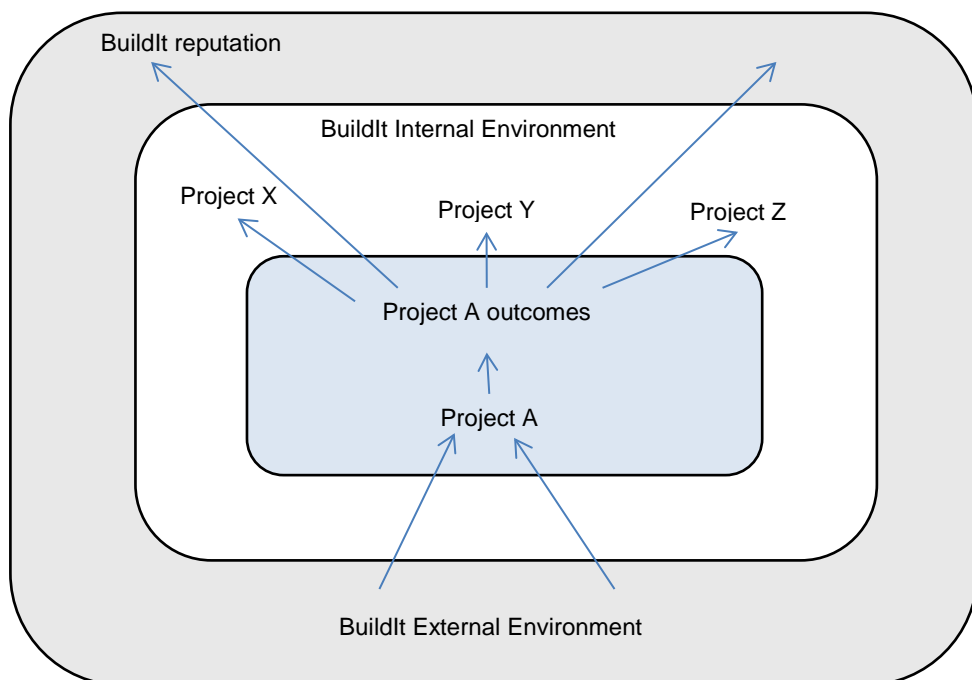
Figure 41 Conceptual illustration of interacting project contexts

A further finding from project A data was that **factors affecting overruns can induce dynamic project behaviours.** For example, as discussed above, defects trigger delay however it was found that delay in attending to defects could cause secondary defects thus **increasing the complexity of rework** which was shown to further contribute to delays (illustrated in Figure 42 below). A reasonable deduction to make here is that defects should be attended to immediately upon their being reported however the systemic nature of the factors influencing overruns comes to the fore. This is because, as noted earlier, one of the factors that causes delay is a shortage of staff caused by the **external environmental conditions** of a shortage of skilled staff in the market place therefore making attending to delays quickly potentially problematic.
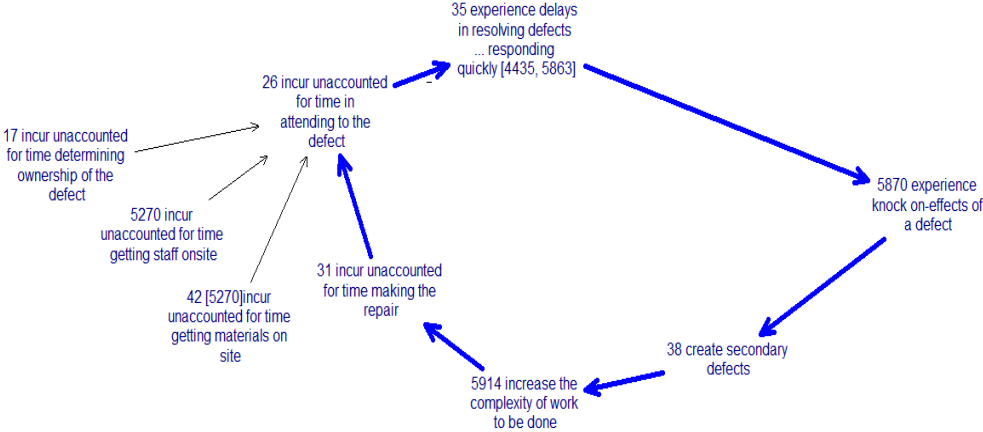
Figure 42 Dynamic behaviour induced due to delay in remedying defects

Finally, the issue of being able to attend to defects quickly was found to be important in relation to **managing the client stakeholder**. It was noted that if a project experiences high numbers of defects and attendant delays this **can induce the client to adopt an aggressive posture toward Buildlt**. However, it was found that this situation can be mitigated if defects are fixed promptly.

4.2 CASE B FINDINGS

4.2.1 Introduction

The purpose of this section is to report on the findings from the second case study examined in this research, project B. The section opens with brief context to the project which is then followed by a macro level view of how interviews with participants of project B unfolded. This information is provided to the reader to give further context to Project B but also to reveal the logic behind the structure used to present the insights drawn from the case study. The remaining sections present the findings from project B concluding with a section containing a summary of the findings.

4.2.2 Context to Project B

Project B was a similar to project A in that it was a large public medical facility procured under a Private Finance Initiative (PFI) contractual arrangement to design, construct, operate and maintain the facility. Unlike project A, however, which had been heralded as a 'success' by BuildIt, project B had been identified by BuildIt as having experienced cost overruns during the operational phase of the facility. Thus project B provided an opportunity for polar comparison (Pettigrew, 1990) with project A.

4.2.3 Overview of Interviews

The main focus of participants concerning overruns in project B was the operational phase of the project in which costs had exceeded their estimated values and thus had jeopardised the financial objectives of the project.

Again, like project A, delays in bringing the facility back up to specification following a reported defect were the driver for rising costs. As discussed in section 4.1.1, in a PFI contract the provider has a set window of opportunity within which a defect must be remedied. For each unit of time taken by the provider beyond this window, the client can deduct a proportion of the service payment to the provider.

Consequently, delays encountered in attending to defects puts the financial objectives of the project from the providers perspective at risk.

Unpacking the issue of delay, participants revealed that reported defects, in particular experiencing a high number of reported defects, was the cause of delay. In short, if there was no defect to be remedied then there could be no delay in bringing the facility back up to specification. Participants revealed a variety of factors that could trigger or generate defects reports including design decisions, end user perceptions, stakeholder interests and changes to project stakeholders. Participants also revealed a number of contextual conditions that were thought to be have contributed to triggers of defects and thus influenced the project's behaviour.

Although reports of defects were the trigger of delay, like project A, project B suggested that there were a series of factors that could compound delay. These included inadequate resource capacity and capability in the team tasked with managing defects.

Like project A, participants revealed 'Knock-on effects' of experiencing high numbers of reported defects and attendant delays in project B. These knock on effects were over and above experiencing the cost overruns and revealed that factors affecting overruns can induce dynamic project behaviours.

Finally, participant interviews revealed the counteractions that were taken to tackle the system of factors described above.

Using the points above the structure of reporting empirical insights gained from project B is as follows:

- On project objectives
- On triggering and compounding of defect reports
- On factors compounding Delays
- Emergent consequences of experiencing high numbers of reported defects and attendant delays
- Counteractions to undesirable project behaviour

4.2.4   Empirical Findings from Project B

This section presents the insights and resultant findings that were gained from project B using the process of analysis described in detail in section 3.7.

4.2.5   A Systemic View of Project B

As discussed in the methodology chapter, this thesis adopts a systemic modelling perspective of projects. One of the tenets of this approach is that to gain a full appreciation of project behaviour a holistic rather than a discrete view of projects is needed. In short, one must gain a view of the whole system that explains project behaviour, as well as its parts.

As described earlier, the sections that follow report individual insights gained from project A. While each insight makes its own unique contribution to explaining the behaviour of the project, it focuses only on a 'part' of the system that explains project A's behaviour. Focusing on the 'parts' is necessary so that they can be more fully explored and understood. However, focusing on the 'parts' means the reader is without a full appreciation of the whole system to which the 'parts' belong and which explains the behaviour of project B.

In order to attend to this gap, a model of the system that explains the behaviour of project B is presented (Map B1). It is not the intention that the reader be able to interrogate this model since, as discussed, each of its component parts will be examined in the forthcoming sections. Rather, the model is offered to provide the reader with a holistic view of the system, giving a fuller appreciation how the 'parts' of the system discussed in the following sections interlock to create a complex system that explains the behaviour of project B.
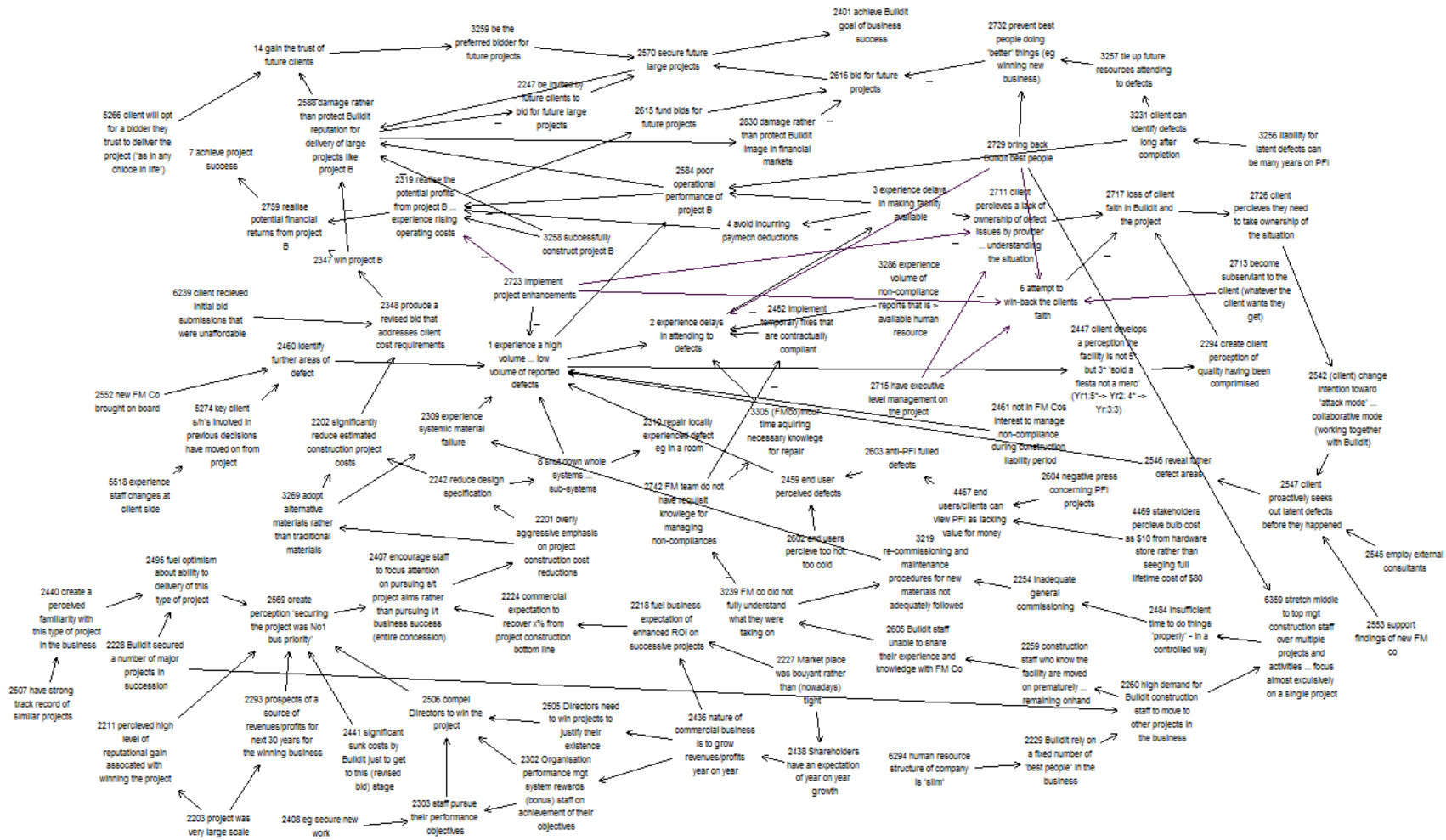
Map B1 A systemic view of project B

4.2.6 On Project Objectives

Insight B1 (Map B2) positive and negative objectives influence project behaviour

As noted in the introduction to this section, project B had experienced cost overrun during its operational phase. Consequently the aim of exploring project B was to understand the factors that contributed to the project outcome of cost overrun.

As discussed in the first case study introduced in the findings of project A, the literature suggests that objectives play a fundamental role in achieving project outcomes because objectives guide the actions of project actors (Ward, 1991, p.345). Consequently, gaining insight into the objectives that might have driven actions within project B and contributed to the outcome of project overruns would be valuable. The literature suggests that to gain this understanding, the objectives must be seen from the perspective of those involved because project objectives differ according to which stakeholder perspective the project is examined from (Bryde and Robinson, 2005, Turner, 2009). Map B2 illustrates the project objectives that were revealed from the participants of project B.

As can be seen from Map B2, like project A financial objectives were of central concern in project B. However, unlike project A, three of the participants in project B also cited needing to significantly reduce the construction cost of the project [2202] as a central objective in the project.

As shown on map B1, the client of project B had received a number of initial bids that were unaffordable within their available budget [6239]. Consequently, the client requested bidders to submit proposals for a revised design that addressed their financial requirements [2348]. In order to meet the clients cost constraint, and thus win the project, BuildIt needed to produce a revised bid with construction costs that were significantly reduced from their original submission [2202].

As the insights in the next section will show, the pursuit of cost reductions in project B in order to win the project was one of the contributing factors in project B experiencing overrun in its operational costs. The tentative finding being pointed to here is that, **when considering projects, objectives (positive and negative) and their ramifications need to be fully explored**.
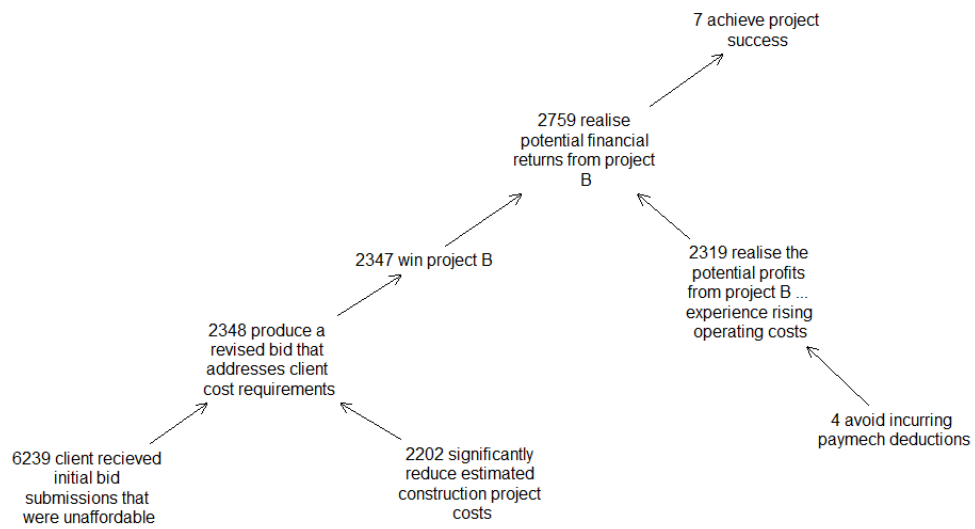
Map B2 Positive and negative objectives revealed by project B data

4.2.7   On the Triggers of Defect Reports

The previous section highlighted that one of the objectives of project B was to avoid paymech deductions as this would cause cost overruns in the operating phase of the project. Given project B experienced operational cost overruns this objective was not achieved.

Four of the participants of project B suggested that a key reason why the objective of avoiding paymech deductions was not achieved was because the project experienced a high number of reported defects [1569] which in turn caused delays in remedying defects [2] and ultimately delay in making those parts of the facility that had experienced defects available again [3]. Consequently, paymech deductions were incurred by the project [4] and it began to experience operational cost overruns.

The participants suggested that the high number of reported defects comprised 'actual' and 'spurious' defects (the distinction between the two types has been discussed in (section 4.1.6, page. 157) and provided insights into what triggered both these type of defects in project B. The triggers of defects are discussed in more depth below.

Insight B2 (Map B3): Design changes can trigger the generation of defects

As discussed in the preceding section, (and illustrated on Map B3) the client of project B had received a number of initial bids that were unaffordable [6239] within the fiscal constriants imposed by central government and consequently requested bidders to submit proposals for a revised design that could meet their finanical constraints [2348].

To meet the client's financial constraints, the construction costs of BuildIts initial bid had to be reduced significantly [2202]. In order to achieve the cost reductions BuildIt undertook changes to the design of the facilty, in particular the reduction of design specification [2242] and the adoption of new materials [3269]. As shown on Map B3, these changes contributed to BuildIt successfully winning the project.

However, as also shown on Map B3, during the operational phase of project B, these design changes manifested themselves as triggers of defect reports. The reduction in design spefication [2242], for example, meant that defects

experienced in one part of the facilty were felt else where in the facility. To illustrate, repairing a faulty electrical unit in one part of the facility for example in a room [2310] would require the electrical supply to be isolated. However, with a reduced design specification of the system, isolating the supply to the room might mean having to shut down whole systems [8], isolating the supply to all rooms in that area of the facility. Consequently, all rooms would be without electrical supply (rather than just the one with the defect) causing a high number of defect reports to be raised [1] and rendering multiple rooms 'unavailable' within the terms of the paymech system.

A further step taken to meet the clients cost needs was the adoption of new materials [3269] that were less expensive to install [3269]. As can be seen from Map B3, the adoption of new materials in the design [3269] was not, in and of itself, a trigger of defects being reported. Rather the data suggests that it was the adoption of the new materials [3269] *combined* with commissioning and maintenance procedures not being followed [3219]. Commissioning and maintenance is discussed in detail in the next insight however, in short, the use of new materials led to a gap in knowledge concerning the maintenance of these materials [3293] within the team tasked with maintenance. The combined effects of new materials and maintenance issues led to systemic material failures [2309] and consequently a high number of defect reports being experienced [1].

The tentative findings drawn from this insight thus far are that **design changes**, in particular the adoption of new materials, **can create a gap in the knowledge of the FM Co concerning the maintenance and re-comissioning procedures of these new materials leading to inadeqaute maintenance** and thus defects. Furthermore, should a defect occur during the operation of the facilty, then **design changes** (like reduced specification) **can have a multiplicative effect on the cost associated with repairing the defect**. In summary, **design changes that help to meet construction cost objectives can place operational cost objectives in jeopordy**.

As discussed above, the driver for reducing the cost of the design in project B was the need to meet the clients cost constraints. However participants also suggested there were a multitude of other conditions at work which were thought to have had contributed an overly aggressive emphasis on construction cost reduction. Map B4 illustrates these contextual factors which are discussed below.

What Map B4 illustrates is an interplay between external contextual conditions, internal contextual conditions and the influence these conditions had on the actions of the project team. In terms of external conditions, for example, the data indicates that there is an expectation that the business will grow revenues and profits year on year [2436], an expectation which is driven by market economic conditions, in particular shareholder expectations concerning revenue and profit growth [2438]. These conditions that are compounded by a further condition of buoyancy in the market place at the time of project B [2227], served to fuel an internal expectation of enhanced returns on project investments [2218] and the need to return x% from project B [2224].

Moreover the perceived need to grow revenues/profits [2436] appears to contribute to other internal conditions such as the use of performance management of staff that is focused upon winning new projects [2302] as well as creating expectations on management staff that they need to win new business to justify their position[2505]. The compound effects are to compel management to win new projects [2506] contributing to a perception by management that securing project B was a number one business priority [2569].

Adding to the perception that securing project B was a business priority [2569] are a number of other factors. First, that significant cost's had already been incurred by BuildIt to reach the position of the revised bid stage [2441]. The costs associated with a PFI procurement exercise can be substantial therefore having incurred significant sunk cost this served to further fuel the need to win the project so that the costs were not sunk. As noted above, the market expectation of a commercial business like BuildIt is to grow revenues/profts [2436]. This factor coupled with the fact that project B was very large scale [2203] and therefore presented significant revenue/profit opportunities further compounded the perception that the project was a priority to secure. A further factor that is relevant is the sense of optimism within BuildIt concerning their ability to deliver this type of project [2495]. In short, BuildIt had significant past experience of delivering projects of a similar type to project B [2607, 2440, 2228] therefore there was no reason to believe that they could not successfully deliver project B. A final factor that contributed to the perception of the project being a business priority was that securing project B could contribute to growth in reputation of BuildIt for this type of project[2211]. As noted in case A, track record plays an important role in securing future projects.

Based upon the above discussion it seems that the project team were under significant pressure (from multiple sources) to win project B [2569] and also to achieve the expected return on investment[2224]. As shown on Map B4, this pressure contributed to focusing staff decisions on the pursuit of short term cost savings [2407] rather than adopting a longer term view on decision making that took account of the entire life time of the project. As a consequence, it was believed by participants that this may have led to an over emphasis on cost reduction [2201], an emphasis which informed design change decisions such as reducing the facility specification [2242] and adopting new materials [3269].

What Map B4 also shows is that the external pressure of needing to reduce construction costs to meet the client's financial objectives [2348] was acting in unison with the internal pressures described above. Consequently, it was the systemic effect of these pressures that drove a strong emphasis on construction cost reduction rather than only the need to meet the clients cost requirements.

In summary, while a focus on construction cost reduction was triggered by client need other factors were at work. In particular, external conditions such as the need to return shareholder value created internal conditions at BuildIt that include pressure on management staff to win new work and pressure concerning expectations about the value of profit margins. These pressures further drive decision making toward achieving the lowest construction cost to attain the short term objectives of securing the project and achieving profit expectations. The focus on cost reduction was therefore strong because of the systemic effect of the foregoing pressures.

A strong focus on reducing the construction cost of the facility, perhaps diverted attention away from gaining a fuller appreciation of the longer term implications of cost reduction decisions, in particular their impact upon the operation of the facility therefore contributing to the operational cost overrun situation.

The tentative findings drawn from the above are that:

- **External contextual conditions** such as shareholder expectations for growing revenue/profits that are compounded by buoyancy in the market place **influenced internal contextual conditions** at BuildIt (Figure 43)**.**
- **Internal conditions** can include **expectations of the need to grow revenues and profits year on year** within the business; **organisational**

culture that compels management to win new projects to 'justify their existence' [2525] compounded by **performance management systems** that are geared to drive management toward winning new work. Furthermore, **strong past experience** of successfully delivering similar projects **creating optimism bias**.

- The above internal conditions draw staff attention toward **short term objectives** of securing work and achieving expected profit margins and as a consequence cost reduction can become a focus.

- Where attention is already focused on cost reduction due to the need to meet a client's cost constraints, the above conditions can serve to compound this focus. The systemic effect can be an **overemphasis on construction cost reduction to achieve short term objectives** (winning work and construction profits) which can marginalise longer term concerns about the operation of the facility. Particularly in PFI, operational concerns are of importance to the provider because, as discussed (page. 142), it is the provider not the client that is responsible for the facilities operation.

Figure 43 The interaction of contextual conditions and the project environment

2347 win project B

2348 produce a revised bid that addresses client cost requirements

2 experience delays in attending to defects

3 experience delays in making facility available

4 avoid incurring paymech deductions

2319 realise the potential profits from project B ... experience rising operating costs

1 experience a high volume ... low volume of reported defects

5274 key client s/h's involved in previous decisions have moved on from project

5518 experience staff changes at client side

2460 identify further areas of defect

2202 significantly reduce estimated construction project costs

2309 experience systemic material failure

8 shut down whole systems ... sub-systems

2459 end user perceived defects

2461 not in FM Cos interest to manage non-compliance during construction liability period

2552 new FM Co brought on board

6239 client recieved initial bid submissions that were unaffordable

2310 repair locally experienced defect eg in a room

2603 anti-PFI fulled defects

3269 adopt alternative materials rather than traditional materials

2242 reduce design specification

3219 commissioning and maintenance procedures for new materials not adequately followed

2602 end users percieve too hot; too cold

4467 end users/clients can view PFI as lacking value for money

4469 stakeholders percieve bulb cost as $10 from hardware store rather than seeing full lifetime cost of $80

2604 negative press concerning PFI projects

Map B3 The impacts of design changes to meet client cost objectives

2347 win project B ← 2348 produce a revised bid that addresses client cost requirements

2202 significantly reduce estimated construction project costs

3269 adopt alternative materials rather than traditional materials

2242 reduce design specification

2201 overly aggressive emphasis on project construction cost reductions

2440 create a perceived familiarity with this type of project in the business

2495 fuel optimism about ability to delivery of this type of project

2407 encourage staff to focus attention on pursuing s/t project aims rather than pursuing l/t business success (entire concession)

2224 commercial expectation to recover x% from project construction bottom line

2218 fuel business expectation of enhanced ROI on successive projects

2607 have strong track record of similar projects

2228 Buildlt secured a number of major projects in succession

2569 create perception 'securing the project was No1 bus priority'

2506 compel Directors to win the project

2505 Directors need to win projects to justify their existence

2211 percieved high level of reputational gain assocated with winning the project

2293 prospects of a source of revenues/profits for next 30 years for the winning business

2441 significant sunk costs by Buildlt just to get to this (revised bid) stage

2303 staff pursue their performance objectives

2436 nature of commercial business is to grow revenues/profits year on year

2227 Market place was bouyant rather than (nowadays) tight

2203 project was very large scale

2408 eg secure new work

2302 Organisation performance mgt system rewards (bonus) staff on achievement of their objectives

2438 Shareholders have an expectation of year on year growth

Map B4 The influence of contextual conditions on project behaviour

Insight B3 (Map B5) Inadequate commissioning and maintenance can trigger the generation of 'actual' defects

As touched upon above, and can be seen from Map B5, the compound effect of using new materials *and* the procedures for commissioning and maintenance of the new materials not being followed properly were believed to have caused systemic materials failures. Project B data provides deeper insight into the issue of commissioning and maintenance procedures. In order to fully explore this insight, the commissioning and maintenance trigger [3219] identified on Map B5 is reproduced on Map B6.

Map B6 offers explanations as to the causes of commissioning and maintenance procedures not being adequately followed. What it shows is that two contextual conditions were at work. First that BuildIt had secured a number of major projects in quick succession at the time of project B [2228] and second that human resource structure within the organisation [6294] meant that the organisation relied on a small fixed number of 'best people' [2229]. The compound effect of these conditions was to create high demand for management staff on project B to be involved in other projects within the business[2260]. The consequences of this demand were two fold.

Firstly, management staff were stretched across multiple projects [6359] and therefore were unable to dedicate adequate time to ensure that commissioning processes were conducted 'properly' [2484→ 2254]. Secondly, management staff were moved off the project prematurely [2259]. These staff had been involved in the project for a number of years and therefore had significant knowledge about it. However, by being moved on to new projects, these staff were not on hand to share their knowledge with other stakeholders, in particular the FM Co, to ensure they had adequate understanding of the facility and its systems [3239] thus creating a knowledge gap. The compound effect of management staff being unable to adequately supervise commissioning and to share knowledge with those maintaining the facility was believed to have led to inadequate commissioning and maintenance and, consequently, the occurrence of defects on project B.

The tentative finding drawn from the above insight is that **contextual conditions** including **operational success** and **human resource policies** can have significant effect on the **ability to commission and maintain** projects like project B (Figure 44 below).
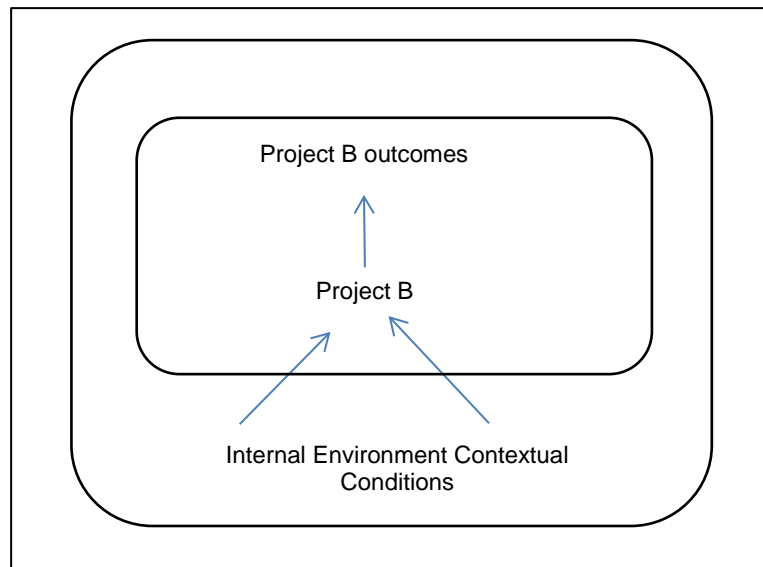
Figure 44 Conceptual model of interaction between external environment conditions, the project and its outcomes

Map B5 The effects of deficiencies in re-commissioning and maintenance procedures

1 experience a high volume ... low volume of reported defects

2309 experience systemic material failure

3219 re-commissioning and maintenance procedures for new materials not adequately followed

3269 adopt alternative materials rather than traditional materials

2254 inadequate general commissioning

3239 FM co did not fully understand what they were taking on

2484 insufficient time to do things 'properly' - in a controlled way

2605 Buildlt staff unable to share their experience and knowledge with FM Co

6359 stretch middle to top mgt construction staff over multiple projects and activities ... focus almost exculsively on a single project

2259 construction staff who know the facility are moved on prematurely ... remaining onhand

2260 high demand for Buildlt construction staff to move to other projects in the business

2228 Buildlt secured a number of major projects in succession

2229 Buildlt rely on a fixed number of 'best people' in the business

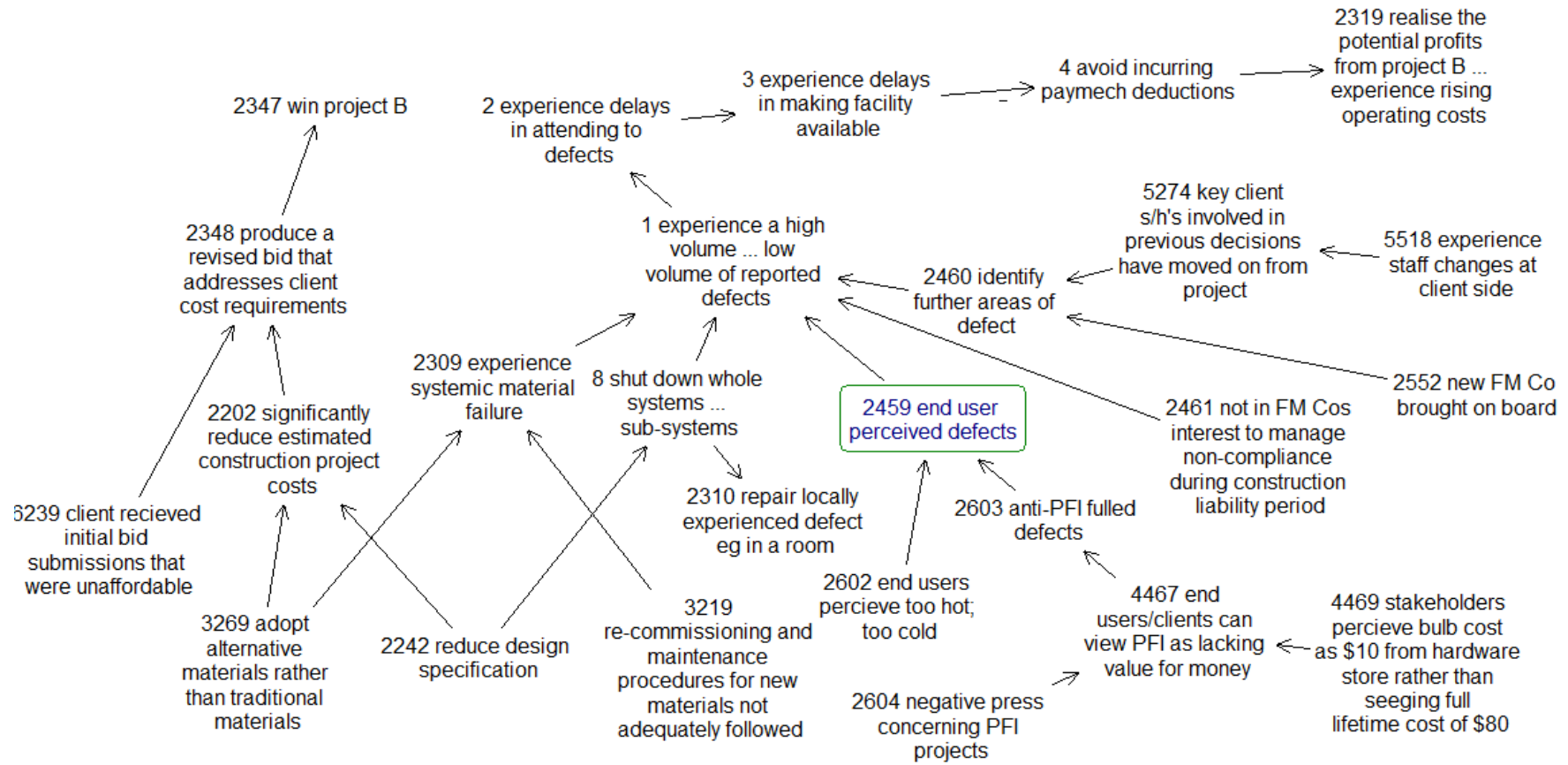6294 human resource structure of company is 'slim'

Map B6 Causes of deficiencies in facility commissioning and maintenance

Insight B4 (Map B7): Subjective stakeholder assessments can trigger the generation of 'spurious' defects.

A further trigger that generated reported defects in project B, in particular spurious defects was stakeholders making subjective assessments about the facility [2459]. The nature of this trigger was discussed at length in case study A (page. 158) however project B provides additional insight, in particular relating to end user and client perceptions about the value for money of PFI projects [4467]. Project B provided two examples of what can drive this questioning of value for money. The first example concerns replacement costs, in particular the cost of replacing a bulb [4469]. The costs associated with bulb replacement will include the cost of the bulb ($10) but also costs associated with sourcing, delivery, fitting and any necessary servicing ($70). Therefore, the total cost of replacement might be $80. However, what the data from project B suggests is that stakeholders only include the cost of the bulb ($10) in their estimation of replacement cost and consequently can perceive the value of $80 to replace a bulb as lacking in value for money.

The second example is that media attention concerning the value for money of PFI projects in general [2604] can also affect end user and client perceptions about value for money [4467]. For example, news in the press concerning poor value for money being experienced on PFI projects similar to project B can fuel end user and client perceptions of poor value for money. This negative perception can cause end users and clients to be very critical of, and thus find fault with [2603], the project leading to spurious defects being generated.

The tentative finding that can be drawn from the insight above is that **gaps in stakeholder knowledge** concerning the costs associated with maintaining the facility can lead to **negative stakeholder perceptions** and **spurious defects being reported.** A further contributing factor in this regard is an **external condition of negative media concerning PFI projects** which can further fuel negative perceptions and thus affecting the project. **Key stakeholders** in this regard are **end users** and **the client**.

2347 win project B

2348 produce a revised bid that addresses client cost requirements

2202 significantly reduce estimated construction project costs

6239 client recieved initial bid submissions that were unaffordable

3269 adopt alternative materials rather than traditional materials

2242 reduce design specification

2309 experience systemic material failure

8 shut down whole systems ... sub-systems

2310 repair locally experienced defect eg in a room

3219 re-commissioning and maintenance procedures for new materials not adequately followed

2 experience delays in attending to defects

1 experience a high volume ... low volume of reported defects

2459 end user perceived defects

2602 end users percieve too hot; too cold

2604 negative press concerning PFI projects

2603 anti-PFI fulled defects

4467 end users/clients can view PFI as lacking value for money

2460 identify further areas of defect

3 experience delays in making facility available

4 avoid incurring paymech deductions

2319 realise the potential profits from project B ... experience rising operating costs

5274 key client s/h's involved in previous decisions have moved on from project

5518 experience staff changes at client side

2461 not in FM Cos interest to manage non-compliance during construction liability period

2552 new FM Co brought on board

4469 stakeholders percieve bulb cost as $10 from hardware store rather than seeing full lifetime cost of $80

Map B7 The effects of subjective stakeholder assessments of the facility

219

Insight B5 (Map B8) Stakeholder interests can trigger reported defects

Data from proejct B also suggests that a further trigger of defects being reported is stakeholder interests. This trigger was also identified in project A and concerns defects being reported because stakeholders are, legitimately, working to protect their interests. However, project B provides further insight. It is that if the defect occurs during the construction liability period [2461]. then this, in essence, creates an incentive for the FM Co to pursue BuildIt to attend to the defect in the first instance. The logic here is quite simple, to resolve a reported defect would cost the FM Co money, therefore, it is worthwhile for the FM Co in the first instance to pursue BuildIt to resolve the defect rather than resolve it immediately themselves.
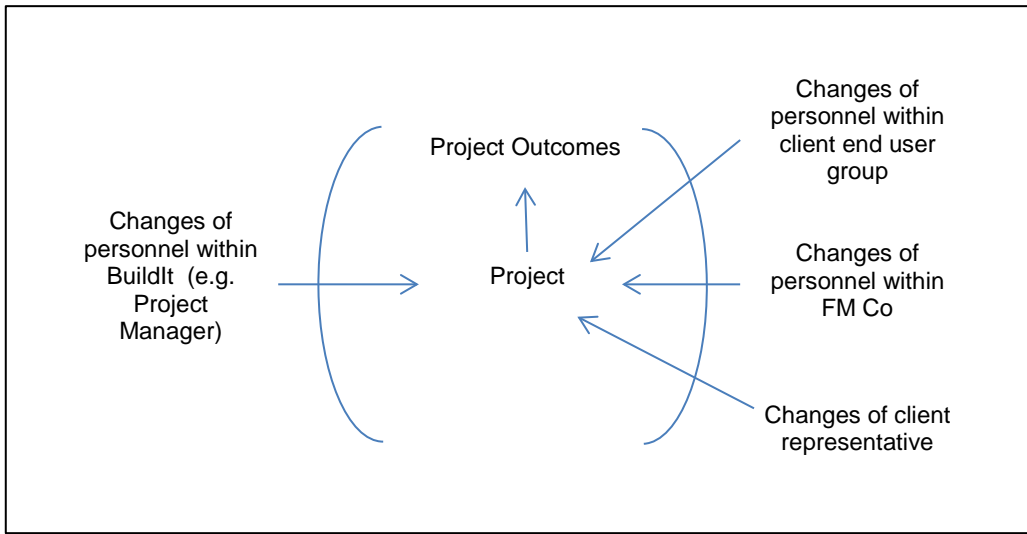
The tentative finding drawn from this insight is that **stakeholder interests** can cause defects to be generated and therefore must be understood and, where possible, managed during the **operational phase** of a PFI project.

Insight B6 (Map B8) Changes to stakeholder personnel can trigger reported defects
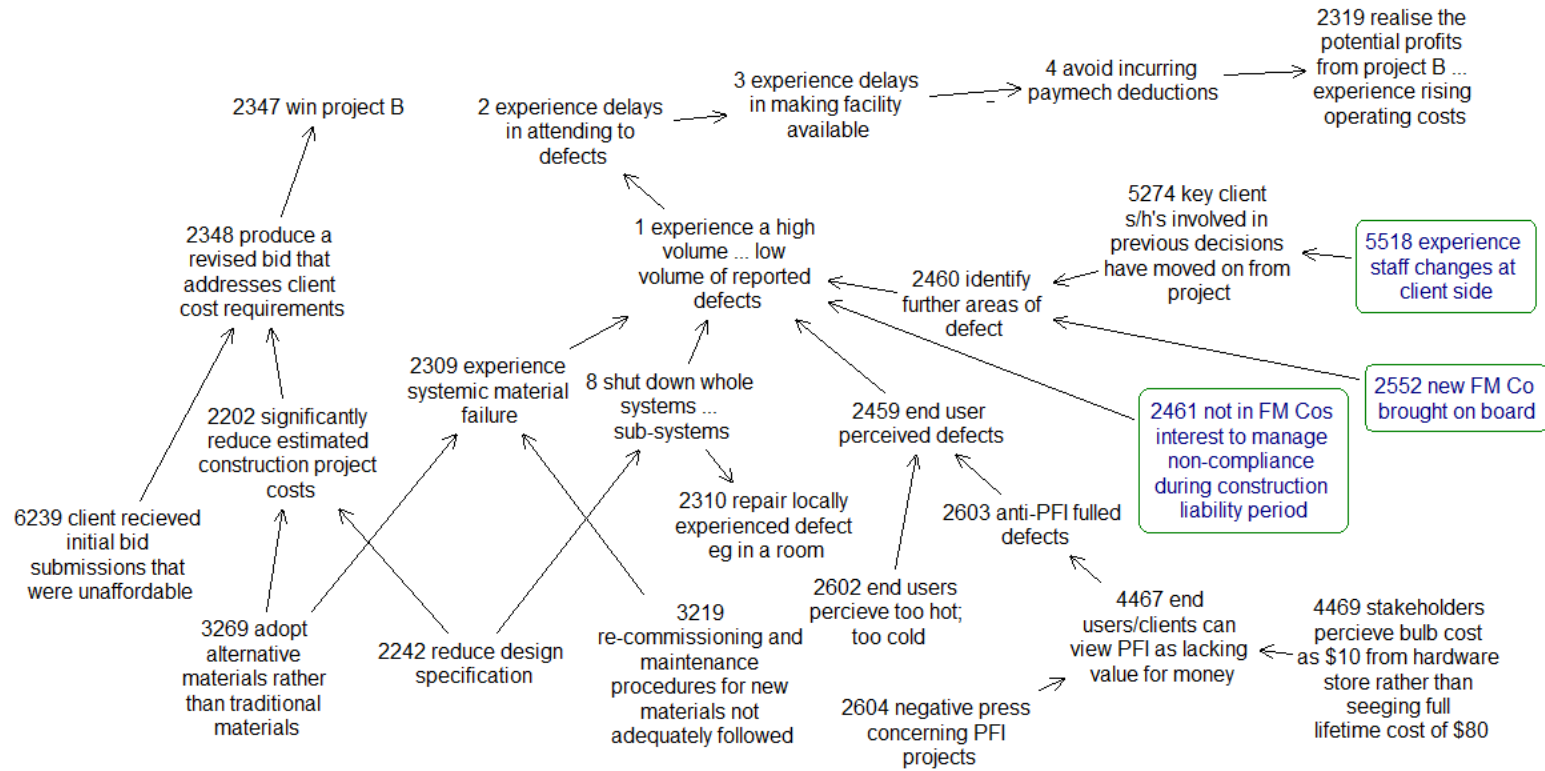
Data from project B suggests that a further trigger of defects being reported were changes to stakeholder personnel. Project A also revealed this trigger however project B data provides additional insight into its nature. In particular data from project B also suggests that personnel changes at the FM Co [2552] and also the client [5274] can result in further reports of defects. In essence, new stakeholder personnel joining the project can cause gaps in knowledge to re-emerge. For example, there might be defects that have been raised and agreed as resolved in the past between the predecessors of the client representatives and FM Co. However, the new client representative or FM Co personnel might not be aware of these agreements, or perhaps might not concur with them, thus causing new reports of defects to be raised.

Project A also identified that changes in personnel can generate defects, in particular the end user group, however the tentative finding drawn from the above insight is that a broader perspective on **changes of personnel** that considers **change within other stakeholder groups** include **FM Co** and **Client** might be valuable.   Based upon this finding the conceptual model presented in project A can be extended to the following (Figure 45).

Figure 45 Conceptual model of changes to personnel across project stakeholder groups

2319 realise the
potential profits
from project B ...
experience rising
operating costs

4 avoid incurring
paymech deductions

3 experience delays
in making facility
available

2 experience delays
in attending to
defects

2347 win project B

2348 produce a
revised bid that
addresses client
cost requirements

1 experience a high
volume ... low
volume of reported
defects

5274 key client
s/h's involved in
previous decisions
have moved on from
project

5518 experience
staff changes at
client side

2460 identify
further areas of
defect

2552 new FM Co
brought on board

2461 not in FM Cos
interest to manage
non-compliance
during construction
liability period

2202 significantly
reduce estimated
construction project
costs

2309 experience
systemic material
failure

8 shut down whole
systems ...
sub-systems

2459 end user
perceived defects

6239 client recieved
initial bid
submissions that
were unaffordable

2310 repair locally
experienced defect
eg in a room

2603 anti-PFI fulled
defects

3269 adopt
alternative
materials rather
than traditional
materials

2242 reduce design
specification

3219
re-commissioning and
maintenance
procedures for new
materials not
adequately followed

2602 end users
percieve too hot;
too cold

4467 end
users/clients can
view PFI as lacking
value for money

4469 stakeholders
percieve bulb cost
as $10 from hardware
store rather than
seeing full
lifetime cost of $80

2604 negative press
concerning PFI
projects

Map B8 The effects of stakeholder interests and changes to stakeholder personnel

4.2.8   On Factors Compounding Delay

The two preceding sections revealed triggers of defects being reported during the operational phase of project B and also revealed the contextual conditions that might have contributed to bringing about those triggers. As discussed, defects can cause parts of the facility to be rendered 'unavailable' under the terms of the paymech system. Consequently, delay in making the facility available again results in deductions being made by the client from the provider's (BuildIt) regular payment and thus rising operating costs of the facility from the perspective of BuildIt and its partners.

While reported defects might be the trigger of delay, two of the participants also identified factors that compounded the delay experienced on project B. These compounding factors do not trigger delay but rather can serve to worsen the extent of delay. These are explored below:

Insight B1 (Map B9): Resource capacity of FM staff can compound delays in attending to reported defects

The first compounding factor [3286] is a simple matter of resource capacity. In particular, the number of staff within the FM team tasked with co-ordinating defect reports being too small to cope with the volume of defects being reported. As a consequence, delay ensues in attending to defects. Project A data provided some insight into why the resource capacity of the FM team might be limited which was that skills shortages in the market place coupled with the complexity and scale of projects like project B, could make it potentially difficult to find highly trained FM staff in the numbers needed.

Insight B2 (Map B9) Resource capability of FM staff can compound delays in attending to reported defects

The second compounding factor [2742] concerned the capability of FM staff, in particular, their knowledge concerning the management of defect issues. For example, Map B9 illustrates that gaps in knowledge have two consequences. Firstly, time is incurred in gaining the knowledge needed to repair the non-compliant aspect [3305]. Secondly, there is a gap in knowledge concerning the contractual obligations of the consortium. In this example, the gap in knowledge concerns what constitutes

resolution of a defect in the eyes of the contract. As Map B9 suggests [2462] implementing a temporary repair for some defects could constitute resolution and therefore prevent further delay in making the facility available again. However, without this nuanced understanding of the contract the FM team pursued a permanent solution that took longer to implement, serving to extend the time delay in making the facility available again leading to rising paymech deductions. Furthermore, it can be seen that the premature transition of construction staff to new projects (discussed earlier) can also contribute to the gap in FM Cos knowledge relating to the management of defects.

As Map B9 shows the capacity and capability of FM staff have a compounding effect on delay.

The tentative findings from the two insights above are that the **capability and capacity of staff** tasked with managing defect situations can result in **delay in attending to defects**. In relation to capability, delays are incurred while **gaps in knowledge** are filled such that remedial action can be taken. Furthermore, **gaps in knowledge concerning contractual arrangements** can lead to **lost opportunities to resolve defects quickly**.

4 avoid incurring
paymech deductions

3 experience delays
in making facility
available

2 experience delays
in attending to
defects

2462 implement
temporary fixes that
are contractually
compliant

3286 experience
volume of
non-compliance
reports that is >
available human
resource

3305 (FMco)incur
time aquiring
necessary knowlege
for repair

2742 FM team do not
have requisit
knowlege for
managing
non-compliances

3239 FM co did not
fully understand
what they were
taking on

2605 Buildlt staff
unable to share
their experience and
knowledge with FM Co

2259 construction
staff who know the
facility are moved
on prematurely ...
remaining onhand

Map B9 Factors compounding delays in repairing defect issues

4.2.9 Emergent Consequences of High Numbers of Reported Defects and Attendant Delays

Thus far the findings have focused upon the causes of high numbers of defects experienced during project B. It has also been shown that experiencing a high number of reported defects contributed to delay in making the facility (or part thereof) available and, as a consequence, through the paymech system the client made deductions from BuildIt's regular payment.

Three of the participants of project B also suggested that there were other consequences, over and above incurring paymech deductions, that emerged as a result of experiencing high numbers of reported defects and attendant delays. This section examines these emergent consequences.

Insight B7 (Map B10) high numbers of reported defects and attendant delays can lead to a loss of the client's trust in BuildIt and the Project

As shown in Map B10 the compounding effect of experiencing high numbers of reported defects [1] and attendant delays [3] is that it can lead to a loss of client faith or trust in BuildIt and the project [2717]. To explain further, delays in making the facility available again following a defect report [3] are perceived by the client as the provider (BuildIt) not taking ownership and responsibility for the reported defects [2711]. As a consequence, this erodes the clients trust in BuildIt that they will adequately manage defects.

The high numbers of reported defects [1] also serves to erode client trust [1→2447→2294]. The value of project B was very high and therefore client expectations about quality were equally high. Indeed the client's expectation was for '5 start quality' [2447]. When that quality expectation is not met, the client feels that they are paying for a 5 star level of quality but only receiving 3 star and as a consequence they perceive that quality has been compromised by the provider (BuildIt).

The systemic effect of a perceived lack of ownership by the provider of reported defects coupled with the perception that quality has been compromised, eroded the clients trust in BuildIt and the facility [2717].

As a consequence of eroded trust, client feels *they* need to take control of the situation [2726] (rather than leave it to the provider). This sees client behaviour

move to, as one participant put it 'attack mode' [2542] or as another participant put it one of 'do not let them [BuildIt] get away with it [defects and delays]'. A similar scenario to this was touched upon in project A data which suggested that experiencing defects and delays can cause the client's behaviour toward BuildIt to change, to become more adversarial than co-operative. Project B data (Map B10), however, provides further insight into what the consequences of that change in behaviour can be.

What Map B10 suggests is that in this new mode of behaviour the client proactively seeks out non-compliant issues [2546] (defects), for example by bringing in external consultants to conduct audits of the facility [2545] or siding with the views of other stakeholders who are raising issues [2553]. As a consequence, new areas of non-compliance (defects) are revealed [2546], adding to the volume of defects that have been reported [1] which serves to further substantiate the clients original perception that quality has been compromised. Consequently a vicious feedback loop is generated (labelled feedback loop 1 – defect ownership on Map B10).

Furthermore, the additional defects to deal with [1] cause further delay [2, 3] which in turn serves to substantiate the clients original perception that the provider is not taking ownership of the issues [2711]. Consequently a second feedback loop is generated (labelled on Map B10 as feedback loop 2 – quality of facility).

The systemic effects of both feedback loops is to further erode the clients trust in BuildIt and the facility [2717] and so these vicious feedback loops continue creating a situation that participants described as an 'operational situation that is out of control rather than being managed' and that can never get back to a 'managable state'. This sense of being 'out of control' when feedback behaviour is present in projects is echoed within the project management literature which suggests that such dynamic behaviours are often incredibly difficult to recover from (Ackermann et al 2014, Cooper, 1994; Williams 1995).

Map B10 suggests that reducing the number of reported defects can bring the situation described above back under control because this breaks both feedback loops (1 and 2). Thus reducing the number of defects should be the focus of managerial action in the first instance. However, Map B10 also suggests that improving the response times to remedying defects might help to maintain client trust and thus potentially mitigate the effects of both feedback loops. To explain further, erosion of client trust is the compounding effect of both delay and high
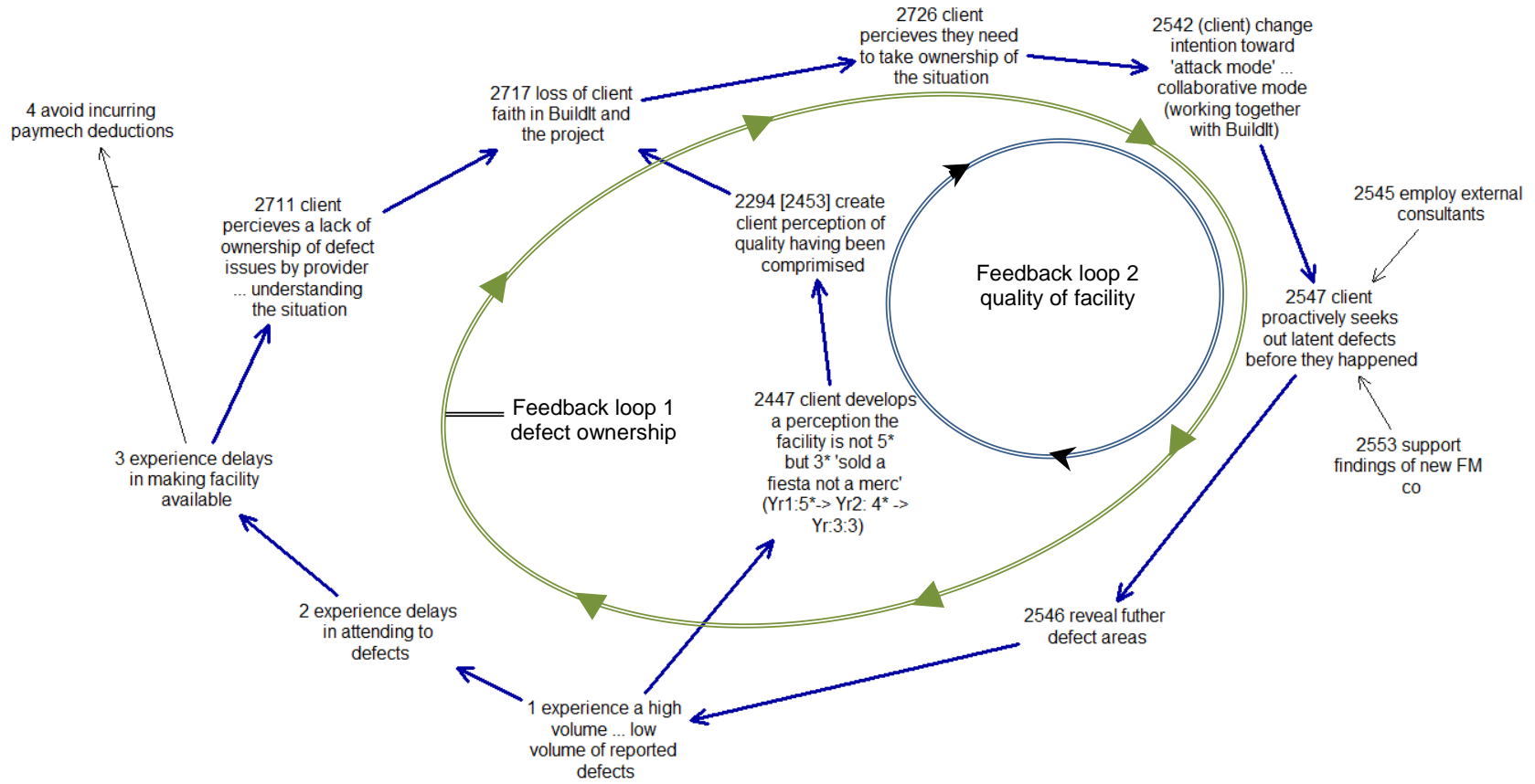
volumes of reported defects. Therefore, responding to defects quickly (thus reducing delays) might serve to maintain client trust. If client trust is maintained then this breaks both feedback loops. This action is substantiated by project A data which made a similar finding. There is also logic that supports this action. Fundamentally, the client's interest is in using the facility therefore the more the facility is available the better. If defects are resolved quickly then this will contribute to ensuring the facility is available therefore satisfying the client's interest.

A further suggestion made by one of the participants was that better management of the client during the defect situation could have been valuable. The meaning of 'better' was not expanded upon by the participant however the author reflected upon the suggestion which generated some ideas on what 'better' management of the client could entail. For example, in relation to delays in attending to reported defects, if it is assumed that, contrary to the perceptions of the client, BuildIt were taking ownership of reported defects and were working hard to resolve them, then perhaps helping the client understand more about the situation by informing them of the measures and resources that the BuildIt was putting in place to tackle the high volumes of reports could have helped maintain the clients trust in BuildIt that they were taking full responsibility for the situation and working on it. Furthermore, earlier *Insight B4* suggested that *reported* defects comprise of both *actual* and *spurious* defects. However, if the client only sees *reported* defect numbers then it may be valuable to furnish the client with information about the number of *actual* defects in order to help mitigate perceptions of poor quality. As a further step, if it is assumed that *actual* defects are of varying degrees of severity, then furnishing the client with information on the degree of severity could also help to allay perceptions of poor quality.

The tentative findings drawn from this insight are that **defects and resultant delays** can **induce dynamic behaviour** in the form of **vicious feedback loops** within the project. A central node in these feedback loops is the **erosion of the client trust in the provider and the facility**. Erosion of trust can cause a **shift in the client's role** in the project **from a passive mode**, where the provider (BuildIt) is given relative freedom to manage the operations of the project, **to an active mode** where the client takes a much more proactive role, in particular in seeking out defective aspects of the facility. Consequently, dynamic behaviour (feedback loops) is generated causing a situation that is out of control.

A further tentative finding is that to bring this situation back under control **tackling the number of defects should be the first priority** of the provider (in this case BuildIt) as this will help reduce delays in attending to defects as well as meeting client quality expectations thus breaking the feedback loops described above. A second action that can break one of the feedback loops (feedback loop 1 – defect ownership) and potentially mitigate the other (feedback 2 – quality of facility) is to **improve response times in remedying defects**.   Lastly, **improved stakeholder management of the client** could also **contribute to maintaining the clients trust in BuildIt and the facility**.

4 avoid incurring paymech deductions

2711 client percieves a lack of ownership of defect issues by provider ... understanding the situation

2717 loss of client faith in BuildIt and the project

2726 client percieves they need to take ownership of the situation

2542 (client) change intention toward 'attack mode' ... collaborative mode (working together with BuildIt)

2545 employ external consultants

2294 [2453] create client perception of quality having been comprimised

Feedback loop 2 quality of facility

2547 client proactively seeks out latent defects before they happened

Feedback loop 1 defect ownership

2447 client develops a perception the facility is not 5* but 3* 'sold a fiesta not a merc' (Yr1:5*-> Yr2: 4* -> Yr:3:3)

2553 support findings of new FM co

3 experience delays in making facility available

2 experience delays in attending to defects

1 experience a high volume ... low volume of reported defects

2546 reveal futher defect areas

Map B10 Dynamic project behaviour triggered by a loss of client trust in BuildIt and the project

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Thus far the discussion of findings from project B has focused attention at the level of the project. However, experiencing a high number of reported defects and attendant delays within the project was found to have damaging consequences at the organisational level of BuildIt. These consequences, discussed below, ultimately manifest themselves in BuildIt experiencing difficulty in securing future projects.

As Map B11 shows one of the consequences is that poor operational performance [2584] on project B (in terms defects and delays) damages BuildIt's reputation in the market place concerning their ability to deliver large projects like project B[2588]. In particular the damage concerns BuildIt's reputation from the perspective of two key stakeholders – future clients and future financiers.

This damage of reputation can be seen to generate three feedback loops.

- Feedback loop 1 suggests that damage to BuildIt's reputation might mean they are less likely to receive invitations from future clients for large projects therefore preventing them from securing future large projects.
- Feedback loop 2 suggests that, even if BuildIt are invited by a future client to bid for a large project, they might find difficulty in securing the position of preferred bidder therefore preventing them winning the project. This is because the data suggests trust plays a role in the clients selection of a preferred bidder [5266] and damage to reputation is likely to negatively affect client trust [2255→ 14].
- Feedback loop 3 suggests that damage to BuildIt's reputation might mean they less able to secure finances from financial markets that are necessary to secure a large PFI project like project B.

Map B11 shows that to secure future projects both clients [2247, 3259] *and* financiers [2830] are needed and, therefore, losing reputation with either stakeholder can prevent BuildIt securing future projects. Without securing projects BuildIt would be unable to maintain or grow its track record in delivering projects like project B, in effect, further erode their reputation [2588] and thus a vicious feedback loop is sustained.

A second consequence of poor performance on project B (in terms of defects and delays) is that BuildIt do not realise the potential profits of the project [2319]. Consequently, this might mean funds are not available to bid for new projects. PFI projects are hugely expensive therefore availability of significant funds is important.

A final consequence is that, in order to better manage the defect and delay situation on project B, BuildIt brought management staff back to the project [2729]. As discussed earlier, one of the roles of management staff is to secure new business however by being re-assigned to project B they were unable to perform this task therefore limiting BuildIt's ability to secure future work.

One further issue shown on Map B11 that is worthy of note with respect to the above discussion is the liability period associated with PFI projects. The liability period for defects in a PFI projects can be many years in length [3256] meaning clients can pursue BuildIt long after practical completion of the project[3231]. One participant cited an example project where the client had pursued BuildIt 6 years after construction completion. What this suggest is that the system of consequences described above can potentially emerge long after the project has been complete in terms of construction and therefore they present long term risks to the business. As one participant put it, these projects can 'come back to bite you'.

The tentative findings drawn from the above insights are that **poor operational performance on a project** (in terms of defects and delays) **can affect the BuildIt organisation as a whole**. For example, staff needing to return to the project and reduced operating profits from the project mean BuildIt has **less resources available to bid for future work**. Furthermore, poor operational performance on projects **can cause damage to the providers (BuildIt) reputation**, and **damage to reputation can be a central node in generating and sustaining vicious feedback dynamics** that can further prevent BuildIt from securing future large projects. In short, the **consequences of project risks** such as experiencing defects and delays **can extend beyond the boundaries of the project itself**. They can **penetrate up in to the organisational level** (in terms of reduced organisational profits) and **out into the external environment** (in terms of damage to reputation) thus project risks can translate into business risks. It appears that the membrane between the project and the organisation is highly permeable. That is, while the organisation can affect the project, it appears that the project can have significant effect on the organisation.

Finally while PFI projects may be valuable to the provider (BuildIt) in terms of providing a long term revenue stream, the length of the liability period associated with these projects means the above risks can be triggered long after the project has been complete in terms of construction. Consequently, PFI projects introduce long term risks into the on-going operations of the organisation (BuildIt) that if actualised can result in these **projects being business affecting** long after they have passed practical completion.

2401 achieve BuildIt goal of business success

Feedback loop 2

2570 secure future large projects

Feedback loop 3

2616 bid for future projects

2247 be invited by future clients to bid for future large projects

3259 be the preferred bidder for future projects

14 gain the trust of future clients

Feedback loop 1

2830 damage rather than protect BuildIt image in financial markets

2615 fund bids for future projects

2732 prevent best people doing 'better' things (eg winning new business)

5266 client will opt for a bidder they trust to deliver the project ('as in any chioce in life')

2588 damage rather than protect BuildIt reputation for delivery of large projects like project B

2319 realise the potential profits from project B ... experience rising operating costs

3257 tie up future resources attending to defects

2729 bring back BuildIt best people

3231 client can identify defects long after completion

2347 win project B

3258 successfully construct project B

3 experience delays in making facility available

2584 poor operational performance of project B

1 experience a high volume ... low volume of reported defects

3256 liability for latent defects can be many years on PFI

Map B11 The dynamics of project risk and long term future business risk

4.2.10 Counteractions to Undesirable Project Behaviour

The preceding sections focused upon revealing the systems of factors that brought about operational cost overrun in project B. However, two of the participants suggested that actions were taken by BuildIt in order to mitigate the overruns. These actions and their consequences are explored below.

Insight B9 (Map B12) Counteractions to cost overrun can induce undesirable consequences

The actions taken by BuildIt are shown on Map B12. As Map B12 shows, the actions were directed at three issues. Firstly to win back the faith of the client [6], secondly to reduce the number of defect reports [1] and third to reduce delays in attending to defects [2]. The actions and intended consequences are discussed in more detail below

One action that was taken was to implement project enhancements [2723] to improve the project's resilience, for example upgrading materials or equipment. The consequences of this action were multiple. First, the improved resilience mitigated further defects [2723→1]. Second, it demonstrated to the client that BuildIt were taking full ownership of defects thus negating the clients perception that BuildIt were avoiding ownership [2723→2711]. Third, the gesture of implementing the enhancements was believed to have helped re-instate the clients faith in BuildIt and the project [2723→ 6]. As can be seen from Map B12, this action had a powerful systemic effect on tackling the feedback loop identified in *Insight B8*. This is because it tackles three nodes in the loop concerning volume of defects [1], client perception concerning defect ownership [2711] and client trust [2717]. By tackling these two nodes, the feedback loop can be weakened or completely removed.

However, implementing project enhancements was very expensive and therefore, while the action had positive effects; it also carried a significant negative consequence of increasing the operating cost of the facility to BuildIt [2319].

A second action that was taken was to bring back some of BuildIt's best management staff to the project [2729]. The consequences of this action were also multiple. Firstly, this action helped to improve how defects were being managed, reducing the time taken to attend to defects [2729→2]. Second, the gesture of putting their [BuildIt] best people on the project was also believed to have helped re-

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instate the clients faith in BuildIt and the project [2723→ 6]. Like the action of implementing project enhancements, bringing back high calibre staff can be seen from Map B12 to have had a powerful systemic effect on tackling the feedback loop identified in *Insight B8*. This is because it tackles two nodes in the loop concerning delays [2] and client trust [6]. By tackling these two nodes, the feedback loop can be weakened or completely removed. However, this action also has a negative consequence for BuildIt which was touched upon earlier. It is that by bringing management staff back to a project these staff are unable to pursue new project opportunities for BuildIt.

Third, BuildIt also assigned an executive level member of their management team to the project to oversee proceedings, further demonstrating to the client their commitment to taking ownership of the defect situation [2711] and helping to re-instate the clients faith in BuildIt [6].

A further subtle counteraction that was taken was to adopt a subservient attitude toward the client [2713]. The sense here was that whatever the client needed they would get. This behaviour improved relations with the client [2713→6] however, like the actions discussion above, it also contributed to a negative consequence. The systemic effect of subservient behaviour [2713] coupled with BuildIt not meeting the contractual obligations (in terms of availability performance) [2594] was to change the nature of the power base between the two stakeholders [2719]. As one participant put it, the client had BuildIt 'over a barrel' and they (BuildIt) were 'on the back foot'. The impact of this 'change in power base' was to further empower the client enabling them to pursue their interests (i.e. having a facility that was of 5 star quality). As a result, the client adopted opportunistic behaviour [2720]. As one participant put it, the client attempted to 'drive the horse and cart through the door', for example, identifying yet other aspects of the facility they felt warranted attention [2721]. In order to continue reparing their relations with the client these additional aspects were attended to by BuildIt resulting in further rising of operating costs [2720→2319].

The tentative finding drawn from the above insight is that *reactive* counteractions to tackle dynamic behaviour can be costly and make the financial position of the project significantly worse before it gets better. This cost tentatively brings into question whether proactively attending to factors that can trigger this dynamic behaviour (defects and resultant delays) might be less costly than trying to recover from it. The costs of dealing with this (feedback) ramification included the financial

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cost of implementing project enhancements, opportunity costs associated with bringing back staff, costs associated with assigning executive level management, not to mention the potential reputational costs. Some a priori assessment of these costs would seem prudent so that an informed judgement can be made.

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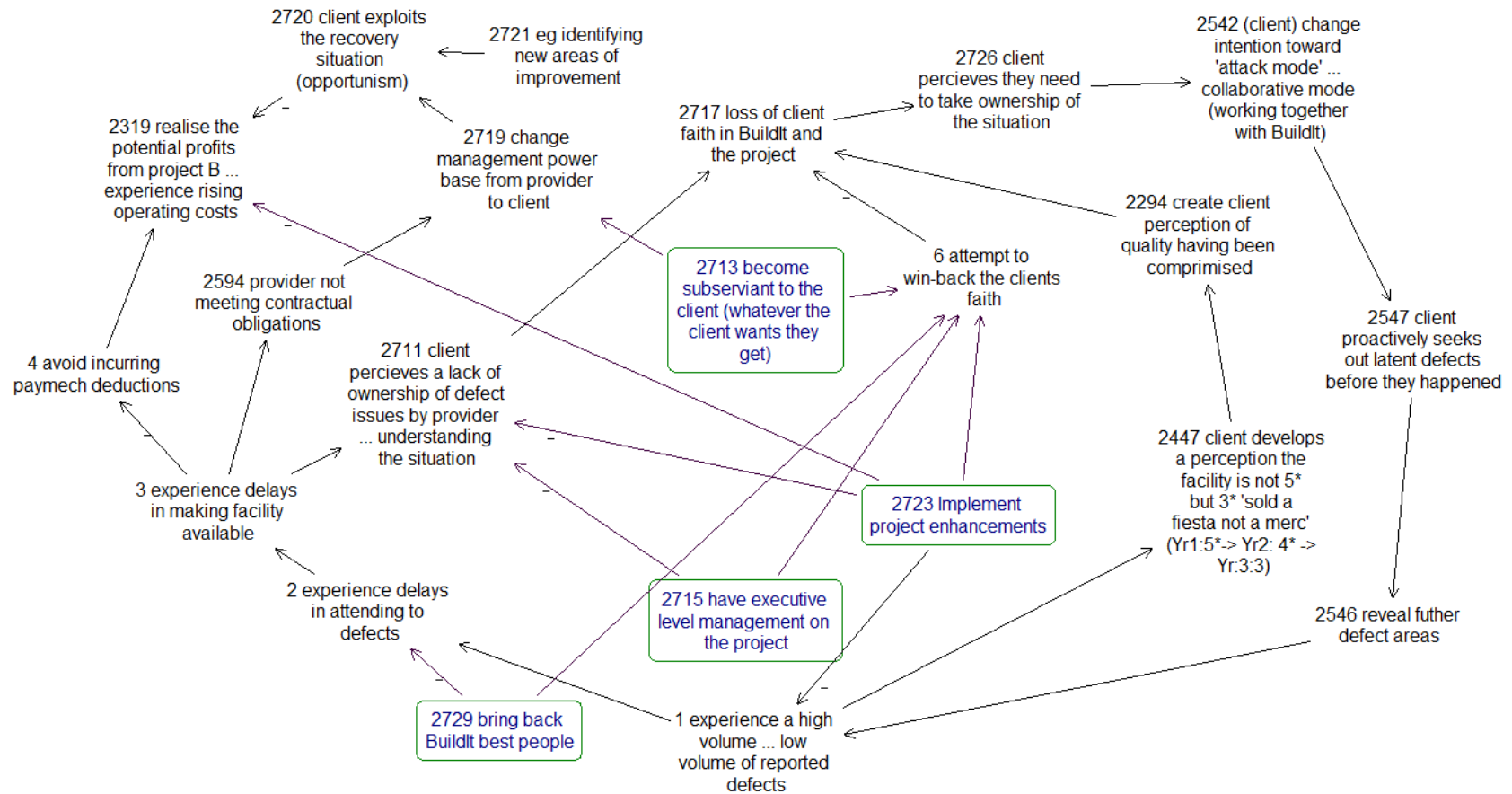
Map B12 Counteractions (highlighted) to recover the dynamic behaviour caused by the client's loss of trust

4.2.11 Summary of Findings from Case B

Chapter 2 (page. 55).set out the following research aim for this study:

- To identify the factors, and the relationships between them, that describe a system of factors that can bring about overruns in complex projects, in particular PFI projects.

Insights gleaned from analysis of case study B, described in the preceding sections, have taken steps toward tentative findings that attend to the above aim as well as revealing the consequences of actions taken by BuildIt to mitigate the extent of cost overruns. This section provides a summary of those findings.

Data from project B revealed that, from BuildIt's perspective, project B had in common with project A the ambition to avoid the 'negative objective' (Ackermann and Eden, 2011, p.118) of incurring paymech deductions during the operational phase. However, unlike project A, project B a further objective was cited by participants as salient which was the need to significantly reduce the construction cost of project B due to client financial constraints.

As has been discussed in the previous sections, the pursuit of construction cost reductions in project B was one of the contributing factors in the project experiencing operational cost overrun. The tentative finding that was drawn was that, **when considering projects, objectives (positive and negative) and their ramifications need to be fully explored**.

It was found that defects can comprise **'spurious'** and **'actual'** defects, and that there were a number of **factors that can generate defects.** One factor was design changes. It was found that defects can comprise **'spurious'** and **'actual'** defects, and that there were a number of **factors that can generate defects.** One factor was design changes. It was found that in order to reduce construction costs (discussed above) BuildIt undertook some design changes. It was subsequently found that these **design changes**, in particular the adoption of new materials, *combined* with **commissioning and maintenance procedures not being adequately followed** led to systemic material failures and consequently a high number of defects experienced on project B. Furthermore, it was found that in the event of a defect occuring, **design changes**, in particular reduced specification **can have a multiplicative effect on the cost associated with repairing the defect**. In

summary, **design changes that helped to meet construction cost objectives placed operational cost objectives in jeopardy.**

A further factor was **stakeholders making subjective judgements** about the facility which generated **spurious defects. Gaps in stakeholder knowledge,** in particular end users and clients, concerning the costs associated with maintaining the facility were found to fuel **negative stakeholder perceptions concerning value for money**. These negative perceptions were believed to cause stakeholders to become critical of and find fault with the facility and thus generate **spurious defects.**

A further factor found to generate defects for BuildIt to manage was **stakeholder interests,** in particular the FM Co. It was found that if the defect occurred during the construction liability period then this, in essence, created an incentive for the **FM Co** to pursue BuildIt to attend to the defect in the first instance (whether BuildIt was responsible or not). The logic here was that to resolve a reported defect would cost the FM Co money, therefore, it is worthwhile for the FM Co in the first instance to pursue BuildIt to resolve the defect rather than resolve it immediately themselves.

Data from project B suggests that a further trigger of defects being reported was **changes to stakeholder personnel**. Project A also revealed this trigger however project B data provided additional findings into its nature. In particular data from project B also suggested that personnel changes at **the FM Co** and also **the client** can result in further reports of defects. In essence, new stakeholder personnel joining the project can **cause gaps in knowledge to re-emerge**. For example, there might be defects that have been raised and agreed as resolved in the past between the predecessors of the client representatives and FM Co. However, the new client representative or FM Co personnel might not be aware of these agreements, or perhaps might not concur with them, thus causing new reports of defects to be raised.

It was also found that **contextual conditions** had important influence on the above triggers of defects. For example it was found that the **external conditions** of **shareholder expectations** for growing revenue/profits coupled with **buoyancy in the market** place, fuelled **internal contextual conditions** at BuildIt such as **expectations of the need to grow revenues and profits year on year** within the business; **organisational culture** that compelled management to win new projects to 'justify their existence'; use of **performance management systems** that were

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geared to drive management towards winning new work. Furthermore, **strong past experience** of successfully delivering similar projects **created optimism bias**. These internal conditions were found to have **drawn staff attention toward short term objectives** of securing work and achieving profit expected profit margins and **as a consequence cost reduction became 'the' focus**. However, as discussed above **attention was already focused on cost reduction** due to the need to meet a client's cost constraints, therefore the preceding conditions **served to compound this focus, t**he systemic effect of which was an **overemphasis on construction cost reduction** to achieve shot term objectives (winning work and construction profits) which marginalised longer term concerns about the operation of the facility in particular the implications of design changes.

Internal contextual conditions were also found to play an important role the commissioning and maintenance of the facility. It was found that BuildIt had enjoyed operational success in terms of securing a number of major projects in quick succession at the time of project B. It was also found that the human resource structure within the organisation meant that the organisation relied on a small fixed number of 'best people'. The **compound effect of these internal conditions** was to **create high demand for management staff on project B to be involved in other projects within the business**, the consequences of which were two fold.

Firstly, management staff were stretched across multiple projects and therefore unable to dedicate adequate time to ensure that commissioning processes were conducted 'properly'. Secondly, management staff were moved off the project prematurely and were, therefore, not on hand to share their knowledge about the facility with other stakeholders, in particular with the FM Co, to ensure they had adequate understanding of the facility and its systems [3239] thus creating a knowledge gap. The compound effect of management staff being unable to adequately supervise commissioning and to share knowledge with those maintaining the facility was believed to have led to inadequate commissioning and maintenance and, consequently, the occurrence of defects on project B.

External contextual conditions were also found to contribute to subjective stakeholder assessments of the facility (described above). In particular the **external condition of negative media coverage concerning PFI projects** was found to further fuel negative perceptions of project B causing end users and clients to be critical of and find fault with project B, leading to **spurious defects being generated**.

Although the trigger of delay was defects, data from project B suggested that there were **factors that could compound delay**. In particular these were the **capability** and **capacity of staff** tasked with managing defect situations. In relation to capability, time spent attending to **gaps in knowledge** so that actions to remedy defects could be taken incurred delay. Furthermore, **gaps in knowledge concerning contractual arrangements** led to **lost opportunities to resolve defects quickly**.

A further finding from project B data was that **factors affecting overruns can induce dynamic project behaviours.** In particular, **defects and resultant delays** was found to induce **vicious feedback loops.** A central factor in this feedback behaviour was the **erosion of the client trust in the provider and the facility**. It was found that this feedback loop sees a **shift in the client's role** in the project **from a passive mode to an active mode** whereby the client actively pursues defects which causes further defects and delays. A further finding was that to bring this situation back under control **tackling the number of defects should be the first priority** of BuildIt as this will help reduce delays in attending to defects as well as meeting client quality expectations thus breaking the feedback loops described above. A second action that can break one of the feedback loops (feedback loop 1 – defect ownership) and potentially mitigate the other (feedback 2 – quality of facility) is to **improve response times in remedying defects**. Lastly, **improved stakeholder management of the client** could also **contribute to maintaining the clients trust in BuildIt and the facility.**

A further factor that was central to feedback dynamics was **damage to BuildIt's reputation** caused by **poor operational performance on project B** (in terms of defects and delays). **Damage to reputation** was found to be a central node in **generating and sustaining vicious feedback dynamics** that can **prevent BuildIt from securing future large projects** and consequently **can affect the BuildIt organisation as a whole.**

Poor operational performance on project B was found to affect the BuildIt organisation in other ways. For example, staff needing to return to the project and reduced operating profits from the project (due to paymech deductions for delays) means BuildIt has **less resources available to bid for future work**.

The summary finding drawn from the above points was that the **consequences of project risks** such as experiencing defects and delays **can extend beyond the**

boundaries of the project itself. They can **penetrate up in to the organisational level** (in terms of reduced organisational profits and tying up human resources) and **out into the external environment** (in terms of damage to reputation). The **project risks can translate into business risks**. It appears that the **membrane between the project and the organisation is highly permeable**. That is, while the organisation can affect the project, it appears that the project can have significant effect on the organisation.

Finally, data from project B provided insight into the actions that were taken by BuildIt to mitigate the extent of operational cost overruns. In particular, these actions attended to the dynamic behaviour described above. The finding drawn was that *reactive* **counteractions to tackle dynamic behaviour can be costly** and **make the financial position of** the project significantly worse before it gets better. The costs of dealing with this (feedback) ramification included the financial **cost of implementing project enhancements**, **opportunity costs** associated with bringing back staff, **costs associated with assigning executive level management**, not to mention the potential **reputational costs**. These costs **bring into question whether prevention rather than correction** of the factors that can trigger dynamic behaviour (defects and resultant delays) might be less costly. Some a priori assessment of these costs by BuildIt would seem prudent so that an informed judgement can be made.

4.3   COMPARISON OF CASE STUDY FINDINGS

The preceding sections presented the findings drawn out from each of the case study projects. This section focuses on comparison of the two case studies to draw out overall research findings. The process of comparison follows guidance from Yin (2003) who suggests that cases be compared using replication logic. Replication logic has two forms. One is literal replication where a finding from one case is found to be replicated within another case. The second type of replication is analytic replication which is where findings might be different between cases however this difference can be explained theoretically.

Recognising that the reader may wish to refer back to the case study findings for more detail, page references are included during the following comparison.

4.3.1   The Nature of Cost Overrun

A common finding in the two case study projects was that neither suffered time or cost overrun during their construction phase. Instead the locus of discussion for cost overrun centred upon the operational phase of the two projects.

Both project's (page.157 and page.207) revealed that **operational cost overruns** experienced by the provider (BuildIt) can be the result of **incurring deductions** to their regular operational payment from the client. These deductions, referred to as paymech deductions, are brought about due to the facility (or part thereof) becoming 'unavailable' under the terms of the payment mechanism. The cause of unavailability was found in both cases to be the **occurrence of defects**. Experiencing a high number of defects, in particular, can trigger delay in remedying defects thus increasing the likelihood of the facility being 'unavailable' and paymech deductions being made. In short, the finding from both projects was that a very superficial explanation of operational cost overrun is described by the causal chain of events in Figure 46 below.
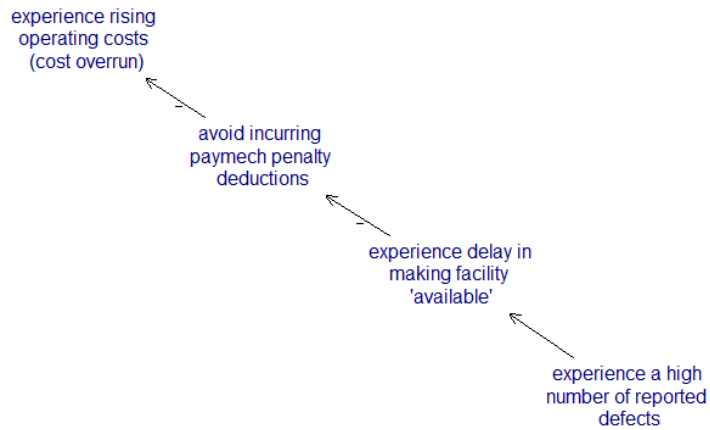
Figure 46 Superficial explanation of operational cost overrun

4.3.2 Emergent Consequences of Defects and Resultant Delays

In both case A and case B it was observed that the simple chain of events in Figure 46 above can induce much more **complex dynamic project behaviour**, in particular **feedback loops.** A feedback loop identified in project A (page. 177) was a **vicious feedback loop involving the occurrence of re-work** in the project, illustrated below in Figure 47.
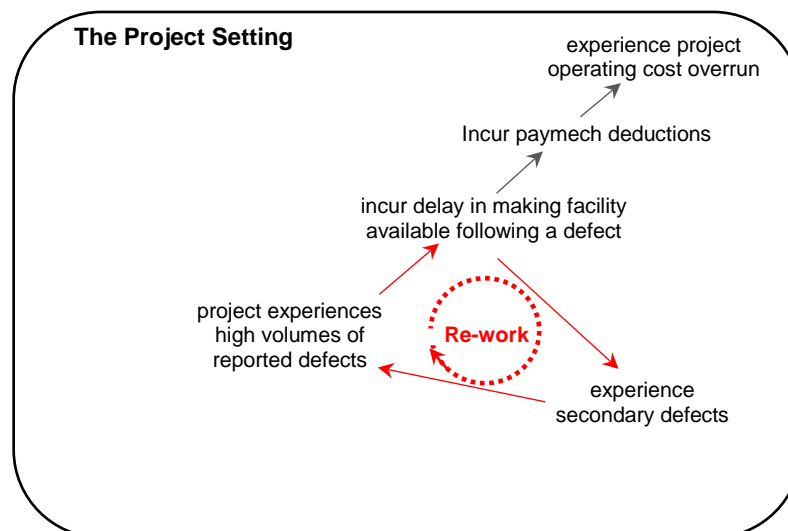
Figure 47 Vicious feedback loop involving re-work

Although the re-work feedback loop was not identified in the data of project B, two of the elements that are central to the loop (*high volumes of defects* and resultant *delays)* were found in project B. Consequently, it seems reasonable to suggest that this loop could have presented itself in project B and therefore analytic replication of this feedback loop is argued for.

A feedback loop identified in project B (page. 228) that was *high volumes of defects* and resultant *delays* was a **vicious feedback loop** involving **erosion of the client's trust in Buildlt and the facility** (Figure 48).
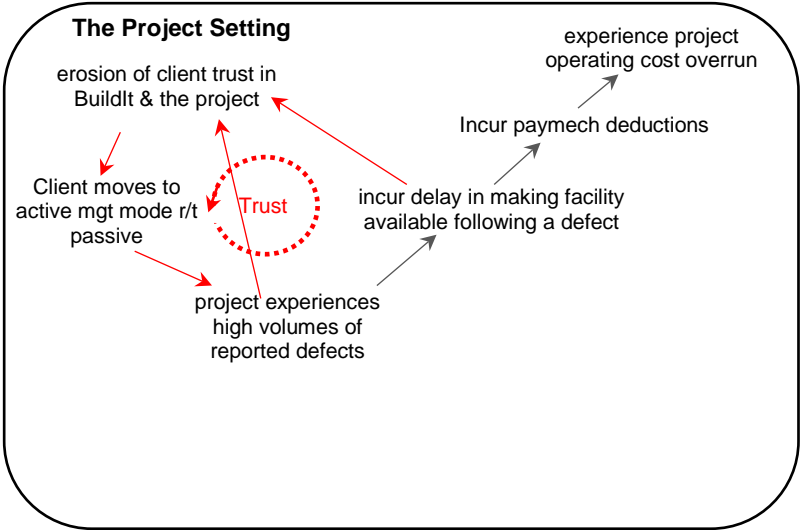
Figure 48 Vicious feedback loop involving erosion of client trust

As illustrated in Figure 48, it was found that the erosion of client trust, induces a change in the client's behaviour from **passive to active,** the latter being where the client takes a much more **proactive role** in the management of the project's operations.

Although this feedback loop was not identified in project A, elements that were central to its activation in project B (high volumes of defects and resultant delays) were identified in project A (page. 172) suggesting that this feedback loop could have presented itself. One reason the loop did not appear in project A was the counteractions taken by the project team to minimise defects and delays. On the basis of the foregoing evidence, analytic replication of the erosion of trust feedback loop is argued for in project A.

The erosion of trust feedback loop and re-work feedback loop which are both induced by defects and resultant delays were found to have strong effects at the project level by **exacerbating the cost overrun situation.**

However, project B findings (page. 232) suggested that **poor project performance** (in terms of defects and resultant delays) **can induce dynamic feedback outside the boundaries of the project** (Figure 49). In short, poor project performance can trigger damage to Buildit's reputation for delivery of projects like project B which in turn acts as a barrier to BuildIt securing future projects of a similar type. Difficulty in securing future projects causes **damage at the organisational level** in terms of reduced profitability.
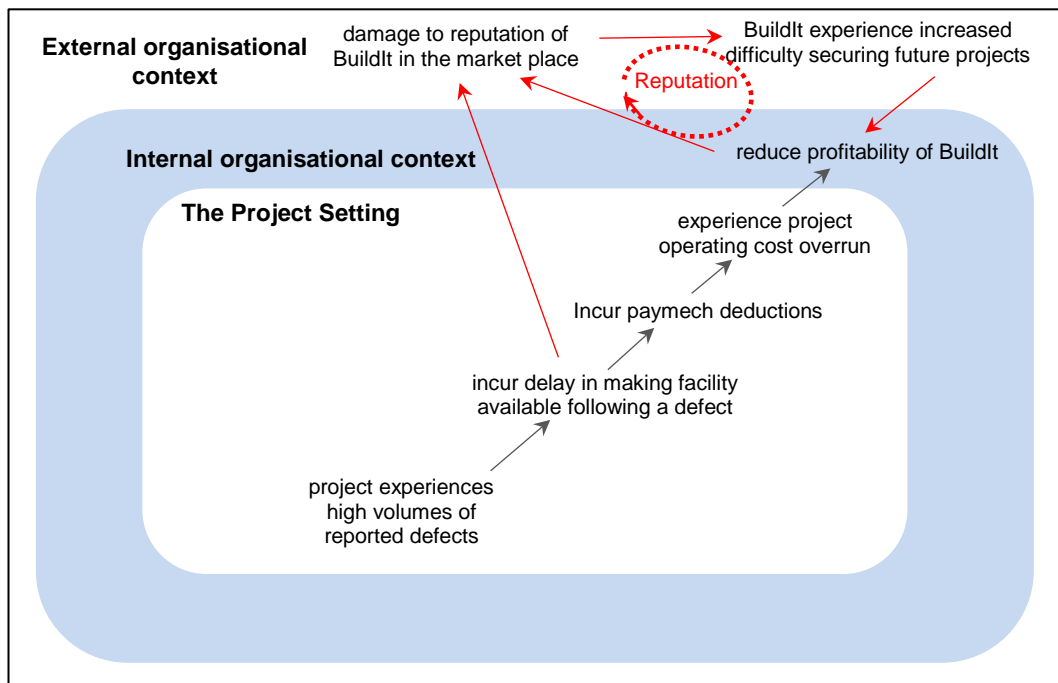
Figure 49 Vicious feedback loop involving damage to reputation

Although the reputation feedback loop is not identified in project A, concepts that are central to its activation, in particular reputation and its role in securing future projects were identified in project A data (page. 179). This suggests that the feedback loop *could* have presented itself in project A. The absence however can be explained by the fact that project A was a success and did not encounter defects and delays. Indeed reversing the logic of the feedback loops identified above would suggest that project A served to improve BuildIt's reputational position. Based upon

the foregoing points, analytic replication of the reputation feedback loops is argued for in project A.

The overarching finding drawn from the above points is that the **consequences of project risks** such as experiencing defects and delays **can extend beyond the boundaries of the project itself**. They can **penetrate up in to the organisational level** (in terms of reduced organisational profits) and **out into the external environment** (in terms of damage to reputation). As a consequence, project risks can translate into business risks that can affect the ongoing operations of BuildIt. It appears that the membrane between the project and the organisation is highly permeable. That is, while the organisation can affect the project, it appears that the project can have significant effect on the organisation.

Following the principles of a critical realist approach to research set out in Chapter 3:, the aim in both case studies was to **get beneath the chain of events** described above in Figure 46 Figure 49 to **understand how these events were brought into being**. In both cases a series of factors were revealed that can have influence, these are explored next.

4.3.3   Triggers of Operational Cost Overrun

4.3.3.1   Design Changes

Case study B (page. 207) found that design changes can lead to defects being experienced in the operational phase of the project. Firstly, reduced design specification meant that to resolve a defect in one area involved shutting down entire systems therefore making other areas unavailable and increasing the number of defect reports. Secondly, design changes brought about the use of alternative materials which in combination with inadequate commissioning (discussed next), was found to be a potential trigger of defects being generated.

Design change did not appear in case study A data however this absence can be explained. In case study B, the reason design changes were undertaken was to reduce construction costs in order to satisfy the client's financial constraints. In case study A there was no evidence that such cost reduction was necessary. However, had it been necessary, then it seems reasonable to suggest that the effects

observed in case study B *could* have been observed on case study A and therefore analytic replication is argued for.

4.3.3.2   *Commissioning and Maintenance*

The issue of inadequate commissioning and maintenance was found to be literally replicated in both case studies. In project A (page. 163), this was found to be a risk that never materialised whereas in project B the risk came to fruition. In both cases a reason for inadequate maintenance was found to be the skill base of the FM Co. In project A, this risk was mitigated by BuildIt keeping some of its construction staff onsite for 6-9 months to share with the FM Co their experience of the facility and its systems.

In project B, on the other hand, the risk associated with the activities of commissioning and maintenance came to fruition and was believed by participants to have played a role in causing defects (page. 214). High demand for BuildIt construction staff to move on to, or get involved in, other projects was found to influence both activities. In terms of maintenance, the demand caused construction staff to be moved off the project and therefore, unlike in project A, they were not available to share their experience of the facility and its systems with FM Co staff. In terms of commissioning, demand for management staff to be involved in other projects meant they were stretched across multiple projects meaning they had less time to dedicate to project B and ensure activities like commissioning were adequately undertaken.

As touched upon above, the combined effect of design change (in particular using new materials) combined with inadequate commissioning and/or maintenance were believed to have triggered systemic material failures (defects).

4.3.3.3   *Gaps in Stakeholder Knowledge*

In both case A (page. 161) and case B (page. 220) gaps in stakeholder knowledge, in particular end users and the client, were also found to generate defects. Gaps in knowledge included end users lacking knowledge about the technologies being used in the facility and thus perceiving them not to be operating

properly. Gaps in client knowledge concerning their understanding of what they had specified within the contract was a further source of defects being reported.

A further gap concerned end user and client knowledge about the costs associated with maintaining the facility. It was found that this could lead to negative stakeholder perceptions concerning value for money, causing stakeholders to be critical of, and finding fault with the facility, resulting in defect reports.

All of these gaps in knowledge were found to generate 'spurious' defects. These were defects that were reported by stakeholders but upon investigation by BuildIt were found not to breach any of the contractual arrangements. None the less, these defects still contributed to a high number of reported defects and resultant delays.

Gaps in knowledge were also found to play a role in the *reporting* of defects, in other words the administrative process of recording defects and subsequently alerting the relevant stakeholders. In particular, it was found that the FM Co might not filter out spurious defects because they are not fully aware of the contractual obligations associated with the facility. As a consequence, the FM Co might wrongly categorise some defects to be legitimate when in fact they are spurious. Recording, rather than filtering, these spurious defects in turn contributed to inflating the number of defect reports to be managed.

4.3.3.4   *Stakeholder Interests*

A further factor that was found in both cases to generate, and also affect the reporting of, 'spurious' defects was stakeholder interests. For example, in project A (page. 167) overlapping stakeholder interests were found to create informal coalitions between stakeholders whereby they supported one another's claims about defects. For example, a defect reported by end users might receive support (rather than be opposed) by the client or FM provider because it plays to their (FM Co and/or Client) interests. To explain further, a defect reported by end users might require the replacement of an element of the facility (e.g. a piece of equipment or part of the building fabric) and thus increase the life span of that element. This outcome could be in the FM provider's interests since they are responsible for the maintenance of the facility and therefore increasing the lifespan of an element might decrease the cost to the FM provider of maintaining the facility. This coalition between stakeholders adds to the defect and delay situation.

A further example of stakeholder interests at work was found in in project B (page. 220). It was found that the FM Co pursuing its business interest of keeping maintenance costs low can lead to 'spurious' defects being reported to BuildIt to resolve. The underlying reason was that when working within the construction liability period, it is in FM Cos interests to pursue BuildIt to remedy defects in the first instance (rather than FM Co resolving). This situation adds to the number of defects for BuildIt to manage and causes resultant delays in resolving the defects.

4.3.3.5 *Changes to Stakeholder Personnel*

In both cases, changes to personnel were also found to trigger defects to be reported. Again this trigger focused on 'spurious' defects. Changes to personnel identified in project A were end users (page. 161). Changes to personnel in project B related to FM Co and Client (page. 220). In both cases, these changes were believed to cause the types of knowledge gaps described above (page. 249) to re-emerge as well as introducing new stakeholder interests to manage. Knowledge gaps and stakeholder interests, as discussed, both contribute to the defect and delay situation.

4.3.4 **Factors Compounding Delays**

In both case A (page. 169) and case B (page. 223), factors were identified that could compound delay in resolving defects. However, there was no commonality between the factors found in the two cases. In project A the compounding factors were identified to be simple logistical matters such as getting materials as well as more complex socio-political matters such as disagreement between stakeholders over defect ownership. In project B however, delays seemed to be compounded by the capability and capacity of staff tasked with managing defect situations which resulted in delay in attending to defects. In relation to capability, delays were incurred while gaps in knowledge were filled such that remedial action could be taken. Furthermore, gaps in knowledge concerning contractual arrangements led to lost opportunities to resolve defects quickly by means of temporary repairs. Gaps in knowledge have already been identified as important in both cases whereas issues

around logistics and socio-political matters such as disagreement between stakeholders over defect ownership found in project A were not verified by project B.

4.3.5   The Influence of Contextual Conditions

Exploring the above factors in greater detail revealed that, in both case studies, they were **influenced by contextual conditions** existing within the **internal** and **external organisational environments** of the stakeholders involved in the project. In project A (page. 163), the contextual conditions of facilities management skills shortages in the market place, coupled with the complexity and scale of the project, were found to contribute to the risk of not being able to find maintenance staff with the right skills in the numbers needed for the project. The consequence of this risks, in turn contributed to risk concerning maintenance of the facility (discussed above).

In project B, the contextual condition of **tight government fiscal policies** contributed to the client being financially constrained driving the need for **design changes to achieve cost reductions**. However, **design changes to achieve cost reductions** were also found to be influenced by internal conditions at BuildIt's which put pressure on their staff to win new projects (page. 210). The combined effect of a financially constrained client and the need to win new projects were believed to have led to an overemphasis on cost reduction to achieve short term objectives (i.e. winning the project and achieving construction profits). As discussed in case B findings, the consequences of cost reduction were design changes which contributed to the defect and delay situation experienced on the project.

Contextual conditions at the client's side were also found to have influence, in particular on the high rate of turnover of personnel (page 161). As one participant noted, in other types of projects such as schools the stakeholders (teachers and clients) are more static than in health care projects. Furthermore, at the client side an **external condition of negative media concerning PFI projects** was found to fuel negative end user and client perceptions leading these stakeholders to be critical of, and thus finding fault with, the project.

It was also found that the **contextual conditions** of **organisational success** and **human resource policies** at BuildIt can have effect on the **ability to commission and maintain** projects like project B (page. 214). BuildIt had secured a number of projects in quick succession and the organisations human resource

structure meant it relied upon a small number of best people. The compound effect of these was to stretch staff across multiple projects which negatively impacted their ability to assist in activities such as commissioning the building properly as well as sharing their knowledge about the facility with stakeholder such as the FM Co. As noted above, inadequate commissioning and maintenance was found to be a contributing factor in the defect and delay situation on project B.

4.3.6   On Project Objectives

The findings revealed that both projects had in common a central concern for project financial objectives. In project A, a key aspiration for the team was to avoid the 'negative objective' (Ackermann and Eden, 2011 , p.118) of incurring paymech deductions. However, in project B a central financial objective focused upon achieving construction costs. The pursuit of cost reductions in project B, in order to win the project, was one of the contributing factors in the project experiencing overrun in its operational costs.

The overall finding that is drawn from the case studies is that when considering projects, objectives (positive and negative) and their ramifications need to be fully explored. This is because the objectives can be interdependent as was illustrated by project B where decisions taken to meet construction objectives negatively impacted the project's operational objectives. Based upon the foregoing it is suggested that project management might benefit from using the concept of a 'goals system' (Ackermann and Eden, 2011) when considering project goals. Understanding a project's goal system would facilitate practitioners identifying possible conflicts of proposed actions (e.g. an action which attends to one goal having a negative consequence on another, such as the impact of design changes on project operations).

4.3.7   The Systemic Nature of Operational Cost Overrun in Projects

In both case A and case B the findings described in the foregoing sections were found to operate as a system rather than each having its own discrete effect on the projects. To reflect the systemic nature of the factors, the findings are used to construct the following model which offers a description of the pathology of operational cost overrun in projects (Figure 50). The word 'pathology' is used simply to denote that explaining '*the* cause' of cost overrun actually requires the explanation of a series of interacting causes and effects.
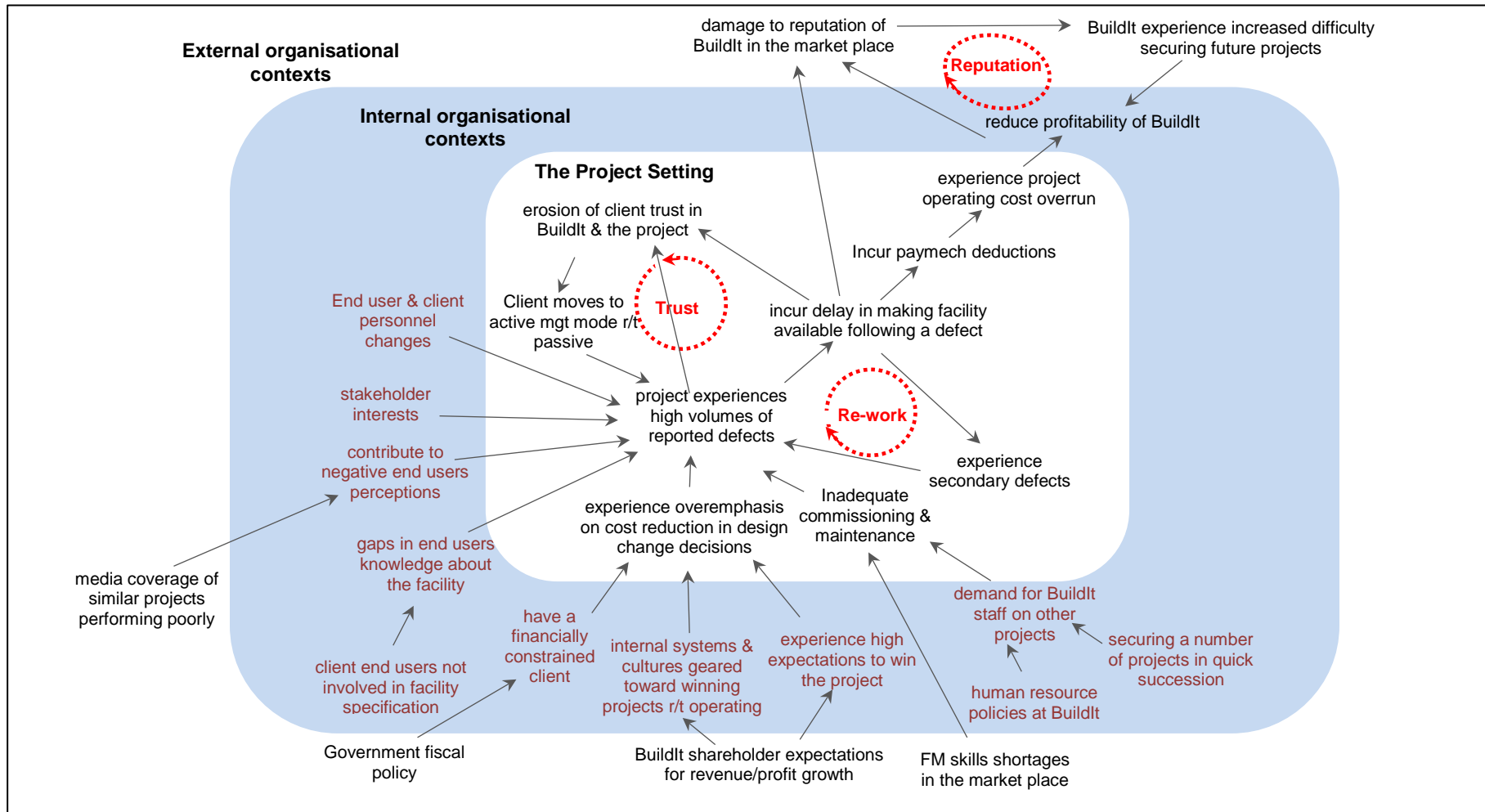
Figure 50 A model explaining a pathology of operational cost overrun in PFI projects

4.3.8   Counteractions to Systemic Behaviour

The purpose of this research was to reveal the causes of project overruns. However during the course of inquiry, participants of both case studies brought attention to actions that were taken either to avoid cost overrun or mitigate the scale of overrun.

The approach used in each of the case studies was fundamentally different; in that project A adopted a proactive approach to the factors described above, whereas project B took a reactive approach. The approach used in project A (page. 182) was underpinned by joint problem solving among the key stakeholders of BuildIt, FM Co and SPV. This led to a series of actions to mitigate the risk associated with the factors described in the preceding sections. For example, BuildIt took steps to share knowledge with end users, the client's representatives, and the FM Co concerning the operation of the facility. BuildIt also kept construction staff onsite for 6-9 months to support defect management. A 'fix first argue later' policy was agreed between SPV, FM Co and BuildIt. The policy meant defects were remedied by which ever organisation was best placed to do so at the time the defect occurred thus ensuring a rapid response. Time was then spent at a later point agreeing who *should* have been accountable. Finally, regular defects management meetings were conducted involving BuildIt, FM Co and SPV in order to discuss and agree necessary actions. These were identified as central to project A mitigating the risks associated with the factors described in the preceding sections.

Case B on the other hand adopted a reactive approach (page. 235) to the factors described above. The actions that were taken were to implement project enhancements, bring back some of the best BuildIt staff, as well as executive level management, and also to adopt a subservient attitude toward that client. The combination of these actions was found to bring the operational cost overrun situation back under control. However, it was also found that these actions were costly.

The quantification of cost associated with the actions was not undertaken as part of this research study. The costs included implementing significant project enhancements, opportunity costs associated with bringing key BuildIt staff, costs associated with assigning executive level management, and the potential reputational costs of the defect and delay situation. While these costs were not quantified, comparing them with those of the proactive approach used in project A, it

seems reasonable to suggest they may have been significantly higher than those of project A's proactive approach. The damage to BuildIt's reputation alone could have served to negate BuildIt's opportunities to win future projects, the income from which would presumably far outweigh the costs associated with the proactive approach of project A. It is of course accepted that such an assertion would require quantification to verify it. None the less, some a priori assessment of these costs by BuildIt would seem prudent so that an informed judgement can be made as to whether a reactive or proactive approach to the factors described earlier in this section are more cost effective.

4.3.9   Conclusions

The preceding discussion compared the findings of the two case study projects. It was found that a broad range of findings from case study A were literally or analytically replicated in case study B thus forming the overall research findings. In the next section, these findings are examined in light of the extant literature to reveal the contributions to knowledge that they can make.

CHAPTER 5:   DISCUSSION OF RESEARCH FINDINGS

5.0   CHAPTER ABSTRACT

This chapter examines the research findings in light of the extant literature on project overruns. The chapter is opened with a synopsis of the findings which are subsequently examined in light of the extant literature to establish what contributions to knowledge the findings can make. Next consideration is given to how the research findings can usefully inform project management practice. Implications for methodological practice of the thesis is also explored before the limitations of the study are examined.

During the following sections, page references to the case study findings are included recognising that the reader may wish to refer back to this material for more detail.

5.1   SYNOPSIS OF RESEARCH FINDINGS

The opening chapters of this thesis argued that despite growing academic research and practitioner experience in projects, they are regularly reported as having failed to meet time or cost objectives. Consequently, the argument was made that more needs to be done to **understand the phenomenon of overruns in projects**. It was further suggested that **the aim of research be to provide 'causal explanations**, explanations that revealed the factors, but also relationships between those factors, that can bring overruns into being.

To attend to the aim of this research, analysis of two PFI case study projects was undertaken from the perspective of the provider, in particular the company BuildIt. It was found that neither of the two projects suffered time or cost overruns during their construction phase therefore the locus of discussion for this thesis was cost overruns during the operational phase. The project management literature suggests that success during the construction phase of a PFI project, at least in relation to schedule, is not unusual. Ive (2004, p.366), for example suggests that PFI projects 'have achieved an excellent track record of becoming operational at or before contracted date'.

It was revealed that **cost overruns** experienced by the BuildIt **during a project's operating phase** can be the result of **incurring deductions** to their regular payment from the client (page. 244). These deductions, referred to as paymech deductions, are brought about by facility (or part thereof) becoming 'unavailable' under the terms of the payment mechanism. The cause of unavailability was found in both cases to be the **occurrence of defects**. Experiencing a high number of defects, in particular, can trigger delay in remedying defects thus increasing the likelihood of the facility being 'unavailable' and paymech deductions being made. In short, a very superficial explanation of operational cost overruns in PFI projects is captured by the causal chain of events in Figure 51 below.

experience rising
operating costs
(cost overrun)

avoid incurring
paymech penalty
deductions

experience delay in
making facility
'available'

experience a high
number of reported
defects
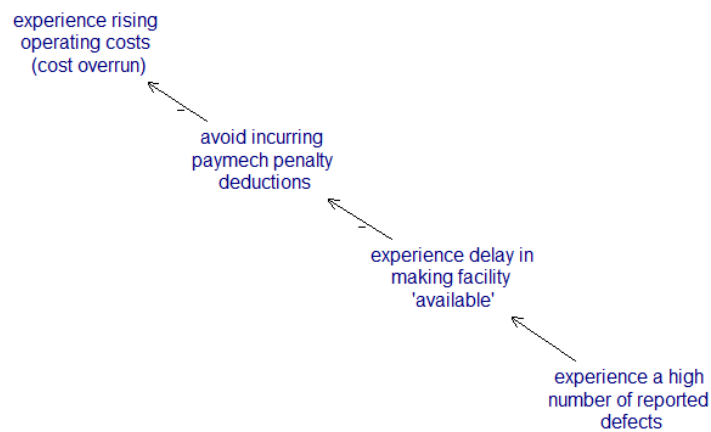
Figure 51 Superficial explanation of operational cost overrun

The research revealed that this simple chain of events (Figure 51) can **induce complex dynamic project behaviour**, in particular **vicious feedback loops;** one involving **re-work due to secondary defects;** and another involving **decay of client trust** in the provider (page. 245). Both were found to damage the project by **exacerbating the cost overrun situation** (Figure 52 below).

The research findings also suggested that **poor project performance** in terms of occurrence of defects and attendant delays in making facilities available **can induce a feedback loop outside the boundaries of the project.** This feedback loop involves **damage to the provider's reputation** for delivery of these types of projects which can in turn **damage the organisation (BuildIt) as a whole** (page.

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247). In summary, **poor performance experienced at the project level can have serious business affecting consequences (**Figure 52**)**.
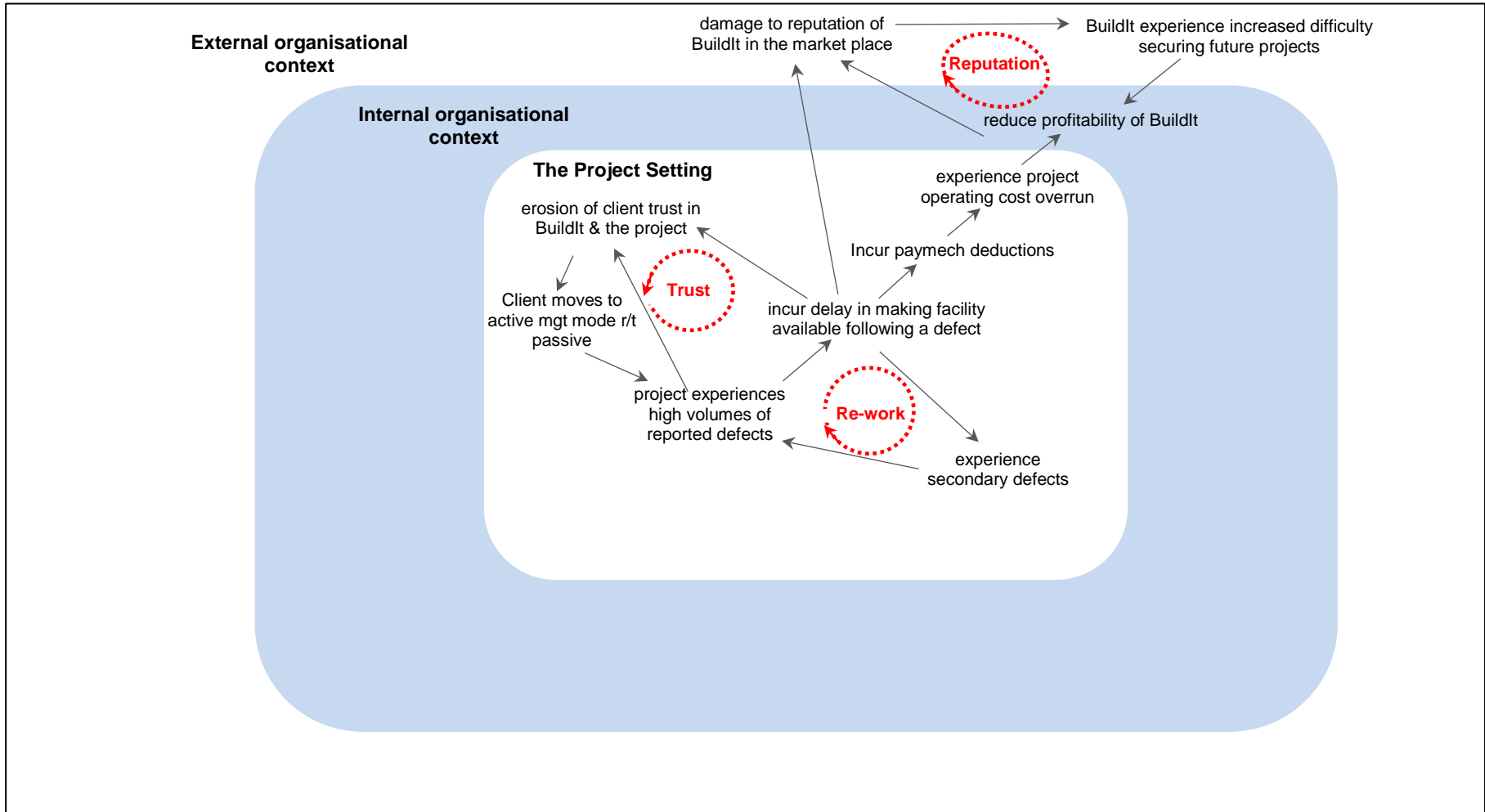
Figure 52 Feedback dynamics induced by defect and resultant delay situation

Following the principles of a critical realist approach to research set out in Chapter 3:, the aim was to **get beneath the simple chain of events** in Figure 51 and the dynamic behaviours described above to **understand how these events were brought into being**. A series of factors were revealed to have influence. In particular, **the occurrence of design changes** (page. 248), **issues with commissioning and maintenance** (page.249), **gaps in stakeholder knowledge** (page. 249), **stakeholder interests** (page. 250), **changes to personnel** (page. 251) were all found to be capable of **triggering defects to be generated**. Exploring these factors in greater detail revealed that they were **influenced by a number of contextual conditions** existing within the **internal organisational and external organisational environments** of the stakeholders involved in the project. These conditions included **skills shortages in the market place**, **government fiscal policy**, **shareholder expectations** and **staff performance management systems** at BuildIt, **human resource policies and practices,** and **media coverage of PFI projects** (page. 252).

Finally, it was revealed that the foregoing **triggers** of defects, **contextual conditions**, and **dynamic behaviours** operate as a **system of factors.** Consequently, to gain a full appreciation of operational cost overruns the foregoing factors need to be considered within the greater whole, and on this basis a model was developed describing the pathology of operational cost overrun (reproduced in Figure 53 below).

The following section examines the above findings in light of the extant project management literature to determine what their contributions to knowledge can be. As discussed, the two projects examined within this thesis were both PFI projects. Although strictly speaking PFI is a type of PPP (Public Private Partnership) the terms are often used synonymously within the literature (Tuner, 2004) consequently literature in the following discussion uses both terms.
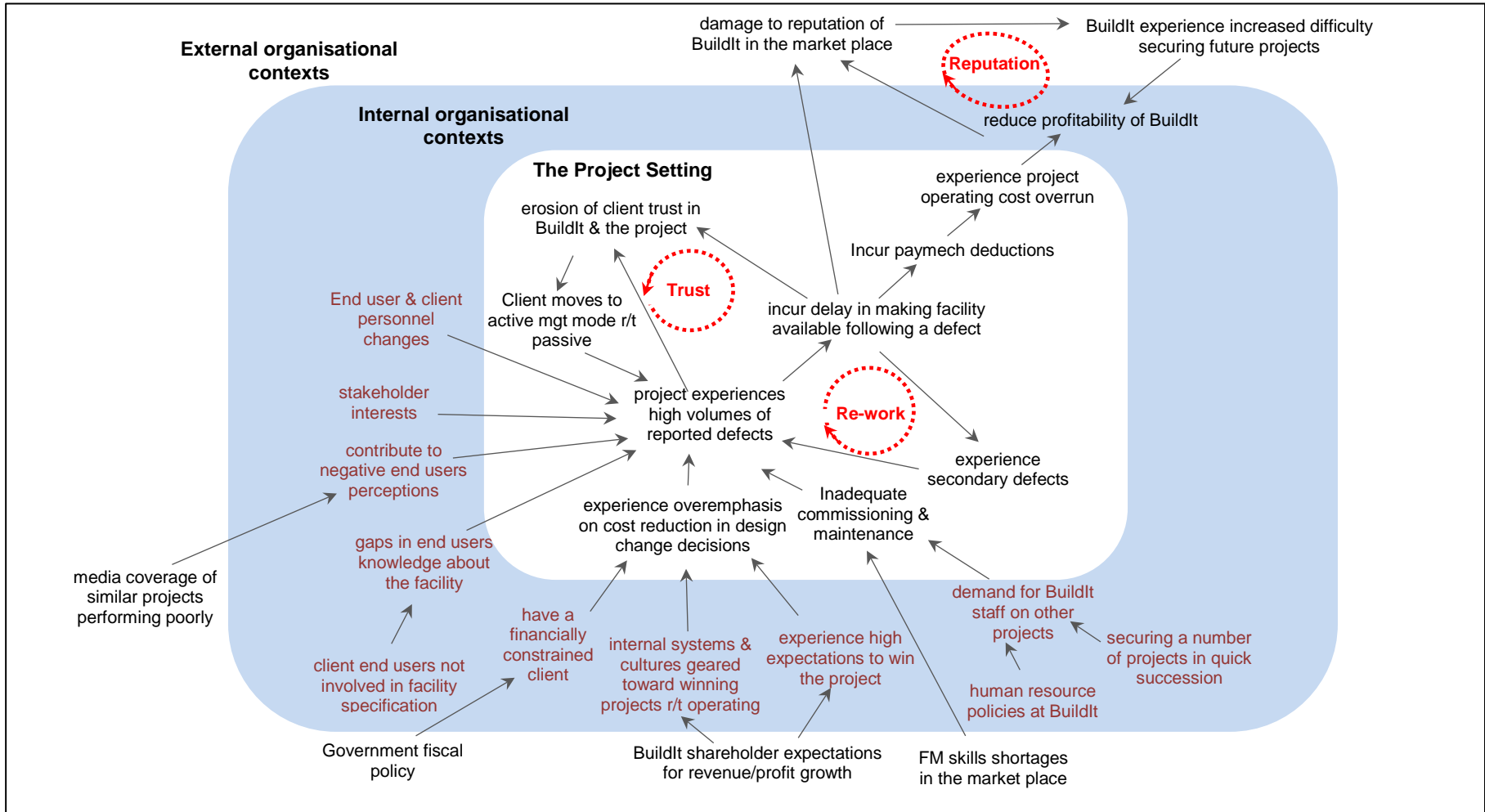
Figure 53 A reproduction of Figure 50

5.2 IMPLICATIONS FOR PROJECT MANAGEMENT KNOWLEDGE

5.2.1 A Micro-Level View of PFI Operational Cost overruns

Evidence from Ke et al. (2009) suggests that there has been growing academic interest in PFI projects. In their review of literature, the author's found that early research interest (1998-2003) largely revolved around three topics of risk, procurement and finance. More recent literature reviews (Tang et al., 2010) suggest that the variety of research topics has broadened to include relationships, project success factors, concession periods, investment environment, economic viability and governance issues.

Yet despite this broadening of academic interest in PFI projects, there remains an important gap. Through their review of PFI literature, Yuan et al. (2009, p.256) found that much of existing research has offered a macro-level view of PFI projects focusing on examining PFI's 'at a broad social or organisational level'. Research at this level of analysis has, for example, explored finance structuring (Turner, 2004), the rationale for the PFI model (Hodge and Greve, 2005, Roehrich et al., 2014), the costs of the PFI procurement process (Tang et al., 2010) as well as risk allocation/sharing between public and private sectors (Grimsey and Lewis, 2002, McDowall, 2003, Bing et al. 2005a). While this research is valuable, Yuan et al (2009) concluded that focusing on the macro-level leaves a 'significant gap' in current understanding of PFI's concerning the 'micro-level' processes of managing these projects. The authors suggested that all factors, not just the macro ones 'must be considered if they may affect the process, implementation and success' of PFI projects (Yuan et al., 2009, p.256).

Examining literature in the prevailing period since Yuan et al's (2009) publication, research at a more micro-level has emerged. For example, El-Gohary et al. (2006) examined the management of project stakeholders, Holmes et al. (2006) conducted a qualitative study of health care projects from bid stage through to construction, De Lemos et al. (2004) conducted a case study of the Lusoponte bridge project in Portugal. However, despite these contributions to fine grained understanding of PFI projects, research at the macro-level is still dominant by far and so the 'significant gap' to which Yuan et al. (2009) referred remains to be addressed. The findings presented in this thesis provide fine grained insight into the micro-level processes associated with operational cost overrun in PFI projects

therefore it is argued that the findings are in a good position to contribute to addressing the gap in knowledge identified by Yuan at al. (2009).

In particular the thesis contributes to understanding the risk of operational cost overruns in PFI projects, from the perspective of the provider (BuildIt). The risk of operational cost overrun has been identified within the literature for some time. For example, Akintoye et al. (1998, p.12) in their survey of PFI practitioners (clients, contractors, lenders and SPV members) identified the 'risk of operating/ maintenance cost' as one of the '10 most important risk factors' in a PFI project. Akintoye's study focused on the risk associated with *estimating* operating costs (in terms of maintenance and repair costs) but provides no insight in terms of explaining the factors that can affect operating costs in PFI projects and ultimately manifest in cost overrun. The importance of operational cost overrun still features in more recent research. For example, studies by Bing et al. (2005a) and Hwang et al. (2013) both identify operational cost overrun as a major risk. However these studies take a macro-level view of the risk, in particular how risks are allocated in PFI projects, and therefore offer little in-depth insight into the nature of the risk.

Recent research examining health care projects (Shaoul et al., 2008, Henjewele et al., 2014) suggests that these projects are subject to rising operating costs. However, the research has tended to look at operating costs from the perspective of the client (rather than the provider) and also has provided little in the way of fine grained explanation into the cause of rising operating costs.

Based upon the foregoing points, it is argued that this thesis makes a contribution to knowledge by extending existing understanding of operational cost overrun in PFI projects. In particular, through new findings which provide a nuanced explanation of a system of factors that can bring about operating cost overrun in PFI projects.

5.2.2   Feedback Dynamics

As illustrated in Figure 53, page. 263, the findings of this study revealed that feedback dynamics were a feature of the system that explained operating cost overrun in PFI projects. Three vicious feedback loops were identified - one involving **re-work due to secondary defects,** another involving **decay of client trust** in the provider, and a third involving **damage to BuildIt's reputation**.

The role of feedback dynamics in explaining project behaviour such as overruns has been explored within the general project management literature. Eden et al. (2000) for example, revealed feedback involving rework brought about by changes in design. Similarly, Cooper (1993, p.175) revealed feedback involving rework brought about due to the 'quality of work done'. Howick and Eden (2001) revealed feedback involving rework brought about by staff fatigue because of the extended use of overtime during compression of projects.

However, the role of feedback dynamics in PFI projects in particular has received much less attention. Perhaps the closest work has been the use of system dynamics models on macro-level issues such as concession pricing (Xu et al., 2012) which is concerned with prediction of project outcomes rather than explanation of project behaviour. The lack of attention to feedback dynamics is somewhat unsurprising given that much of PFI research has focused upon macro-level issues (Yuan et al., 2009) whereas feedback dynamics tend to be found deep within a project at the micro-level.

That the PFI literature is silent on feedback dynamics involving rework, trust, and reputation, presents opportunities for this thesis to contribute to knowledge in this regard. The contribution to knowledge concerning the role of rework is perhaps less significant than those of trust and reputation given that the general project management literature has already examined rework in depth (Cooper, 1993, Love et al., 2009, Godlewski et al., 2012). However, a modest contribution to knowledge can still be claimed in that the general PM literature has tended to look at rework from the design and build perspective whereas what this thesis has done is reveal that rework can be present itself within the operational stages of a project. In particular, the thesis has revealed that rework feedback dynamics experienced during the operational phase of a PFI project can serve to worsen operational cost overruns.

Turning attention to the topic of trust, this has received attention in the general project management literature and PFI specific literature. Smyth et al. (2010) for example explored the value of trust and how trust is formed within projects. Lazar (2000) examined trust-based partnering relationships in projects. Black et al (2000) revealed that trust was a central pre-requisite to successful project partnering. Smyth and Edkins (2007)Smyth and Edkins (2007) suggested that trust was one measure for evaluating the condition of relationships between project partners in PFI projects. All of these authors underline the importance of trust however the literature

is silent on the dynamic behaviours described in this thesis that can result from the loss of trust between the client and the provider. In particular it does not reveal the feedback loop described in Figure 53. Indeed, Pinto et al. (2009) assert that the literature is lacking in empirical study of the importance of trust in projects.

Research suggests that, once lost, re-establishing trust is likely to be challenging (Maurer, 2010). The findings of this thesis suggest that, once the trust feedback loop has been induced, recovery is likely to be problematic. This finding corroborates the general assertion made by Williams, (1995) and Ackermann et al. (2014) that recovery from feedback dynamics in projects is challenging.

Similar to the topic of trust, the importance of organisational reputation in project management has received attention within the general project management literature. For example, Watt et al. (2009) and later Watt et al. (2010) identified the importance of reputation as a selection criterion in tender evaluations.

In the context of PFI projects, the survey of PFI practitioners by Akintoye et al., (1998) did not reveal reputational risk to be one of the considerations of practitioners. However, more recently research has pointed to the importance of reputational risk in PFI projects, in particular infrastructure projects such as highways (Verweij, 2015). In their case study of the Lusoponte bridge PFI concession project in Portugal, De Lemos et al (2004, p.68) identified damage to reputation as a 'major risk' to the provider. While existing research has identified the importance of reputation risk and revealed possible causes, the systemic effects of reputational damage on the provider have not been examined.

Yet this thesis has revealed a vicious feedback loop involving organisational reputation which can have powerful negative consequences (Figure 53). The feedback loop explains that poor project performance (in terms of defects and resultant delays) can damage the provider's (BuildIt) reputation which in turn can act as a serious barrier to the organisation securing future projects which are central to the organisations ongoing profitability. This finding resonates with those of Watt's mentioned earlier concerning the importance of reputation as a criterion in tender evaluations.

The reputation feedback loop links project performance to organisational reputation and subsequently to organisational success (in terms of securing future projects). Although the link between project performance and organisational success is recognised in the project management literature for a long time (Morris 1997) the

aforementioned feedback loop has not been elucidated within the project management literature. A possible explanation for this gap is that the importance of maintaining a strong reputation with regard to future organisational success is perhaps self-evident and so does not require any attention.

However, the author of this thesis argues that in the context of PFI projects, and from the perspective of the provider (BuildIt) in particular, reputation should be a central concern. This argument is based upon a set of compounding assertions, the combination of which is idiosyncratic to PFI projects (illustrated below in Figure 54), and are discussed next.
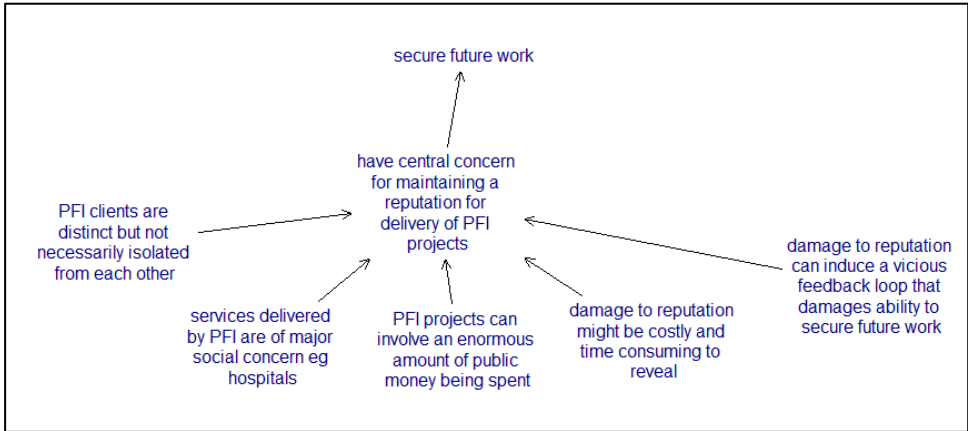
Figure 54 Central importance of reputation in PFI projects

First, PFI projects deliver services which are of central importance to the public such as medical facilities (e.g. hospitals) and schools. The risk of poor service delivery in a PFI project, for example a hospital operating theatre being unavailable, could be life threatening whereas in a factory or office block the risk might concern damage to the client's profitability. It seems reasonable to assert then that a prospective PFI client is perhaps going to be more risk averse than the factory or office block client and, therefore, look more favourably on those providers with a strong track record (reputation) for the successful delivery of similar projects.

Second, PFI projects can involve an enormous amount of public money being spent (National Audit Office, 2009). Given the scarcity of public funds it seems reasonable to assert that prospective PFI clients are likely to be risk averse and therefore look favourably on those providers with a strong reputation for the sorts of projects they wish to deliver.

Third, PFI clients, although being distinct from one another, belong to a wider community. For example, in the UK, NHS Trusts who are responsible for managing

and delivering hospitals operate separately but they are part of a wider community of other Trusts and the Government Department of Health. Consequently, even if news of poor project performance on one hospital does not reach the media it is most likely to reach other constituents of the community, some of whom might be future clients. It seems less likely however that a prospective private sector client's (for a factory or office block for example) will be part of the same community in the way that public sector clients are. Thus again, with respect to PFI projects it would appear that maintaining a strong reputation is of key importance.

Fourth, participation in a PFI procurement exercise can last many months, even years and are notoriously expensive to participate in. However, it might only be after participation in a procurement exercise that the potential provider receives feedback from the client that their track record has let them down. Consequently, damage to a provider's reputation might be very costly and time consuming to reveal, more so than a standard design and build procurement.

Finally, and related to all of the above, this thesis has found that poor project performance can damage reputation and induce a vicious feedback loop making it difficult for the provider to secure future PFI projects therefore affecting the viability of the entire organisation. On this basis, it seems reasonable to assert that perhaps protecting organisational reputation might be of slightly more importance at an organisational level than incurring the costs associated with experiencing operational cost overruns a PFI project. In short, recovery from the reputational feedback loop (Figure 53) is likely to be extremely challenging. However, recovery from operational cost overruns on a project might reasonably be offset by good performance on other projects within the portfolio.

As described above, the PFI literature has given little attention to explaining reputational risk. However, based upon the foregoing assertions the author of this thesis argues that, from the perspective of the provider (BuildIt) at least, reputational risk should be a critical concern within the context of PFI projects due to the long term impact this risk can have on the entire organisation.

In summary, based upon the foregoing discussion, the trust and reputation feedback loops identified by this thesis are argued to make valuable contributions to knowledge because they have not been revealed in the PFI project management literature. It is also argued that although not new, the identification of a re-work feedback loop also makes a contribution to knowledge by extending this concept to

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the operational phase of projects. It is also worthy of note that the these three feedback loops interact with one another and consequently attending to the triggers of one (i.e. defects and delays) can mitigate or avoid both these loops coming to fruition (Figure 53). Furthermore, the difficulty of recovering from these feedback loops suggests that it is better to avoid triggering them rather than to try to recover from them once they are induced.

5.2.3   Triggers of Overruns

As well as feedback dynamics, the research study also revealed a series of factors found to have influence in triggering operational cost overrun, these included design changes, commissioning and maintenance issues, gaps in stakeholder knowledge, stakeholder interests, and changes in stakeholder personnel. The following sections explore the research findings concerning each of these factors in light of the extant literature in order to establish what contribution to knowledge the findings can make.

5.2.3.1   Design Changes

One of the factors identified within this thesis as contributing to operational cost overrun in PFI projects was changes to the project's design (page. 207). In particular it was found that reducing the design specification to meet project cost objectives can have serious implications for the operation of a PFI facility. Moreover, it was found that the use of alternative materials (again to meet cost objectives) in combination with inadequate commissioning and maintenance of those materials can result in systemic material failures during the operation of a project. It was also found (page. 208) that design changes, although driven by a need to meet client cost constraints can also be influenced by other contextual conditions, in particular a perceived necessity within the organisation (BuildIt) to secure new projects (the contextual conditions are discussed in more detail later).

The impact of design change on construction delays has been examined in depth within the general project management literature. Williams et al. (1995) , for example, explored the effects of design changes and resultant delays on project costs. Wu et al. (2004) examined the causes of change orders specifically in

construction projects. The importance of design risk has also been recognised within PFI projects. In a report for the UK Government, design consultants Mott MacDonald (2002, p.55) suggested that the complexity of the design in PFI projects 'needs significant management to reduce the impact on project outcomes'. In a PFI research context, Akintoye et al. (1998) in their survey of PFI practitioners found that contractors regarded design risk as the number one risk in PFI projects.

While Akintoye et al's (1998) study found design risk to be a top priority, there was no exploration of the nature of the risk, only a definition concerned with meeting the performance requirements specified by the client and also the risk of design changes. The study offers no insight as to how design changes can have a negative impact upon the operational performance requirements nor what contextual conditions might influence design changes, both of which were found to be salient in the findings of this thesis. Also in a PFI context, Wong et al. (2009) examined design compliance against the clients briefing document. However, again while providing valuable insight, this research does not reveal the underlying micro processes of what might have caused the design not to meet the client's briefing and thus help in explaining the nature of design risk.

Despite having been identified as a central risk to PFI projects, Raisbeck and Tang (2013, p.36) found that in theory and in practice 'design development has been neglected' in the PFI project management literature. To begin attending to this omission, authors in their study of Australian PFI projects sought to understand the organisational factors and capabilities that are central to the development and management of a PFI design. Thier study identified only one contextual condition that is close to the findings of this thesis which concerned the fact that the design must meet 'established cost benchmarks'. Moreover, the study was concerned with the design and construction phase of projects rather than the operating phase. The findings reported in this thesis indicate that there are a number of contextual conditions that influence design decisions and that design change can have significant effect on a project's operational performance. Neither of these points is addressed in Raisbeck and Tang (2013).

In summary, while design risk has received significant attention in the general project management literature there is a scarcity of research on this issue from a PFI project perspective. Furthermore, the PFI research that has taken place, while offering valuable insights, provides little in the way of explanation as to the impacts of design changes in the operational phase of PFI projects or why design changes

are brought about. Both of which were found to be salient in the findings of this thesis. It is therefore argued that this study extends knowledge concerning design change risk in PFI projects through the following new findings:

Firstly, that design changes can have serious operational consequences in terms of maintaining the facility which in turn can induce operational cost overrun (page. 207). In particular, it was found that reducing the design specification to meet construction cost objectives can have a multiplicative effect on the cost associated with repairing defects during a project's operating phase. For example, to help meet construction cost objectives the electrical design specification might be reduced by decreasing the number of isolators within the electrical system. As a consequence, isolating the electrical supply to a room to affect a repair during the operational phase of a project might mean having to isolate the electrical supply for an entire corridor of rooms. This would render all rooms on the corridor (rather than just the one with the defect) 'unavailable' under the terms of the paymech system. Consequenelty, the provider would experience a multiplicative increase in the cost associated with repairing a defect. This suggests that the operational costs of design changes should be examined a priori to determine whether the construction cost saving is worthwhile when examined in light of operational cost implications.

Secondly, this thesis found that design changes (page. 207) coupled with inadequate commissioning and maintenance procedures, can trigger systemic failures within the operating phase of the project (page. 249). For example, it was found in project B that to meet construction cost objectives new materials were adopted that were quicker (therefore cheaper) to install. However, if commissioning and maintenance procedures of these new materials were not rigorously followed, as was the case on project B, then these materials were more prone to failure than conventional materials. The result in project B was systemic material failure and operational cost overrun. (Detailed discussion of the reasons for inadequate commissioning and maintenance are explored in the next section)

A final contribution the thesis makes with respect to design changes is made through the finding that, although driven by a need to meet client cost constraints, design changes can also be influenced by a number of other contextual conditions, in particular a perceived necessity within the provider organisation (BuildIt) to secure new projects. (Detailed discussion of the role of contextual conditions is provided later on page.281).

5.2.3.2   *Commissioning and Maintenance*

As touched upon in the previous section, this study found that commissioning and maintenance risks respectively are salient in relation to operational cost overrun in PFI projects (page. 249). In particular, the risks identified were inadequate commissioning and maintenance, the cause of which was found to be explained by the pattern of factors presented in Figure 55.
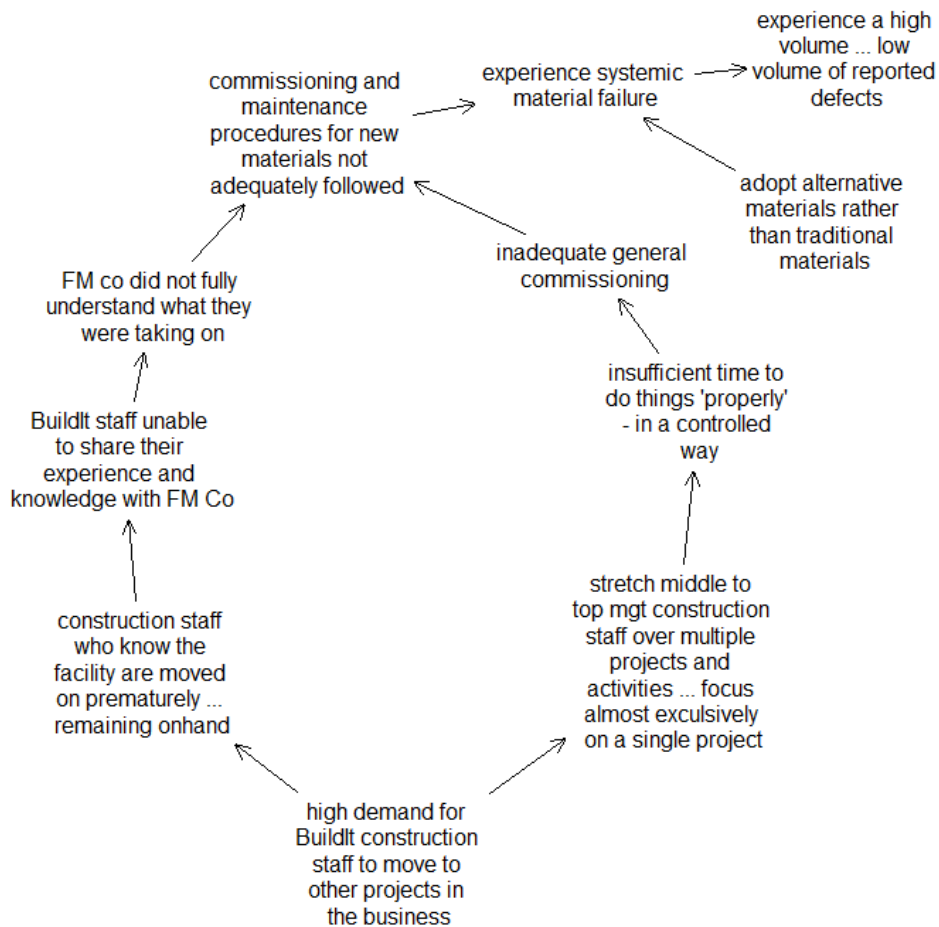
Figure 55 A pattern of factors that can impact upon commissioning and maintenance.

The importance of commissioning risk and maintenance risk has been understood within a PFI context for some time. Akintoye et al. (1998, p.12) for example in their survey of PFI practitioners found that 'commissioning' and 'operating maintenance' are among the top 10 risks in PFI projects. The authors' focus on the risk of commissioning taking longer than expected and the risk associated with estimating the volume of repairs to defects that might need to be conducted over the life time of the facility. However, the study is silent on the causes

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and effects of inadequate commissioning and maintenance, both of which have been revealed by the findings presented in this thesis.

Although Akintoye et al. (1998) identified commissioning and maintenance risks almost a decade ago, nuanced explanation of these risks and their systemic consequences has received scant attention in the PFI literature. Indeed, Dvir (2005) notes that there is a dearth of research focused on project commissioning in particular within the project management literature suggesting that this omission is because few researchers see project commissioning as part of the project lifecycle. Perhaps part of the reason omitting commissioning from the lifecycle is that the projects studied are largely design and build, and therefore completion of the construction phase might be seen as the project being 'complete'. However, the same cannot be said of PFI projects since the project lifecycle will continue some 25+ years after completing construction.

It is therefore argued that commissioning and maintenance, as Akintoye et al. (1998) found, should be a key concern in PFI projects. Furthermore, it is argued that the findings of this thesis extend knowledge regarding commissioning and maintenance risks in PFI projects through the following new findings.

Firstly, at a simple level the nature of commissioning risk and maintenance risk involves the adequacy with which the two tasks are undertaken, rather than only the duration of time needed for the activities. As shown in Figure 55, if either task is not adequately performed then systemic material failures can ensue which can lead to operational cost overruns.

Secondly, as shown in Figure 55, the risks of inadequate commissioning and maintenance can be interrelated, in particular due to demand for construction staff to move on to, or get involved in, other projects (the drivers of this demand are discussed later, page. 281). As Figure 55 shows, demand for BuildIt staff to move to new projects can lead to construction staff being moved off their current project. They are, therefore, unavailable to share their experience and knowledge of the facility with FM Co staff meaning FM Co staff might not have a full appreciation of the facility, ultimately leading to inadequate maintenance activities. Similarly, demand for BuildIt staff to be involved in other projects can mean staff are stretched across multiple projects and therefore have less time to dedicate to ensuring project commissioning activities are adequately undertaken. The compound effect of inadequate commissioning and maintenance can lead to systemic material failures

during the operating phase and ultimately to a project experiencing operational cost overrun.

5.2.3.3   *Gaps in stakeholder knowledge*

A further finding of this research study was that gaps in stakeholder knowledge can contribute to the phenomenon of operational cost overruns in PFI projects (page. 249). In particular, it was found that gaps in the knowledge of end users, the client, and FM Co all have the potential to generate defects, specifically spurious defects. These defects, although illegitimate in the eyes of the contracts, contribute to a project experiencing a high number of defects and ultimately operational cost overruns.

Looking across all of the stakeholders in the case studies, the principal issue was one of how knowledge is communicated and shared across project stakeholders. The project management literature suggests that this issue is encapsulated in the topic of knowledge management (Schindler and Eppler, 2003).

Knowledge management has received significant attention in the project management literature. Reich et al. (2014) found that knowledge management was central to the performance of projects. Pemsel and Müller (2012) examined the organisational mechanisms and structures that enable knowledge management in terms of using, sharing and integrating knowledge, finding that these structures can help to avoid knowledge silos among project participants. Others have looked at knowledge sharing among supply chain stakeholders (Xue et al., 2011, Aloini et al., 2015), among construction teams (Zhang and Ng, 2012), and between design teams (Ding et al., 2007). While all this research has provided valuable insight into the nature of knowledge management in projects, the tendency has been to focus on the design and construction stages. There has been little in the way of insight regarding knowledge sharing among stakeholders during the operational phase of projects which, as noted above, was found by this thesis to be salient to operational cost overruns.

In the context of PFI projects knowledge management has also received attention. For example, Carrillo et al. (2006) focusing on collective learning looked at transferring knowledge between PFI projects. However, again there is little in the

way of literature concerning knowledge sharing among stakeholders at the operational stages of PFI projects.

In summary, the general project management literature, and literature on PFI projects in particular, tends not to look at knowledge sharing among stakeholders during the operational phase of projects. Yet, this thesis has found that knowledge sharing during the operational phase is important to attend to gaps in stakeholder knowledge; gaps which have the potential to generate defects and ultimately contribute to a project experiencing operational cost overruns. It is therefore argued that this study extends knowledge concerning knowledge management in PFI projects through the following new findings.

Firstly, it was found that gaps in stakeholders' knowledge can contribute to defects being reported. For example, it was found (page. 158) that ventilation and cooling of a facility can be achieved through sophisticated design of the building structure to create natural airflow and/or by using technologies such as 'chill beams' (ceiling mounted devices that use pipes of water to cool areas of a facility using a process of convection). In both approaches there might be little or no physical indication to end users that ventilation and cooling is taking place. Therefore, if they are not furnished with information about how the system operates then this gap in knowledge can lead to perceptions that the ventilation system is defective when in fact the system is operating as specified.

Secondly, it was found (page. 249) that gaps in knowledge are not restricted to a particular stakeholder but rather can affect all of the main stakeholders involved in the operation of the facility, namely end users, FM Co, and the client. These gaps mean that it is possible that defect reports can emanate from all of the main stakeholders.

Finally, it was found that knowledge gaps can be in relation to financial, contractual, or technical matters. An example of a gap in the technical knowledge of end users has already been provided above. In relation to gaps in financial knowledge, it was found (page. 250) that a gap in client and end user knowledge concerning the cost associated with affecting repairs on the facility can lead these stakeholders to perceive that the project is lacking in value for money. A particular situation that illustrated this point was the replacement cost of a bulb (page. 218). The costs associated with bulb replacement include the cost of the bulb ($10) but also costs associated with sourcing, delivery, fitting and any necessary servicing

adding an additional $70 to the cost of replacement. Therefore, the total cost of replacement might be $80. However, the findings from this study suggest that end user and client stakeholders can be unaware of the additional costs over and above the cost of the bulb itself, leading them to perceive the $80 cost of replacement as being excessive and lacking in value for money. This negative perception was found to cause stakeholders to be critical of, and find fault with, the facility.

In relation to gaps in contractual knowledge it was found (page. 250) that these can affect the *reporting* of defects, in other words the administrative process of recording defects and alerting the relevant stakeholders. In particular, it was found that if the FM Co does not have a full appreciation of the contractual obligations associated with the facility then this can result the FM Co wrongly categorising defects to be legitimate when in fact they are spurious. Recording (rather than filtering out) these spurious defects in turn contributes to inflating the number of defect reports to manage and ultimately to project cost overruns.

5.2.3.4   Stakeholder Interests

A further factor identified within this thesis as contributing to operational cost overrun in PFI projects was the various interests of stakeholders (page. 250). In particular, it was revealed that stakeholder interests can cause defects to be generated. For example, In project B (page. 220) it was found that the FM Co pursuing its business interest of keeping maintenance costs low can lead to 'spurious' defects being raised because, during the construction liability period, it is in FM Cos interests to pursue BuildIt to remedy defects in the first instance thus adding to the number of defects for BuildIt to manage and resultant delays.

Management of stakeholders has received growing attention within the general project management literature (Winch, 2004, Olander and Landin, 2005). However in a recent publication De Schepper et al. (2014, p.1210) noted that 'despite being seen as one of the main success factors of PPP, to date, limited research has investigated actual stakeholder management in PPP's.' One of the studies that has contributed to this space is by El-Gohary et al. (2006) who developed a model for how stakeholders might be managed in PPP projects. While valuable, this study focused upon managing stakeholder interests in the planning and construction phases so as to mitigate the potential for opposition to the project. However, the

findings presented in this thesis suggest that managing stakeholder interests during the operational phase is equally important.

Based upon the foregoing points, it appears that stakeholder management in PFI projects has received only limited attention and, furthermore, in relation to the operational phase of projects literature is silent on stakeholder management. It is therefore argued that this study extends knowledge concerning stakeholder management in PFI projects through the following new findings.

Firstly, it was found that managing stakeholder interests is important during the operational phase of PFI projects because these interests can result in defects being reported which ultimately contribute to operational cost overruns.

Secondly, the findings suggest that overlapping interests among stakeholders can lead to coalitions forming during the operational phase concerning the validity of particular defects. For example, it was found (page. 250) that the FM Co or client might concur with the complaints of the end users because these complaints play to their (FM Co and/or Client) interests. These coalitions can add to the perceived validity of defects making them more difficult for the provider (BuildIt) to argue against without damaging their relationships with stakeholders. A similar picture was painted with regard to the FM Co finding defects which played to the client's interest of improving the facility. Therefore, not only is managing individual stakeholder interests important but understanding how stakeholder interests overlap in such a way as to form coalitions. Literature from the domain of strategy suggests that such coalitions can be very powerful and therefore should be explored within stakeholder management and mapping processes (Ackermann and Eden, 2011).

5.2.3.5   Changes to Stakeholder Personnel

A final factor identified within this research study was changes to stakeholder personnel, in particular changes in the end user population and change to the client representative.

The effect of changes to project personnel has been explored within the general project management literature where the focus has primarily been on changes to project managers between estimation and design stages. Savolainen and Ahonen (2015) for example looked at changes in the project manager between stages of the

project life cycle finding that the change created significant knowledge gaps. Parker and Skitmore (2005) examined turnover in project managers and suggested that this can cause significant disruption and damage to project performance.

While changes to project manager have received attention in the general project management literature, the causes and effects of changes to personnel outside of the project team, and during the operational stage in particular, have not been explored in the context of PFI projects. It is therefore argued that this study extends knowledge concerning changes to personnel in PFI projects through the following new findings.

Firstly, although extant literature focuses on changes to the project manager, the findings from this thesis suggest that change of personnel is not restricted to these project participants. Rather, change can be experience in terms of change to client representative and changes within the end users population. Secondly, it was found that these changes can take place during the operational stage of PFI projects (page. 251) and can cause knowledge gaps to re-emerge as well as introducing new stakeholder interests to manage, both of which can generate defects and ultimately contribute to operational cost overrun (as discussed earlier).

5.2.4 On Project Objectives

The project management literature suggests that project objectives play an important role in achieving projects success because objectives help define what success is and, consequently, guide 'appropriate courses of action' toward the attainment of success (Ward et al, 1991, p.345).

One of the findings from both case studies was that financial project objectives attracted much of the attention of the project team in relation to what constituted project success. This focus seems reasonable given BuildIt were a commercial organisation and consequently to survive would need to maintain a healthy financial position.

However, the project management literature suggests that from an overall project perspective project success should comprise much more than financial objectives. For example, Atkinson (1999) suggested the need to attend to

stakeholder benefits. More recently Turner (2009, p.48) suggests that to focus success on time, cost, and quality is 'simplistic in the extreme'.

Yet, as discussed above, data from both projects studied in this research indicate that financial objectives are of central concern when projects are examined from the perspective of a commercial organisation such as the construction company. Survey research by Bryde and Robinson (2005) within a residential housing context, also found that the emphasis of contractors was on cost and duration. From a PFI perspective Ive (2004) identified 6 objectives from a provider's point of view, of which four are financially related such as return on investment (the other 2 are about gaining experience and presence in the market place). Consequently, the research findings presented in this thesis corroborate existing literature concerning the relative emphasis placed upon project financial objectives.

A further finding of this study in relation to project objectives concerned the nature of objectives. For example, in project A (page. 154) an objective which gained the attention of the project team was to avoid paymech deductions whereas in project B (page. 205) the objective of achieving construction cost reductions gained attention. As noted above, the literature suggests objectives guide 'appropriate courses of action' (Ward et al, 1991, p.345). Project A's objective of avoiding the undesirable outcome of paymech deductions at least in part framed the actions of the project team. Within the project management literature concerning objectives, the tendency is to focus on aspirations to be achieved rather than those to be avoided. Expanding the search for literature concerning objectives to organisational strategy making revealed the concept of *negative objectives* which Ackermann and Eden (2011, p.118) describe as 'aspirations to be avoided'. The authors suggest that, in the context of organisational strategy making, negative objectives can have just as strong an influence on organisational action as those of positive objectives (desirable outcomes). The finding from project A was that negative objectives can have a similar strong influence in a project management context.

Based upon the findings from this study it seems reasonable to suggest that the courses of action guided by the two previously described objectives of project A and project B could result in quite different and perhaps even conflicting actions. For example, in project B there was a strong emphasis on achieving construction cost reductions which guided the project team's actions toward achieving this outcome. However, a ramification of the actions to reduce costs (such as design changes,

page. 207) was to trigger defects and resultant delays which jeopardised the objective of minimising paymech deductions and ultimately the overall objective of achieving operational financial returns.

The overall implication for project management knowledge is that, when considering projects, objectives (positive and negative) and their ramifications need to be fully explored. This is because the objectives can be interdependent as was illustrated by project B were decisions taken to meet construction objectives negatively impacted the project's operational objectives. It is suggested that project management might benefit from using the concept of a 'goals system' (Ackermann and Eden, 2011) when considering project goals. Understanding a project's goal system would facilitate practitioners identifying possible conflicts of proposed actions (e.g. an action which attends to one goal having a negative consequence on another, such as the impact of design changes on project operations).

Based upon the foregoing it is argued that this study extends knowledge concerning project objectives in PFI projects by introducing the concept of negative objectives in a project management context as well as bringing to light that when considering projects, objectives (positive and negative) and their ramifications need to be fully explored in order to gain a broader appreciation of the actions that might be necessary to successfully delivery the project.
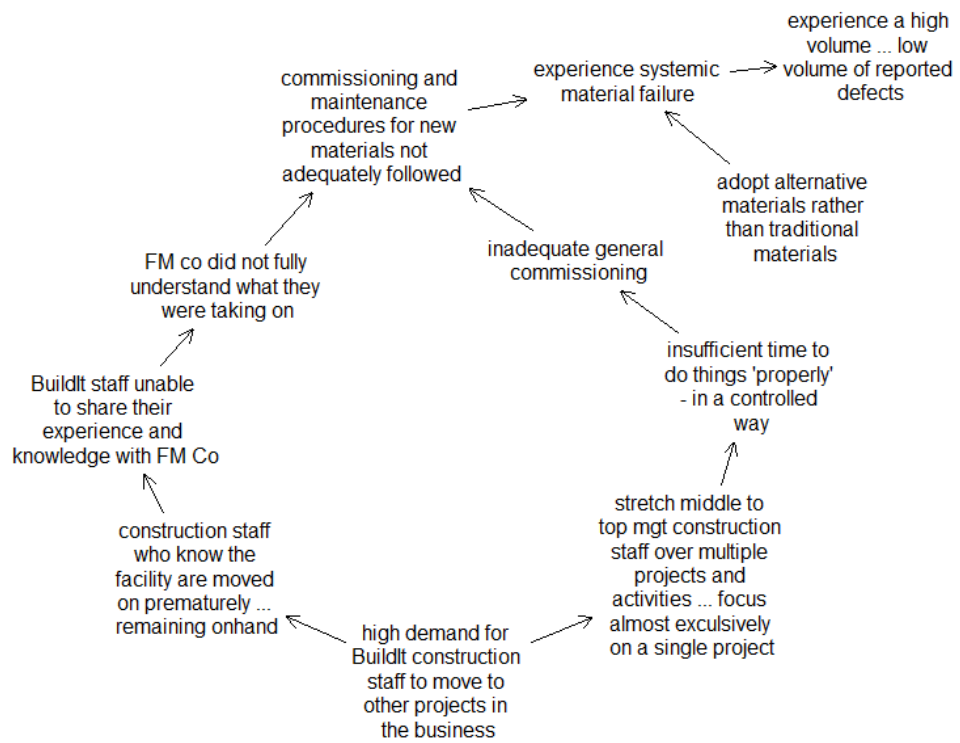
5.2.5   Contextual Conditions

As discussed earlier, an aim of this research was to get beneath the superficial explanation of overruns illustrated in Figure 51 (page. 263) in order to understand how these events can be brought into being. A series of factors were found to have influence and have been discussed in the foregoing sections. These included design changes, commissioning and maintenance issues, gaps in stakeholder knowledge, stakeholder interests, and changes in stakeholder personnel. However, the research study also revealed a number of contextual conditions at work (page. 252) which were found to have influence on the previously described factors. These were identified as being internal or external contextual conditions, internal signifying a condition within the organisation of one of the project stakeholders, and external signifying a condition in the external environment.

The following sections explore the research findings concerning contextual conditions in light of the extant literature in order to establish what contribution to knowledge the findings can make.

Internal Contextual Conditions

As discussed earlier, and illustrated in Figure 56 below, one of the findings was that high demand for construction staff (at BuildIt) to move on to other projects can have negative consequences for commissioning and maintenance of projects which, in turn, can contribute to a situation of operational cost overruns. The findings also revealed that a number of compounding contextual conditions offer explanation as to why there might be such high demand for construction staff to move on to other projects. In particular these concern contextual conditions in relation to human resource management and organisational success. These are highlighted in Figure 57 and discussed briefly next.

Figure 56 A pattern of factors that can impact upon commissioning and maintenance.
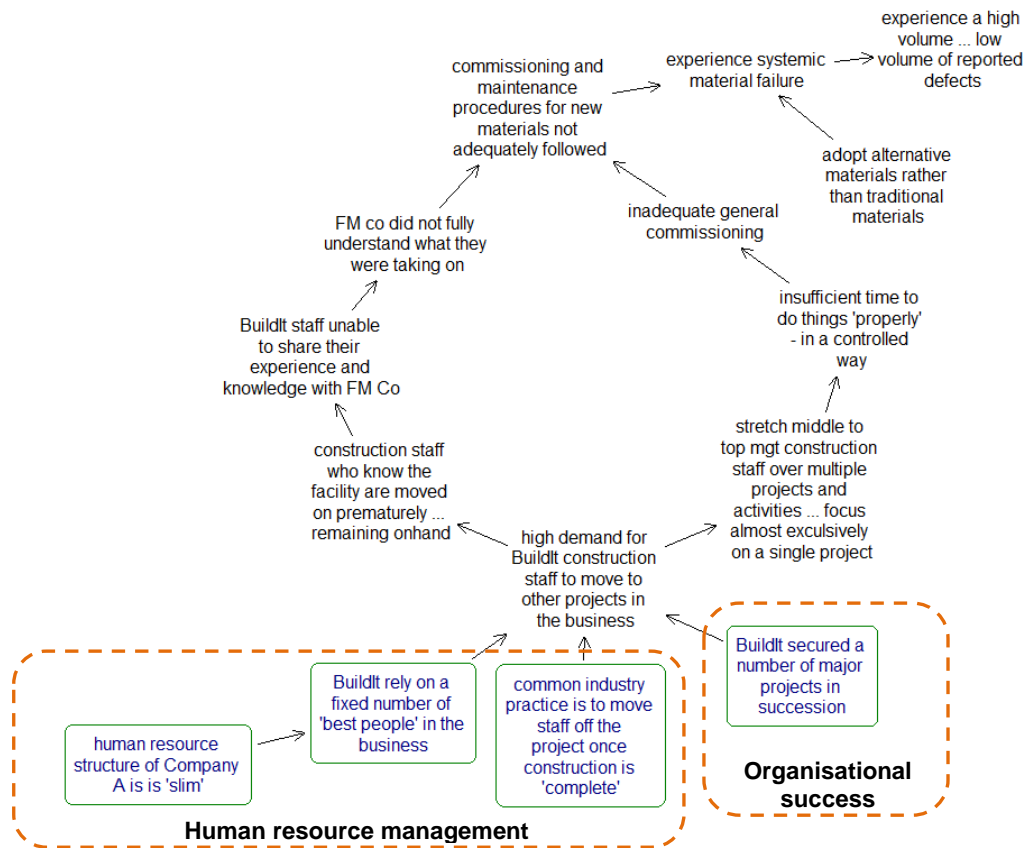
Figure 57 The influence of contextual conditions (highlighted) on commissioning and maintenance

Firstly, in relation to human resource management, the common practice in project organisations is for staff to be moved on to new projects once their current assignment (project) is 'complete'. In the context of this research study it was found that as projects approached construction completion there was already demand for construction staff to move on to new projects.

Secondly, it was found that the business model within BuildIt was akin to that of a consultancy on the grounds that if project staff were not working on a project they were, in effect, incurring cost to the organisation. As a result, it was found that the tendency was to run a 'slim' human resource base with respect to project staff in order to manage organisational costs. However, the impact of this was that BuildIt relied upon a small and fixed number of 'best people'. Naturally when new projects came on line, these 'best people' were in high demand.

Both of the foregoing conditions are concerned with human resource policies/practices however as Figure 57 shows, organisational success compounded

the situation. In particular, it was found that securing a number of major projects in quick succession only served to further increase the demand for project staff to move on to or be involved with other projects rather than focus solely on a single project.

In summary, it was found that the compound effect of the contextual conditions of human resource management and organisational success can have significant effect upon commissioning and maintenance activities on projects which in turn can contribute to projects experiencing operational cost overrun.

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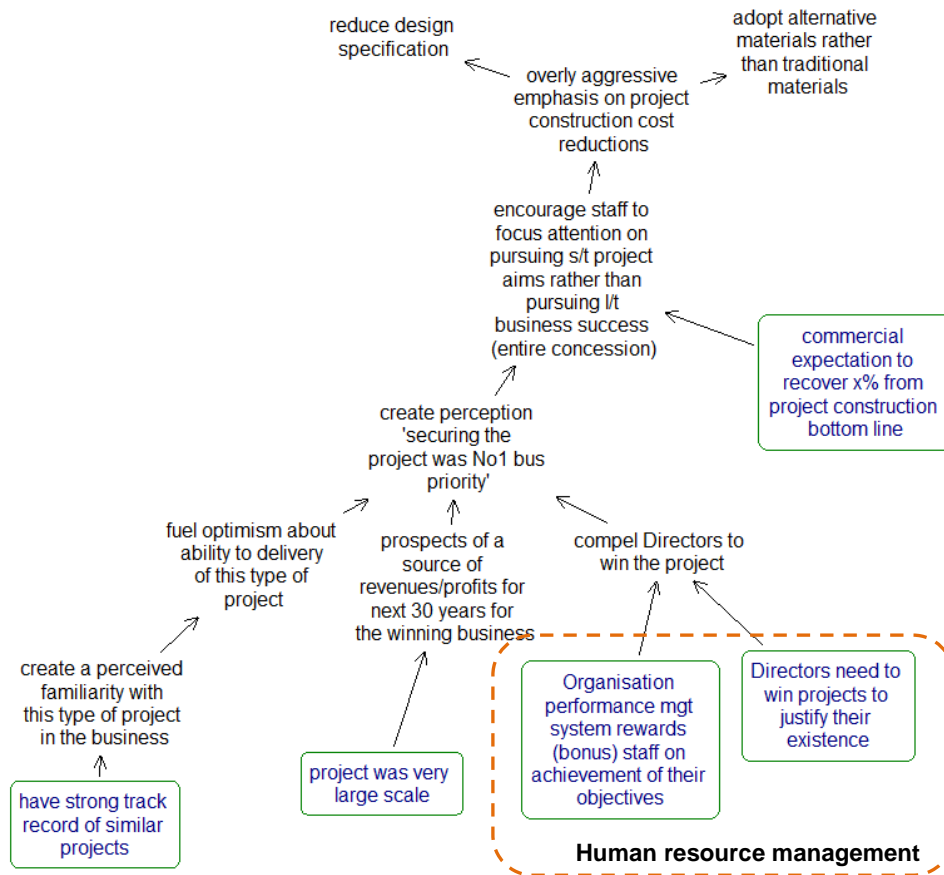
Figure 58 The influence of internal contextual conditions (highlighted) on design change decisions

As illustrated in Figure 58 above, alongside other conditions, conditions relating to human resource management were also found to influence decisions concerning design changes. What Figure 58 shows is that the compound effect of the following contextual conditions can generate significant pressure on staff at the bid stage to secure the project:

- Human resource management practices and systems that are geared toward winning new projects
- Organisational track record of having delivered similar projects
- Large scale and duration of PFI projects which create prospects of securing long term revenues and profits

As Figure 58 shows, the findings of this study suggest that pressure to win a project coupled with the contextual condition of needing to recover $x\%$ from construction profits can drive team behaviours toward a short term focus on securing the project, leading to design change decisions that are driven by an (over)emphasis on cost reduction. While design decisions to achieve cost reduction can help achieve the short term aim of securing the project, the findings of this study also suggest the same decisions can have longer term operational implications.

Summarising the foregoing points, one of the findings from this study was that human resource management acting in combination with other contextual conditions such as organisational success, organisational track record, and organisational commercial expectations can contribute to the outcome of operational cost overrun in a project.

Human resource management has received limited attention within the general project management literature. Fabi and Pettersen (1992) in their review of literature concerning human resource management (HRM) concluded that 'publications on this particular management function are relatively rare', a point later supported by Belout (1998) review of literature. More recently Huemann et al. (2007) suggested that HRM practices in 'project-orientated companies have generally been neglected'. The extant literature with respect to human resource management in relation to PFI projects is even less well populated.

Consequently, it is argued that this study extends knowledge concerning human resource management in PFI projects in particular, and projects in general, by providing some elementary insight into the potential impacts of human resource practices and policies on projects in terms of project overruns. Moreover, the findings bring to light how human resource management practices and policies can interact with other contextual conditions such as organisational success (in terms of securing many new projects) suggesting that HRM needs to be considered within the wider system of factors and conditions.

The findings from this study also suggest that the influence of contextual conditions is not restricted to the provider (BuildIt). For example, contextual conditions at the client's side were found to influence a high rate of turnover of end user personnel and client presentative (page 161). As one participant noted, in other types of projects such as schools there is much less change in stakeholder personnel (end users and client representatives) than there is in health care

projects. Changes to personnel were discussed earlier as contributing to the situation of operational cost overruns

External Contextual Conditions

As well as internal contextual conditions, this study found that conditions in the external environment can also have influence on project outcomes. For example, it was found (page. 163) that shortages of FM skills in the market place can mean the FM Co are unable to adequately satisfy the human resource requirements of projects which can lead to difficulties concerning maintenance and re-commissioning.

Two further external conditions that were identified were BuildIt's shareholder expectations for year on year revenue/profit growth and buoyancy in the market place. These external conditions were found to influence the internal conditions at BuildIt (discussed above). In particular, they were found to contribute to a culture that emphasised the (short term) necessity to win new projects and the need to satisfy commercial expectations to recover x% construction profits, the effects of which were found to contribute to issues in the operational phase of the project.

A final contextual condition identified in this research was the role of news media, in particular in relation to how end users and clients responded toward the project. For example, it was found (page. 252) that news in the press concerning poor value for money being experienced in other similar PFI projects can fuel end user and client perceptions of poor value for money. As discussed earlier, this negative perception can in turn cause end users and clients to be very critical of, and thus find fault with, the project leading to defects being generated. The conclusion drawn is that the media is clearly a powerful stakeholder for whom strategies should be developed to aid the strategic management of these stakeholders (Freeman and McVea, 2001)

In summary, this study has identified a series of contextual conditions that can have influence on project outcomes *and* that these conditions can interact with one another to create a system of conditions that can affect project outcomes.

The influence of contextual conditions in the general project management literature has received attention, recognising that projects exist in open systems

(Engwal, 2003). Love et al. (2002) focusing on the construction phase identified a variety internal and external conditions, such as changes to government policy, as key triggers of change and resultant rework in projects.

Within the PFI context, Bing et al (2005a) highlighted the importance of a variety of contextual risks to PFI project outcomes including macroeconomic risks, political and government policy and social risks such public opposition to projects. However, like many PFI studies (Yuan, 2011) the approach adopted in Bing et al (2005a) gave a macro-level view of these risks. Verweij (2015) on the other hand offered a more micro-level view, examining how project managers respond to events from contextual conditions and how their response can affect project outcomes.

The findings presented in this thesis corroborate existing research on the important role of contextual conditions in PFI projects. However, it is also argued that the findings extend existing research by providing a more micro-level view of the conditions. This view reveals how internal and external conditions can interact with one another and how this interaction can come to affect project outcomes.

5.2.6   The systemic nature of the Factors Influencing Cost Overrun

The factors discussed in the previous sections have been discussed in isolation from one another in order that each could be explored in detail and in light of the extant research base so as to establish their contribution to knowledge about cost overrun.

Although each of the foregoing factors makes a unique contribution to explaining operational cost overruns, the study found (page. 255) that the factors are in fact constituents of a system from which operational cost overrun can manifest. This has two implications. First, to gain a fuller appreciation of individual factors it is necessary to examine them in light of one another because, to borrow a quote from Reason, the characteristics of each factor 'are largely determined by the whole to which it belongs and by its particular location in the whole system' (Reason and Rowan, p.137-8).

The second implication is that, as noted above, operational cost overrun is the manifestation of a system of factors, therefore, in order to gain a comprehensive explanation of operational cost overrun a view of the system of factors is needed.

For example, the internal contextual condition of a shortage of FM skill capability is influenced by the shortage of skills in the market place (an external market condition). A further example is to examine the occurrence of defects. It was found that part of the explanation for defects occurring during the operational phase was the *combined* effects of design change and poor commissioning procedures. Therefore only by exploring the system of factors can one gain an appreciation of why and how operational overruns can be experienced in PFI projects.

By way of a final illustration of the importance of gaining a system view, Akintoye et al. (1998) also identified design risk and commissioning risk. These risks were reported as a list with no facility for exploring the relationships between them. Design risk is reported as the number one risk and commissioning risk reported as 17th. Yet, based upon the previous points above, taking a systemic approach suggests that the two risks can have equal effect when acting in unison which is to generate defects during the operational phase.

To attend to both of the above implications, the findings were used to develop a model which provides a holistic view of the system of factors that have been identified in this study and offers a model of the pathology of operational cost overrun (reproduced for ease in Figure 59).

A number of models offering insight into the pathology of overruns in projects have already been presented within the extant project management literature. For example, Eden et al. (2005) provided a conceptual model of the amoebic growth of project costs during the design and construction phase, Cooper (1993) modelled the effects of the re-work cycle on project costs, Williams et al. (1995) offered a model that explained the effects of design changes.

The model presented by this thesis aligns with some of the models already presented within the literature. In particular, it fits with the findings of Cooper (1993) which suggests that the rework cycle can negatively impact project outcomes. The model also fits with the work of Williams et al (1995) who identify the negative effects of design changes on project outcomes. However, it is also argued that the model presented in this thesis offers a number of extensions to existing models and, therefore, makes the following new contributions to knowledge.

First, the model offers an explanation of the pathology of cost overruns in the operational phase of projects whereas previous models have tended toward explanation of overruns in the design and construction phase. Second, the model

extends the concepts of rework (Cooper, 1993) and impacts of design changes (Williams et al., 1995) illustrating that these concepts can present themselves in a PFI context and in particular the operating phase. Third, the model introduces two new feedback loops involving erosion of client trust and reputational damage which have not as yet been identified within the cost overrun project management literature. Fourth, the model captures contextual conditions and offers explanation as to how these conditions can affect project behaviour during the operational phase. Lastly, but perhaps most significantly, the model presented by this research integrates all of the foregoing points, taking steps toward an integrated view of the pathology of project cost overruns during the operational phase. Existing models on the other hand have tended toward focusing on a particular issue affecting project overruns (such as design change (Williams et al., 1995) or re-work (Cooper, 1993) or compression (Howick and Eden, 2001). The integrated view provides a fuller appreciation of the components that can affect project overrun. It suggests that overrun can be the culmination of concepts identified in existing literature (such as the rework cycle and design change) as well as new concepts such as the trust feedback loop, which interact with one another and can be in operation simultaneously.
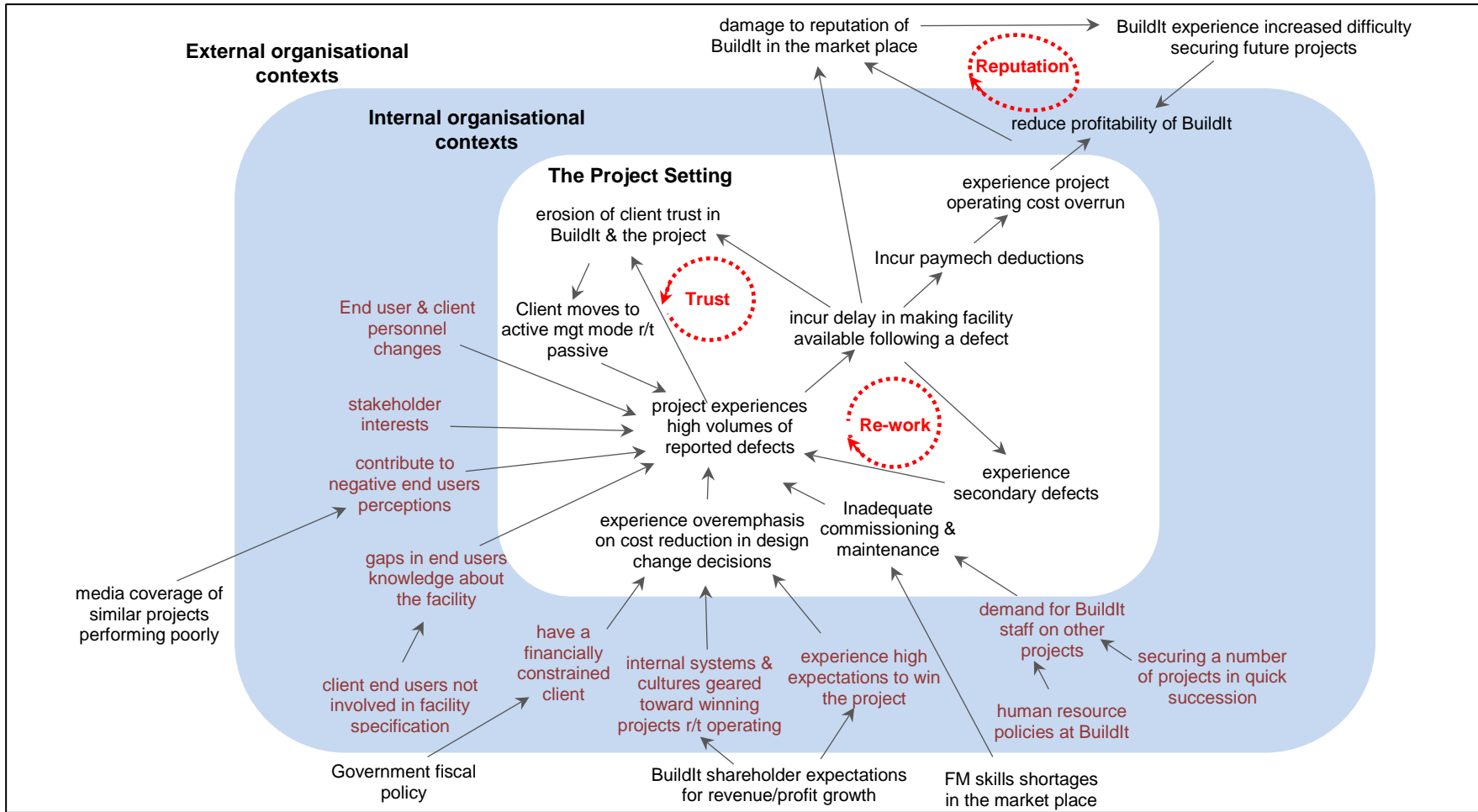
External organisational contexts

damage to reputation of BuildIt in the market place → BuildIt experience increased difficulty securing future projects

Reputation

reduce profitability of BuildIt

Internal organisational contexts

experience project operating cost overrun

The Project Setting

erosion of client trust in BuildIt & the project

Incur paymech deductions

Trust

End user & client personnel changes

Client moves to active mgt mode r/t passive

incur delay in making facility available following a defect

stakeholder interests

project experiences high volumes of reported defects

Re-work

contribute to negative end users perceptions

experience secondary defects

gaps in end users knowledge about the facility

experience overemphasis on cost reduction in design change decisions

Inadequate commissioning & maintenance

media coverage of similar projects performing poorly

have a financially constrained client

internal systems & cultures geared toward winning projects r/t operating

experience high expectations to win the project

demand for BuildIt staff on other projects

securing a number of projects in quick succession

client end users not involved in facility specification

human resource policies at BuildIt

Government fiscal policy

BuildIt shareholder expectations for revenue/profit growth

FM skills shortages in the market place

Figure 59 Reproduction of Figure 50

5.2.7 Counteractions to Operational Cost Overruns

A final contribution to knowledge of operational cost overruns that is made by this thesis concerns actions to mitigate or avoid the phenomenon. The findings revealed two approaches to avoiding or mitigating cost overrun in the operational phase of PFI projects. One approach was reactive, whereby actions were taken once the factors that manifest in overruns began to emerge. The second approach was proactive, whereby actions were taken to mitigate factors that might bring about overruns. Of the two, it was argued that a proactive approach outweighed the reactive approach because of the associated costs of the reactive approach which included reputational damage discussed earlier to be very harmful to the organisation (BuildIt) as a whole.

Underpinning the proactive approach was joint problem solving through a 'brain storming session' between the key stakeholders involved in the provision of the service, in particular the construction company (BuildIt), SPV managers and the FM Co. It was found that the brain storming session provided a forum for stakeholders to surface potential operational risks as well as to jointly explore and agree potential mitigating actions. Consequently, the session was instrumental in identifying and operationalising counteractions to operational cost overruns such as the 'fix first argue later policy'.

However, it was also found that a brain storming session can have more subtle effects concerning the social processes taking place between the stakeholders involved in it. In the findings of this study these subtle effects manifested themselves most obviously the establishment of the 'ethos' of the group involved in the session in terms of how they would work to manage defects. In essence, the brain storming session was an enabler for, and helped engender, common values, beliefs and understandings among the stakeholders – a willingness to work together.

The effects of this ethos were found to be important and systemic. For example, while the brain storming session revealed the risk of disagreement between stakeholders over defect ownership, without the ethos of working together the policy of 'fix first argue later' which neutralised disagreements might never have been agreed to. Moreover, the ethos of the team to work together encouraged openness about possible issues, therefore facilitating issues to be surfaced earlier and managed collectively.

The construction industry is recognised within the literature as being adversarial in nature (Black et al., 2000). Moreover, because the paymech system in PFI is designed to incentivise the provider to resolve defects quickly, there is tremendous emphasis on *urgency* when defects do occur. In effect there is a paymech clock ticking while defects are unresolved and consequently managers are under significant pressure to make quick decisions. Nutt's (1999, p.80) research on decision making shows, that putting managers under pressure engenders behaviours that focus on 'who is responsible' and invoke 'defensiveness'. Thus it seems that the inherent behaviours within the industry coupled with the conditions created by a paymech system meant the scene in project A was pre-set to adversary. However, the findings of this study suggest that the ethos of working together, generated by the brain storming session, mitigated tendencies for partners to be adversarial in their relationship with one another and yielded benefits to the project.

In short, while the primary purpose of the brain storming session was to elicit and manage risks, the session also played a role in managing the social processes among the partners in a way that changed the way partners behaved toward risks (and perhaps toward one another) and in a way that had lasting positive effects on the project.

However, the findings revealed a weakness of the brain storming session which was there was no codified process followed either for managing the social aspects of the session or the process of risk elicitation. In essence, the structure of the session was very fluid and involved staff simply 'pitching in' their thoughts. It is suggested that the adoption of risk management workshops (Ackermann et al., 2014) could be valuable in tackling this weakness as they provide a structured means of risk elicitation, supporting a systems perspective, and providing active management of the social aspects of group working. These features could be incredibly valuable in the context of PFI projects where stakeholders, sometimes with opposing objectives, are brought together to achieve a common goal of project delivery.

A further step to augment the foregoing proposal would be to point practitioner's to Peter Senge's (1990) book on the 'The 5th Discipline' as a point of entry to gain familiarisation with the concept of systems thinking. Although Senge's (1990) book is written from an organizational perspective, the concepts it presents have relevance in a project management context. In particular, Senge (1990, p.94) draws

attention to 'system archetypes', or in other words 'certain patterns of structure that recur again and again' in organisations and in life more generally. If project managers were aware of these archetypes then it might prompt them to look for the archetypes when making decisions – thus adopting a systems thinking perspective.

To further illustrate the relevance of the archetypes in a project management context, the two archetypes which Senge (1990) describes in detail are summarised below. For each archetype, an example situation is drawn from one of the two case studies in this thesis. The example is used to illustrate how the archetype presented itself in the case study and thus demonstrate the relevance of the archetypes in a project management context.

Archetype 1: Limits to Growth

In the limits to growth archetype actions are put in place to create a desired result. These actions can create success however they can also create 'inadvertent secondary effects' which eventually slow down or reverse success (Senge,1990, p.95). Senge (1990) illustrates this archetype with the example that the decision to work long hours might solve a sudden deadline pressure but that the added stress and fatigue of working long hours will eventually slow work down.

This archetype presents itself in the second case study examined in this thesis. In case study B a decision was taken at the design phase to reduce the project's design specification as a means of reducing project costs. As discussed in the findings section however, reducing the design specification resulted in inadvertent secondary effects during the project's operational phase (rising numbers of defects and delays in resolving defects). Thus, although the decision to reduce specifications lowered project costs in the short term, in the medium to long term the decision contributed to rising project costs.

Archetype 2: Shifting the Burden

The essence of this archetype is that approaches to solving problems often focus on attending to the symptoms rather than the underlying cause of the problem. Senge (1990) explains that this approach is often adopted because attending to the underlying cause can be demanding and costly.

This archetype can be seen in an example drawn from case study A. The project team identified that delay in rectifying a defect was a key problem because it would

result in rising project costs (through the Paymech system). A contributing factor to delay was the time needed for contracting partners to agree who among them was responsible for rectifying the defect. To tackle this problem the project team could have set about finding ways of reducing the time needed for the partners to reach agreement. However, instead, the team sought to understand the underlying cause of the issue which transpired to be the protocol for how defects were managed. In short, a defect needed to be rectified by the partner who was contractually accountable for that particular defect. Thus, until agreement was reached as to which partner was accountable no work could be done to resolve the defect.

The project team therefore proposed that the protocol be changed. In the new protocol *any* partner who had the skill set to resolve a defect and who could reach the defect quickly would do so. Identifying and agreeing who was contractually accountable for the defect would take place later. The change in protocol required significant effort, time and negotiation among the partners. However, through co-operation and joint problem solving, the project team succeeded. The underlying cause of delay was remedied, allowing defects to be rectified at the first possible opportunity and thus minimising delay.

The importance of co-operation and joint problem solving in partnership projects is recognised in the project management literature (Black, 2000) however the literature is scant on how this is to be achieved in practice. Therefore, it is argued that the foregoing findings and proposals, in particular the use of risk management workshops, represent a further contribution to knowledge.

5.3 SUMMARY OF KEY CONTRIBUTIONS TO KNOWLEDGE

The review of literature conducted in the previous chapter revealed that PFI projects are of growing interest to the research community. However it was found that current research has generally adopted a high level perspective on these projects exploring them from a social or organisational perspective and leaving a 'significant gap' in current understanding of PFI's' concerning the 'micro-level' processes concerning the management of these projects (Yuan et al., 2009, p.256). In particular, there has been little fine grained analysis of the operational stage of PFI health care projects to expose the nature of operational cost overruns. It is therefore argued that, through a nuanced exploration of two DBFO PFI health care

projects, the overarching contribution to knowledge this makes is revealing a system of factors that can bring about operational cost overruns in PFI projects from the perspective of the service provider, in particular the construction company BuildIt. This system was encapsulated in a model that offers an explanation of the pathology of operational cost overrun.

It was argued that the research findings concerning the factors and patterns of factors that comprise the system contribute to knowledge of cost overruns during the operational stage of PFI projects in the following specific ways.

The findings extend theory concerning feedback dynamics in projects. In particular, two new feedback loops not yet revealed in the PFI literature have been identified. The first, involving the decay of client trust in the provider which found to exacerbate operational cost overruns. The second, a feedback loop involving damage to the provider's reputation in the market place which was found have potentially long term damaging consequences for the providers business as whole. In addition, the findings extend theory concerning the re-work cycle. Extant literature on the rework cycle (Cooper et al, 1993) has tended to focus on the design and construction stages. This thesis extends existing knowledge with the finding that the cycle can present itself in the operational stage of projects and contributes to operational cost overrun. Finally, existing literature has tended to explore individual forms of feedback behaviour, such as rework. The findings of this study extend knowledge concerning feedback behaviour with the finding that different forms of feedback behaviour involving rework, trust and reputation can exist concurrently.

The findings of this study also extend theory concerning the triggers of overruns. In particular triggers of operational cost overruns in PFI projects have been identified and include design changes, inadequate commissioning and maintenance, gaps in stakeholder knowledge, and stakeholder interests. It was argued that although some of these triggers, particularly design changes, have been identified previously in the general project management literature, they have received scant attention from a PFI project perspective. Therefore, by identifying the aforementioned triggers of operational cost overruns in PFI projects and uncovering reasons why these triggers can come about, the findings of this study extend knowledge concerning the triggers of overruns.

The study also extends theory concerning the consequences of experiencing operational cost overruns. In particular, it was found that the consequences are not

contained within the boundaries of the project. Instead it was found that they can propagate up to the organisational level to affect other projects within the construction company's portfolio because, for example, in order to remedy the overrun situation staff may need to return to the project therefore impacting upon their ability to undertake their current project assignment. While this issue can be said to be true of all projects, the findings of this study indicate that it is particularly salient with respect to PFI projects. This is because of the lengthy defects liability period which is idiosyncratic to these types of project. It was found that this period can be many years in length. In one of the case studies it was greater than 10 years, a duration that is far longer than in the more common lump sum contract where the period might be in the order of one year. The lengthy defects liability period in a PFI project means, in theory, the construction firm could be returning to the project over a period of many, many years. Therefore, the risk to the project portfolio is arguably much greater in a PFI project than in, for example, a lump sum contract where the liability period is likely to be much shorter.

The study also found that the consequences of experiencing operational cost overrun in PFI projects can propagate outside of the organisation, in particular damaging the construction company's reputation in the market place with respect to delivery of these types of projects. In turn, this can significantly damage the company's prospects of winning new PFI projects. Again this issue could be said to be true of all projects however the findings of this study indicate that it is particularly salient with respect to PFI projects because of their idiosyncrasies. In particular, it was argued that the client base of PFI projects is likely to be risk averse because these projects deliver services that are of vital social importance (for example, hospitals) and involve investment of enormous amounts of scarce public funds. Moreover, it was argued that clients of PFI projects, although being distinct entities, have connections with one another by virtue of being part of a wider public sector community. This creates conduits for news of poor project performance to reach potential future clients.

Based upon the foregoing it was argued that this study extends theory concerning the consequences of experiencing operational cost overruns in a PFI context.

The findings of this study also contribute to knowledge concerning the role of contextual conditions in PFI projects and how these conditions can interact with one another to affect project behaviour. For example, it was found that demand by

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shareholders for revenue/profit growth (external condition) can influence internal contextual conditions (e.g. staff performance management systems) that focus staff decision making on achieving near term goals (e.g. securing and constructing new projects), marginalising a longer term outlook (e.g. making design decisions in light of project operability).

Finally, the findings contribute to knowledge concerning mitigating the risk of operational cost overrun in PFI projects. A proactive approach to risk management through brain storming among the project stakeholders of the construction company (BuildIt), SPV and FM co was found to be effective (page.256). However, it was also found that the brainstorming session was potentially flawed because it lacked a codified process for managing the session. It was therefore proposed that a systemic risk management workshop (Ackermann et al., 2014) could offer value in this regard.

5.4   KEY CONTRIBUTIONS TO PROJECT MANAGEMENT PRACTICE

The aim of this research study is to contribute to both theory and practice. This section attends to the latter aim. It examines the research findings through the lens of project management practice, in particular exploring how the findings can help practitioners mitigate or avoid the risk of project overruns.

Firstly, as shown in the model presented earlier Figure 59, feedback dynamics involving the erosion of trust, re-work and damage BuildIt's reputation were all found to be salient in this study. The project management literature, corroborated with the findings of this thesis, suggest that recovering from these feedback dynamics once they are in progress is very difficult to achieve. The implication for project management practice is that efforts should be focused on avoiding these dynamic behaviours before they are induced. An excerpt from the model developed in this thesis (Figure 60) suggests that focusing resources on minimising the delay in making the facility available following a defect situation can mitigate or break all three of the feedback dynamics. In other words, if the node *incur delay in making the facility available following a defect* is removed from Figure 60 then the feedback loops are broken.
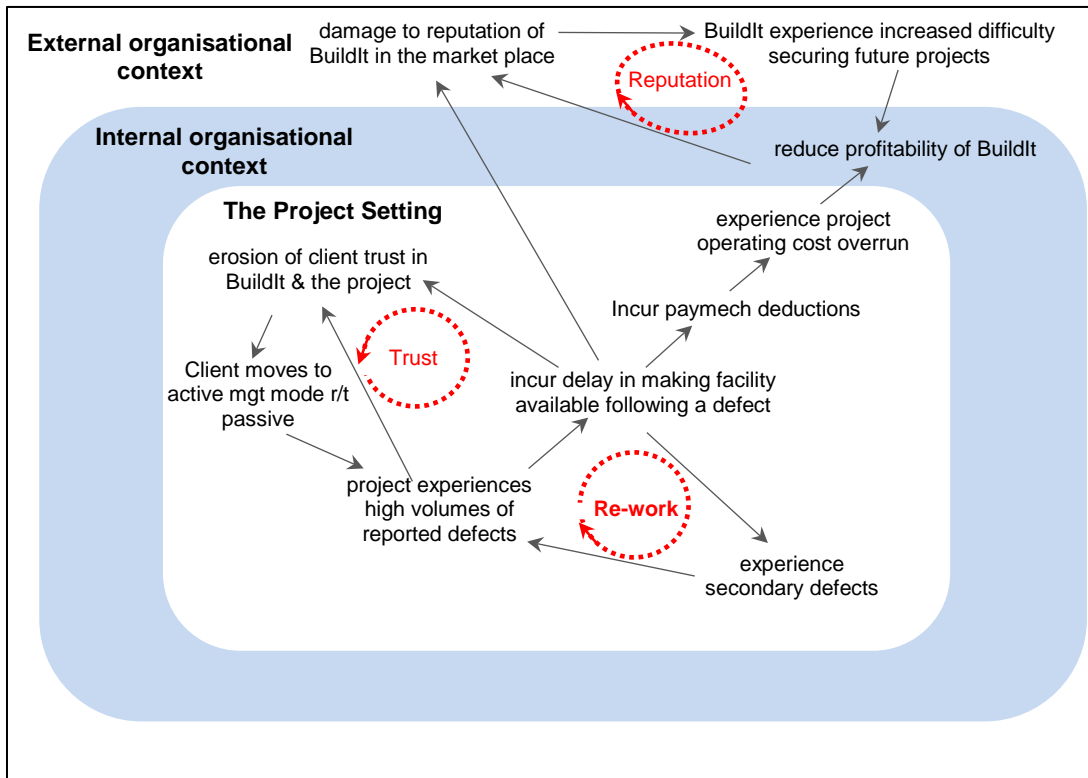
Figure 60 Excerpt from model of pathology of cost overrun

Secondly, gaps in stakeholder knowledge, stakeholder interests, and changes to stakeholder personnel were all found to be contributing factors to projects experiencing a high number of reported defects (a key driver of rising operating costs). The implication for practice is that these factors should be managed. For example, it was found that a proactive approach to knowledge sharing between the construction company (BuildIt) and stakeholders (end users, client and FM Co) can help attend to gaps in stakeholder knowledge. Workshops were found to be valuable in this regard as well as for managing stakeholder interests. In terms of changes to stakeholder personnel, these changes could be managed through communication with stakeholders which could give visibility of impeding change. In addition, developing a transition management plan for key stakeholder personnel (such as the client representative) could be valuable so as to identify the key actions that need to take place in the event of a change.

Thirdly, it was found that decisions taken to meet construction goals can have negative consequences on the operability of projects. For example, reducing the design specification to meet construction cost goals was found to have a multiplicative effect on the cost of attending to defects experienced during the

operating phase. What this finding suggests for practice is that design decisions should be made in light of the project's operating phase if these multiplicative effects are to be avoided. However, the more general implication for practitioners is that project decisions should be made in light of the full suite of project goals (for example design, construction, operation goals). To aid this process, it would be valuable for practitioners to borrow form the world of strategy the concept of seeing project goals as a system of goals rather than each goal being distinct from the other. As Ackermann and Eden, (2011, p.113) explain that organisations normally aspire to achieve more than one goal and that these goals are interconnected whereby 'each goal is supported by others, and in turn each gaol supports other goals – the goals make up a *system of goals'*. Understanding a project's goal system would allow practitioners to identify possible conflicts of proposed actions (e.g. an action which attends to one goal having a negative consequence on another, such as the impact of design changes on project operations).

Fourthly, it was found that a decision taken at the project level (e.g. design changes) which contributed to experiencing defects and resultant delays, in turn, presented substantial risk to the ongoing operations of the construction company (BuidlIt), in particular, putting at risk the organisations ability to secure new PFI projects (due to damaged reputation) and delivering its existing project portfolio (due to resources being channelled toward resolving defects). However it was also found that human resource management policies at the organisational level such as having a 'slim' human resource base can lead to construction staff being stretched over multiple projects contributing to defect and delay situations on projects. What the foregoing findings point to is a powerful reciprocal dependence between organisation decision making and project goals; and project decision making and organisational goals. What this suggests for practice (in particular for senior management and project managers) is that decision making at one level should take into consideration potential impacts on the other.

Fourthly, the thesis also found that a proactive approach to managing the risk of operational cost overrun, in particular, the use of a brain storming session among the project stakeholders ((BuildIt), SPV and FM Co), was effective (page.256). However, it was also found that the brainstorming session was potentially flawed because it lacked a codified process for managing the session. It was therefore proposed that Ackermann et al's (2014) systemic risk management workshop approach could offer value in this regard.

Finally, Loosemore and Cheung (2015) suggests that it is normally case in PFI projects for risk management to treat risks as discrete. However, a finding of this thesis is that factors (risk) which influence overruns interact with one another to form a system rather than each factor operating in isolation from the others. The implication for practice is that a systemic approach to risk management in PFI projects is needed.

The model presented in this thesis provides contribution to practice with regard to supporting a systemic approach to risk management. The model could be used, for example, to stimulate reflection among practitioners concerning the management of these projects, reflection that includes consideration of systemic effects. The model points to a range of risks and sources of risk thereby encouraging project managers (and other project participants) to open their mental antenna to the multitude of risks that can face a project. This might also stimulate practitioners to reveal risks that are specific to their context but perhaps not represented on the conceptual model. Furthermore, by capturing interrelationships between risks the model can be used to stimulate a systemic way of thinking, encouraging practitioners to look for potential linkages between risks rather than adopting a typical mentality of treating risks as discrete (Loosemore and Cheung, 2015). Encouraging practitioners to think systemically may in turn help them to see the added value of adopting a systemic approach. As a consequence, the model could act as a segue to more sophisticated systemic modelling techniques such as systemic risk management workshops (Ackermann et al., 2014) and system dynamic modelling(Rodrigues and Bowers, 1996).

Loosemore and Cheung (2015) found that one of the barriers to systemic thinking in PFI projects is that it challenges conventional reductionist approaches which are deeply embedded in the world of practice. The model presented in this thesis could help in this regard by providing a training device to introduce the ideas and benefits of systemic thinking to practitioners. The sophistication of the model is low therefore making it accessible to a broader population than, for example, system dynamics models which require specialist knowledge to engage with. Furthermore, systemic modelling could be used to complement conventional approaches. For example, as noted above, the model presented in this thesis could be used to stimulate thinking about a broad range of risks and the interrelationships between those risks thus constructing a systemic model of project risk. This model could then

be deconstructed into a project risk register (PRR) format, a format that aligns to conventional reductionist approaches.

5.5   CONTRIBUTIONS TO METHODOLOGICAL PRACTICE

Chapter 3: of this thesis highlighted that there have been frequent calls by leading academics for project management research to move beyond the use of the dominant positivist approach to research and to adopt new approaches that can offer fresh insights (Williams, 2005, Turner et al, 2010, Söderlund, 2012, Bredillet, 2013). With critical realism as its methodological foundation, this research study answered this call by adopting a systemic modelling perspective to researching the phenomenon of overruns. In the discussion that follows, it is argued that the research approach used in this study of project overruns represents a methodological contribution to knowledge.

The review of literature found that critical realism has only been recently introduced (by Smyth and Morris, 2007) as an approach to research in project management. Since then, there have been no explicit instances of its application in the central journals of project management research (e.g. IJPM, PMJ). Smyth and Morris' (2007, p.427) aim was to introduce critical realism as a 'possibility' and to 'stimulate consideration of this option among researchers' rather than provide a detailed exposition of the approach which the authors left to future research projects. However, without detailed exposition, important gaps in contextualising critical realism within project management research remained. Gaps included elucidation of how it is that critical realism can have concern for the particular *and* the general (Smyth and Morris, 2007) while other leading academics have proved strong arguments that researchers cannot have both in equal measure (McGrath, 1981). Implications for the nature of theory developed using a critical realist approach also remained to be explained. Nor had it been brought to light how a critical realist contribution to theory 'fits' with an extant project management research base that, as noted earlier, is largely positivist orientated (Bredillet, 2004, Williams, 2005).

Comprehensive exploration of a critical realist approach to researching project overruns, including comparison with the dominant positivist paradigm, was conducted in Chapter 3: of this thesis. It is argued that this exploration attended to

gaps concerning the adoption of critical realism in a project management context and thus contributes to the methodological knowledge base in project management by extending the work of Smyth and Morris (2007) in the following ways:

- Explicating an approach to research that has been explicitly designed and conducted using an underlying critical realist philosophy of research. Smyth and Morris found no evidence of project management research that had explicitly adopted, and thus explained, the use of a critical realist approach to researching projects in practice.

- Revealing the perceived 'weaknesses' of the approach including knowledge claims that not statistically generalisable but demonstrating that such limitations are consistent with a growing appreciation in the project management literature of projects being context dependent.

- Explicating the concept of generalisation within a critical realist approach to researching projects, qualifying the meaning of the concept 'generalisation' which, if left ill-defined, can lead to false knowledge claims and methodological confusion.

- Presenting an argument, supported by extant literature outside of project management, that theory in critical realism is progressed in an incremental fashion and is, therefore, representative of Wieck's (1995) notion of 'interim struggles' and consequently Merton's (1968) concept of middle range theory. This argument extends the work of Smyth and Morris (2007) by unifying a critical realist approach to research with calls for middle range theory development in project management (Packendorff, 1995, Söderlund, 2004, Bredillet, 2013).

- Bringing to light that, by accepting *part* of inquiry can be about observed events, critical realism offers an approach to research that can generate findings which can converge with those of extant project management literature, even though extant research has largely adopted an alternative realist approach of positivism. Consequently it has been shown in this thesis that critical realism offers theoretical progress, rather than theoretical fragmentation, within project management research by providing an approach to research that is different to but not separate from existing project management literature.

A methodological contribution to knowledge is also argued for in terms of the use of the causal mapping technique adopted within this thesis. Causal mapping

has received attention in project management (Eden et al., 2000, Maytorena, 2004, Edkins, 2007) and has been suggested as offering an alternative perspective for researching projects (Ackermann and Alexander, 2015). This thesis extends the existing methodological knowledge base concerning causal mapping in project management by unifying it with a critical realist research philosophy and in so doing demonstrating how it can form part a cohesive approach to researching overruns in projects.

Causal mapping has been used to research a variety of topics in project management research. Some examples include studying the process by which project managers identify risks (Maytorena et al. 2004), exploring the effects of schedule compression (Howick and Eden, 2001), understanding how projects are affected by disruptions such as design changes (Williams, et al. 1995), and being used for modelling feedback dynamics in project litigation claims (Eden et al., 2000). This thesis extends this work by explicating how the technique can be used for researching overruns in projects to gain a holistic view of the phenomenon, in particular in the context of complex PFI projects.

Thus it is argued that, although causal mapping has already been used in project management, its application in researching the problem of project cost overruns in combination with a critical realist research philosophy is a contribution to knowledge.

5.6   LIMITATIONS OF THIS RESEARCH

McGrath (1981, p.179) observed that '*all* research strategies and methods are *seriously* flawed' and therefore, despite best efforts, all research has its limitations. The particular limitations of this study are discussed below.

One of the significant limitations of this study is that the findings are based exclusively on primary data rather than complementing the findings with secondary data. As discussed in section 3.6.2.4, (page.126) organisational change and commercial sensitivities surrounding the project's themselves meant accessing secondary data from BuildIt was incredibly problematic, indeed accessing *primary* data was at times in jeopardy. A search for secondary data outside of BuildIt (e.g. news media and industry reports) returned no substantive contributions on either project, a finding that is perhaps unsurprising given the commercial sensitivities

surrounding the projects. None the less the exclusive use of primary data is recognised as a limitation, though it is argued that the methodology described in Chapter 3: yielded robust findings from the primary data.

A second limitation of the study is that it is based upon the provider's perspective therefore the findings are bias toward this point of view. It would have been useful to gain input from the client and also end users to gain a more rounded view of the projects that were studied. These opportunities were pursued during the research study but were not realised due to commercial sensitivities.

A third limitation of the study is that it focuses on the operational phase of PFI projects. There are two compounding reasons for this. Firstly, as discussed in section 4.1.2, neither of two project studied encountered construction cost or time overruns. Secondly the method of interviewing that was used had an open style (Chapter 3:, page. 93) and therefore the researcher provided little in the way of direction to interview participants in terms of the topics to be covered. Consequently, when questioned about the relative success or failure (in terms of overruns) of projects, interview participants rather than the research decided the meaning of success or failure. In both projects participants moved directly to a discussion about operational costs. A further round of interviews specifically geared toward investigating the design and construction phases could have illuminated other salient issues however this was precluded due to the limitation of accessing participants described earlier.

Fourth, the findings are based upon only two case studies both of which were: health care projects; design-build-finance-operate (DBFO) PFI projects rather than concession PFI projects; and based in the United Kingdom. Consequently, the findings contained with this thesis document may be limited to application in the foregoing contextual conditions. None the less, it is argued that through analytic generalisation the findings can be transferred to other projects of this type.

Finally, it is important re-emphasise that the findings presented in this thesis document have been arrived at using a critical realist methodology. In line with the underpinning assumptions of critical realism discussed in Chapter 3: the research findings, encapsulated in the model of the pathology of operational cost overrun, are limited in their predictive power. Instead, they offer rich explanation of the system of factors that can bring about operational cost overrun in PFI projects.

CHAPTER 6:   CONCLUSIONS

This brief final chapter brings the thesis to a close. It opens by examining how the research aims set out at the beginning of the thesis document have been addressed. Next, the specific contributions to theory and practice that the thesis has made are examined. The chapter is closed with proposals for future research and concluding remarks.

Addressing the Research Aims

The overarching goal of this study was to contribute to understanding of phenomenon of overruns in projects. This goal was argued to be important for two interrelated reasons. First, projects are of significant economic and social importance, and secondly, despite a growing body of knowledge concerning their management, projects are frequently reported as having failed to meet expectations of cost and time.

Based upon a review of the extant literature, the particular aims were set out as follows in Chapter 2: (page. 55)

- To identify factors, and the relationships between them, that describe a system of factors that can bring about overruns in complex projects, and subsequently
- To use the knowledge gained about the system of factors to develop a conceptual model that could be put to use by practitioners to mitigate overruns in current and prospective projects.

It is argued that this study has addressed the above aims by using the methodology set out in chapter 3 to develop a nuanced understanding of a system of factors that can bring about cost overrun in the operating phase of PFI projects and, furthermore, using this understanding to develop a model explaining a pathology of operational cost overrun.

Based upon the findings and arguments made in the preceding chapters, it is argued that this study has the above research aims from the perspective of theory and practice in the following specific ways.

Contributions to Project Management Theory

From a theory perspective, contributions to knowledge concerning operational cost overruns in PFI projects have been made. The main unique contributions are revealing a system of factors that can bring about cost overrun in the operational phase of PFI projects and encapsulating this system in a model that offers a broader appreciation of the pathology of operational cost overrun. The model was found to align with existing models of overrun in the extant literature but also extend them in key ways. In particular, it explains cost overrun in the operational phase of projects where other models have tended toward the design and construction phase. The model also identifies new feedback dynamics involving trust and reputation. Finally, the model offers a holistic view of a pathology of overrun which comprises design change, feedback dynamics (e.g. rework, trust, reputation) and contextual conditions. Although it was found that some of the features have been explored in the extant literature individually, the model presented in this thesis suggests that they interact with one another and, in the case of feedback dynamics, operate concurrently.

Contributions to methodological practice have also been claimed. Firstly, Chapter 3: of this thesis highlighted that there have been frequent calls by leading academics for project management research to move beyond the use of the dominant positivist approach to research and to adopt new approaches that can offer fresh insights (Williams, 2005, Turner et al, 2010, Söderlund, 2012, Bredillet, 2013). With critical realism as its methodological foundation, this research study answered this call by adopting a systemic modelling perspective to researching the phenomenon of overruns in projects. In was subsequently argued that the research approach used in this study represents a methodological contribution to knowledge in the following specific ways.

Secondly, the thesis builds on the proposal made by Smyth and Morris (2007) that critical realism offers an appropriate philosophy of research for the study of projects. Although Smyth and Morris (2007, p.427) introduced the philosophy to project management research, the authors omitted a 'detailed exposition' of the philosophy, leaving this to future research projects. It was argued in this thesis, that this omission left important gaps in knowledge concerning the suitability of critical realist methodology to project management research and its practical application within the domain. The main contributions made by this thesis have been to attend to the knowledge gaps and to provide a detailed exposition of the practical

application of a critical realist methodology in the context of project management research.

Thirdly, the research approach extends the use of a causal mapping technique to researching the phenomenon of overrun in projects. The technique was found to have been applied to a variety of problem topics in project management such as examining the effects of project design change (Williams et al. 1995), examining the impact of project schedule compression (Howick and Eden, 2001) as well as being applied to researching risk identification practices (Maytorena et al., 2004) and the process of project risk management (Ackermann et al., 2014). The previous chapter argues that this thesis extends the application of causal mapping to researching the topic of project overruns, explicating how it can be used as part of a critical realist methodology to research to gain a holistic appreciation of the phenomenon of overruns in projects. In summary, it is argued that, although causal mapping has already been used in project management, its application in researching the problem of project cost overruns in combination with a critical realist research philosophy represents a contribution to knowledge. It is subsequently argued that the methodology presented in this thesis offers a start point for future studies of project overrun using an alternative to the dominant positivist paradigm.

Contribution to Project Management Practice

The main unique contribution to project practice is the model describing a pathology of operational cost overrun in PFI projects. In particular the model offers added value to project management practitioners and their management teams in the following ways:

- Bringing to attention the need for practitioners to gain a systemic view of projects in order to that they can gain a fuller appreciation of project behaviour.
- Encouraging project managers (and other project participants) to open their mental antenna to the multitude of risks that can face a project.
- Stimulating a systemic way of thinking among practitioners, encouraging them to look for potential linkages between risks rather than adopting a more typical (Loosemore and Cheung, 2015) mentality of treating risks as discrete.

- Encouraging practitioners to think systemically which may, in turn, help reveal the added value of adopting a systemic approach. As a consequence, the model could act as a segue to more sophisticated systemic modelling techniques such as systemic risk management workshops (Ackermann et al. 2014) and system dynamic modelling (Rodrigues and Bowers,1996).
- Stimulating reflection about the approaches used to manage these types of projects and encouraging these approaches to be informed by systemic thinking.
- Related to the previous points, the model could be used as a training device to introduce the ideas and benefits of systemic thinking to practitioners. The sophistication of the model is low therefore making it accessible to a broader population than, for example, system dynamics models which require specialist knowledge to engage with.

A series of other practical implications were also inferred from the findings. The thesis found that a proactive approach to managing the risk of operational cost overrun, in particular, the use of a brain storming session among the project stakeholders (BuildIt, SPV and FM Co), was found to be effective (page.256). However, it was also found that the brainstorming session was potentially flawed because it lacked a codified process for managing the session. It was therefore proposed that a systemic risk management workshop approach (Ackermann et al. 2014) could offer value in this regard.

The findings suggested that that practical efforts should be focused upon avoiding the onset of feedback dynamics because once they are induced they are difficult to recover from. Based upon the findings of this study, advice on how to achieve this was provided. In particular, mitigating delays in attending to defects was found to be a potent action that could mitigate the onset of feedback dynamics involving rework, loss of client trust and reputational damage.

It was also proposed that practical efforts be focused upon knowledge sharing activities between the provider (BuildIt) and other key stakeholders (including the end user, client and FM Co) so as to attend to gaps in stakeholder knowledge. The findings suggested that workshops involving key stakeholders can be useful in this regard.

Changes to personnel were found to re-instate gaps in stakeholder knowledge and introduce new stakeholder interests both of which were contributors to a defect and delay situation. It was therefore proposed that practical efforts be focused upon managing personnel change through transition plans and stakeholder communications.

Finally, project goals were found to be interdependent, in that decisions to achieve one goal (e.g. a construction goal) can have a negative effect on others goals (e.g. operating goals). It was therefore suggested that project management practitioners might benefit from using the concept of a 'goals system' (Ackermann and Eden, 2011) when considering project goals. Understanding a project's goal system would facilitate practitioners identifying possible conflicts of proposed actions (e.g. an action which attends to one goal having a negative consequence on another, such as the impact of design changes on project operations).

Future Research Areas

As discussed in Chapter 3:, in fitting with the critical realist methodology adopting by this thesis the author subscribes to Wieck's (1995) view that theoretical progress is incremental in nature. Thus while a number of contributions to knowledge are argued to have been made by this thesis there remains a series of research avenues that can extend the contributions and attend to the studies weaknesses. These avenues include the following:

- Only two case studies were examined in this research. Examining other health care PFI projects would therefore be valuable for verifying the factors and patterns of factors identified in this research as well as identify other factors and patterns of factors that might form part of the system that can bring about operational cost overruns in PFI projects
- As discussed in section 4.1.1, Ive (2004, p.360) explains that PFI projects come in two forms - *Concessions* and *DBFO (Design Build Finance Operate).* The two case studies explored in this thesis document were both DBFO therefore it would be valuable to explore whether the findings hold in concession type PFI's.
- The thesis examined operational cost overruns from the provider's perspective, in particular the construction company (BuildIt). In future research into overruns in PFI projects, it would be valuable to

complement this perspective with those of other key stakeholders in particular the client and end users to gain a more rounded view of the phenomenon.

- Based upon the findings drawn from the extant PFI project management literature presented in this thesis, further qualitative approaches to researching overruns in PFI projects would seem to offer a fruitful avenue for future research in terms of the revealing the micro-processes concerned with the management of these projects.

- Adopting an action research paradigm (Eden and Huxham, 1996)to examine the practical implementation of the findings of this thesis, in particular the application of the model of pathology of overrun, would be valuable for developing understanding of how practitioner-led (rather than researcher-led) systemic modelling can be achieved.

- Finally, the PFI literature examined in this thesis suggests that it is common for PFI projects to be delivered on time and to budget in terms of their construction (Ive, 2004). It would, therefore, be valuable to investigate the design and construction phases of PFI projects to understand why PFI projects are so successful in their delivery and, furthermore, whether efforts to achieve construction time and cost objectives have any influence on the operational phase of the projects.

Concluding Remarks

Projects are of central economic and social importance; this is particularly the case in relation to PFI projects which are tasked with the delivery of essential public services such as hospitals, schools and roads. Experiencing project overruns can negatively impact the delivery of these services therefore it seems an imperative to better understand the phenomenon so that this type of behaviour can be avoided or mitigated. This thesis has advanced understanding of cost overrun by identifying a system of factors that can bring about the phenomenon during the operational phase of PFI projects and encapsulating the system in a model that provides a broad appreciation of the pathology of operational cost overrun. As with all research, this study has its limitations however it is hoped that the work presented has made credible and useful contributions to both academic and practical knowledge within the project management domain.

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Appendix A Case Selection Matrix

Contract type	Project Outcome	
	Successful	**Unsuccessful**
For example: Joint Venture		
For example: Sub-contract		
Other		

Appendix B Model Themes and Descriptions

LABEL/THEME	Description
Procurement process	including its rules and stages; cost of participation; maturity of the process; as well as organisational roles & responsibilities in the process.
External organisational context	the environment outside of an organisation involved in the project, comprising for example competition, government legislation, and market conditions
Project Design	all statements referring to the design of the facility, including changing, elaborating, reviewing, as well as design data/information
Contracts	their content, and the development thereof
Construction milestones & schedule	statements relating to construction start and construction end dates (hand over)
Mentality, behaviours and cultures (of individuals, teams, orgs)	For example, Silo or holistic; opportunistic; subservient or dominant; co-operative or adversarial; complaining and critical; open or closed;
Partnering arrangements	Partnering between organisations, for example partnering to create the JV including its distributions of equity and liability
The 'bid'	concerning 'the bid' in terms of its development, timescales for submission, and its content (eg proposed value, schedule and design)
Organisational objectives	the objectives of individual organisations involved in the project (eg winning future work)
Invoke (or reduce) feelings or emotions in others	eg feelings of trust, being under pressure, optimism, anger, nervousness, threat, frustration, dependability,
Conflicts and negotiations	statements relating to conflicting views and negotiating toward agreement
Team performance	Relating to the performance of teams involved in the project e.g. bid team, construction team
Project cost	relating to the costs of construction or operation of the facility
Project staffing	concerning staffing on the project e.g. allocating, capacity issues, changes, skill levels,
Knowledge sharing	sharing of knowledge between project team members, and between individual projects (eg lessons learned)
Problems and problem solving	Concerning issues (e.g. cost, operational, construction) and the process of solving issues including determining accountability, information gathering, decision making, resource allocation, response time, implementation of remedial actions.
Risk	statements relating to the risk and its assessment
Internal organisational context	the context inside of an organisation involved in the project for example organisational decisions, processes, structures, polices
Roles and responsibilities	roles and responsibilities of individuals, teams, and organisations at various stages of the project
Commissioning	Commissioning of facilities as part of preparation for handover as well as part of general operational maintenance
Delays	statements referring to incurring time delays
Expectations	expectations of those involved

Incentives to win the tender	incentives such as potential revenues, reputational growth
Paymech system	concerning the payment mechanism (paymech), for example monitoring, points accrual, and deductions
Project characteristics	characteristics such as scale, complexity
Project objectives	e.g. time, on budget, operating objectives
Public ownership	statements relating to the public ownership and financing of the project
Publicity	publicising events beyond those directly affected
Reputation and image	reputation of individuals or organisations
Stakeholder management	relating to the management of internal and external stakeholders
History	of decisions, structure, relationships that exist in the project at a particular time
Relationships between people	forming and cultivating relationships between individuals (rather than organisations)
Preconceptions	relating to individuals preconceptions of people and situations
Communication	relating to communication and modes of communication (eg face to face; telephone; email) among individuals and teams
Colocation of staff	locating those involved in the project in close physical proximity
Common understandings	unified understandings among those involved in the project
Project management structures	organisational structures created within the project to support its management (e.g progress meetings)
Lender	aspect relating specifically to the financers (lenders) of the project
Project planning and monitoring	concerning the development of project plan and monitoring against the plan
Process of facility handover	activities surrounding handing over of the project between construct and operate
Managing staff	management of direct reports