Individual and Collective Success: The Social Dynamics of Multidisciplinary Design Teamwork

Dina Koutsikouri

Buro Happold Engineers
17 Newman Street
London
W1P 1PD

Centre for Innovative and Collaborative Engineering
Department of Civil & Building Engineering
Loughborough University
Loughborough
Leicestershire, LE11 3TU

INDIVIDUAL AND COLLECTIVE SUCCESS: THE SOCIAL DYNAMICS OF MULTIDISCIPLINARY TEAMWORK

By
Dina Koutsikouri

A dissertation thesis submitted in partial fulfilment of the requirements for the award of the degree Doctor of Engineering (EngD), at Loughborough University

September 2009

Buro Happold Engineers
Newman Street
London
W1P 1PD

Centre for Innovative and Collaborative Engineering
Department of Civil & Building Engineering
Loughborough University
Loughborough
Leicestershire, LE11 3TU

ACKNOWLEDGEMENTS

To my supervisors Simon Austin and Andy Dainty in the Department of Civil and Building Engineering, Loughborough University, for their continued encouragement, support and guidance over the past five years. To Mike Cook and Adrian Robinson for inviting me to Buro Happold and introducing me to the wonderful world of building design. To Steven Yeomans for his engagement in my research and friendship.

To the grounded theory community for their generous support and inspiration. In particular, Barney Glaser, Helen Scott, Judith Holton and Antoinette McCallin. To Wendy Guthrie who patiently guided me through the grounded theory process and always took time to answer my questions. Thank you for believing in me!

To the many people in Buro Happold, Fosters and Partners, Aedas and Capita Percy Thomas who generously gave up their time to participate in this study. You made this research worthwhile!

To the following people, thank you for the help and support at different times during the research period: Joyce Fortune, David Bartholomew, Paul Chinowsky, Janice Barnes, and my fellow EngD students at the CICE.

Most of all I would like to thank my husband Greg who have always been there for me and Curly for keeping me calm. Your love and support made all of this possible.

ABSTRACT

Effective team working across disciplines is essential to solve the technological and managerial problems associated with construction projects. However, while it is widely accepted that this method of working is critical to the achievement organisational goals, it is a poorly understood process. Generic 'best practice' recipes on how to improve team work in collaborative projects appears to have had limited impact on performance. Unless the realities of implementing and managing such joint endeavours are conceptualised and articulated in a manner that reflects the actual processes and patterns of behaviour, multi-disciplinary team working will remain a poorly understood working model.

The goal of this work was to develop a conceptual framework that visualises the real success factors of multi-disciplinary working so that practitioners can apply a new understanding of predictable processes and patterns of behaviours to improve collaborative project outcomes. To achieve this, the project started with an exploration of critical success factors in multi-disciplinary design projects, encompassing extensive interviewing, workshops and a survey followed by a grounded theory (GT) study of collaborative working in six multi-disciplinary design projects. The switch to GT methodology offered possibilities to further probe into the dynamics of multi-disciplinary team working from the perspective of the team members.

The findings show that team working in multi-disciplinary design projects can be explained through the social process of *'informalising'*. Informalising refers to the strategies practitioners use to cope with the multiple pressures and unforeseen demands that pervade the collaborative design environments. It portrays the relevance of managing of expectations and value-judging to remain effective and efficient in the face of change and uncertainty. These are critical factors that influence the project trajectory and experience of those involved. Alongside these results the work also demonstrates the importance of so called 'super soft factors' such as shared values, creativity and innovation and passion and enthusiasm to achieve positive project outcomes.

Overall, recognising that the process of *informalising* forms an essential part of cultivating collaboration, and hence 'getting the work done', more attention should be given to understand such activity in today's turbulent and transient project organisations. Knowledge and understanding of this form of emergent and improvisational strategy may enable managers to predict and control patterns of behaviour inherent in the management of collaborative design projects, and positively influence project outcomes in terms of perceived value and profit.

KEY WORDS

Collaboration, Construction projects, Design Management, Grounded Theory, Informality, Multidisciplinary team working.

PREFACE

The research presented in this thesis was conducted to fulfil the requirements of the Engineering Doctorate (EngD) at the Centre of Innovative Construction Engineering (CICE), Loughborough University. The research was financially supported by the Engineering Physical Sciences Research Council (EPSCR) and the commercial sponsor Buro Happold.

The core aim of the EngD is to solve one or more significant problems or challenges within an industrial context. For example, the project could involve understanding an industrial process and discovering how to make it more efficient or investigating the properties of a novel material. Here the aim was to explore and expose the real challenges that practitioners face in delivering inter-disciplinary design within the built environment. As such the EngD is a radical alternative to the traditional PhD, requiring the researcher to be located within a sponsoring organisation guided by an industrial supervisor while also receiving academic support from participating university. In light of this, the EngD programme provides students with a good understanding of how research, academia and industry can work together to produce work that is both useful and valuable.

The format of the EngD thesis consists of a main discourse supported by publications or technical reports. This thesis includes two journal papers (of which one is yet to be published) and two conference papers, which are referred to throughout the main body of text and found in the Appendices A to D. The papers should be read in conjunction with the main discourse.

USED ACRONYMS / ABBREVIATIONS

BIM	-	Building information modelling
CICE	-	Centre of Innovative Construction Engineering
EngD	-	Engineering Doctorate
EPSCR	-	Engineering Physical Sciences Research Council
GT	-	Grounded theory
QDA	-	Qualitative data analysis
CSFs	-	Critical success factors
EngD	-	Engineering doctorate
FSM	-	Formal Systems Model
RE	-	Research Engineer
QMS	-	Quality management system

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PAPERS

The following papers, included in the appendices, have been produced in partial fulfilment of the award requirements of the Engineering Doctorate during the course of the research.

PAPER 1 (SEE APPENDIX A)

Koutsikouri, D., Austin, S.A., and Dainty, A.R.J. (2006) Critical success factors (CSFs) in a multidisciplinary engineering practice, *Proceedings of the 2nd CIB/ASCE Specialty Conference on Leadership and Management in Construction,* Grand Bahama Island, Bahamas, May 4-6, 2006

PAPER 2 (SEE APPENDIX B)

Koutsikouri, D., Austin, S.A., and Dainty, A.R.J. (2006) Critical success factors for multidisciplinary engineering projects, *Proceedings in Association of Researchers in Construction Management (ARCOM), Twenty-second Annual Conference*, UCE, Birmingham, September 4-6, 2006

PAPER 3 (SEE APPENDIX C)

Koutsikouri, D., Austin, S.A., Dainty, A.R.J. (2008) Critical success factors in collaborative multidisciplinary design projects, *Journal of Engineering, Design and Technology*, Vol 6 No 3, pp 198-226

PAPER 4 (SEE APPENDIX D)

Koutsikouri, D., Austin, S.A., Dainty, A.R.J., and Guthrie, W. (2009) Informalising: A grounded theory of multidisciplinary collaborative design. *Paper submitted to Design Studies in August 2009 and currently under review.*

1 INTRODUCTION

The purpose of this chapter is to provide an introduction to the subject domain and background of this project. The chapter sets out the industrial and commercial context of the work, identifies the research problem and offers a justification for the need for the research. It also describes the main aim and objectives of the project, briefly comments on study methodology and outlines the overall thesis structure. The final section provides a summary of each paper that has been published during the research period including a forthcoming paper. Ideally the papers should be read in conjunction with the thesis and are therefore referenced within the chapters (appendices A-D, pp 77-149).

1.1 BACKGROUND TO THE RESEARCH

The built environment brings many benefits to people's lives; well designed schools contribute to educational attainment, hospitals to patient outcomes, offices to productivity, public open space to recreation and well being (Jupp and Macmillan, 2010). Alongside the issue of social outcomes is the increasingly important risk of environmental impact, including climate change. There is an urgent need to improve facilities that minimise resource use in their construction, minimise energy and water requirements, and limit the damage to the natural world (ibid, 2010). To meet these challenges construction professionals including designers and engineers need to work together effectively (Dickson, 2001). In other words, producing a good building demands that people are able to handle the undeniable complexity of managing interdisciplinary projects.

1.1.1 THE UK CONSTRUCTION INDUSTRY

Indeed, there is a widespread agreement in the construction industry that projects could be delivered more effectively. Both of the most influential government reports within the industry confirm this (Latham, 1994; Egan, 1998). Describing and illustrating what needs to be changed, team working has been highlighted as one of the most important factors in transforming the UK construction industry. This has led academics and practitioners alike to search for best practice solutions to promote collaboration; between disciplines, between professions and between different parts of the supply chain. At the heart of this is a strong belief that effective team work can improve industry performance and innovation. The team work approach is therefore perceived as an important source of competitive advantage (Bennis and Biederman, 1997).

Collaborative working is almost universally viewed as good for organizations. Leaders routinely challenge employees to tear down silos, transcend boundaries, and work together in cross-unit teams (Hansen, 2009). And although such initiatives often meet with resistance because they place an extra burden on individuals, the potential benefits of collaboration are significant: innovative cross-disciplinary product development, increased inter-professional interaction and resource efficiency. Although the focus has mostly been to promote the positive aspects of collaboration and team based work, there is an increasing awareness that this is not unproblematic (Hackman, 1987; Sveiby; 2002; Beyerlein et al, 2004).

This has urged organisations to find other (and better) ways of working together in project work and increasingly the companies in the construction industry have begun to exploit the opportunities that technology may offer. In recent years, developments such as business

information modeling (BIM) are receiving increased attention from the construction industry including design consultancies. However, the success of using technology supported information sharing and collaboration does not depend solely upon the technology itself (Shelbourn et al, 2005). Studies have shown that unless people are willing to use the technology it is not likely to improve joint working (e.g. Conner et al, 2003). Further, the challenges of managing multidisciplinary project work, especially getting people from different professional and cultural backgrounds to work more effectively together, highlights the importance of establishing a context in which individuals feel motivated and supported to perform well; individually, and as part of a team.

Achieving success in today's dynamic project based organizations, especially in the context of construction, is therefore increasingly reliant on the conditions, i.e. pressures and dynamics that prevail the multi-project setting. The study of project success factors must therefore go beyond simply describing identified factors to conceptualise the (social) processes that impact on behaviour and ultimately project outcomes.

1.1.2 PROJECT COMPLEXITY IN CONSTRUCTION

Project organisations in construction typically involve people with different knowledge, experience and skills who come together to solve a common task; projects can thus be seen as arenas for knowledge creation, integration and sharing, where new and proven ideas and thoughts are combined (Fong, 2005). Projects in construction work on time scales that are frequently lengthy, non-repetitive, and often organised around teams assembled specifically for the project and often disbanded upon its completion. It would seem that most project work in the construction sector is characterised by various pressures; political processes of negotiation of the context of work, as well as demands to deliver on an organisational, professional and individual level (Koch, 2004).

In view of this, the frequently quoted reasons for continuous problems with project performance are the uniqueness and temporality of project arrangements, and uncertainty in the execution of projects. Further, the constraints in which individual project team members perform their work include a high degree of complexity and interconnectedness of tasks where the formal structures needed to facilitate coordination and control of work are lacking and high dependence on diverse skills and collective knowledge in the arrangement where individuals have little time to find out who knows precisely what (Cicmil, 2005). In this project environment relationships must often be developed quickly, and important interpersonal interactions occur frequently in situations where relationships are still being established. Further, relationships must withstand constant change as the project and its product progress (Druskat et al, 2006). An added complexity (or perhaps paradox) is that working together in such settings involves both social and solitary work. In other words, there is a constant interplay between the need to interact and the need to work effectively by oneself (Heerwagen et al, 2004). Taken together it is clear that working together represents a constant struggle to keep the project group together as well as achieving 'success'.

Based on research into construction project complexity Cicmil et al (2005) identify three important aspects of construction projects that capture the persisting concerns articulated by both researchers and practitioners:

- Complex processes of communicative and power relating among project actors.

- Ambiguity and equivocality related to project performance criteria (what constitutes success or failure?) over time.
- The consequence of time flux (change, unpredictability and the paradox of control.

The implication, as expressed by the authors themselves, is that managerial concerns and interventions should go beyond a mechanistic view of communication of information and team integration, and address issues of ambiguity, unpredictability and power that are important part of how people jointly accomplish a sophisticated project task. Thus, understanding the collaborative interaction in multi-party coalition is therefore a key to understanding complexity in construction projects. It highlights the importance of exploring the reality of the challenges facing those working on projects if one is to understand organisational effectiveness and 'success'.

1.2 CONTEXT OF THE RESEARCH

1.2.1 THE IMPORTANCE OF UNDERSTANDING PROJECT SUCCESS FACTORS IN CONSTRUCTION DESIGN PROJECTS

As projects are increasingly becoming the primary way of organising work to achieve wider organisational goals, defining and managing project success is more relevant than ever (Jugdev et al, 2005; Morris, 2004). This has prompted a greater focus on project management practice and theory over the past two decades spanning various work contexts including engineering, construction and information systems. Despite the rapidly growing body of knowledge regarding the effective management of projects, the developed methods, techniques and best practice recipes seem to have had limited impact in the real world of projects. Worse still, practitioners appear to experience the same type of problems again and again, indicating that even the most sophisticated methods are not able to ensure success (Fortune et al, 2005). Taken together it is clear that managing projects represents a constant struggle to keep it together as well as enabling learning and knowledge transfer (Koch, 2004).

1.2.2 STUDIES OF PROJECT SUCCESS FACTORS

The study of project success and the critical success factors (CSFs) are considered to be a means to improve the effectiveness of projects. However the concept of project success has remained ambiguously defined in the mind of the construction professionals. Consequently, this research is conducted in order to make an attempt to identify the variables (or drivers) that influence the success of project implementation with a focus on the construction design process.

Interest in critical success factors has increased dramatically over the past forty years, with several research papers and books being written on the topic. The term 'critical success factors', defined as those features which have been identified as necessary to be achieved in order to improve the chances of project success, is therefore widely used within the management literature. Largely, as a result of this popularisation, practitioners are inundated with 'critical' information about what to pay attention to in order to manage projects more effectively.

Over the past decade, researchers in construction and construction project management have become increasingly interested to explore critical success/failure factors (Chua et al, 1999;

Toor et al, 2009; see also Appendix A, Journal paper 1). This has begun to clarify the particular success factors that are important for achieving project success in dynamic organisational environments.

1.2.3 STUDIES AIMING TO DETERMINE CONSTRUCTION PROJECT SUCCESS FACTORS

Search for project success and failure factors in construction has particularly focused on partnering, construction contracting methods and project planning (Chua et al, 1999) with limited attention paid to the construction design process. This is surprising since it has been claimed that design defines up to 70% of the final construction product (Kochan, 1991, cited in Bibby, 2003). Further, the majority of construction delays can be traced back to poor design performance. The design phase has many interfaces with other processes such as construction and procurement, and organisations including the client, user representatives and regulatory bodies. Current success frameworks do not seem to apply to this project environment which is often multi-disciplinary and characterised by creativity, iteration and temporality of project arrangements. These aspects bring forward the question how to best manage design projects to achieve successful project outcomes. Specifically, what factors and issues really influence the project process within a complex and fast-paced practice context?

In light of this, clearly, a different approach to studying project success in contemporary organisations is needed if the study of critical success factors is to achieve credibility. The response within the discipline of project management has been to re-think the future directions of project management research. What is noticeable in the sub field of construction project management is a greater emphasis on portraying the 'lived reality' managing projects from practitioners' perspectives (Green, 2006). Following this, the research described in this thesis is designed to capture the reality of getting work done in inter-disciplinary design projects. The ambition was to reach beyond the explicit, easily communicated dimensions of work to render the informal and emergent aspects of projects visible; in particular, those features that remain unrecognised in formal project management procedures but nevertheless impact on project outcomes and satisfaction.

In view of this, achieving project success, and indeed team work in today's project-based organisations is becoming increasingly challenging, and hence a more comprehensive and contextually embedded understanding of what factors influence project outcomes is needed. In particular, one that takes into account the challenging and conditions transition to a more holistic understanding of the success and failure factors, however, can only be driven by more research in various real world settings. This is important since it influences the development of current bodies of knowledge in project management. It was against this backdrop that this research programme was developed and undertaken.

1.3 THE INDUSTRIAL SPONSOR

Buro Happold was founded in 1976 as a small structural design consultancy based in Bath, UK. Since its early days the company has evolved in scope, size and stature. The practice has chosen to follow a path of organic growth, in part to preserve rather than dilute the prevailing culture. Buro Happold has a strong commitment to innovative solutions including research

into sustainability and renewable technologies. Annually 1% of turn over is re-invested at the leading edge of design.

As a leading multi-disciplinary consulting engineering company, Buro Happold has been involved in many high profile projects including the British Museum Great Court, the Millennium Dome, BBC White City and Arsenal Football Stadium. While UK has been a particularly strong market for the practice over the years, the diminishing national funding for buildings in recent years has led to a greater focus on increasing international work in the Middle East and the Far East.

The investigation was located in Buro Happold's London office which employed around 400 staff including engineers and support staff. In 2009 the total number of employees was around 1700 worldwide; spread across 25 international offices[1].Typically each engineer is involved in two to seven projects simultaneously, reflecting a dynamic and busy work environment. Generally the consultancy will work with a separate architectural practice to provide the complete design team for a project.

1.3.1 PROBLEM DEFINITION

As a consequence of rapid growth over the past ten years, coupled with changes in the way projects are procured and the need to create sustainable building solutions, senior management in the company was looking for practical 'tools' and 'ideas' to improve the delivery of multi-disciplinary design projects. They were trying to solve the conundrum of staying competitive in a tightening market place: 'How do we offer expertise across an expanding spectrum of skills while continuing to offer the small-firm feel our clients enjoy?'

Moreover, the company recognised that to achieve exceptional performance in projects, practitioners have to better understand the 'whole picture' of work and life within the multi-disciplinary project environment. The response to the internal and external pressures felt by the company led to the development of a new corporate governance structure which was launched in May 2007. To quote the managing director Gavin Thompson: 'It is a devolved form of governance which places decision making close to those who work on and support project work… the aim is to measure the success of the practice much more directly by the success of projects'(Quarterly Buro Happold Bulletin, May 2007). Framing it differently, this new business model emphasised project leadership, technical excellence along with the capacity to work cooperatively in projects. Specifically, the challenge was to find better ways of working together and create a culture that promotes collaborative behaviours. Following this, a number of initiatives and tools were championed within the company to support collaboration in projects. For example, a collaboration services team was employed to support internal and external consultancy on collaboration systems for delivering projects; a project delivery discipline group (DDG) was instituted to streamline the company's project systems to make life easier for project leaders to share best practice; and Microsoft Sharepoint software was introduced to run the intranet and knowledge systems, providing in-built tools for document handling, searching and collaboration sites. However, in order to change working practices in the long term it was recognised that there was a gap in knowledge regarding the behavioural factors involved in achieving more cooperation, coordination and integration in the project process.

[1] The staff number was 2000 in 2008 and has been reduced during 2009 due to the global economic down turn.

To this end, the EngD was considered as an ideal vehicle for investigating factors that are important in accomplishing successful multidisciplinary projects. It was believed that increasing awareness of the social dynamics of multidisciplinary design projects would enable the company to address the wider issues of improving organisational performance and client satisfaction.

1.3.2 SCOPE OF THE RESEARCH

This research project, as a whole, is fundamentally concerned with capturing the realities, or *actuality* of multi-disciplinary design project work; increasing understanding of what factors may be 'critical' to achieve success. It focuses on understanding the 'lived reality' of design professionals involved in collaborative building design projects including structural engineers, building services engineers, architects and CAD-technicians. Initially focusing on perceptions of project success factors the study was extended to also to capture the main concern of the substantive population and how that concern is processed, in order to inform practice. This research questions were thus:

Research Phase I :

- What factors do you think influence project success?

Research Phase II:

- What are the issues that design professionals face?
- How are these issues resolved or processed?

The questions guided the ambition to develop a theory of explanation for the social processes that underpin project success/failure in increasingly complex project environments.

1.4 AIMS AND OBJECTIVES

In May 2004 when research project was set up, the industrial sponsor Buro Happold was endeavouring to improve collaborative working within the practice and the task of identifying potential barriers in multi-disciplinary team work was given high priority. Underpinning this improvement agenda was a desire to 'make work more efficient, productive and enjoyable' (First outline proposal for the EngD project, May 2004), and hence a fresh a perspective on how to promote collaborative behaviours was sought. In sum, the research was driven by an interest on the part of the sponsoring company to ascertain research based insights about how to effectively manage project teams to achieve organisational success.

In order to address the professional concern of the company, the research was conducted in two main phases.

Phase 1 Exploration of critical success factors in multi-disciplinary design projects to establish the main factors that influence project outcomes. This provided essential information regarding what managers and practitioners need to pay attention to in the project life cycle to ensure project success.

The outcome and analysis of Phase 1 formed the basis for developing the direction and research activities for Phase 2.

Phase 2 Investigation of how people work together in real project to show the sponsor how practitioners cope with their main concerns on a daily basis, revealing the strategies that people to get their work done.

The research activities associated with Phase 1 were conducted in the first and second year of the EngD programme and Phase 2 activities were carried out the in the third and fourth year. Based on this, the overarching **aim** was to:

'Contribute to an expanded understanding of project success factors within the context of inter-disciplinary building design projects'.

'Develop a holistic model (practical theory) for understanding the social processes (success factors) that underpin multi-disciplinary team based project work, allowing managers and practitioners to predict, control and manage projects more effectively'.

The associated **objectives** were:

1. To identify and explore success and critical success factors, in project work as perceived by the project members. (Phase 1)
2. To group and label these factors and understand their interrelationships within the project context. (Phase 1)
3. To explore how practitioners work together in design projects; discovering their main concerns and how they continually resolve these. (Phase 2)
4. To develop a preliminary theory of multi-disciplinary team based project work that takes into account the complexities embedded within multi-project settings. (Phase 2)

1.4.1 A RETROSPECTIVE LOOK ON DEFINING THE RESEARCH AIM AND OBJECTIVES

Defining the *central aim* and associated objectives has been an ongoing subject of discussion since the start of this EngD project. Taking a retrospective look at the research process it becomes evident, however, that allowing the research problem to emerge rather than to preconceive it was the best possible approach to achieve the goals of the research. The following memo describes the progress as experienced by the RE:

> *Originally this research project was going to be about knowledge transfer and strategies for improving communication in inter-disciplinary design projects. The aim was to support the implementation of the Design and Technology Board's objectives on 'collaboration and knowledge sharing in project work' across the practice. Barley six months into the research programme the consensus was to let the research unfold without pre-defining 'the problem'. Put simply, the strategy was to allow the real issues to emerge and hence this research was totally driven by data. This opened up opportunities to explore project working and get to the core of what really 'goes on' in complex and turbulent multi-project team based settings (without a clear script). Specifically, the purpose was to improve the chances of understanding the challenges and dynamics of collaboration in inter-disciplinary design projects. Thus, it was an ideal platform upon which to develop and respond to the company's expectation,*

namely, 'to increase awareness of the factors that may improve team working practices'.

1.4.2 STUDY METHODOLOGY

In order to understand the practice context in which multi-disciplinary team based work is embedded and explore project success factors from the practitioners' point of view, an inductive research design was adopted. This guided the collection and analysis of data in both phases of the research. Primarily, ethnographic type of fieldwork was conducted including in-depth interviews with design professionals including CAD-technicians and observations of daily project work. The data collection also included a survey which was carried out in response to the demand for quantitative data. This was also necessary to promote the research throughout the business unit in which the research was undertaken. Overall, the plurality of research methods was a deliberate endeavour to conduct a reflexive and innovative study of organisational life in project based organizations.

The impetus for switching research strategy from qualitative data analysis (QDA) to grounded theory methodology came from a realization that something was missing. What was actually going on in collaborative design projects? What exactly was the problem? While the first phase of exploring project success factors pinpointed a number of important areas that 'must go right' in achieving project success, it did not provide a conceptual rendering of people's behaviour; i.e. what they actually do. The second phase of the research project was therefore utilising the classic grounded theory methodology based on the early work of Glaser and Strauss (1967) and Glaser's subsequent work (1978, 1992, 1998, 2001, 2005). The resultant grounded theory of *informalising* through managing expectations and value judging is presented in a forthcoming paper (see Appendix D). Details of the adopted research methodology can be found in Chapter 3.

1.5 OUTLINE OF THE THESIS

This thesis comprised of five chapters structured as follows:

Chapter 1 describes the background to the research, defines its aim and objectives, discusses the justification and scope of the research and briefly comments on the study methodology. The chapter concludes by outlining the papers completed during the course of the research.

Chapter 2 reviews related work on the main subject domains of this research: critical success factors and team based project work with a special emphasis on collaboration. The review also highlights the significant issues and factors that impact on project success in project based organizations including construction. The chapter also establishes the contribution of the research to the area of project management and management of multi-disciplinary teams, in particular within the multi-project interdisciplinary design environment.

Chapter 3 provides an overview and justification for the chosen research strategy. The chapter sets out the research process, the philosophical positioning of the study, and then details the specific design associated with Phase 1 and 2 of the project, including data sources and collection procedures. It also describes the grounded theory methodology in terms of its origin and usefulness in achieving the practical objectives of the EngD.

Chapter 4 presents the activities undertaken during the research period and discusses the main research findings with a particular focus on the emerging theory of *informalising,* which integrates the entire factors and issues of this research projects.

Chapter 5 presents the impacts and implications of the research on the project sponsor, the wider industry and suggests possible avenues for future researchers. The chapter also provides a critical evaluation of the research in terms of its validity and limitations before concluding.

Table 1.1 Summary of published and unpublished papers

ID	Title	Journal/ Conference	Status	Description
Paper 1` Appendix A	Critical Success Factors (CSFs) in a Multi-disciplinary Engineering Practice	Proceedings of the 2nd Specialty Conference: Leadership in Management Construction, Grand Bahama Island, Bahamas	Published`	Explores success factors within the context of a building design practice. The findings show that project success are related to five dimensions of work: individuals, teams, process, project and product. These need to be communicated effectively within the project community.
Paper 2` Appendix A	Critical Success Factors for Multidisciplinary Engineering Projects	Proceedings of the 22nd Annual ARCOM Conference, UCE, Birmingham	Published`	Examines perceptions of critical success factors in multi-disciplinary projects from the perspective of the project members. Builds upon the previous paper and clarifies the success dimensions of work, emphasising the role of social capital.
Paper 3` Appendix A	Critical Success Factors in Collaborative Multi-disciplinary Design Projects	Journal of Engineering, Design and Technology	Published`	Explores critical success factors in inter-disciplinary design projects. Management factors, design team factors, competencies and resources factors and project enablers were identified as the interdependent group factors. Concludes that managers have the power to influence, motivate and enhance positive feelings and creative performance of projects.
Paper 4` Appendix A	Informalising: An emerging theory of multi-disciplinary team based project work	Design Studies (submitted August 2009)	Unpublished`	Investigates the pressures and dynamics of the multi-project interdisciplinary project environment. The emerging grounded theory of *informalising* highlights the role of managing expectations and value-judging in the management of complex projects.

1.6 SUMMARY

This chapter has provided the reader with an overview of the thesis by presenting the contextual background to the study, information about the industrial sponsor, the research problem and the purpose of the study including its aim and objectives, justification for the research and its potential significance. The chapter continued with a brief comment on the study methodology, outline of each of the published papers and an overview of the overall structure of the thesis. Chapter 2 offers a review of the literature related to the project success factors and team based collaborative working.

2 LITERATURE REVIEW

This literature review focuses on providing an understanding of two different but interrelated topics within the discipline of managing projects: 1) project success factors and, 2) collaboration as a working model to improve/achieve organisational effectiveness. The first section seeks to establish the current knowledge of critical factors for achieving success in major projects with a particular focus on construction related projects. The second section offers a selected review of research in the field of collaborative working; a concept which has received increased interest in the management of multi-agency projects. This chapter is not designed to provide an exhaustive literature survey of all the approaches, methods and techniques that can be used to gain and understanding of project success factors and collaborative working, but will cover the general approaches of relevance to today's complex project environments. Additionally, in deciding what material to include, an attempt has been made to illuminate factors that are found to be particularly interesting, useful and informative for construction/design professionals.

2.1 INTRODUCTION

Projects have become a central activity in most organisations. Indeed, in many industries and companies, the project is now the normal work form. The opportunities are clear to see; the huge increase in interest in project management presents clear evidence that more and more firms recognise it as a viable and effective means to achieve organisational goals. As Turner (2005, p. xi) notes: 'the flexibility, responsiveness, and innovativeness that projects offer modern organisations demonstrate again an again that project based work … represent a very real sea change in the manner in which organisations must do business if they are to be successful in a fast-paced global market place'. However, as the project form is becoming increasingly common, it is also clear that they present challenges that cannot be ignored. Even the most professional project-based organisations show high failure rates, often in terms of both delays and budget overruns (Morris et al 1987). Concurrently, the frequently cited reasons for continuous problems with project performance are the uniqueness and temporality of project arrangements, and uncertainty in the execution of projects work (Young, 1998; Meredith et al, 2000; Maylor, 2001, cited in Cicmil, 2005). In the many comparisons made between project work and 'ordinary work', project work is usually described as an opposite; challenging, creative and controversial (Pinto, 1996, cited in Lindgren et al, 2005). Further complexity is added through the particular work conditions (constraints) in which project members perform their tasks. These include a high degree of interconnectedness of tasks and high dependence on diverse skills and collective knowledge in the arrangement where 'individuals have little or no time to find out who knows precisely what' (Cicmil, 2005, p. 157). Therefore, good project skills have never been more important and underline the importance of developing a greater awareness of what it means to manage project successfully. But what factors really influence positive project outcomes in today's unpredictable and uncertain project environments?; and how can practitioners and project managers know what to do ahead of time to achieve 'success'?

The next section of this chapter focuses on bringing together the most important work on project success factors in generic projects with a particular emphasis on those peculiar to construction projects. The literature review makes clear that there is very little research into project success in such project settings, particularly in understanding the idiosyncratic context

of interdisciplinary design. This is surprising since design is such a critical part of the creation of the built environment.

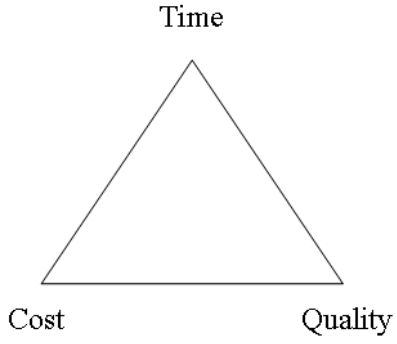
2.1.1 DEFINING CRITICAL SUCCESS FACTORS (CSFS)

Identifying critical success factors (CSFs) is an established method for organisational analysis. CSFs can be events, conditions, circumstances, activities, characteristics or competencies that really hold the key to organisational success. The approach was first proposed by Rockart (1979) who saw it as a means for gaining 'critical' information about how to implement change more effectively. While not intended for strategic planning purposes, the identification of critical success factors can help top management by: 1) determining where management attention should be directed and 2) developing measures for critical success factors. According to Toor and Ogulana (2009) appraisal of project critical success factors can *really* help project leaders to achieve the project objectives and scope. Consequently, disregarding these factors will increase the likelihood of project failure (Andersen et al, 2006).

Traditionally, the objectives of any project have been represented in the form of a triangle showing time, cost and quality (or schedule, budget or specification), illustrated in Figure 2.1. This is considered a useful metaphor because it demonstrates that the three criteria of project success are inextricably mutually dependent. The paradox is that once the project has been completed, schedule and cost problems tend to be forgotten and the quality or, usefulness, of what has been delivered becomes the key factor. A good example is the Millenium Dome in Greenwich (UK) which was completed in 1999 and hailed as an engineering success but was rejected by the general public. Interestingly, ten years on perceptions on its 'success' has changed and it is now seen to be a landmark building.

An important and often ignored aspect of defining success criteria is expressed by De Wit (1988) who differentiates between the success of project management (short term goals) and the success of the project (long-term goals). Similarly, Kerzner (1998, p. 37, cited in Pinto & Slevin, 2004, p. 100) makes the distinction between 'successful projects' and 'successfully managed projects' and concludes that 'successful implementation of project management does not guarantee that individual projects will be successful'.

Figure 2.1 Time-cost-quality triangle.



Despite the rich literature on project success, it is evident that the concept of 'success' is a whole lot more complex than just meeting the 'priority triangle' criteria. According to Cooke-

Davies (2004, p. 99) much of the complexity arises around: 1) definitions of success; individuals involved in projects have different views points, interests and expectations of what they want to achieve, 2) the tendency of perceptions to evolve over time and 3) the difficulty of assessing complex phenomena using simple metrics. What is evident is that the criteria for success and the factors that need to be employed to achieve that success need to be defined and agreed by all parties (i.e. project stakeholders including project manager, sponsor and users) from the outset. The message conveyed in most research is that project managers should concentrate on success criteria relating to users and sponsors, consequently softer factors to deliver those success criteria. This is a step forward in looking at project success from a more holistic perspective.

The literature on project success factors is more extensive than that on success criteria.
The remainder of this chapter aims to provide the reader with a contemporary understanding of the meaning of CSFs and project success, locating the gap in the current knowledge regarding this seemingly well-researched area.

2.2 SUCCESS FACTORS ON GENERIC PROJECTS

Numerous studies have been conducted to identify project success factors for generic projects, especially within information systems, R&D construction and various engineering environments. Within the project management literature a variety of studies can be identified. There are several literature reviews that summarise and synthesise the most important research that has been carried out over the past four decades. Based on a review of 30 articles, primarily from North American sources, Jugdev et al (2005) developed a framework portraying the evolving understanding of 'success' and project success factors. They underline that 'we are now aware that success factors relate to the organisation (e.g. top management support) and to the external environment (e.g. politics, economy, social, technological, nature, client, competition and subcontractors)' (p. 28).

In their comprehensive review of the CSFs literature Fortune and White (2006) found that the three most cited factors are the importance of a project receiving support from senior management; having clear and realistic objectives and producing an efficient plan. Nevertheless, they also note that although the majority of sets of criteria include at least one of these factors, very few include all three.

Although most studies emphasise different success factors, there seem to be relative consensus on the importance of human factors or 'people' for successful project outcomes (Lechler, 2000; Cooke-Davies, 2002). The 'discovery' that performance, and thus success is achieved through people draws attention to the importance of understanding the very core of what constitutes organisations, namely human and social capital. While the human dimension in organisations is implicated in most CSFs it remains a challenge to conceptualise in a manner that reflects 'what it is' as well as 'how to manage it' in relation to the demands of meeting various project targets. An important aim of the work portrayed in this thesis is to elucidate the relationship between people and project outcomes.

The problems of developing a method for analysing and predicting the likelihood of success or failure of an ongoing project is by no means a simple one (Pinto and Slevin, 2004). There are a number of reasons that this process presents a challenge. For example, one obvious

reason is that words like success and failure like beauty are often in the eye of the beholder. A second problem with accurately predicting project outcomes lies in the often incomplete nature of the data themselves. Many times a project's development is surrounded by a great deal of ambiguous and even contradictory data that make midstream assessments problematic. Finally, and closely related to the first reason listed, is the often subjective nature of project assessment, depending as it may individuals' having biases one or another toward the project, makes it difficult to develop objective measures that offer a reasonably reliable method for judging project outcomes.

2.2.1 STUDIES ON PROJECT FAILURE

The body of literature on project success also encompasses project failures. For example, the Standish Group have studied project success and failure with a focus on Information Technology (IT) projects since 1994. They indicate that the top success factors involve user involvement, executive management support, experienced project managers, clear business objectives, minimizing scope, agile requirement processes, standard software infrastructure, a formal methodology, reliable estimates, skilled staff and effective tools. (Standish Group, 2003).

Fortune and Peters (2005) studied 'real-life' project information systems projects using a systems approach to come to grips with the causes of actual and potential failure. They present a model of a system, the FSM (Formal Systems Model) capable of purposeful action without failure that can be used as a yardstick to judge existing and planned information systems (or other undertakings) and they suggest measures that need to be taken to achieve success. The model is illustrated in Appendix C, p. 114. Use of the approach helps to identify some of the most common characteristics of failure, namely, organisational deficiencies; ineffective control and communication; poor reliability; disregard for human factors and neglected environmental effects. It also emphasises the importance of 'stakeholder mapping' to identify the people or groups who have a stake in the project and hence may influence its outcome. The formal systems model (FSM) contains within it all of the 'critical success factors' found in a review of 63 publications that focus on CSFs (Fortune and White, 2006). In other words, their research shows that it is possible to map most CSFs with the features of the FSM model. Recently a project specific version of the FSM has been developed that can be used by project managers and other professionals to identify actual and potential weaknesses in a present structure or process and to look for difficulties in the relationships between the project and the context in which it is or will be taking place (White and Fortune, 2009). From this perspective the FSM model provides a robust means for helping project managers avoid failure and thus provides a more grounded approach to solving practice problems.

2.3 SUCCESS FACTORS IN CONSTRUCTION PROJECTS

Project success factors have been of interest to the engineering design and construction research community for many years. Work by Pinto and Slevin (1987), Jaselskis and Ashley (1991), Sanvido et al (1992), Parfitt and Sanvido (1993); Anderson and Tucker (1994), and many others successfully created a comprehensive list of management factors that when present, increase the likelihood of design and construction project success. More recent

literature on project critical success factors summarises the empirical results of several studies and outlines the main categories of success.

In building construction, Sanvido et al (1992) found four CSFs:

- A well-organised and cohesive facility team;
- A series of contractors allowing to encourage the various specialists to behave as a team without conflicts and to allocate risk and reward correctly;
- Experience in various aspects of similar facilities; and
- Timely, valuable optimisation information from related parties in the planning and design phases.

In their study of large-scale construction projects Toor and Ogulana (2009) identified that factors related to project planning and control, project personnel, and involvement of client were perceived to be critical for project success. They also found that participants showed their high concern for sufficient resources, adequate communication, mutual understanding of stakeholders on project goals and award of bids to the 'right' designers and contractors. Although the research was carried out in Thailand it is evident that the findings resonate with research conducted in other parts of the world.

Clearly, in view of what has been said about success factors, many frameworks can be used to understand the forces that may impede and/or facilitate project success. The tendency however is for researchers to seize a particular point of view. For example, the role of the project manager has attracted more and more attention in terms of raising the probability of success. Concurrently, this has brought attention to project management techniques and various technologies to support information flow as a measure to increase project related information and control. Other studies have focused on success factors on specific areas of construction projects. Chan et al (2001) studied success factors in design-and-build projects. Their survey revealed six critical factors including project team commitment, the client's competencies, risk and liability assessment, end user's need, and constraints imposed by end users. Factor analysis showed that the first three were the most significant to success. To sum up, although the list of potential success factors provided in the literature gives some idea as to the most important elements that could be included in a performance model for construction projects, there is no general success framework that 'fits all' type of projects. An added aspect is that some studies concentrate on certain issues of construction project, while others have larger scope in terms of factors under investigation. Moreover, most of the studies on success factors in construction and beyond are based on survey questionnaires, and thus they shed more light on what project participants *think* the success factors are than on the real project experiences. This makes it difficult to make a fruitful comparison between studies, emphasising the subjective nature of project success.

2.3.1 CRITICAL SUCCESS FACTORS IN THE CONSTRUCTION DESIGN PROCESS

Construction design is often described as a richly iterative activity which has to be managed with care. That is, too much control stifles the design development and the emergence of creative solutions (which usually happens through the iterations and loops), however, taking a laissez-faire approach (leaving it to the design professionals to work things out) may lead to delays and cost-overruns; and, at worst, fragmentation of the team. According to Emmitt

(2007) the fluid nature of the project there is a tendency for design work to consume more time than estimated and budgeted. This is often forgotten when assessing project success of construction projects. Another important variable to recognise is that design activities involve various contributors (e.g. architects, engineers, quantity surveyors) that may hold different views as to their perceived amount in relation to design liability, and this may well influence how they behave (communicate and act) during the development of design (ibid, 2007). The assembly of the most appropriate organisations and individuals is considered as a key influence on the success of design projects. Importantly, it affects collaboration which underpins most project work in construction and beyond.

Despite the proliferation of CSFs studies in the construction industry, limited attention has been given to investigate critical success factors that influence the construction design process and its contribution to the overall project success. This is surprising since design is a key activity in the construction industry. Past research has shown that decisions made in this phase of the construction project have the greatest impact on the eventual total project cost (Paulson, 1976). Further, the cause of the majority of construction delays and defects can be related to poor design performance (Horner et al, 1998; Josephson et al, 1996, cited in Bibby, 2003). Some research has begun to study the impacts of project management actions on design performance. For example, Kuprenas (2003) found that *design team meetings* and *reporting frequency* were significantly correlated to design costs.

2.3.2 CONCLUDING REMARKS ON THE STUDY OF CSFS

Looking back at the research on critical success factors presented above, most of it is quantitative, based on surveys and questionnaires aiming at generating statistical analyses on factors. Although some of the studies are qualitative and relate factors to cultural and organisational factors, none of them provides an integrated theory of the project success process. Questions never answered are: What conditions give rise to certain factors? What strategies do the practitioners employ in order to deal with the work situation? In this thesis, therefore, applying an inductive approach to qualitative study, the aim is to attempt to answer the questions presented above.

The RE's view on the current body of knowledge regarding project success factors is that it is too focused on determining a set of factors without much consideration of the social processes that continuously go on to achieve project success. Hence, the real success factors are those behaviors (e.g. strategies and tactics) that people apply to resolve practice problem that get in the way of delivering projects on time, within budget and to specification. By describing a factor, for example leadership, without explaining what it actually means in practice is of very little use for managers who are looking for 'golden nuggets' or practical advice on how to deliver successful projects, or simply how to avoid project failure. Rather than regarding critical success factors as variables that influence projects, it is suggested that they may be considered as a form of knowing. Such an approach draws attention to the need to research ways in which projects may be understood and managed.

In an increasingly turbulent business environment, managers are looking for prescriptions or best practice models to follow. A quick search in the literature shows that there is plenty of prescriptive advice on what practitioners should focus on. It seems that regardless of research scope and context, the CSFs method is seen as a vital managerial tool to achieve organisational survival. But beyond prescription, many studies seem to offer not more than

descriptions of what is important within a major project, organisation or collected perceptions of a group of project managers in a specific context. Interestingly, Phua and Rowlinson (2004, p. 46) notes that many of the project success factors often incorporated in earlier studies have become a form of received wisdom that are take to directly influence project success. From this perspective, practitioners tasked with improving the management of design projects are often readily applying 'best practice' recipes based on traditional project management. For example, by developing formal structures, policies, and strategies, and providing management training for organisational members people tend to believe that they are more likely to be successful; or increase the chances of 'getting it right'. This appears to be familiar in many construction related organisations, not the least design engineering practices[2]. As noted by Stapley (2006, p. 1) 'even when we have selected those that we perceived to be the best personnel and provided them with attractive terms and conditions and some of the best working conditions, many of us still didn't get the success we planned for in the organisations concerned'. Moving beyond traditional qualitative research methods this research project aims to provide a richer, yet *real*, understanding of the 'factors' that contribute to project success and effective performance.

The major part of this research therefore is an exploration of factors that influence project success, especially in collaborative multi-disciplinary design projects. The aim is to contribute to the wider understanding of the particular demands of managing projects in such complex settings.

2.3.3 IDENTIFYING THE KNOWLEDGE GAP IN THE LITERATURE

Over the past two decades considerable progress has been made regarding project success and project success factors in construction projects and beyond. While this knowledge has broadened the scope of project management and what knowledge is needed to manage projects more effectively (APM BOK, 2006), managers still struggle to deliver projects successfully. This is especially true within the construction industry, where projects depend on collaborative working between different stakeholders, professional disciplines and specialist consultants. Clearly in spite of their popularity it appears that CSFs studies have had little impact on practice. As noted by Sauser et al (2009, p. 2): '…few organisations or managers are actually using the findings of these studies to improve their managerial processes'.

Jugdev and Muller (2005, p. 29) adopts the perspective that 'projects are about managing expectations, and expectations has to do with perceptions on success', and hence project relationship building and creating an environment in which interactions can flourish are fundamental to project success. This way, the CSF method may be misleading, because projects are realised through constant interaction between people (and technologies, see actor-network-theory, Law et al, 1999) and structural constraints (e.g. organisational as well as personal structure such as commitments to various projects) which cannot usually be extracted as factors with clear boundaries. Put differently, it may be that project success factors as a term is becoming less useful to describe what actually leads to success. While it is clear that knowing that for example project management is important factor to achieve project success, little is published on what project managers (and other practitioners) actually do

[2] This is all too familiar for the company under investigation. Project management 'initiatives' have been initiated to improve the project process; from the bidding stage right through to project completion.

when they are managing projects. What social processes do they engage in to move the project in a particular direction? CSF as a method does not provide enough insight into the *actuality* of projects. Thus, what is needed is more research that takes greater account of the complex social reality of project based organisations and managing in today's increasingly complex business environment (Bresnen et al, 2005)[3]. A more grounded understanding of how people get their projects done is important because it has bearings on the future directions of project management research, practice and education. The work presented in this thesis aims to fill that gap. Specifically, by focusing on the social processes that take place within the project context, it is possible to detangle how and why things happen.

To sum up, the research presented in the present thesis aims to study project success factors using the classic grounded theory approach, as described in Chapter 3, which allows the emergence of 'new variables' in a well studied field. Next the concept of collaboration as a working model is examined in terms of its importance for overall project success. Emphasis is on understanding the team dynamics that underpin collaborative working in construction and beyond.

2.4 LITERATURE REVIEW ON COLLABORATION

Successful delivery of construction projects relies on collaboration between a wide range of professionals from different disciplines and backgrounds. Ensuring that project members/stakeholders are working together as a team is therefore a key factor in achieving overall project success. Despite the importance of team work, it is clear that collaborative ventures are hard to realize in practice. Simply bringing a group of experts together does not necessarily ensure that they will function effectively as team. Lack of organisation, misunderstanding, poor communication and inadequate participation can all lead to problems (Yeomans, 2005). Collaboration in construction is therefore an extremely complex process that requires a high level of strategic planning (Austin et al 2001) on the one hand; and relationship maintenance on the other (Huxham et al, 2005).

This review examines the most relevant research on groups and teams, giving special emphasis to research investigating factors that influence the effectiveness of multi-disciplinary teams. The review shows that there are no easy recipes to follow when it comes to implementing team work as a work structure. It concludes that more practice based research is needed to produce theories that reflect the realities of 'working together' in cross-disciplinary teams. This may improve the chances of developing a practical model of the 'factors' that truly affect team dynamics as well as project outcomes. The review begins with explaining the basic terminology.

2.4.1 DEFINING COLLABORATION

What is meant by collaboration? Webster's New World Dictionary and Microsoft office thesaurus, offer a whole host of definitions for the term collaboration, namely 'working together', 'a joint venture', 'working in partnerships' 'acting as a team' 'and 'cooperating

[3] Studying the reality of projects is becoming increasingly popular in the field of project management. Some authors have managed to portray the reality of managing projects, for example, Clegg et al (2005), Ivory et al (2005), Cicmil et al, 2005.

with one another'). Schrage (1989) defines collaboration as 'the process of shared creation: two or more individuals with complementary skills interacting to create a sharing understanding that none had previously possessed or could have come to on their own' (p. 33). Other researchers focus on the very practice of collaboration and argue that the traditional view is partial. For example, Heerwagen et al (2004) holds that effective collaboration entails both 'working together' and doing 'solitary work', suggesting that organisations need to focus on both these activities when implementing team based models of work. Further, it has also been recognised that collaboration can range from being a lengthy meeting where complex problems are solved to an informal chat by the water cooler which can transform to a collaborative relationship (Schrage, 1989).

Clearly there is no simple answer to the question what collaboration is. This lack of clarity has resulted in the term 'collaboration' being used in a variety of ways in both research and practice settings. For example, it is often considered synonymous with other modes of interaction such as cooperation and compromise. Kvan (2000, p. 410) argues that part of the problem with the term 'collaboration' is that the activities that are undertaken in such acts 'may vary in intent and degrees of participation, yet be called the same thing'. For example, it is often considered synonymous with other modes of interaction such as cooperation and compromise. Mattessich and Monsey (1992) have defined collaboration in relation to two other important words often used to denote 'collaborative working', namely *cooperation* and *coordination*.

- *Cooperation* is characterised by informal relationships that exist without a commonly defined mission, structure or effort. Information is shared as needed and authority is retained by each organisation. Resources are separate as are rewards.

- *Coordination* is characterised by more formal relationships and understanding of compatible missions. Some planning and division of roles are required, and communication channels are established. Authority still rests with the individual organisation, but there is some increased risk to all participants. Resources are available to participants and rewards are mutually acknowledged.

- *Collaboration* connotes a more durable and pervasive relationship. Collaborations being …'(a) full commitment to a common mission. Authority is determined by the collaborative structure. Risk is much greater…'.

As Mattessich and Monsey emphasise, collaboration requires a greater commitment to a common goal than cooperation. This means that trust must be higher in 'collaborative acts' (Kvan, 2000). Kvan (2000, p. 410) points out that design collaboration 'is a far more demanding activity, more difficult to establish and sustain, than simply completing the project as a team. I suspect we collaborate far less often than we pretend to'.

2.4.2 WHY COLLABORATE?

In the new era of faster, looser, more rapidly changing connections between people and groups, working together is becoming more central to the ability of organizations to manage their dynamics efficiently and effectively and ensure their growth and survival. For this reason, the study of teams and collaboration has become important in organisational psychology, organisational behaviour, management and policy making. There is an expanding

body of knowledge in the field of inter-organisational collaborations and partnerships that is aimed at facilitating the management of temporary and on-going forms of group and team work.

Collaboration has become a particularly attractive concept within construction for it seems to capture a quality of interaction between professionals that is based on mutual respect and progress. Managers often talk about it as 'the name of the game' as it were[4].

2.5 PERSPECTIVES FROM RESEARCH ON MULTI-AGENCY WORKING

There is a growing body of literature on inter-professional working which has relevance to understanding team based work in contemporary organisations. According to Henneman et al (1995) a significant number of personnel and environmental factors influence whether or not collaboration occurs within a multi-disciplinary settings. These are summarised as follows (pp. 106-107):

- **Personnel factors** relate to characteristics of the individual as well as to the group. For example, many of the antecedents to collaboration are dependent on the readiness of an individual to engage in this type of interpersonal process. This readiness may result from a number of factors such as educational preparation, maturity and prior experience working in similar situations.
    - Another recurrent antecedent is the ability to communicate effectively Communication is a critical antecedent in that it serves as the vehicle for articulating other important precursors to collaboration such as respect, sharing and trust. Trust between members of a group is an essential element of collaboration. It requires that individuals get to know one another, through communication and sharing. It requires effort, patience, and previous positive experiences. A lack of trust presents an insurmountable barrier to the development of collaboration.
- **Environmental factors**: collaboration requires an environment with a team orientation. It necessitates an organisational structure which is flat rather than hierarchical. Emphasis must be placed on cooperation as a model of dealing with issues rather then competition. Organisations which support collaboration base power on knowledge and expertise as opposed to role or function.

Another theme evident in the literature concerns trust. Trust is often cited as the key factor related to successful group work and goodwill (Granovetter, 1985; Owen, 1996). Typical suggestions are that it is important to: 'have clarity of purpose and objectives', 'deal with power differences', 'have leadership but do not allow anyone to take over', 'have patience and understanding'; 'resolve different levels of commitment'; 'have equal ownership and no point scoring' and so on (e.g. Huxham and Vangen, 2000). However, Huxham and Vangen (2003) point out that the reality of collaborations and partnerships is that people frequently have to work together without dealing with all aspects of trust building. Hence the idea that trust is a precondition for a successful collaboration is somewhat flawed at least in temporary settings where project members are expected to 'hit the ground running' without much time for social interaction.

[4] The theme for the RIBA International Conference held in Paris, 25-27 October 2007, was Collaboration. The general message was that collaboration is extremely important for the delivery of successful buildings and innovative architecture. At the same time it was recognised that it requires dedication and proper technology.

Much of the literature on team work cites the work by Tuckman (1965) as important in understanding team dynamics. Tuckman wrote that any team appears to go through stages of: forming, storming, norming and performing. Only in the last stage is productive work done on the task itself. While this framework shows the developmental nature of team work, it has been criticised for giving a rather simplistic representation of team development (Hackman et al, 1990). Specifically, it fails to take into account the unpredictable and fast paced nature of modern day projects which inevitably influence groups the propensity to collaborate. Team dynamics are also affected by pressures and dynamics stemming from working in several projects simultaneously (typical in project based work) and the various priorities that have to be made. This in turn affects the quality and depth of interaction as well as to what extent that individual team members view themselves as a true member of a team. Thus, team behaviour needs to be understood from the perspective of the team members and what they actually do rather than built upon what should or ought to happen (logico-deductive perspective).

Within the context of construction few studies have been conducted to investigate multi-agency collaboration in practice. A notable exception is the work of Shelbourn et al (2005) on the requirements for effective collaboration in construction projects. Their research show that a focus on the 'softer' issues such as business process and people rather than a technology focus are needed to plan and implement collaborative working more effectively in projects. However, while this research offers an array of insights into the challenges of multi-agency working and possibilities for management intervention, it masks the formal and informal aspects of how people handle and respond to demands associated with collaboration in general.

Working together across organisational and professional boundaries as an ideal continues to challenge practitioners in sectors where collaboration between people is essential to deliver a desired service or product (McCallin, 2007). From the literature it can be concluded that today's increasingly challenging business environment requires managers who are socially competent and engage in building teams, which draws attention to the leadership function of the modern manager in addition to the managerial functions of delivering projects. However, even if construction management is becoming increasingly focused on taking notice of the needs of the people within the team and their individuality it is evident that the message is still not getting through to the construction industry as a business community. Many proclaim that people are the greatest asset in their business and subsequently 'working together as a team' and 'collaboration' is essential to organisational success, yet they do not act as though they believe it. The evidence coming from studies of 'real-life' multi-disciplinary projects suggests that practitioners are often bogged down by coping with daily pressures while at the same time attempting to deliver projects within time and budget (Koutsikouri et al, in press).

2.5.1 CHALLENGES OF COLLABORATION

Construction project teams attempting to integrate face considerable challenges. Baiden et al (2006) suggests that the level of team integration in collaborative design projects is affected by the team practices adopted, set within the context of the procurement approach. They found that none of the investigated teams were completely fragmented; neither did any of them exhibit all the characteristics of a truly integrated team. From this the authors conclude that '[either] fully integrated teams are not necessary for effective team operations within the

industry, or that the sector must overcome significant organisational and behavioural barriers if the benefits of integration are to be fully realized in the future' (p. 22).
In the context of construction design activities collaboration involves a complex interplay of relations and dependencies embedded within the team. Managing collaboration can therefore be difficult to achieve, particularly in attempting to ensure that the team shares knowledge and arrives at consensus-based and efficient decision making (Foley and Macmillan, 2005). Added to this complexity is the need for successful multi-disciplinary interaction. This is all too familiar within the sponsoring company and of particular interest in the investigation of understanding what actually 'goes on' in collaborative design projects. The relational and social issues that constitute the so-called 'soft' management challenges are receiving increased focus among researchers and practitioners alike.

Too often a business leader asks, 'How can we get people to collaborate more?' (Hansen, 2009, p.83). Collaboration can deliver tremendous benefits (innovative offerings). But it can also backfire if costs (including delays stemming from turf battles) prove larger than expected. Although the collaboration imperative is a hallmark of today's business environment, some writers suggest that the challenge is not to cultivate more collaboration (e.g. Huxham and Vangen, 2008; Hansen, 2009). Rather it is to cultivate an understanding of the conditions that variously affect the process of working together. This puts managers in a better position to anticipate problems and issues in on-going collaborative projects and remove obstacles that may lead to collaboration inertia.

2.5.2 IDENTIFYING THE KNOWLEDGE GAP IN THE LITERATURE

One way of understanding the complexity of delivering multi-disciplinary design projects is to explore the kinds of issues that tend to cause anxiety and reward in collaborative team based work and to unpack the challenges inhered in each. According to Vangen and Huxham (2005) most commonly, issues to do with aims, culture, communication, power, trust and complexity tend to get in the way of making any real progress. For example, they state that many managers believe it is necessary to be clear about the aims of joint working if partners are to act together. The problem with this is that 'partners rarely have the same aims and needs, so reaching agreement is difficult' (p.3). In view of this, they argue that collaborative success is more likely to happen when people simply get started on some action, leaving further discussions about joint aims until some joint achievements have been made (ibid, 2005).

This reflects a concern that current project management literature does not adequately address the 'whole picture' of work and life in the local project environment. Rarely do studies uncover the main concerns of professionals working in teams, explaining the processes team members used to continually resolve practice problems. Instead, too much research effort has been directed towards clarifying the reasons for project success and failure and/or identifying the requirements for the implementation of successful projects. For this reason, academics have increasingly become interested in researching the actuality of projects to provide insights into the management of complex projects. The assertion is that 'a better understanding' of the project reality in terms of the practitioners' experiences of project working will contribute to more satisfactory outcomes of contemporary projects (Cicmil et al, 2006).

The underlying assumption is that conventional project management theory has to move beyond looking into what practitioners should be doing and pay more attention to the behavioural tensions and paradoxes that play out in projects.

To sum up, in order for multi-disciplinary team working to be effective, organisations that employ this working model must recognise that to enhance multi-agency working, practitioners need time, support and coaching to work through differences in values, thinking patterns and problem solving as they move through the project process. As Huxham and Vangen (2000, p. 800) note, 'if you are seriously concerned about achieving success in partnerships [collaborative working], be prepared to nurture… nurture and nurture'.

2.5.3 CONCLUDING REMARKS ON COLLABORATION

Collaboration and teamwork is becoming increasingly important in today's organisations. Working together provides synergy that exceeds individual effort, making it pertinent in complex project environments such as collaborative design. Yet this literature review reveals that co-operative ways of working is not straightforward; rather it is a complex and multifaceted process with no clear guidelines. By assembling some of the key factors: trust, rapport, team dynamics, leadership, communication and physical environment, this literature review reveals what is already known about group effectiveness: it is about individuals behaviour, motivation, and values, and the dynamic interrelationship between these.
This literature review makes clear that there is scope for further research into collaborative working. What is currently missing is research that takes into account the realities of collaborative practice in project based organisations. While there is much rhetoric on how to set up teams and manage them, research explaining how multi-disciplinary team manage their concerns and work together in everyday practice is minimal. More research is needed to provide empirical evidence, grounded in practice, of the processes which teams use as they work and interact together in the current context of construction projects. The heart of the challenge is not about providing more convincing evidence of the benefits of 'working together'; rather there is a need to build practitioner relevant knowledge about collaboration in practice and the real challenges of collaborative working in a fast-paced practice context.

2.6 SUMMARY

The purpose of this literature review has been two fold, namely: 1) to examine relevant research related to project success factors and, 2) to provide an overview of current knowledge of collaboration as a working model to achieve organisational effectiveness.

A comprehensive answer to the question what factors really influence project success is difficult to provide. Similarly, judging whether a project is a success or failure depends on the observer(s); who they are and their particular interests and so there is no surprise that commentators only agree on one thing; 'success' is an ambiguous concept. Although considerable progress has been made to the general understanding of project success over the past four decades, there is clearly scope for more studies that can help managers to improve the management of projects. From this perspective, the application of CSFs method is very promising and can help practitioners and managers to focus on 'what must go' right to achieve positive project outcomes.

An attempt has been made to illustrate generic project success factors including those particularly relevant to construction projects. Of these factors, collaborative working has been further examined in terms of its definition and importance for achieving overall project success. The conclusion is that CSFs does not provide enough 'information' for managers to act on. What is needed is more research that reflects the realities of project based organisations and the management of complex projects. This represents a genuine knowledge gap in contemporary project management knowledge. A more grounded approach has potential to contribute to the further understanding of collaborative working, allowing the theory behind the actions of those involved to emerge.

The next chapter provides a description of the chosen research strategy as well as describing the methods and analysis which underpin the studies undertaken to fulfil the aim and objectives of the EngD thesis. Emphasis is placed on describing the classic grounded theory method as prescribed by Glaser and Strauss (1967).

3 STUDY METHODOLOGY

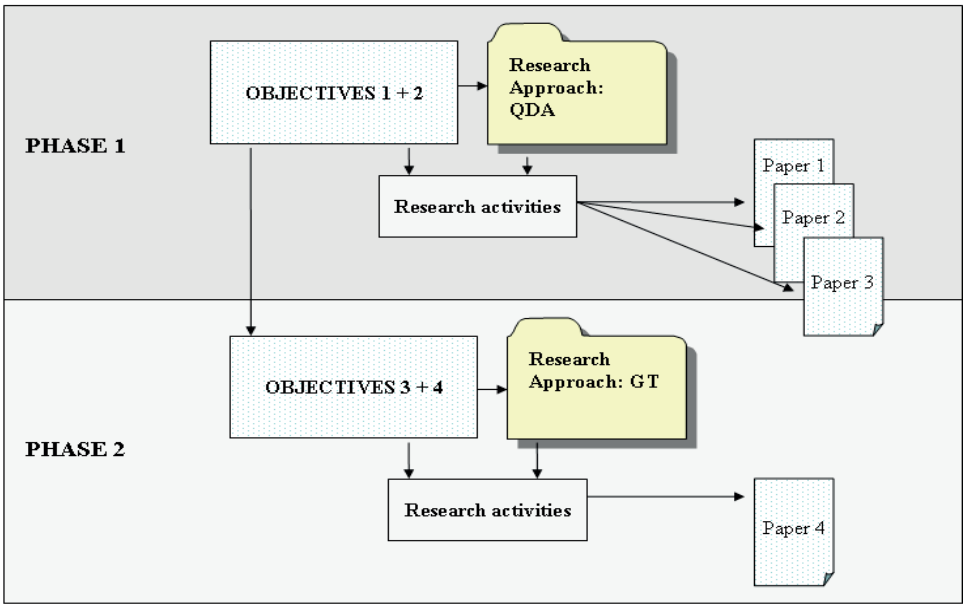
3.1 INTRODUCTION

This chapter explains the overall research strategy which was utilised to address the overall aim and objectives of the project. The chapter begins by outlining the chosen methodology, data collection methods and analysis associated with Phase 1 then continues to describe the approach and design associated with Phase 2. Following this, the chapter offers a justification for the methodological switch from qualitative data analysis (QDA) (Silverman, 2000) to classic grounded theory (Glaser and Strauss, 1967), which greatly influenced the procedures undertaken in the second phase of the project. It continues with an overview of grounded theory methodology as a general research methodology including its origins and philosophical foundations. The chapter ends with an explanation of the grounded theory procedures and the resultant theory of 'informalising'. The chapter concludes with a brief note on the value of grounded theory in creating practitioner-relevant knowledge.

3.1.1 OVERVIEW

This research began as an inquiry into critical success factors in multi-disciplinary design projects and gradually developed into a grounded theory study on the pressures and dynamics of such joint endeavours. The aim was to gain insights of the issues that influence project outcomes from the viewpoint of the practitioners themselves. Ultimately it was to create new knowledge (theory) that can be useful to improve the management of projects in highly dynamic environments. This necessitated a flexible research methodology that would allow the researcher to tap into the reality of managing multi-disciplinary team based project work, exploring the subjective experiences of what *really* leads to positive project outcomes. An inductive-qualitative research approach was considered ideal to obtain rich data and unpacking the important issues that the practitioners experienced. Owing to the complexity of the research inquiry, the research evolved through two main interrelated work phases as illustrated in Figure 3.1. Each phase adopts a particular research approach in terms of data collection and analysis.

Figure 3.1 Research map delineating the two main research phases and associated objectives.



3.2 RESEARCH APPROCHES

Within the research arena there are varying views on how to carry out research. One only has to look at contemporary research texts available to students and researchers to become aware of the variety of approaches. Selecting a research methodology is by no means a simple or transparent decision (Knox, 2004). Saunders, Lewis et al (2003) state that the 'research process is rarely rational and straightforward, the reality [being] considerably messier'. Glaser (1998, p. 11) conceptualises the choice of methodology in terms of: 'appeal, the goal of the researcher, cost, rigour, interpretations, and usefulness'. Alternatively the selection of approach may be due to disciplinary expectations (Knox, 2004). For example, psychologists are usually expected to produce evidence in the form of statistical data. Others point out that choosing methodology is very personal (Stern, 1994) and that the research question itself is dependent on the 'worldview' of the researcher (Annells, 1996). Clearly then researchers are likely to choose methodology based on what they believe (ontological positioning), their preferences (Scott, 2006) as well as on what they know. This highlights that the fit between the method and the person, between their style of working, who they are and how they think inevitably impinge on the choice of methodology; a point rarely discussed in the literature (Goulding, 2003).

Against this background, the main reason for choosing a qualitative research strategy for this project was the nature of the research problem, especially the emphasis on understanding people's experience. Looking back at the process of developing the research, however, it is apparent that the choice of approach was also partly influenced by the researcher's beliefs (philosophical position) and research experience as well as the demands and expectations from the sponsoring company. The expectation was that the researcher at the end of the project would be able to 'hold a mirror up' to the company to help it see how work is getting done in a fast paced practice context.

3.2.1 THE QUALITATIVE APPROACH

The definitions of qualitative research vary. In general terms, qualitative research is a means for exploring and understanding the world of human experience (Myers, 2000 Cresswell, 2007). Researchers collect data in natural settings with sensitivity to the people under study, and they analyse their data inductively to establish patterns or themes. A qualitative approach is therefore ideal to use to study a research problem when (as noted before) the problem needs to be explored; when a complex, detailed understanding is needed; when the researcher want to write in a literary, flexible style; and when the researcher seeks to understand the context of settings of participants (Cresswell, 2007). In comparison, quantitative research is a means for testing objective theories by examining the relationships between variables. These variables in turn can be measured so that the data can be analysed using statistical procedures. Qualitative and quantitative approaches should not be viewed as polar opposites (Cresswell, 2008); instead they represent different ends on a continuum. That is, a study tends to be more qualitative than quantitative or vice versa. With the development and legitimacy of both qualitative and quantitative research, an increasing number of researchers choose to combine both types of research as a way of improving research process and findings (Bryman, 2004).

3.2.2 MULTI-METHOD STRATEGY

The distinguishing feature of multi-method research is that it generates multiple data sets about the same research problem; each set being collected with a different method (Brewer & Hunter, 2006). The main advantage of the multi-method approach therefore is not the quantity of data that it provides but rather the data's diversity and the opportunities for comparison that this diversity affords. From this perspective, collecting different kinds of data by different methods from different sources may result in a fuller picture of the unit under study than would have been achieved otherwise (Bonoma, 1985). The mixed methods approach is extremely appealing in applied research where solutions and concrete findings are expected. At the time of developing the research proposal for the EngD it was decided that the multi-method approach was appropriate to address the research objectives associated with Phase 1. This meant that qualitative data collection was combined with statistical data derived from a survey. However, overall the procedures or guidelines for gathering knowledge (data) was based on exploring the issues and understand from the practitioners' perspective; to explain the nature of social reality.

3.3 RESEARCH METHODS

When researching dynamic systems such as teams researchers need to find methods that can encapsulate the multi-dimensionality of the human experience (Deacon, 2006). However, there is no 'right' method to proceed; 'everything depends on what you are trying to achieve' (Silverman, 2006, p. 8).

Due to the broad scope of this research and the need to collect qualitative data from various project teams and to some extent in external sites, it was decided early on that a multi-method approach to the field work would be utilized. An advantage of employing multiple methods is that it allows the researcher to use different techniques and methods for recording and generating data which accords with the perspective that 'good' qualitative research depends upon the collection of many kinds of empirical material (e.g. Silverman, 2001). The method of data collection took three forms:

- Interviews
- Workshops (focus groups)
- Observations

3.3.1 INTERVIEWS

The interview is probably the most common form of qualitative research method (Bryman, 2004). Indeed the fact that it is widely used beyond purely ethnographic studies demonstrates that is an ideal form of data collection method irrespective of the research inquiry and design. However, generally interviewing in qualitative research as opposed to quantitative is usually less structured. As a result qualitative interviewing tends to be flexible, responding to the direction of the interviewees' concerns (ibid, 2004).

The need for rich and detailed data depicting life from the 'natives' point of view' necessitated a semi-structured interview approach. In Phase 1 were the aim was to understand the perceptions regarding project success factors interviewing provided the participants

enough freedom to express what they thought constitutes a 'success factor'. Questions were based around a number of themes and did not always follow the order of the interview guide. In this way, the process of interviewing took the form of conversations about project and project experiences. This allowed genuine access to the world views of the members and the discovery that people preferred to tell stories around project success factors rather than simply listing them. Surprisingly, what Kvale (1996) proposes as important qualification criteria for an interviewer does not include listening with total openness (i.e. listening without challenging the respondent or reiterating what the respondent just said). His list of ten 'commandments' tend to steer the interviewee in the direction of the researcher rather than vice versa. The argument here is in doing so, the researcher run the risk of missing vital issues. Learning the skill of interviewing is experiential and requires reflection on the part of the researcher. Thus, it was not until halfway through the interviews (about 15) the researcher found a balance between how to phrase the questions, how to tackle moments of quietness 'in the room', and not least important probing by asking for examples and instances that illustrate a particular issue. Each of the interviews conducted were tape recorded and then later transcribed in full.

3.3.2 WORKSHOPS (FOCUS GROUPS)

Focus groups are used increasingly as a way of learning about public opinion on a variety of issues (Bouma and Ling, 2004). The function of the workshops was an important step in furthering the understanding of the project success factors. Specifically, it offered a venue for validating the outcomes of the interview study which had resulted in 176 factors considered to be critical to achieve project success. Using the same principles for setting up focus groups the aim was to gather data through prompting interaction between the participants. Thus, the focus was on how the group participants; the different engineers, representing various job roles, made sense of the data presented to them in the form of post it notes (detailed description can be found in Paper 3: Appendix C). The researcher's role was minimal to avoid influencing the conversations that were 'playing out' in each workshop session. Although the workshops were not recorded, notes were taken throughout each session to record issues, disagreements and tensions between participants. Perhaps the most beneficial outcome of these facilitated workshops was the opportunity for members of the staff to voice their opinions and reactions to what they consider important in achieving positive project outcomes. The major limitation of the workshops was that there was very little time to discuss the outcomes of each session.

3.3.3 OBSERVATIONS

An important part of 'getting to know' the company and understanding the world of building design was through continuous observation. From this perspective the researcher took on a role similar to that of an anthropologist in studying the inner workings of team based project work. The observations as utilized in the field work meant that at times (often unplanned) the researcher was able to sit in on meetings, workshops and other gatherings as an observer. The data collected at these occasions were field notes made during and after each event. According to Bryman (2004, p. 167) this type of observational work can be described as non-participant observation and signifies a situation where the 'observer observers but does not participate in what is going on in the social setting'. This method was used throughout the duration of the project.

3.3.4 FURTHER DATA COLLECTION

The research also involved the collection and analysis of different documents relating to the sponsoring company and construction industry in general. These were accessed through the company intranet and official websites. The document sources were divided into four different categories:

- Official government reports on the construction industry published by the DTI and other government agencies and programmes relating to construction and building design.

- Best practice guides, case studies, news letters, e-mail alerts and pages from Construction Excellence and BSRIA (www.bsria.co.uk).

- Internal documentation such as BH online newsletters, project and design reviews, forum discussions on project delivery, presentations, and company strategy reports.

- Documentation of the quarterly progress reports and meeting minutes for the industrial sponsor. These reports and memos were discussed with the academic and industrial partners throughout the four years of the project. As such they constitute official (albeit internal) documents that have been treated as a form of data.

Another important source of knowledge was the BH Annual Conference. This conference gathers key personnel and external speakers who deliver speeches relating to an important topic for the business. The main theme for the 2008 conference held in the London office was collaboration and 'connecting people', which provided useful insights into the company's strategy for improving collaborative practices.

3.4 ANALYSING THE RESEARCH DATA

The following section details the analysis of the data and in particular the different steps taken to manage and code the empirical material associated with both research phases. Specifically it describes the qualitative data analysis associated with developing the findings related to the study on critical success factors (CSFs) as well as explaining the procedures undertaken to develop the grounded theory of 'informalising'.

Broadly speaking, data analysis in qualitative research consists of preparing and organising the data (i.e. texts as in transcript) for analysis, then reducing the data into themes through a process of coding and condensing the codes and finally representing the data in figures, tables or a discussion (Cresswell, 2007). Beyond these steps, depending on the approach to inquiry there may be additional steps. Data analysis is not off-the-shelf; rather it is custom-built, revised and 'choreographed' (Miles et al, 1994, cited in Cresswell, 1994, p 150). Unlike the analysis of quantitative data, there are few well established and widely accepted rules for the analysis of qualitative data. Consequently, researchers who look for a straightforward format or exemplar to follow they are likely to be disappointed. To a large extent this is a result of the variable nature of qualitative data as well as the relative novelty of published qualitative studies in comparison to quantitative (Johnson et al, 2002). For the purposes of this project a general qualitative analytic method was used. The choice of thematic analysis was based on

its flexibility and usefulness to take into account different types of data. In addition, it is not tied to a particular theoretical or epistemological position which is often the case with other qualitative analytic methods such as discourse analysis (DA), conversation analysis (CA) and interpretative phenomenological analysis (IPA). This means that one recipe guides analysis (Braun and Clarke, 2006).

3.4.1 THEMATIC ANALYSIS

Thematic analysis was employed in analysing the interview material, work shop 'outputs' and general field notes taken during non-participant observations. The analytic process was based on immersion in the data. All written transcripts were read several times to obtain an overall feeling for them. From each transcript, significant phrases or sentences that pertain directly to 'success' and/or 'success factors' were identified. Meanings were then formulated from the significant statements and phrases. The formulated meanings (factors) were then clustered into themes and labelled accordingly. For a detailed overview of the data analysis the reader is directed to the published journal paper on critical success factors (Paper 3, Appendix C).

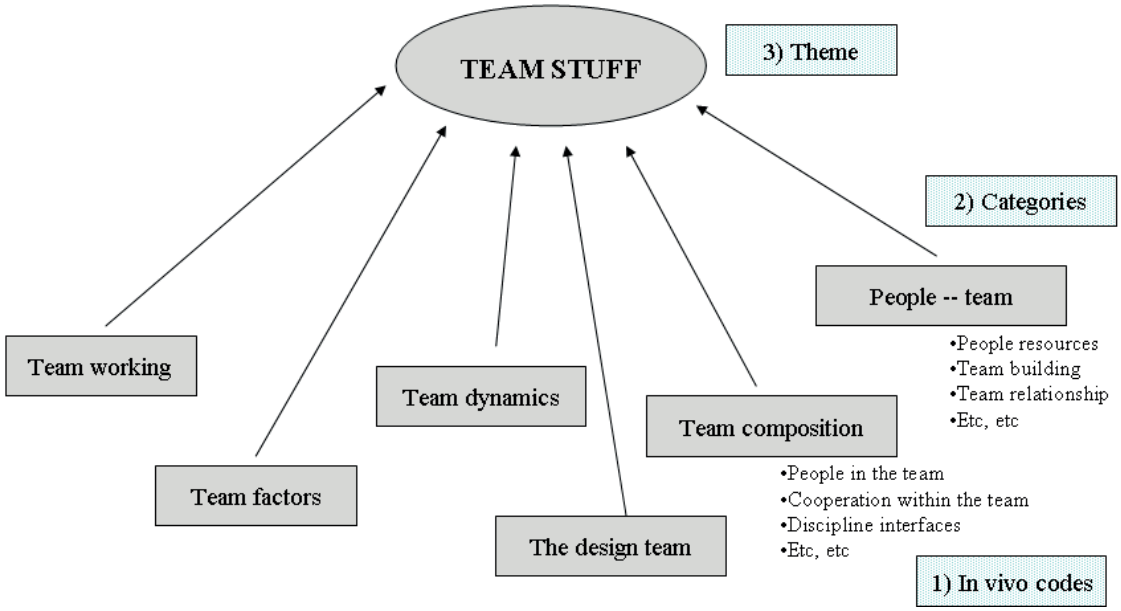
Table 3.1 Phases of thematic analysis (Braun and Clarke, 2006)

Phase	Description of the process
1. Familiarising your self with the data:	Transcribing data (if necessary), reading, and re-reading the data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes:	Checking if the themes work in relation to the coded extracts and the entire data set, generating a thematic 'map' of the analysis.
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme and the overall story the analysis tells, generating clear definitions for each theme.
6. Producing the report:	The final opportunity for analysis. Selection of vivid compelling extract examples, final analysis of selected extracts, relating back the analysis to the research question and literature, producing a report of the analysis.

Braun and Clarke (2004) acknowledge that it is difficult to specify what exactly interpretative analysis actually entails. Following their recommendation the first step was to look at published examples of thematic analysis. This was helpful in that it provided a sense of the sorts of questions that one should be asking the data and the analytic claims that are feasible to make (ibid, 2004). Initially, the researcher claimed that the data was analysed 'within a grounded theory framework' (Koutsikouri et al, 2006, p. 374). The aspiration was to adhere to the main principles underpinning Strauss and Corbin's (1990) version of grounded theory. However, looking back at the study, it is clear that it represented a good example of thematic analysis in terms of the coding process. From this perspective it can be seen as a remodelled

version of grounded theory. Applying thematic analysis was therefore beneficial in understanding and learning the process of coding data and generating themes that reflect the experiences of participants. There is no surprise that it is considered to be an ideal first qualitative method of analysis that researchers should learn, as it provide core skills that will be useful for conducting many other forms of analysis. Methodological rigour was attained through adhering to the tenets of thematic analytical method as suggested by Braun and Clarke (2006), keeping field notes, using an adequate sample, and interviewing until saturation of data was achieved. A thematic map of the early stage can be seen in Figure 3.2.

Figure 3.2 Thematic map illustrating the emerging theme 'team stuff'.



The next phase of the research project was devoted to studying 'live' multi-disciplinary projects. The specific objective was to generate a better understanding of the inner workings of such joint endeavours (consistent with Research objectives 3 and 4). Emphasis was on explaining the social processes within this environment that is simultaneously relevant to project management theory and professional practice. The following section describes the gradual transition of methodology resulting from the need to conceptualise what is actually going on within the research setting, rather than describing and interpreting the factors that are perceived as essential to project success.

3.5 METHODOLOGICAL SHIFT

To create new knowledge (theory) requires 'a methodology that enables the researcher to enter the field, collect and analyse whatever data is available' (Holton, 2007, p. 49), thereby enabling the emergence of latent patterns (Glaser, 1998). As have been shown in previous PhD projects (see Guthrie, 2000; Christiansen, 2004, Holton, 2007), classic grounded theory methodology (Glaser and Strauss, 1967, Glaser 1978, 1998, 2001, 2003, 2005) provides a

systematic process for conceptualising such latent patterns of social reality. This general research methodology was guiding the second research phase.

The impetus for switching research strategy from qualitative analysis to grounded theory came from the need progress the research in terms of developing theory instead of testing existing theories and framework on new data. While thematic analysis had greatly facilitated the development of the findings related to the first research phase, the identification of critical success factors, it was not able to handle the complex and varied data resulting from studying real project work. The researcher was overwhelmed by facts and descriptions of various projects. In other words, the research project had come to a cross roads and one option was to sticking to it; continuing with more qualitative interviews and apply a more thorough analysis of the data. The other option was to explore the grounded theory methodology with its particular procedures for data collection and analysis. It became clear that clinging to the same research approach used to identify the CSFs would limit the research scope and hence compromising the research results. At this point, the second phase of the project had started in terms of interviewing project participants and making observations in 'real' multi-disciplinary design projects. This meant that a considerable amount of data was gathered before making the decision to switch methodology.

The switch to grounded theory methodology meant that the collected data and preliminary analysis had to be reworked. This reworking entailed re-reading and re-coding collected material according to the procedures prescribed by Glaser (1978) and which are outlined in section 3.6. Analysing data the grounded theory way requires unlearning the way one normally analyses text in that that the researcher has to stay alert to what emerges from the data. As the process of coding the data progressed the researcher became increasingly aware of what was going on in the empirical field (the projects). This marked the start of using the grounded theory methodology.

3.5.1 THE ROOTS OF GROUNDED THEORY

Grounded theory is a general methodology of analysis linked with data collection using systematically applied set of methods to generate an inductive theory about a substantive area (Glaser, 1992, p.16). It is the discovery of what is there and emerges. The methodology originated in the mid-1960's with the groundbreaking work in medical sociology of Barney Glaser and Anselm Strauss (Glaser and Strauss, 1965, 1970, 1971, 1974, 1975) and the publication of *The discovery of Grounded Theory* (Glaser and Strauss, 1967) the initial published documentation of the methodology. While Glaser and Strauss were later to disagree about the precise nature of grounded theory research methodology and discontinue their professional collaboration, Glaser is generally recognised as having retained both the spirit and the substance of the original work (Locke, 2001, cited in Holton, 2006, p 5. While Glaser remained consistent with the early rationale of the method and thus defined grounded theory as a method of discovery and trust in emergence, Strauss moved the method toward verification and his co-authored works with Juliet M. Corbin (1990; 1998) furthered this direction. Despite some apparent similarity, the research rationales attached to these two different sets of grounded theory procedures are clearly different. Glaser (1992) contends that Strauss and Corbin's procedures force data analysis into preconceived categories, and thus, contradicts the fundamental tenets of grounded theory. In his book *Emergence vs Forcing* he elaborates on all the methodological differences between these two types of 'grounded

theory'. However, because of the greater prominence of Strauss's writings, his version is largely the one followed by researchers.

3.5.2 CHOOSING CLASSIC GROUNDED THEORY

The decision to use classic grounded theory methodology was driven by the wish to explore social behaviour within the context of multi-disciplinary projects and to find out what was really going on in these temporary organisations. How did people work together across professional boundaries? How did they get their work done? As a research strategy, grounded theory is particularly well suited for exploring the amorphous nature of emergent and informal organisational entities (Holton, 2006). Further, it allows the researcher to produce a theory that is relevant to practitioners. Relevance to the grounded theorist means bringing tangible benefits to the experts (Fernandez, 2008).

The method enables the researcher to get close to the phenomenon under study through extensive and iterative data collection and analysis, thereby enabling substantive theory development. Specifically, it focuses on participants' perspectives and taps into their thoughts about issues they consider important, allowing them to reflect on these issues of concern to gain understanding and new insights (Glaser, 1998). This ability does not render grounded theory superior to either quantitative or qualitative methods but rather complementary (Parry, 1998). As noted by Glaser (2003, p. 118: 'Quantitative research and QDA [qualitative data analysis] provide description of aggregates and in-depth cases respectively and GT [grounded theory] provides the conceptual overview with grounded explanations, impacts, underlying causes and so forth. In other words, grounded theory raises qualitative research above the descriptive level of analysis.

The promise of 'lifting' the analysis from being descriptive to providing a conceptual overview of what is going on was extremely appealing. Prior to this, the only knowledge the researcher had about the methodology was through text books[5]. Advice from the academic supervisors guided the researcher to this methodology. They suggested that the GT methodology could possibly be the most adequate research method to use in the given research context. The choice of classic grounded theory had some immediate effects for the research objectives, data collection and the timing of the whole research project. It also meant that the researcher had to spend considerable time 'learning' the method through self-study, attending grounded theory seminars and simply 'doing it'.

In sum, the main reasons for using grounded theory research methodology for the purpose of this research was: 1) the need for a systematic yet flexible method capable of handling large quantities of data and discovering the underlying patterns of meaning, 2) the desire to develop a practical theory that is relevant for those under study, and finally, 3) the researcher's personal belief and conviction that 'it works' in terms of explaining how people process or resolve their main concern.

[5] At the time of undertaking the first study of CSFs the researcher was not aware of the different versions of grounded theory, in particular, the divide between the *Glaserian* and *Straussian* (Corbin & Strauss, 1990) set of procedures.

3.6 EXPLAINING GROUNDED THEORY METHODOLOGY

To understand the nature of classic grounded theory, one must understand the distinction between conceptualisation and description. Grounded theory is not about the accuracy of descriptive units, nor is it an act of interpreting meaning as ascribed by the participants in a study; rather, it is an act of conceptual abstraction. Thus, 'a grounded theory must offer a conceptually abstract explanation for a latent pattern of behaviour (an issue or concern) in the social setting under study. It must explain, not merely describe, what is happening in a social setting. This abstraction to a conceptual level theoretically explains rather than describes behaviour that occurs in many diverse groups with a common concern (Glaser, 2003). The following is a summary of the essential terminology and elements of GT methodology. Figure 3.4 presents a graphical illustration of the stages and processes of doing a GT-project.

3.6.1 THE GROUNDED THEORY TERMINOLOGY

Before explaining the procedures employed in generating grounded theory, a brief outline of the some key terms that are essential to understand. The process and language of grounded theory are unlike those of other methods. *Concepts*, sometimes called categories, are the major 'findings' of the research. In other words, they capture the underlying patterns in the data. *Properties* are lesser concepts that delineate or describe other concepts. Finally, *indicators* are pieces of raw data and can be seen as evidence which clearly demonstrate the theory's grounding.

3.6.2 ALL IS DATA

'All is data' is a fundamental property of grounded theory, which means that everything that gets in the researcher's way when studying a certain area is data (Glaser, 1998). For example, although interviews were the predominant data in this project as the research progressed, other data was also included in the analysis; memos (field notes), meeting minutes, e-mails and other types of written data. Glaser writes: 'The briefest of comments to the lengthiest interview, written words in magazines, books and newspapers, documents, observations, biases of self and others, spurious variables, or whatever else may come the researcher's way in his substantive area of research is data for Grounded Theory' (ibid, 1998, p. 8). Thus preconceiving what data will be used in a study restricts the generative aspects of the study and consequently the theory.

3.6.3 PRECONCEPTION

The first step in grounded theory is to enter the research setting or substantive field of research without knowing the problem (Glaser, 1998). This requires that the researcher goes into the study with a totally open mind suspending his/her knowledge, especially of the extant literature. Glaser suggests that remaining open to discovering what is really going on in the field of inquiry is often blocked, by preconceived notions resident within the researcher's worldview, an initial professional problem or extant theory or framework; all of which pre-empt the researcher's ability to suspend preconception and allow the research problem and its resolution to emerge (cf. Holton, 2008). In this study, entering the field without knowing the problem was impossible since the researcher had already been in the field for three years before starting the grounded theory study. Additionally, a literature review on collaboration

and project success factors had already been written. By following the coding process prescribed by Glaser (1978) and so to speak 'letting the data speak for itself' it was possible however to see what was going on in the research context. The most helpful way recommended by Glaser is to ask the following questions during the open coding phase: 'What is this a study of?, 'What category does this incident indicate?', and 'What property of what category does this incident indicate? From this viewpoint, suspending one's knowledge and experience is an experiential process.

3.6.4 THEORETICAL SENSITIVITY

Theoretical sensitivity is the ability to attune oneself to the subtleties of social situations and to be aware of their implications for theory development (Guthrie, 2000). It refers to the researcher's knowledge, understanding, and skills, which foster his or her generation of categories and properties and increase his/her ability to relate them to hypotheses. Cultivating theoretical sensitivity was an ongoing concern throughout the second phase of the project. The ways in which the researcher increased her theoretical sensitivity was primarily through reading and re-reading texts on grounded theory methodology (Glaser, 1978; 1998) and studying examples of well constructed grounded theories. However, since 'true sensitivity comes with experience' (Guthrie, 2000, p. 44) it is dependent on 'actually doing grounded theory and reflecting on it'.

The first step in gaining theoretical sensitivity is to enter the research setting with as few predetermined ideas as possible, especially logically deducted, a prior hypotheses. Since the grounded theory phase of this research project started after about two years of 'being in the field' and getting familiar with some of the literature regarding critical success factors, project management theories and the management of building design project, it is essential to acknowledge that it this may have compromised the initial stages of the coding and analytical process. However, by attempting to 'stay open to the emergent' (Glaser, p. 2005, p. 1) and what is relevant it is possible to find the link that illustrates the ways in which substantive codes and data they express are interrelated.

3.6.5 MEMOING

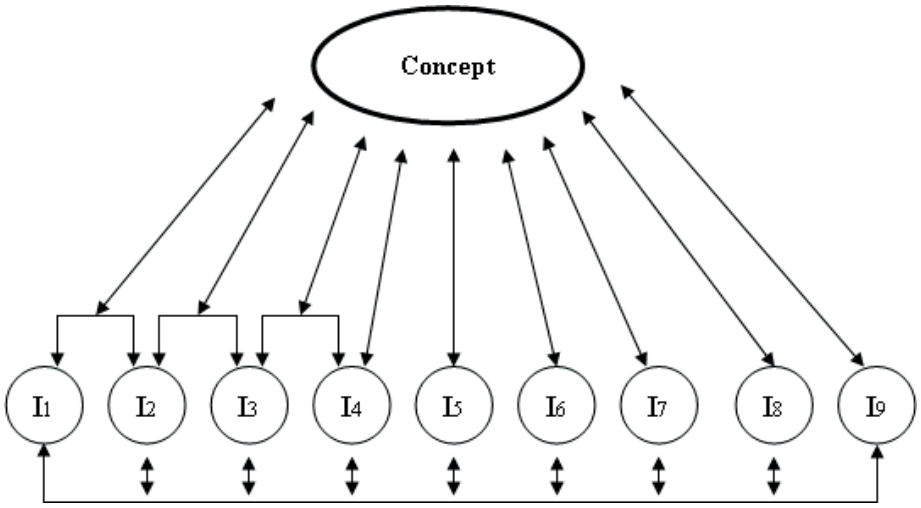
Memoing is carried out throughout the process and a memo holds the ideas the researcher has about a concept or property of a concept and how concepts relate to each other. "Memos capture and keep track of the emerging theory" provides the leads to theoretical sampling (Glaser, 1998, p. 177). In practice, memos are often written on the go and may therefore only consist of a single sentence or a paragraph with a bit of conceptual elaboration. At other times it may be long story about a category. Glaser (ibid) encourages researchers to constantly stop to get the ideas down in writing otherwise many they may be lost or distorted and their full relevance for the theory diluted. Examples of memos written during the research process can be found in Appendix E, p 144.

3.6.6 CONSTANT COMPARISON

The constant comparison method is a fundamental process in grounded theory. The purpose of this continuous process is to see if the data support and continue to support emerging categories. Indicator is compared to indicator, and concept to concept. This way, constant

comparisons sharpens the validity of the study because the concepts fit the data (Glaser, 1998). At first, one usually compares interview (or other data) to interview (or other data) and as theory emerges the next step is to compare data to theory. Figure 3.3 represents the comparison of indicator to indicator and the generation of a conceptual code.

Figure 3.3 The concept indicator model (Glaser, 1978)



3.6.7 CORE VARIABLE

As the researcher proceeds to compare incident to incident in the data, then incident to categories, a core category begins to emerge. This core variable can be any kind of theoretical code: a process, a typology, a continuum, a range, dimensions, conditions, consequences and so forth (Holton, 2008). The core category is the main concepts to which all others are related. It accounts for the pattern of behaviour which is both 'relevant and problematic those involved' Glaser, 1978, p. 93).Thus, it explains how the main concern is continually resolved. It emerges as the overriding pattern in the area of study. Thus, 'keeping clients in line' is how veterinarians guard against becoming overwhelmed by the demands of their work (clients) (Guthrie, 2000). 'Pluralistic dialoguing' is how interdisciplinary team working among health professionals is facilitated (McCallin, 2007).

The criteria for establishing the core variable within a grounded theory are listed below:

- It is central, relating to as many other categories and their properties as possible, accounting for a large proportion of the variation in a pattern of behaviour.
- It occurs frequently in the data and comes to be seen as a stable pattern in the data.
- It has clear and grabbing implications for formal theory. A formal theory has more general application than a substantive theory. A substantive theory is a theory that is limited to a specific or substantive area (Glaser, 2008).

Based on this, the current knowledge of this research indicates that 'informalising' is considered as the core variable. Saturation of this concept was evident since when further data was generated, the same patterns reoccurred. Nevertheless, as will all substantive theories it is expected that future research and the generation of new data will refine this.

3.6.8 THEORETICAL CODING AND SORTING

When doing classic grounded theory research, one of the most problematic areas, particularly for novice researchers, is the theoretical coding process (Hernandez, 2009). Theoretical coding is the process of identifying the theoretical code(s) which conceptualise how given concepts relate to each other. Sorting literally involves sorting the memos into piles by concepts and these two stages can occur simultaneously. Glaser (1998, p. 187 explains:' [it] is the last stage of the grounded theory process that challenges the researchers' creativity'. In the context of the present work, the researcher spent a lot of time placing memos in piles in terms of how they 'fit' together. This process also involved more memo writing about how different concepts may be related.

3.7 DATA COLLECTION

This study fully embraced openness to all forms of data for analysis. Based on this the study included the following type of data:

- Open ended interviews with practitioners from different disciplinary backgrounds; structural engineers, building services engineers and architects.
- Non-participant observation in project meetings, project reviews and workshops.
- Ethnographic studies of practitioners involved in projects.
- Personal reflections on experiences and informal conversations.
- Scholarly literature on project management, organisational behaviour and social psychology.

3.8 DATA ANALYSIS

The procedural stages of the research are generally sequential, but once the research process begins, they are often conducted simultaneously or serendipitously according the requirements of the particular research (Christansen, 2007). The implementation of the data analysis process is described below beginning with open coding.

3.8.1 OPEN CODING

The objective of grounded theory methodology is to discover basic social processes that explain the resolution of the problem or issue, which confronts people in the substantive area under study. The procedure of open coding is to find the core variable.

The process began with line by line coding of the data to identify substantive codes emergent within the data. This is done by coding for as many categories as possible without a preconceived set of codes (Glaser, 1978). From the start, Glaser's (1998) key questions, namely: 'What is this data a study of?, 'What category does this incident indicate?', and 'What is actually happening in the data? (Glaser, 1998) were constantly asked. These questions were important to keep the researcher sensitive to *what is going on*, rather than to the words used to describe and incident when analyzing, collecting and coding the data. This way, open coding allows the analyst to see the direction in which to take the study (Glaser &

Holton, 2004). An illustration of substantive coding may help understand the process (see Table 3.2).

Table 3.2 An example of substantive coding

Extract from interview transcript	**Open codes**
Line 267 (transcript 10) One thing and this is not unique to this practice, it is fairly universal, people will always say that they are busy and sometimes they convince themselves that they are busy because panic is around… They have done 15 things today! Instead of taking a few deep breaths take one thing at a time, doing it right and moving on to the next one. There is some psychology there that people make themselves busier than they have to be, they make themselves panic more than they have to if that makes sense.	Universal state Normalising busyness Working blindly Spiralling panic

This way, line by line coding forces the researcher to verify and saturate categories, minimizes missing an important category and ensures grounding of categories in the data.

The Main Concern

After three months of open coding, the researcher started to 'see' what the *main problem* in the area of study might be. In preparation for a Grounded Theory Seminar in October 2004, the elaboration to the question 'Have you identified your core category?' is shown in Table 3.3:

Table 3.3 Getting to the core variable.

Having read about GT I have started to interrogate my data differently and realise that I cannot find an overarching theme that explains everything. What pop into my head are many categories but not a main concern. It could be related to INFORMAL PRACTICES because it seems that a concern is that there are so many things to deal with and the only way to deal with them is through informal measures, rather than following the quality management procedures. These are seen as cumbersome so people follow their own individual project management practice. So informal practices is how they manage through the projects. Below are list of codes and categories that I have gathered.

- Keeping it together: past, present and future. Whatever happens in projects is influenced by pervious events, what is happening now and what lies in the horizon. Most often projects are kick started without much reflection (risk assessment and conversations about the project brief) leading to changes in design and other problems which causes delay and costs.
- Changes (staff changes, design changes, client changes, contract changes)
- Continuity (team staying the same including leadership)
- Communicating (design, cost, intention)
- Delivery (how to deliver the project)
- Busyness (BIG problem; too busy to manage, to think, integrate, deal with etc)
- Moving forward (momentum has to be kept other wise the people get bored)
- 'Not being the master of our own destiny' (engineers struggle and always feel out of control because whatever they do is controlled by the fee, architects or something else outside their control).
- Inward looking mindset. There is a realisation that everybody looks after their own discipline rather than looking at the broader picture; the whole project and how the different disciplines make up the whole.

At this stage the main concern was to find the point from which to 'hang' the theory. The sense of knowing but not knowing was frustrating until at last it was almost evident that 'coping with multiple and unforeseen demands' was the problem for all practitioners. Hence, the first core category was labelled *keeping it together*. Conceptualising the problem proved extremely useful and paved the way forward though the researcher was aware that it was not quite right. As the conceptualisation evolved over the next few months, the core variable evolved and 'keeping it together' was dropped or subsumed by the emerging core variable of 'informalising'.

3.8.2 SELECTIVE CODING

The next steps were to selectively code incidents that relate to 'coping with multiple demands', to saturate those codes and to theoretically sample within the substantive population of design professionals. Glaser writes:

> "The general procedure of theoretical sampling, as we now shall describe it, is to elicit codes from raw data from the start of data collection through constant comparative analysis as the data pour in. Then to use the codes to direct further data collection, from which the codes are further theoretically developed with respect to their various properties and their connections with other codes until saturated. (Glaser, 1978, p. 37)

In this study, initially *keeping it together* and later modified to informal processing/informalising were important to delimit the theory which acted as a guide for further data collection and analysis. At this point, the significant variables identified were *managing expectations*, *value judging*, *blame avoidance* and *affiliating*.

3.8.3 THEORETICAL SAMPLING

Theoretical sampling is the process of data collection for generating theory whereby the analyst jointly collects, codes and analyses the data and decides what data to collect next and where to find them, in order to develop the theory as it emerges (Glaser and Holton, 2005). Put simply, the researcher should refrain from sampling of informants/participants in advance of the emerging theory. From this viewpoint, this approach to data collection is far different from the typical QDA pre-planned, sequential approach to data collection and management. In this study, the sampling was directed by both 'the data' and whether practitioners were available for interviews. Since some of the interviews were conducted before the switch to using grounded theory it was not possible to adhere fully to this requirement from the outset.

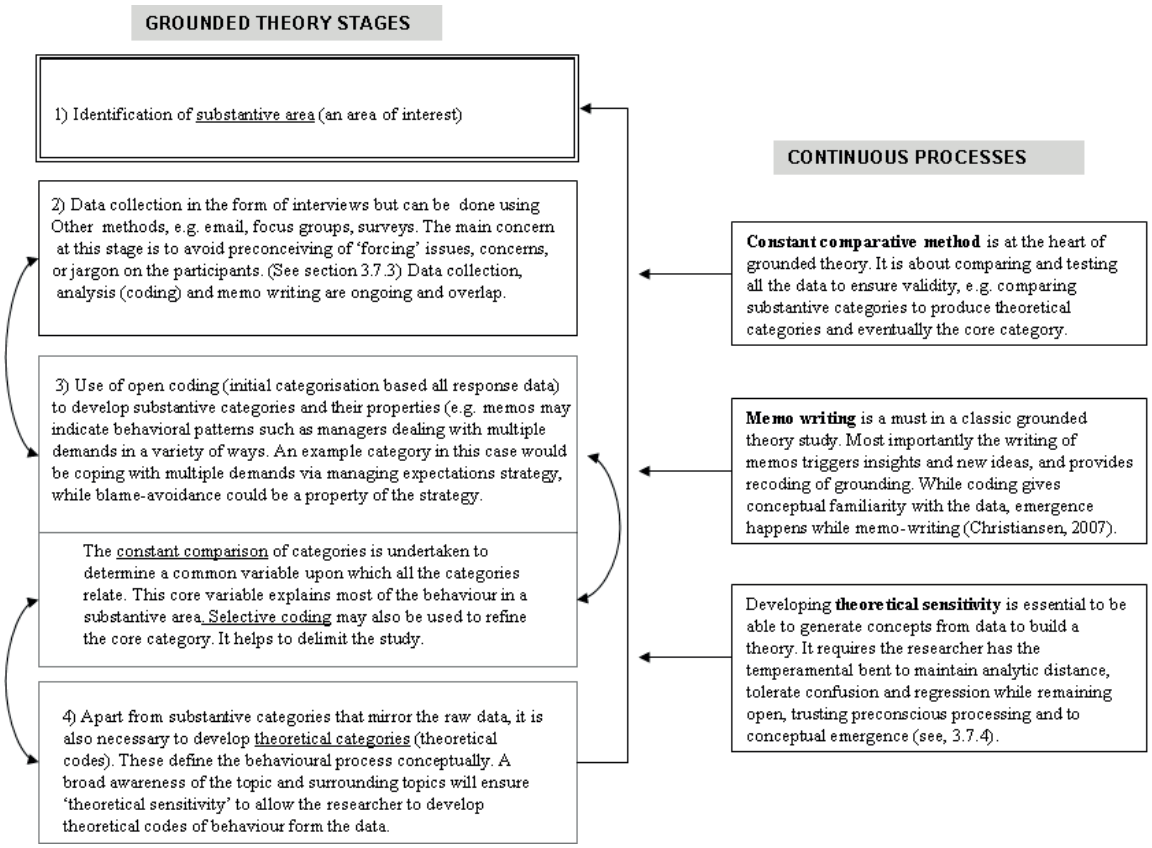
3.8.4 THEORETICAL CODING

This emergent process helps the researcher to perceive relationships between substantive codes. The integration of concepts is fundamental to generate a meaningful theory. Without theoretical coding the subtleties of how the variables interact are lost (Guthrie, 2000). The researcher experienced the process of theoretical coding as challenging. However, after following Glaser's advice to 'sort my memos' received at the grounded theory seminar in Manchester 11-13 November 2008, the procedure felt a bit easier.

The procedure of sorting does not refer to data sorting, but to conceptual sorting of memos. The procedure of memo-writing is an integral part of a classic grounded theory study. Memos are the 'theorising write-up' of ideas about substantive codes and their relationships (Christiansen, 2007). The writing of memos throughout the study triggered insights and new ideas and provided a record of how categories and concepts were grounded in the data.

The one theoretical code of major importance in this study is the 'basic social process' which explains how practitioners cope with multiple demands while trying to meet their own and other's expectations over the project life cycle. The basic social process and core variable in this study was Informalising which will be outlined below. A full elaboration of the theory including its sub-core variables can be found at the back of the thesis (see Appendix 4)

Figure 3.4. Illustrating practical processes in a grounded theory project



3.9 THE EMERGING THEORY OF INFORMALISING

Through constant comparative analysis of data the social process of informalising emerged. Informalising is a basic social psychological process that enables practitioners to cope with the multiple demands associated with managing multi-disciplinary projects in a manner that is consistent with their personal and professional needs, goals and values. This study discovered that rather than focusing on 'the team' or 'implementing collaborative working', practitioners are most concerned with various forms of prioritising to handle multiple demands.

The literature on multi-disciplinary team based project work and project management makes clear that there are problems with achieving high performance in construction projects (e.g. Chinowsky et al, 2008; Morris, 2004). It is not clear however what the problem is, or what the solutions might be. This study theorises that from the perspective of the practitioners the problem is to do with prioritising and how practitioners might make best use of time given the competing demands for attention that continuously influence work. It theorises about what conspires to facilitate of impede efficiency and progress across the project process. Many of the issues were known about but the large number and seemingly unrelated nature of the issues meant that the complexity could not be well understood. The power of this theory is in its encapsulation of the main concern of project members, its theorising about the interrelationships between the issues and how these interrelationships determine members' propensity to manage effectively. It is this power that confirms the choice of the grounded theory method as an appropriate one.

3.9.1 HOW TO JUDGE GROUNDED THEORY

Glaser's criteria for judging a grounded theory are fit, workability, relevance and modifiability. Additionally, parsimony must be achieved. Parsimony refers to the theory's ability to account for the problematic behaviour under study with the fewest possible concepts. The four principal criteria are explained below (Glaser, 1998, p. 18)

- **Fit** is another word for validity. Does the concept adequately express the pattern in the data which it purports to conceptualise? Fit is continually sharpened by constant comparisons.
- **Workability** means do the concepts and the way they are related into hypotheses sufficiently account for how the main concern of participants in a substantive area is continually resolved.
- **Relevance** makes the research important because it deals with the main concerns of the participants involved. To study something that interests no one really or just a few academics or funders is probably to focus on non-relevance or even trivia for the participants. Relevance, like good concepts, evokes instant grab.
- **Modifiability** is the final criteria against which the validity of the theory is measured. It encompasses the capacity for the theory to accommodate new dimensions as and when they are revealed. New data simply alters the theory, by way of further constant comparisons, it does not invalidate it.

It should be emphasised that, consistent with the work of Scott (2006) and Gynnild (2006) the chapter will not provide an audit trail of the development of concepts; its intention is to evidence honest endeavour, rigorous adherence to method, and to illustrate the development of the researcher's understanding of the grounded theory research method achieved during the research process. This way, it is the RE's judgment that the concepts developed in this theory adequately express the data. However, it is likely that they could be improved.

3.9.2 ETHICAL CONSIDERATIONS

Before the interviews begun, the interviewees were informed by the purpose of the investigation. They were told that participation was voluntary and that they could end the interview at any time, if there was a need to do so. The participants were asked about giving

their permission for tape-recording the interview and told that the information was to be stored safely and that only the researcher should have access to the recordings. They were informed that the results would be presented in a way that assured the participants confidentiality.

3.10 SUMMARY

The sections in this chapter described the research strategies, data collection methods and analysis associated with Phase 1 and 2 of the research project. In addition, an account of the switch from using qualitative analysis to grounded theory was provided. A particular emphasis was placed on explaining the elements and procedures of classic grounded theory methodology along with the resultant theory of 'informalising'. The benefits of grounded theory to researchers and laymen alike, is that it deals with what is actually going on, not what ought to go on. In brief, it is a rigorous method that allows the researcher to produce theory that is fit, works, is relevant and modifiable. While rewarding and satisfying, it is also a highly demanding research methodology that requires staying power and persistence on behalf of the researcher.

The next chapter describes the research studies undertaken in Phase 1 and 2 and presents the research outcomes.

4 RESEARCH UNDERTAKEN AND KEY FINDINGS

4.1 INTRODUCTION

This chapter discusses the research undertaken to achieve the overall aim and objectives of the EngD research. It describes each study carried out in relation to the study objectives and provides an overview of the key findings. Following this, the challenges associated with conducting research in a real world setting are outlined as well as the steps taken to create a viable theory of collaborative design. The chapter should be read in conjunction with the published papers referenced throughout the text (see appended papers 1-4).

4.1.1 OVERVIEW

The first six months of programme was dedicated to learn about the company in terms of its organisational structure, leadership and modes of operation. It also involved taking part in group meetings, forums and events. This initial period of 'getting to know' the company was also important in terms of building relationships with key personnel across the practice. A personal aim was to gain an insight into the project duties of engineers, as the RE came from a marketing and public relations background. The first two years also involved completing MSc modules (65 credits) in Engineering Management and Innovation as part of the EngD programme. This meant that approximately 20% of the researcher's time was spent at Loughborough University, undertaking different MSc modules, coursework and exams. The modules selected facilitated a better understanding of construction management, engineering design, human resource management and qualitative research and analysis. Overall the objectives for the initial investigative stage of the research included to:

- . Develop an understanding of the sponsoring organisation's in terms of its history, specialist services and working culture.
- Learn the basics of building design including terminology, the general stages of the construction process as well as the engineer's role in developing sustainable and innovative buildings.
- Get involved in internal company meetings, attendance at presentations, technical highlights and seminars, MSc modules and a review of collaboration and team work literature were all key activities for gathering the information necessary to outline and address the research context and establish a viable direction for the overall research.

Attending external conferences, workshops and seminars was also an important aspect of the EngD research at an early stage. As the research programme progressed, participating at these events continued, with the RE making valuable contributions as a result of the ongoing research. These events provided opportunities for networking with academics and industrial practitioners in the field of collaboration and construction management and ensured that the research constantly incorporated cutting-edge thinking and ideas.

4.2 RESEARCH UNDERTAKEN

4.2.1 DETERMINING THE 'RESEARCH PROBLEM'

The relevance of 'working together' has been reiterated many times within the sponsoring organisation, especially among senior management; a work ethic promoted by the late founder Ted Happold. Through the development of a new business model and corporate structure at a Group Leader Convention in 2004 the company took the first step to make collaboration and teamwork, knowledge, people issues and customer satisfaction strategic priorities.

The EngD research was seen as a vehicle for supporting the implementation of improved collaborative working or multi-disciplinary working. In order to achieve this aim the research project was developed through a series of incremental steps. This approach allowed the RE to probe deeper into the perceived practice 'problem'. In summary, the project evolved through the following steps, corresponding to the objectives outlined in Chapter 1:

PHASE I Examining critical success factors (CSFs) (Objectives 1-2)

1. **Pre-study.** The researcher initially interviewed a small group of managers to explore their perceptions of the main issues facing senior practitioners in the multi-project inter-disciplinary design environment. This round of informal conversations was prompted by an interest from Buro Happold to introduce the research project to key people within the organization and start the change process of improving work practices.
2. **Exploring CSFs – interviews.** The focus on identifying performance issues in managing multi-project settings, led to a broader investigation on critical success factors (CSFs) in multi-disciplinary projects. By interviewing a cross-section of engineers and CAD-technicians it was possible to explore perceptions regarding project success across both disciplines and job levels.
3. **Exploring CSFs – workshops**. The result of the interview study was validated in workshops where participants were asked to cluster the identified CSFs into groups and label them accordingly. This was an opportunity to getting engineers to talk about project success factors and their significance in project work.
4. **Exploring CSFs – survey.** To further validate the findings from the interview study and the workshops a survey was distributed within IBG 1 (Integrated Business Unit). The aim was to explore the relative importance of the main CSFs identified in the interview study.

Phase II Studying 'real-life' multidisciplinary building design projects (Objectives 3-4)

5. **Grounded theory study**. Although the first phase of the project heightened sensitivity to a number of factors that are important to effective collaboration, it did not reveal anything about the social processes that underpin multi-disciplinary team based project work. To go beyond describing success factors, the next step was to explore and expose the realities of working together in multi-disciplinary projects. Six multi-disciplinary projects were selected for the study and the researcher was given full access to each project in terms of project information, permission to interview project participants and observe project meetings/workshops at any stage of the project. The grounded theory approach was selected as the new research strategy because it would

yield data about 'what goes on' in the practice and thereby reflecting the real concerns in collaborative working (see details of the grounded theory methodology in Chapter 3). Above all, this marked an important step change in refining the research topic. The grounded theory approach is discussed in more detail in the chapter on study methodology on page 31.

The next section explains the rational behind the study projects in each of the two research phases.

4.3 PHASE 1: EXAMINING CRITICAL SUCCESS FACTORS IN COLLABORATIVE MULTIDISCIPLINARY DESIGN PROJECTS

Although collaborative working was used to define the problem within the sponsoring company, it was agreed that the starting point for the research should be to explore *critical success factors*. This would provide an initial understanding of the variables that influence project performance in collaborative design projects.

As noted in the literature review in Chapter 2 very little research has been carried out to establish what factors influence success in collaborative design projects. The challenges faced by the various project participants (including engineers, engineers, clients and contractors) involved in this type of projects are many and varied. As noted by one of the company Directors *(6 March 2006*):

> '*The challenge of collaborative projects is the behaviors that exist between disciplines and people. What can we do to inspire positive (co-operative) behaviour, despite the differences in culture and background? Understanding how to 'break across' those barriers is very important.'*

Interviewing staff from different job levels across the different engineering disciplines; structural engineering, building services engineering and specialist such as façade and infrastructure engineers provided a platform on which to build and develop a better understanding of the success factors that are likely to influence project outcomes. Interviews were seen as the 'main intervention' in realising the research objectives. The expectation was that the interview process would encourage staff to 'reflect on their work'; what they do and how they do it. This meant that the RE was given permission to observe daily work in the office as well as interview staff, and was thus able to gather the kind of data the typical ethnographer is seeking. For example, the RE could readily initiate conversations serendipitously[6] as well as being able to carry out in-depth interviews when it suited the interviewee within his/her office space. This enabled quick rapport between the researchers and the practitioners.

[6] While there is always a risk that the researcher may find it difficult to remain 'objective' when living and working in the research setting, in this research this was not seen to compromise the research findings. Since the researcher was not involved in 'real' company project work; the role was mainly observational this ensured that the researcher would bring 'fresh perspectives' on project team effectiveness.

4.3.1 THE STUDY

By capturing the perceptions of project success as experienced by the team members themselves, the study aimed to make explicit the context-specific CSFs that underpin project success. Specifically, the aim was to develop a success framework that could facilitate practitioners' understanding of how different factors reinforce or impede each other during the project process.

Twenty-two employees took part in the study over an eleven month period. Since the aim was to reflect a broad spectrum of beliefs and values across the group, the study included engineers and technicians from different disciplines such as structural, building services and façade engineering. Six job levels were represented: associate director, associate, senior engineer, engineer, engineer, engineer and CAD-technician. The study comprised three elements:

1. **Face-to-face interviews**. The questions focused on each participant's job role, experience of projects work and examples of successful and 'less successful' projects. They were asked to brainstorm critical success factors in project work. This was aimed to encourage individuals to make 'free associations' without being prompted about factors they perceive as critical to project success. In total 175 CSFs (some overlapping) were identified by the interviewees.
2. **Six workshops accommodating between four and six people in each session.** Here they were asked to group the CFSs identified in the interviews into larger groupings so that they ended up with a number of core categories. A list of 21 CSFs was distilled from the interviews and workshops (Appendix C: Table I on page 99, illustrates the workshop outcome and Table II on page 101, provides an overview over the grouping and labelling of CSFs by the different job levels).
3. **An electronic survey.** The main focus of the survey was to validate the interview and workshop outcomes. It was distributed to all of the staff members of the business unit (108 people). The respondents were asked to review the 21 CSFs and rate them using a 1-10 rating scale. The survey outcome is illustrated in Appendix B, Figure 1, p 86.

From the researcher's point of view the survey was not only another method of gathering more data, it also served as a vehicle for including as many people as possible in the research. Promoting the EngD research was an on-going concern and therefore considered important to produce 'good' data.

4.3.2 INITIAL FINDINGS

The initial qualitative analysis of the interview and work shop data indicated that project success is related to five dimensions of work: *individuals*, *teams*, *process*, *project* and *product*. The dynamics between these critical factor groups and their sub-categories were illustrated in a model to facilitate understanding; see Figure 1 (Appendix A, p. 82). The key findings can be summarised as follows:

- Variations in perceptions of CSFs between the groups appear to be a consequence of job roles rather than professional disciplines, indicating that junior levels (e.g. graduate engineers) view a supportive environment as more critical than resource planning. Similarly, senior levels seem to place more focus on having the right people

and managing the different and sometimes conflicting project demands rather than 'time to play with ideas'.

- There appears to be a significant difference between job levels with regard to the factor creativity and innovation. This factor is rated higher among junior than senior job levels, with senior engineers scoring highest and associate director scoring lowest. The difference may due to different responsibilities associated with each job level, in that more senior staff spends most of their time overseeing and managing the project level whereas more junior staff usually has more time at hand to be creative and express innovative thinking.

- Interestingly, client focus did not emerge as a consistent factor across the groups. There was little reference to 'the client', 'client satisfaction' or 'end-user'. Given the freedom to state any success factor, the majority of interviewees emphasized variables relating to internal characteristics of the project success such as maintaining good relationships, passion for the project, and a clear understanding of their role. External characteristics of the product or service itself such as customer focus or product performance were not emerging as critical.

- The main finding of the survey was that it is near impossible to separate the factors in terms of their weight in relation to other factors. Put differently, project success is dependent on a large number of factors that are dynamically interrelated. Although the findings of the survey were not statistically significant (44 responses) they were considered important to be an important indicator of perceptions.

Assessment of these observations suggest two concurrent events: 1) engineers and CAD-technicians are more focused on getting the design right than focusing on product performance which can only be measured when the building is ready to use, and 2) the culture in the engineering and construction industry seems to emphasise 'getting things done' rather than reflecting 'what is getting done'. In other words, long-term success (building performance, repeat business, innovation etc) is often sidelined for short-term success (fulfilling time and budget requests).

4.4 COMMUNICATING THE FINDINGS

Apart from presenting the research to the sponsor through the quarterly EngD meetings, the main avenue for disseminating the study findings were through conferences and journal papers.

4.4.1 CONFERENCES

Leadership and management in construction 4-6 May 2006, Grand Bahama Island, Bahamas
The initial findings of the CSF study were presented at an international conference on leadership and management in construction in 2006. The study was published in the conference proceedings (see Appendix A). The feedback from the conference delegates who represented construction research institutions from Europe, Asia, Africa, North and South America was useful in terms of further developing the CSF research. It convinced the researcher that there is much more to be learnt about project success factors in multi-project

environments. The main criticism centered on the lack of reference to how project participants' judge project success in the first place, i.e. what are the measures of project success? They are likely to differ in various project contexts and vary across industries. It also became clear that there is a need to develop a success framework that is of practical value to practitioners; what needs continuous attention in day to day project implementation. CSFs per se are insufficient measures to improve project performance.

ARCOM 22nd annual conference 4-6 September 2006, Birmingham
The second conference paper presented at ARCOM (Association of Researchers in Construction Management) included the survey results. The paper was published in the conference proceedings (see Appendix B, paper 2). The feedback from the research community was that while the CSFs model presented in the paper was an 'interesting' study, the frame work was considered too general and lacking in detail with regard to how the factors play out in practice. In response to the feedback the next step in the research process was to bring together the data and probe deeper into the success themes as outlined in the initial study. This resulted in the journal paper named Critical success factors in collaborative multi-disciplinary design projects. (The full paper can be found in Appendix C, paper 3.) The idea was to take the CSFs study forward and explaining the project success factors in more detail using quotes from the practitioners themselves. The emphasis was to show the interdependent nature of success factors. A systems model, the formal systems model (FSM) as developed by Bignell and Fortune 1984) was used to display these important relationships. This model provides a holistic framework (emphasizing the role of the environment) for making sense of project outcomes in various types of projects. In particular, it offers a means for helping practitioners to identify potential risks in the project environment including for example different stakeholder views/opinions. From this perspective, using systems thinking to understand project success and failure was an important milestone in refining the CSF research.

4.4.2 KEY FINDINGS

- Management factors, design team factors, competencies and resource factors and project enablers where identified as the interdependent group factors.
- While the FSM model takes into account most of these group factors (and indeed most success factors found in the literature, see Fortune & White, 2006) it makes no specific reference to factors such as passion and enthusiasm, creativity and innovation, culture and values. These so called 'super soft' factors are particularly important within multi-disciplinary design projects. The mapping of the CSFs onto the components of the FSM is illustrated in Paper 3 (Appendix C, Table IV).
- Although project success still depends on formal project management methods the key point is that team members have to work with each other in a supportive work context to achieve successful project outcomes.
- Socio-political factors are particularly pertinent: passion and enthusiasm, shared values, creativity and innovation. They represent personal success. For the purposes of the research these factors are labelled 'super soft factors'.
- There is knowledge and wisdom about what makes project successful, but pressures of work and sense of independence makes it difficult to achieve more.

4.4.3 Benefits to the company

At this stage the *tangible outcome* of the research was a holistic framework outlining the most important factors that need attending to throughout the project implementation. It was established that the research to date could be useful for company specific projects relating to development of collaboration KPIs (key performance indicators) and development of internal project management and quality management procedures (QMS). Thus, the RE was invited to get involved in supporting the Head of Collaboration Services in developing a way of assessing collaborative working in major projects. Based on the research findings the RE suggested how each number could be translated in terms of whether it denoted a positive or less positive opinion. This was piloted in a number of real projects in order to assess and improve collaborative working, especially in cross-cultural projects.

From the outset it was agreed that the benefits of the research would be long term. From this perspective, the RE was not expected to come up with a hard and fast solution rather the expectation was the deliverable would be focused on achieving a better understanding of the human (emotional) side of project delivery. However, in realizing this objective, it was important to get to grips with the realities of project work; how work actually gets done from the perspective of the project participants themselves. For this reason, it was agreed that the RE would start investigating multi-disciplinary projects. This marked the beginning of the next research phase.

4.5 PHASE 2: INVESTIGATING 'REAL-LIFE' COLLABORATIVE DESIGN PROJECTS

The second phase of the research was focused on capturing project participants' experiences in the authentic setting of design practice. It was the starting point for launching the Academy project study which included six multi-disciplinary projects. Six projects comparable in terms of size, scope and budget were included in the study. The Academy scheme is now part of the government project Building Schools for the Future (BSF programme).

Getting a proper understanding of 'what goes on' in day-to-day project life was considered essential in developing appropriate recommendations for improving practice; the way people work together in projects as well as the day to day management in multi-project settings. This was also important in terms of advancing the research beyond simply describing critical success factors, to attempting to conceptualise (explain) the social processes of collaborative design projects.

4.5.1 ACADEMY PROJECTS EXPLAINED

The Academies programme was launched to challenge the culture of educational under-achievement and to deliver real improvements in standards. Most Academies are located in areas of disadvantage and are either replacing one or more existing schools facing challenging circumstances or are established where there is a need for additional school places. The schools are established by sponsors from business, faith or voluntary groups working in highly innovative partnerships with central Government and local education partners.

Although the Academies are based on similar design briefs, they are all different projects. For example, each Academy has its own particular design and attributes but even in terms of

budget there is a difference between them. The Academy projects have been much criticised not least because the private sponsors have favoured appointing signature architects such as Fosters & Partners who are known to charge a higher fee than other architectural practices. The value of design versus functionality has been questioned. The criticism has been that the budget has been too low from the start to meet the educational aspirations. Finally, from a design point of view the general perception has been that not enough time has been spent thinking through the design, leading to dissatisfaction among teachers especially with regards to 'having to teach in big noisy rooms' (Radio 4, 26 July 2007).

4.5.2 THE STUDY

The field work included 36 in-depth interviews with project members at all levels of which 32 were engineers representing structural-, buildings services-, façade and civil engineering; and four architects. The decision to include the architects in the study was based on the premise that they represent an important discipline in project work which inevitably impacts on the dynamics of the internal engineering team and project outcome. While it could be useful to include the perspectives of other external project members such as contractors and sub contractors, due to time constraints the study was confined to the core team during the design phase.

The semi-structured interview agenda was based around the following questions:

- Describe your role in the project (engineering discipline, engineering grade, task responsibilities).
- Describe the project (complexity, innovation, challenges)
- Describe the project structure (roles and responsibilities)
- How has the project been performance monitored? (Formal and informal methods)
- How would you describe the project success for this project (as it stands now)? (Interviewees were encouraged to elaborate on their answers)
- (This question automatically yielded responses which pertained to both CSFs and success criteria!)
- Did you have a design manager employed in this project?
- How would you describe the role of design manager?

4.5.3 INITIAL KEY FINDINGS

The initial findings from the interviews and observations showed that the results from the Academy study were different from the CSF study. For example, the 'super soft' factors which appeared in the first study (passion and enthusiasm, creativity and innovation) did not feature as strongly in the study of real-project work. Instead interviewees were more concerned with practical issues in on-going project work, e.g. 'what are we supposed to be doing?'; how are we going to do it (execution)?; who does what?; when are we going to do it?

Another important finding was that Academy projects, despite their deceptively standard brief documents, are not steady systems that follow the same pattern. In fact, they are continuously influenced by internal and external influences.

Internal influences:

- Staff changes at all levels
- Inadequate resources
- Lack of specialists
- Time
- Academy fatigue

External influences:

- Changes from the architects
- Clients saying that 'we have to cut 1 million pounds out of the budget'
- Politics in the public arena
- Quality of QS and external project manager
- Quality of contractors
- Contractual arrangements
-

4.5.4 CHALLENGES IN MULTIDISCPLINARY DESIGN PROJECTS

Participants across projects seemed concerned about:

- lack of resources , especially on the building services side;
- constant changes; staff changing roles within the project, staff moving on to other projects, design changes and change of procurement route (being novated to Design & Build, where the design responsibilities are transferred to the contractor);
- coordination of information. Academy projects are services-driven and the complexity lies in coordinating the information flow within services (mechanical, electrical and public health including interfaces with FF&E);
- seeing the bigger picture, i.e. understanding how everything fits together;
- relationships; engineers-architects, engineer-engineer, engineer-contractor, architect-contractor;
- the balance between autonomy and process.

These initial observations were incorporated in the final analysis of the study.

As the study progressed the interview-agenda was replaced by a more open-ended interview style. This was a result of the shift of research methodology half-way through the second research phase. The next section explains how grounded theory provided the researcher with a new set of questions to the investigation of multi-disciplinary project working.

4. 6 FROM CSFS TO THE REALITIES OF WORKING IN MULTI-DISCIPLINARY DESIGN PROJECTS

While Phase 1 of the research yielded a comprehensive frame work of success factors for multi-disciplinary design projects, the RE felt that there was more to be discovered in regards to what actually drives performance in projects. The study had come to a cross roads and it was evident that there was a need to move from descriptive analysis to explaining how practitioners get their work done and how they actually collaborate. What was actually going on in the projects? Was thematic analysis the best way of handling the data? At this stage the

RE was offered the opportunity to learn the classic grounded theory methodology as proposed by Glaser and Strauss (1967).
Grounded theory requires that it is the relevance of the people in the substantive area under study that should drive the focus of the project. It is their main concern and their continual processing of it that is the focus of grounded theory, not what is supposed to exist or what a professional says is important (Glaser, 1998). Thus, Glaser argues that 'it is a waste of time for the researcher to think he/she knows ahead of time what will be relevant. The researcher couldn't possibly dream what will be discovered as relevance … what is going on is going on and further imposing a model that is not relevant fades away'.

Eureka stage was finally reached, meaning that one is intuitively heading in the right direction (Gynnild, 2007). Since considerable amount of data was gathered before the switch from qualitative data analysis (QDA) to grounded theory, the RE had to rework the data. The transition from using traditional qualitative data analysis (QDA) to adopting grounded theory methodology is described in Chapter 3 (p. 32). Choosing to radically change the research strategy at this late stage of the research proved to benefit the whole EngD project. It allowed the RE to gradually build a credible and dense theory that is relevant to practitioners in multi-disciplinary project settings. The main question that guided the analysis of the data was: What is the main concern of the practitioners? How do they continually resolve or manage practice this concern? The grounded theory of 'informalising' is presented in a forthcoming paper (Appendix D). The key findings are summarised in the next section.

4.5.5 KEY FINDINGS

- Project participants in multi-disciplinary design teams are constantly coping with multiple demands and turbulence of change. This makes it very challenging to deliver coordinated design that responds to the requirement of clients and end users.
- Multi-disciplinary team working itself, as expressed by design professionals, does not evolve in a linear, predictable sense. It is often a result of trial and error learning rather than something that happens from the start. This may hamper progress and cause delays in project delivery.
- Multi-disciplinary poses two main challenges to practitioners: *the first challenge* relates to the particular conditions of work generated by multi-project organizations as places to work; the continual readjustment of effort to meet deadlines. Individuals are constantly pulled in different directions because they are often working on several projects simultaneously. This means that practitioners must juggle priorities and balance tensions of conflicting schedules. *The second challenge* relates to the conditions of multi-disciplinary team working. Achieving cohesion among team members in a group, where individuals come from different occupations is notoriously difficult. The challenge of impermeable professional boundaries (or 'thought worlds') may limit implementation in practice.

4.5.6 THE GROUNDED THEORY

The social process of 'informalising' identifies a problem that affects many professionals working in intense project based work environments. It reveals a process through which practitioners cope with the pressures and dynamics of project work by managing expectations and making value-judgments. The need to informalise portrays the relevance of managing

expectations and value-judging to remain effective and efficient in the face of change and uncertainty. These are critical factors that influence project delivery and experience of those involved.

4.7 COMMUNICATING THE FINDINGS

Since the theory of informalising was developed towards the very end of the EngD research period there were few opportunities to present and receive feedback on the preliminary findings (the theory of informalising), especially where the sponsoring organization was concerned. However, the RE had the opportunity to show some of findings at a quarterly EngD meeting which included the main industrial and academic supervisors. The initial feedback from the industrial supervisors was positive; 'it surfaces vital indicators of importance to collaboration' (Meeting minutes, 17 July, 2008). Of particular importance was the behavioural pattern underpinning the process of informalising, in particular the improvisational aspects of working together alongside the 'hidden dimensions' of communication (indicators such as careful messaging and accommodation seeking[7]).

The outcome of the Academy study was also presented at a Grounded Theory seminar organized by the Grounded Theory Institute in Manchester 12-13 November 2008. This was an important step in receiving feedback on the preliminary theory of 'informalising' from a methodological point of view. The positive feedback encouraged the RE to further refine the emerging theory in terms of explaining the conditions that variously impact multi-disciplinary project work.

4.5.7 ISSUES AND CHALLENGES

At the time of delivering the final output of the EngD research (Sept-Oct, 2008), the UK economy was experiencing a fall in economic activity as a result of the effects of the US sub-prime market. The onset of the global recession meant that the sponsor were preparing for 'the worst' in terms of focusing on 'new markets'[i] and keeping expenditure to a minimum. This involved restructuring of business units and staff redundancies across practice. In this environment of turbulence and uncertainty, it was difficult for the RE to promote the EngD project, especially in terms of getting resources to continue to develop and implement change with regards to collaborative working in design projects. During 2009 the company has reduced its workforce by approximately 15% worldwide, pay cuts have been implemented and un-paid leave has been encouraged. Despite talk of 'green shoots' in recent months, hopes of a swift end to the recession are currently crushed by disastrous figures showing that the economy is shrinking fast and recovery is difficult to predict (*London Evening Standard*, *24 July 2009*).

4.8 SUMMARY

This chapter focused on providing a retrospective look at the studies undertaken to realize the aim and objectives of the research. The first research phase was dedicated to exploring critical success factors (CSFs) in multi-disciplinary building design projects. It was based on

[7] These are some of the indicators of the concept managing expectations.

interviews, workshops and a survey. The analysis which was carried out over a period of two years resulted in three published papers (two conference papers and one journal paper). Altogether the study of CSFs provided a departure point for understanding the various factors that influence the project process and ultimately project success in collaborative design projects. The most interesting finding was the presence of so called 'super soft factors' such as passion and enthusiasm and passion, shared values, creativity and innovation which reflect personal success and its importance in achieving positive project outcomes. These particular factors do not seem to figure strongly in other project environments.

The second research phase was aimed to explore 'real-life' projects, and in particular gaining an understanding of the realities of working in collaborative design projects. It started off as a traditional qualitative study and ended up as a grounded theory research project. Instead of probing into perceptions of a pre-conceived 'problem' the focus was on investigating the main concern of the project participants and how they continually resolved practice problems. The resultant theory of informalising shows how practitioners actively cope with multiple and unforeseen demands in the project environment through managing expectations and value judging. Overall, the study reveals that in order to improve project performance including collaborative working managers need to understand the conditions which inevitably impact on how work is getting done.

The conclusions, implications for practice and further study are presented and discussed in the next chapter.

5 CONCLUSIONS, IMPLICATIONS AND OPPORTUNITIES FOR FURTHER RESEARCH

5.1 INTRODUCTION

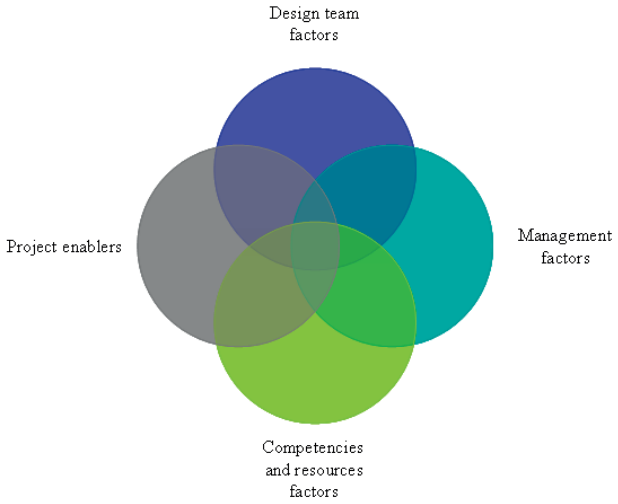
This final chapter discusses the implications of the research on both the industrial sponsor and the wider industry. It provides a critical evaluation of the research terms of its limitations and validity, and offers suggestions for future research. The chapter presents the overall conclusions of the research findings.

5.2 THE IMPLICATIONS FOR THE SPONSOR

Buro Happold's main objective for sponsoring this research was to increase awareness of the factors that influence collaboration in multi-disciplinary design projects. The aspiration was to bring in fresh thinking about how design/construction professionals can work together more effectively. In view of this, the EngD project has made a positive contribution to the sponsoring company.

Firstly, the sponsor has learned more about what factors their employees consider as critical to achieve project success. Facilitating project success within an interdisciplinary design context means that managers and practitioners must balance their attention between formal project management methods (planning and control), and socio-political factors such as passion and enthusiasm, shared values and creativity and innovation. (Research Phase 1)

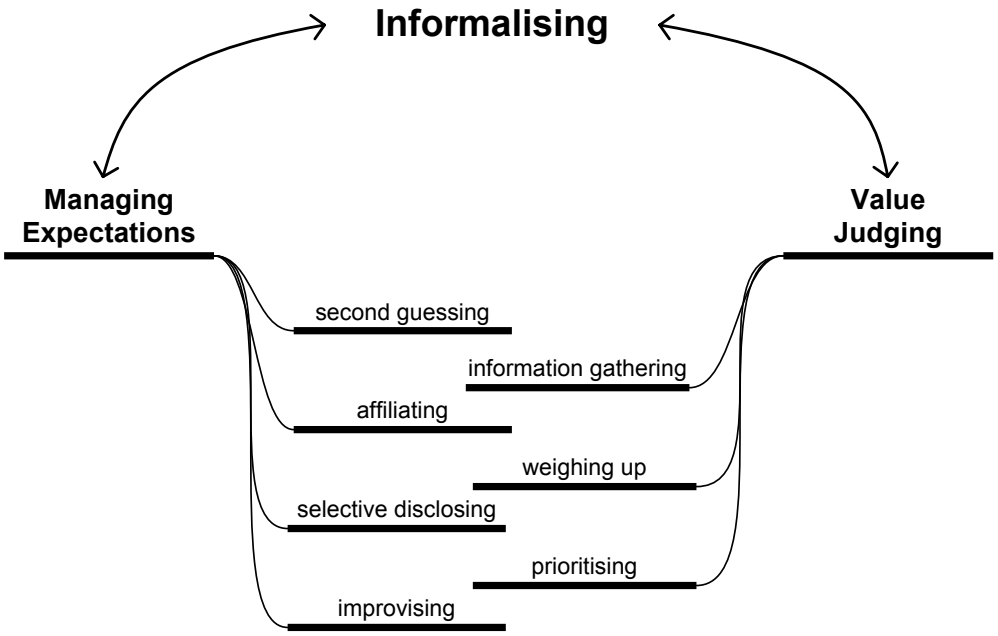
Figure 5.1 Success frame work for multidisciplinary design projects.



Secondly, the research has provided insights into how project members actually work together in collaborative design projects. Understanding that informalising is already a part of project members' practice demonstrates that it is an untapped resource that could be further developed. Practically, the theory of informalising sensitises managers and practitioners to

pressures and dynamics that inevitably impact the project process, and thereby present a more realistic reflection of what project work in comp
lex projects really entails. Figure 5.2 illustrates the resultant of informalising of knowledge work (Research Phase 2)

Figure 5.2 Theory of informalising and its sub-components.



To sum up, the CSFs success framework and the theory of informalising emphasise that project progress is moderated by situational affordances. The behaviour (and personality) of an individual will thus be constrained or enhanced depending on the social, organisational or task context. By focusing on the *performance context,* for example*,* clarifying project goals, roles and contractual issues such as scope of work and fee spend; managers can directly influence individual and collective performance in collaborative projects. As a result the performance of those in leadership positions (e.g. project leaders, design managers etc) has important consequences for the broader success of the organizations[8]. Thus while good managers can inspire a group towards higher levels of motivation and productivity, bad managers can be equally effective in hindering group performance. The next section explains the actual project deliverables in more detail.

5.2.1 PROJECT DELIVERABLE

The primary interdependent factors as presented in Figure 5.1 serve as a generic platform for thinking about project performance in project based organizations. It can be used as an awareness map to better understand the multiple issues affecting project performance, as well

[8] Recent analyses show that 15 percent of the variance in an organisation's profitability is directly influenced by the CEO's actions (Joyce et al, 2003).

as a diagnostic instrument related to risk assessment. The Formal Systems Model (FSM) model as presented and discussed in Paper 3 (Appendix C, p. 95) was the first step to provide the sponsor with a tangible output regarding how to view the various factors that may affect performance. Since the systems approach is widely acknowledged among engineers this proved to be a useful way to illustrate how the CSFs can be applied in most project contexts to increase understanding about project success and/or failure. Using the model facilitates comparison between the ideal state of a project; i.e. where collaboration and communication works, and a less successful project situation where lack of communication between and poor management can be identified.

5.2.2 REFLECTIONS

Using an inductive approach to provide authentic, robust and useful accounts of what people actually do when they 'collaborate' in design projects, the research has yielded several useful and relevant concepts which can assist the development of collaborative working practices. Managing expectations and value-judging are both recognizable concepts for both design professionals and other stakeholders in construction projects. Managing expectations is important since service quality and satisfaction result from how well the actual service performance, in other words the service process and outcomes, matches the expectations. Value judging is an important evaluation process that forms a feedback loop to the managing expectation stage and impacts upon the time and energy expended in future managing of expectations and value judging.

5.3 CONTRIBUTION TO KNOWLEDGE AND PRACTICE

In light of this, the thesis contributes to management praxis by raising awareness and offering insight into the practical value of informal routines as a way to influence and progress project work in multi-disciplinary settings. Adopting the basic social process of informalising as a conceptual framework may assist managers and human resource professionals in developing policies that support collaborative working as well as project management skills. This model plays a key role in developing the kind of intellectual capital and social capital that the sponsor, and other companies in construction, needs in order to manage multidisciplinary collaborative design. Long term it is also important in order to win projects and sustain business relationships. In particular, the theory of informalising offers valuable insights on several issues of specific significance to management practice in project based organizations:

- Collaboration can deliver tremendous benefits (innovative offerings). But it can also backfire if costs (including delays stemming from turf battles) prove larger than expected. Although the collaboration imperative is a hallmark of today's business environment, it is poorly understood. What is important is to cultivate an understanding of the conditions that variously affect the process of working together. This puts managers in a better position to anticipate problems and issues in on-going collaborative projects and remove obstacles that may lead to collaboration inertia.

- Engagement and productivity. Owing to time pressures and focus on meeting financial objectives designers are struggling not so much with technical problems, but rather with challenges related to management of information, communication and continuous change in the form of staff turn over, design rework and other unexpected events.

Thus, success of multi-disciplinary projects cannot be attributed solely to the team and the team members' competencies.

To sum up, the real contribution of this thesis lies not in producing a list of hard and fast actions for making collaborative design project more efficient, rather it is to direct manager's attention and energies to the importance of creating a viable performance context in which people are fully engaged. This way, the thesis provides a platform for re-thinking how to manage and cultivate collaborative design projects.

5.4 RECOMMENDATIONS

As a result of the EngD research the following recommendations for improving collaborative working in multidisciplinary design project are put forward for the sponsor to consider. The recommendations should be seen as ideas that could spark more grounded discussions on how to improve future working practices, rather than a prescriptive route for how to achieve successful project outcomes.

5.4.1 COMMUNICATION AND RELATIONSHIP MANAGEMENT

Focus on expectation management to improve project delivery
In order to achieve anything more than a superficial improvement in practice, managers need to start managing relationships through expectation management. Being aware how individuals make decisions and what is likely to affect that process can lead to a greater understanding between project stakeholders. This is often underestimated in team working. Getting to know each other is only one part of being able to work successfully together during the project process. The process of managing expectation is an important step in improving the level and quality of project communication.

People 'inherit expectations' which may cause delays and frustration. Managing expectations at the early project stages can help avoid disappointment further down the project line, and help create a positive trust loop. This phase is dominated by negotiating a viable solution whereas in the later stages of design development is more about coordinating the flow of information.

Effective management of expectations does not have to be a separate activity; managing expectations is part of normal general management activities. It is the way managers behave on a day to day basis towards those that they manage and report to.

Learning how to manage expectations can reduce the incidence of rework, conflicts and disappointments between different project participants. Use expectation management to create long term relationships.

Uncontrolled, expectations may present a danger to client satisfaction. Sophisticated management of expectations (as shown in other professional service contexts, e.g. Ojasalo, 2001), provide an opportunity to achieve customer satisfaction, strong customer relationships, and competitive advantage. The launch of a customer relationship management system (CRM) in Buro Happold has been the first stepping stone in cultivating healthy relationships

with clients. However, long term relationship management can only be sustained through human interaction where the technology supports the cultivation of relationships and hence the managing expectations.

The overall message is that project managers need to devote as much time to managing expectations as they do ensuring that all the technical features of a new project are performing well. It will go far toward creating an atmosphere in which project priorities are well understood, reducing the 'manageable' reasons for project to fail.

5.4.2 PEOPLE MANAGEMENT AND THE ROLE OF LINE MANAGERS

Keep in mind that line managers are important in creating a supportive work environment
Line managers/project leaders play a pivotal role in handling the challenges that arise from working in multi-project organisations. Specifically, they can help their teams overcome the challenges arising from working across organisational and professional boundaries. Therefore it is essential that line managers understand the whole project environment including behavioural patterns in order to intervene effectively. Recognising their functionality in keeping the team (and the project) together through engagement and communication may help to restore the belief in management as an important factor for achieving positive outcomes.
This may put managers in a better position to anticipate problems and issues in on-going project work.

5.4.3 TRAINING AND DEVELOPMENT

Emphasise 'soft skills' in project management training.
Line managers should give more focused guidance on how employees can develop competencies related to improving their communication skills, especially with regards to managing expectations throughout the project process. This should be integrated in the current Project Leader programme and included as key performance indicator in the professional development review process (PDR process). The significance of developing these skills is that it can increase the level of 'confidence display' (e.g. people who swiftly creates trust through effective communication or remain positive despite setbacks) and 'reliability experience' (e.g. people who have a track record of working in projects) which are key dimensions in service delivery.

5.4.4 COLLABORATIVE WORKING/INTERDISCIPLINARY LEADERSHIP

Focus on nurturing collaborative working rather than relying on individuals to 'get on with it'
In busy environments conversations/communication is frequently concentrated on tasks at the expense of team working issues, which are just as important. Getting together as early as possible and keeping conversations going is likely to improve the chances of achieving effective collaboration. While businesses value efficiency and effectiveness if more than lip service is to be paid to the interdisciplinary team as a means to improve productivity and quality, companies must also recognize that collaboration needs to be continuously nurtured if team practice development is to progress.

Altogether, although team work has been presented as an important way of improving project performance through encouraging better integration and cooperation between project participants it is equally important to understand the various conditions that affect team dynamics. This is not usually addressed in 'interventions' (team building days etc) to improve team work. Thus, the study's significance to building design practice relate to opportunities to develop competencies and capabilities for managing relationships in multi-project interdisciplinary design environments. By focusing more on managing expectations and improving day to day decision making, practitioners are more likely to deal with emergent and sometimes troubling project situations more effectively, thus directly improving project delivery. Recognising that informalising form an essential part of cultivating collaboration and hence 'getting the work done', more attention should be given to support such activity in today's turbulent and transient organisations. Knowledge of this form of emergent and improvisational strategy will enable managers to alter patterns of behaviour that could negatively affect project outcomes in terms of perceived value and profit.

5.5 POTENTIAL IMPACT ON PRACTICE

The potential uptake of the recommendations in practice is highly dependent on the commitment from senior management to cultivate a new way of thinking and leading projects. Perhaps the most daunting challenge is to persuade practitioners that the key to better managing socially complex projects is fundamentally one of communication and involvement. It is also about asking questions; identifying and understanding the stakeholders in a project (internal as well as external); who they are, what their needs are and what is likely to influence their participation and decision-making.

There are no hard and fast rules for the challenges of 'working together' in multi-disciplinary projects. The 'circumstance' in which the project team may find itself will vary and develop over the duration of the project's life time, and interaction relationships will inevitably alter to suit different situations (Foley and MacMillan, 2005). Managing team work can therefore be difficult to achieve, particularly in attempting to ensure that the team communicates and shares knowledge effectively. It is an experiential process, i.e. it is based on experience and learning. In view of this, the recommendations presented here are carefully crafted to address the particular challenges that practitioners face in getting their work done (individually and collectively) in an increasingly complex project environment.

5.6 IMPLICATIONS FOR THE WIDER INDUSTRY

The UK construction industry has been urged for decades[9] to make improvements in the way buildings are designed and delivered. With the support of several government initiatives to promote organisational innovation, the whole construction sector is being expected to raise the quality of its products and the efficiency with which it delivers them. Business process engineering, lean construction and key performance indicators, to give a few examples, have been promoted as panaceas for the industry's supposed performance problems. However, these 'best practice' recipes seem to have made little difference in practice. If construction organizations are to improve their performance and sustain a competitive advantage, a

[9] The improvement agenda has been most successfully promoted through the Latham (1994) and Egan (1998) reports.

conscious endeavour should be made to improve their awareness as to the key drivers of 'success'.

The findings presented in this thesis may provide implications for team working in collaborative projects within the context of the construction industry. Ultimately the thesis may also have implications for enabling the entire chain of participants in a project from the client, through the design team, to the subcontractors and suppliers of components to understand how to 'work together' during the different project phases.

As building design activities are becoming more complex, creating new requirement for designers to work in inter-disciplinary environments, there is a need for practical guidance on how to manage the challenges arising from this method of working. Poor design process performance has a significant effect on the performance of subsequent activities and the finished product (Bibby, 2003). In other words, getting it right at the design stage is one of the most important improvements that the design professions, and indeed the construction industry, need to address. This thesis is offered as a contribution to the general debate about what improvement are possible in terms of *increasing awareness of how people actually collaborate to produce building design.*

From this perspective this research challenges the current industry focus on knowledge management as pivotal to enhanced organisational performance and success. Instead it suggests a more appropriate focus for management attention on the negative impact of multiple and unforeseen demands on practitioners in complex projects. Taking into account the findings of this thesis, managers may focus less on trying to implement systems and processes to improve communication and knowledge sharing and direct and more on creating work environments that may enable project members to collaborate more effectively together.

5.6.1 IMPLICATIONS FOR TRAINERS AND POLICY MAKERS

The literature is extended by providing construction (and design) managers with a new way of understanding their project teams and their situation. Some of the literature discusses the project performance in construction in pejorative terms and this theory offers another way of looking at the challenges in the industry. More importantly the theory offers managers and policy makers a way of supporting practitioners involved in multidisciplinary projects as they strive to deliver sustainable and innovative design. This thesis is a significant contribution to the substantive area of multidisciplinary collaborative design, offering design professionals a conceptual framework by which to be strategic and pro-active in their management of daily practice problems common in fast paced project environments; and offering policymakers and mangers the conceptual framework with which to build a coherent strategy of informed interventions aimed at achieving better relationships across professional and organisational boundaries and thereby improving individual and collective success.

5.7 RECOMMENDATIONS FOR INDUSTRY

The overall recommendation to the construction industry is to recognize the need for *informalising* to overcome the obstacles of achieving project goals in multi-project settings. Specifically, organizations in construction including engineering consultancies must develop and cultivate their abilities to actively manage expectations and make value judgments

throughout the project process. This is likely to improve relationships, trust building and team work in transient organisational settings. Considering this, firms within the construction industry should focus more on developing 'soft' skills as part of improving collaboration in projects. The development of collaborative technologies such as BIM (business information modelling) in recent years further highlights the importance of skilfully dealing with project stakeholders.

5.8 IMPLICATIONS FOR THEORY

The study offers a unique contribution to construction management theory regarding the role of informality in addressing the formal requirements of delivering building design. It is a major element in the culture of collaborative design. Informalising, as a theoretical concept, synthesises several concepts offered in the extant literature on organisational effectiveness. These include concepts of improvising, trust, ambiguity and time tyranny. The fact that *informalising* processes also seem to occur in many areas strengthens the argument that it is a fundamental process of dealing with change and unpredictability in project based organisations. Overall, the implication for theory is an enhanced understanding of practice; both in terms of insights into what really affects project outcomes (success) and the phenomena that enable practitioners to cope and perform in spite of time pressures and continuous change. It is safe to suggest that using grounded theory methodology will allow researchers to bring about more interesting and relevant theories, thus enhancing the credibility of academic research in general.

In light of this, the present study has potential to further increase the utility of the Formal Systems Model/approach (see Appendix C) adding yet another dimension to understanding project failures. In particular, the grounded theory of informalising sheds further light on why 'communication breakdowns' and failure to learn occurs in ongoing project work. The FSM does not currently make specific reference to the informal strategies that project participants use to cope with these perpetual challenges. From this perspective, processes of informalising, namely, managing expectations and value judging should be integrated as additional concepts in analysing and understanding strengths and weaknesses in projects and/or partnerships. These social processes are indispensable to achieve organisational objectives and thus avoiding (perceptions of) failure.

5.9 CRITICAL EVALUATION OF THE RESEARCH

Fulfilling the aim and objectives of this research study was a challenging task considering that the RE had no previous experience of the construction industry or any training in construction/architectural management. Two major limitations have been identified which are explained below. The first one relates to research methodology and being a novice to grounded theory methodology and the second to opportunities for implementing the research findings in practice.

The reason for switching research methodology, as explained in Chapter 2, was important to gain a sharper view of the dynamics within multidisciplinary design projects. Learning to use the classic grounded theory methodology was demanding; the methodology is impossible to learn without practice. Consequently, a researcher does not fully comprehend the

methodology before he/she has finished a major research project and has applied all the prescribed methodological procedures (Christansen, 2007). This means that a source of the weakness in the emerging theory of *informalising* lies in the generative process itself. Within the context of the research the main shortcoming relate to the RE's difficulties in developing an adequate level of theoretical sensitivity; suspending prior knowledge and preconceptions regarding the field under study. In light of this, the RE actively tried to 'stay open', keeping close to what the data said and reading classic grounded theory work.

Throughout the research process the RE was able to cultivate friendly relations with engineers at various levels and function within and outside Buro Happold. Accordingly it was not difficult to test the developing analysis and emerging findings with practitioners. However, the timing for promoting the final research findings and implications for practice internally coincided with the onset of the global economic downturn which has had direct impact on the construction sector. This meant that Buro Happold like many other companies had to focus on more 'pressing matters' such as cash flow and restructuring of the organisation. Due to the changing circumstances, the EngD project had to be completed without any formal feedback on the project as a whole from the company.

5.9.1 VALIDITY OF THE RESEARCH

As far as the generation of the emergent theory of *informalising* and its overall validity, conventional concerns such as sample size and whether it is representative are inappropriate. In order to judge the authenticity of a grounded theory different, more meaningful benchmarks are required. According to Glaser (1978) the criteria for judging a grounded theory are fit, workability, relevance and modifiability. These fundamental sources of trust are explained in the methodology chapter on page x. In brief, this study's adherence to classic grounded theory procedures has ensured that they theory's conceptual codes and categories have emerged from empirical data rather than preconceived selection of 'received' codes of categories from the extant literature. The RE has also endeavoured to name concepts as close to the data as possible. Furthermore, 'grounded theory meets two prime criteria of good scientific deducted theory: parsimony and scope. It accounts for as much variation in behaviour in the action scene with as few categories and concepts as possible (Glaser, 1992, p. 18). In addition to the preceding criteria as established by Glaser and Strauss for judging the quality, additional aspects make it particularly powerful in respect to management practice. It captures what is really going on in the social world which means that it can be easily understood and used by practitioners and lay persons. At the same time its usefulness extends beyond the specific setting or context of the study and even the substantive area from which it was initially generated (Holton, 2007). The scope for contributing to formal theory development is dependent on carrying on further comparisons with emergent theories generated from diverse contexts.

To begin with the RE could continue to theoretically sample more individuals to interview and use as comparison groups, for example, contractors and other stakeholders involved in the design phase of construction projects. The next step would be to seek out contexts where individuals or groups are constantly dealing with multiple demands and uncertainty. For example, examining how public sector organisations handle inter-organisational team work to achieve their goals. This study is therefore left at a point at which it is recognised that modifications can be made to it; suggesting that the theory can be refined.

5.10 FUTURE RESEARCH OPPORTUNITIES

This thesis contributes to expand the current knowledge of the various factors that influence organisational success within the context of collaborative multidisciplinary design projects as well as offering suggestions for future research. Given the need for theoretical understanding within the construction management context the following research opportunities are worthy to consider:

The actuality (or realities) of managing projects. The literature highlighted that despite the increasing interest in researching project success factors in various project contexts including construction in recent years, project managers are still looking for practical guidance as to improve project performance. Current success frameworks do not seem to capture the reality in which project participants operate. Thus conventional project management theory has to move beyond looking into what practitioners should be doing and pay more attention to what they are actually doing. Further research to investigate the realities of what practitioners face in modern organisational settings is therefore encouraged as they provide a holistic and dynamic view of the phenomenon under investigation. This will be valuable not only to construction projects but also relevant to other project based organizations. By extending the relevance of the theory beyond its limits of those in a construction design context, there is potential to increase its use.

Developing the theory of *informalising*. There is clearly scope to develop the emergent theory of *informalising*. The various concepts that have emerged provide opportunities in many directions. The concept of managing expectations that facilitates and cultivates mutual engagement and value judging that provides the necessary information for prioritising work merits further exploration and study. Additionally, future research might examine informality in diverse work contexts. An interesting work context would be the virtual project working context which is becoming increasingly popular across the private and public sectors. Additionally, many of the processes and categories emergent in the substantive theory are ripe for further exploration in diverse contexts. These include *improvising* to cultivate relationships and *selective disclosing* to control clients/stakeholders.

Future research (whether using grounded theory or other research approaches) could also consider the leverage points that *informalising* provides at various stages of the project process.

In addition, the theory of *informalising* offers the potential to significantly contribute to the development of a more formal theory regarding informality of wider relevance to management researchers, with likely applicability to audiences far and wide, thus enhancing the credibility of using grounded theory methodology in CASE study studentships.

5.10.1 USING GROUNDED THEORY TO DEVELOP PRACTICE RELEVANT RESEARCH

An important aim of the EngD programme is to deliver research that makes a practical contribution to solving a particular management problem or usefully enlightening a particular organisational issue, in addition to making a contribution to knowledge. This research has fulfilled this aim by providing a theory that is generated from data, rather than based on preconceived interest of academics, and thus relevance is guaranteed. Overall it shows that the

outcome of grounded theory research, to discover what is really going on in the context of study, contributes to bridging the gap between theory and practice.

Developing sensitivity to what is going on is extremely powerful and empowers the researcher to generate a theory that accounts for the patterns of behaviour which are relevant and problematic for the participants. Thus, Glaserian GT offers a largely untapped, potential for researchers working in the construction management domain because of its emphasis on discovering latent patterns within the data, which reflect issues relevant to those in the field of study and which are not driven by pre-existing assumptions'. If used properly this methodology has the potential to deliver valuable substantive theories capable of providing handles on undeniable complexity (Guthrie, 2009).

5.11 CONCLUSIONS

This research began with a general interest in examining critical success factors (CSFs)in multidisciplinary design teams. Underpinning this was a genuine curiosity to find out 'what is actually going on' in projects and what makes it so difficult to 'work together' effectively. The aim of this EngD project, as has been stated in Chapter 1, was to *'contribute to an expanded understanding of project success factors within the context of inter-disciplinary building design projects'.* The research has satisfied this aim as detailed throughout the thesis.

In summary, the research has:

- Identified critical success factors for collaborative multidisciplinary design project, leading to an enhanced understanding of project participants perceptions of what leads to project success;
- Established that 'soft factors' has a particular value in improving project outcomes in design environments;
- Explored 'real-life projects' in terms of the way design professionals actually collaborate and interact to get their projects done.
- Developed a grounded theory of collaborative multidisciplinary design projects which explains the social processes that practitioners engage in to achieve their own as well as organisational objectives/needs.

Through the identification of *critical success factors* (research phase 1) and the social process of *informalising* (research phase 2) the sponsor has been given an increased understanding of the social dynamics of collaborative working in a fast paced practice environment. In particular, this research indicates that *informalising* is a robust process evident in busy project environments. The need *to informalise* highlights the relevance of managing expectations and value judging to remain effective and efficient in a fast paced practice context. These are important social processes that influence relationship building and decision-making. In addition, it highlights the role of informality to achieve formal requirements (Miztal, 1999).

The implications for practice are significant in terms of managing projects, learning and growth of social capital in collaborative project settings. Access to the proposed success frame work and the processes of *informalising* have the potential to enable project participants/stakeholders to feel more 'in control' of the project process and outcomes and hence increases ownership and engagement. Above all, recognising that *informalising* is integral to cultivating collaboration and hence 'getting the work done', more attention should be given to support such activity in today's turbulent and transient organisations. Knowledge

of this form of emergent and improvisational strategy will enable managers to alter patterns of behaviour that could negatively affect project outcomes in terms of perceived value and profit. Thus this research serves as a response to the persistent call from a significant minority of writers in the field of project management for more inductive, theory building studies, using empirical data to build theories which are useful and relevant; mirroring the reality of the challenges that practitioners face in managing their projects (Hodgson and Cicmil, 2006; Morris, 2006).

Overall the research has afforded the sponsor an opportunity to benefit from a grounded analysis of the challenges that practitioners face in team based multi-disciplinary project work. Many aspects of 'working together' are taken for granted and as such they are frequently overlooked. Knowledge and understanding of these social processes may enable managers to understand their functionality in managing projects, especially those that require cross-disciplinary effort, in the face of persistent and unpredictable change.

In seeking to bring about 'more collaboration' in projects, however, managers need to remove themselves from quick fix 'solutions' and start engaging themselves in what their teams *actually* experience and do in daily project work. This will enable them to support the project performance from start to finish, greatly improving the chances of achieving both individual and collective success. From this perspective, this research study offers the potential to significantly contribute to Buro Happold's competitiveness in terms of fulfilling client expectations through mindful management of collaborative design, thus enhancing the company brand and long term organisational success.

REFERENCES

Andersen, E. S., Birchall, D., Jessen, S.A., and Money, A. H. (2006) Exploring critical success factors, *Baltic Journal of Management*, Vol No 2, pp 127-147

Anderson, S. D. and Tucker, R.L. (1994) Improving project management of design, *Journal of Management in Engineering*, Vol 10 No 4, pp 35-44

Annells, M. (1996) Grounded theory method: Philosophical perspectives, paradigm of inquiry and postmodernisation. *Qualitative Health Research*, Vol 6 No 3, Sage, CA

Association for Project Management (2006) *Body of knowledge for managing projects and Programmes, 6th edition*, APM, High Wycombe

Austin, S. A., Baldwin, Hammond, Murray, Rost, Thomson and Thorpe. T (2001) *Design Chains – A handbook for integrated design teams*, Thomas Telford, London

Baiden, B.K., Price, A.D.F., and Dainty A.R.J. (2006) The extent of team integration within construction projects, *International Journal of Project Management*, Vol 24 No 1 pp 12-23

Baker, B. N. Murphy, D. C., and Fisher D. (1988) Factors affecting project success, in D.I. Cleland, W.R. King, (Eds.), *Project Management Handbook*, Van Nostrand Reinhold, pp 902-919.

Bennis, W., and Ward Biederman, P. (1997) *Organizing Genius: The Secrets of Creative Collaboration*, Addison Wesley, MA, Reading.

Beyerlein, M.M., Johnson, D. A., and Beyerlein, S.T. (eds) (2004). *Complex collaboration: building the capabilities for working across boundaries. Advances in interdisciplinary studies of work teams, Vol 10*, Elsevier, Oxford

Bibby, L. (2003) *Improving design management techniques in construction*, PhD thesis, Centre for Innovative and Collaborative Engineering, Loughborough University, Loughborough

Bignell, V., and Fortune, J. (1984) *Understanding systems failures*, Manchester University Press, Manchester

Braun, V., and Clarke, V. (2006) Using thematic analysis in psychology, *Qualitative Research in Psychology*, Vol 3 No 2, pp 77-101

Bresnen, M., Goussevskaia, A., and Swan, J. (2005) Managing projects as complex settings, *Building Information & Research*, Vol 36 No 6, pp 487-493

Bonoma, T.V. (1985) Case research in marketing: opportunities, problems, and a process, *Journal of Marketing Research*, Vol 22 No 2, pp 199-208
Bouma, G.D., and Ling, R. (2004) *The research process, 5th edition*, Oxford University Press, Oxford

Brewer, J., and Hunter, A. (2006) *Foundations of multi-method research: Synthesising styles*, Sage Publications, London.

Bryman, A. (2004) *Social research methods, 2nd edition*, Oxford University Press, Oxford

Chan, A. P., Scott, D., and Lam E. W. M (2001) Framework of success criteria for Design/Build projects, *Journal of management in Engineering*, Vol 18 No 3, pp 120-128

Chan, P.C., Scott, D., and Chan, P.L (2004) Factors affecting the success of a construction project, *Journal of Construction Engineering and Management,* Jan/Feb, pp 153-155.

Chinowsky, P.S., Diekman, J., and Galotti, V. (2008) A social network model for construction, *Journal of Construction Engineering and Management, ASCE*, Vol 134 No 10, pp 59-66

Christiansen, O. (2007) A simpler understanding of classic GT: How it is fundamentally different methodology, in B.G. Glaser and J.A. Holton, *Seminar Reader in Grounded Theory, Sociology Press*, pp 401-418

Chua, D.K.H, Kog, Y.C., and Loh, P.K. (1999) Critical success factors for different project objectives, *Journal of Construction Engineering and Management*, ASCE, Vol 125, No 3, pp 142-150

Cicmil, S. (2005) Reflection, participation and learning in project environments: A multiple perspective agenda, in P.E.D. Love., P.S.W. Fong., and Z. Irani (Eds.), *Management of knowledge in project environments*, Elsevier, Oxford, pp 155-180

Clegg, S.R., Pitsis, T.S., and Morosszesky, M., and Rura-Polley, T. (2005) Making the future perfect: Constructing the Olympic dream, in Hodgson, D., and Cicmil, C. (Eds.), *Making projects critical*, Palgrave Macmillan, Hampshire, pp 252-264

Cooke-Davies, T (2002) The 'real' success factors on projects, *International Journal of Project management*, Vol 20 No 3,185-190

Cooke-Davies, T. (2004) Project Success, in J.K Pinto and P.W.G. Morris, (Eds.), *The Wiley Guide to project management*, Wiley & Sons Inc, Hoboken, New Jersey

Conner, M., and Finnemore, P. (2003) Living in the new age: Using collaborative digital technology to deliver health care improvement, *International Journal of Health Care Quality Assurance*, Vol 16 No 2, pp 77-86

Cresswell, J. W. (1994) *Research design: Qualitative and quantitative approaches*, Sages Publications, CA.

Cresswell, J. W. (2007) *Qualitative inquiry and research design: Choosing among five approaches, 2nd Edition*, Sage Publications, London.

Cresswell, J.W. (2008) *Research by design*, Sage Publications, London.

Détienne, F. (2006) Collaborative design: Managing task interdependencies and multiple perspectives, *Interacting with computers*, Vol 18 No1, pp. 1-20

De Wit, A. (1988) Measurement of project success, *International Journal of Project Management*, Vol 6 No 3, pp 164-170

Diallo, A., and Thuillier, D. (2004) The success dimensions of international development projects: the perceptions of African project coordinators, *International Journal of Project Management*, Vol 22 No 1, pp19-31

Dickson, M. (2001) The design professions in transition – engineering and architecture for a small world, in S. Macmillan, R. Spence and P. Kirby (eds.), *Interdisciplinary design in practice*, Thomas Telford, London, pp. 37-60

Druskat, V., and Druskat, P. (2006) Applying emotional intelligence in project working, in S. Pryke and H. Smyth (eds.), *The management of complex projects – a relationships approach*, Blackwell Publishing, Oxford, pp 78-96

Dougherty, D. (1992) Interpretative barriers to successful product innovation in large firms, *Organization Science*, No 3 Vol 2, pp 179-202.

Egan, Sir J. (1998) *Rethinking Construction, The report of the Construction Task Force, Department of the Environment, Transport and the Regions,* July, DETR, London, UK.

Emmitt, S. (2007) *Design management for architects*, Blackwell Publishing, Oxford

Fernandez, W. D. (2008) Using the Glaserian approach in grounded Studies emerging business practices, *Electronic Journal of Business Research Methods*, Vol 2 Issue 2, pp 83-93

Foley, S., and MacMillan, S. (2005) Patterns of interaction in construction team meetings, *CoDesign*, Vol 1 No 1, pp 19-37

Fortune J, and Peters, G (2005) *Information Systems: Achieving success by avoiding failure*, John Wiley & Sons Ltd, Chicester

Fortune, J., and White, D. (2006) Framing of project critical success factors by a systems model, *International Journal of Project Management*, Vol 24 No 1, pp 53-65

Gann, D.M., and Salter, A. (2003) Project baronies: Growth and governance in project-based firms, *Paper presented at Druid Summer Conference on Creating, sharing and transferring knowledge: The role of geography, institutions and organisations*, Copenhagen, June 12-14

Glaser, B. G., with the assistance of Judith Holton (2004) Remodeling Grounded Theory, *Forum: Qualitative Sozialforschung/ Forum: Qualitative Social Research*, Vol 5 No 2, Art 4, http//:nbn-resolving.de/um:nbn:de:0114-fqs040245

Glaser, B. G., and Strauss, A. L. (1967) *The Discovery of Grounded Theory: Strategies for Qualitative Research*, Aldine Transaction, New Jersey

Glaser, B. G. (1978) *Theoretical sensitivity: Advances in the methodology of Grounded Theory*, Sociology Press, Mill Valley, California

Glaser, B. G. (1992) *Basics of Grounded Theory Analysis*. Sociology Press, Mill Valley, California

Glaser, B. G. (1998) *Doing Grounded Theory: Issues and discussions*, Sociology Press, Mill Valley, California

Glaser, B. G. (2001) *The Grounded Theory perspective: Conceptualization contrasted with description*, Sociology Press, Mill Valley, California

Glaser, B. G. (2003) *The Grounded Theory perspective II*, Sociology Press, Mill Valley, California

Glaser, B. G. (2005) *The Grounded Theory perspective III*, Sociology Press, Mill Valley, California

Green, S. (2006) The management of projects in the construction industry context: context, discourse and self-identity, pp 232-251, in Hodgson, D and Cicmil, C (Eds.), *Making projects critical*, Palgrave Macmillan, Hampshire, pp 232-251

Goulding, C. (2002) *Grounded theory: a practical guide for management, business and market researchers*, Sage, London

Guthrie, W. (2000) *Keeping clients in line: A grounded theory explaining how veterinary surgeons control their clients*, PhD Thesis, University of Strathclyde, Strathclyde

Guthrie, W. (2009) Choosing to use Glaserian grounded theory research methodology: An informed decision, in *Proceedings of the Association of Researchers in Construction Management (ARCOM) Doctoral Workshop*, Liverpool John Moores University, Liverpool, pp 26-34

Gynnild, A. (2007) Growing open: The transition from QDA to Grounded Theory, in B.G. Glaser and J.H. Holton, *Seminar Reader in Grounded Theory*, Sociology Press, Mill Valley, pp 419-432

Hackman, J. R. (1987) The design of work teams. In J. Lorsch (ed) *Handbook of organizational behaviour*, Prentice Hall, New York, pp. 315-345

Hackman, J. R. (1990) *Groups that work (and those that don't),* Jossey-Bass, San Fransisco

Hansen, M. T (2009) When internal collaboration is bad for your company, *Harvard Business Review*, April, pp 83-88

Heerwagen, J.H., Kampschroer, K., Powell, K.M., and Loftness, S. (2004) Collaborative knowledge environments, *Building Research & Information*, Vol 32 No 6, pp 510-528

Henneman, E.A., Lee, J. L., and Cohen, J.I. (1995) Collaboration: A concept analysis, *Journal of Advanced Nursing*, Vol 21 No 1, pp 103-109

Hernandez, C. A (2009) Theoretical coding in grounded theory methodology, *The Grounded Theory Review*, Vol 8 No 3, pp 51-59

Holton, J. A. (2007) Rehumanising knowledge work through fluctuating support networks: a grounded theory, *Grounded Theory Review*, Vol 6 No 6 pp 23-46

Holton, J A (2008) The coding process and its challenges, in Bryant and K Charmaz (eds.) *The Sage Handbook of Grounded Theory,* Sage Publications, London, pp 265-290

Horner, R.M.W., and Zakieh, R. (1998) Improving construction productivity : A practical demonstration for a process based approach, *Internal publication*, Construction Management Research Unit, University of Dundee

Huxham, C and Vangen, S. E. (2003) Nurturing collaborative relations: Building trust in interorganisational collaboration, *The Journal of Behavioral Science*, Vol 39 No 1, pp 5-31

Huxham, C., and Vangen , S. E. (2005) *Managing to collaborate: The theory and practice of collaborative advantage*, Routledge, Oxon

Huxham C., and Vangen, S. E. (2008) Ambiguity, complexity and dynamics in membership of collaboration, *Human Relations*, Vol 53 No 6, pp 771-806

Ivory, C., Alderman, N., McLoughlin., and Vaughan, R. (2005) Sense-making as a process within complex projects, in Hodgson, D and Cicmil, C (Eds.), *Making projects critical*, Palgrave Macmillan, Hampshire, pp 316-334

Jaselskis, E.J., and Ashley, D.B (1991) Optimal allocation of project management resources for achieving success, *Journal of Construction Engineering Management*, Vol 117 No 2, pp 321-340

Johnson, P., and Harris, D.(2002) Qualitative and quantitative issues in research design, in D. Partington (Ed.), *Essential skills for management research*, Sage Publications, London, 99-115

Josephson, P. E. and Hammerlund, Y. (1996) Costs of quality defects in the 90's, Report 49, *Building Economics and Construction Management*, Chalmers University of Technology, pp 125.

Joyce, W., Nohria, N. and Robertson, B. (2003) *What really works: The 4+2 formula for sustained business success*, Harvard Business School Press, Boston MA

Jugdev, K and Müller, R. (2005) A retrospective look at our evolving understanding of project success, *Project Management Journal*, Vol 36 No 4, pp 19-31

Jupp, J, and Macmillan, S. (2010) Promoting teamwork and sustainable design, *The Structural Engineer*, Vol 88, No 2, pp.16-18

Latham, Sir M. (1994) *Constructing the Team, Final Report of the Government / Industry review of Procurement and Contractual Arrangements in the UK Construction Industry*, HMSO, London, UK.

Law, J., and Hassard, J (1999) *Actor network theory and after*, Wiley Blackwell, Oxford
Lechler, T. (2000) Empirical evidence of people as project success factors, in R. Lundin, and F. Hartman., (Eds.), *Projects as business constituents and guiding motives*, Kluwer Academic Publishers, London, pp 217-227

Lindgren, M., and Packendorff, J. (2005) Projects and prisons, in D. Hodgson., and S. Cicmil, *Making projects critical* (Eds.), Palgrave MacMillan, Hampshire, pp 111-131

Locke, K. (2001) *Grounded theory in management research*, Sage Publications, London

Kerzner, H. (1998) *Project management: A systems approach to planning, scheduling and controlling*, 2nd edition, van Nostrand Reinhold, New York

Knox, K (2004) A researcher's dilemma: Philosophical and methodological pluralism, *Electronic Journal of Business Research Methods*, Vol 2, pp 119, 128

Koch, C. (2004) The tyranny of projects – teamworking, organisational knowledge and project in consulting, Economic and Industrial Democracy, Vol 25 No 2, pp 270-292

Kochan, A. 1991, Boothroyd / Dewhirst – quantify your designs, *Assembly Automation*, Vol. 11 No. 3, 1991, pp 12-14

Koutsikouri, D., Austin, S.A., and Dainty, A,R.J (2006) Critical success factors (CSFs) in a multidisciplinary engineering practice, in *Proceedings of the 2nd Specialty Conference on Leadership and Management in Construction*, May 4-6, Grand Bahama Island, Bahamas

Kuprenas, J.A. (2003) Project management actions to improve design phase cost performance, *Journal of Management in Engineering*, Vol 19 No 1, pp 25-32

Kvale, S. (1996) *Interviews: An introduction to qualitative research interviewing*, Sage Publications, London

Kvan, T. (2000) Collaborative design: what is it?, *Automation in Construction*, Vol 9, pp 409-415

Macmillan, S., Spence, R., and Kirby, P.(2001). *Interdisciplinary design in practice*, Thomas Telford, London

Mattessich P. W., and Monsey, B.R. (1992) *Collaboration: What makes it work?,* Amherst H. Wilder Foundation, St Paul, MN

Maylor, H. (2001) Beyond the Gantt-chart: Project management moving on, *European Management Journal*, Vol 19 No 1, pp 92-100

McCallin, A. (2007) Pluralistic dialoguing: A theory of interdisciplinary team working, in B.G. Glaser and J. A. Holton, *The grounded theory seminar reader*, Sociology Press, Mill Valley, pp 37-54

Meredith, J.R., and Mantel, S.R. (2000) *Project management: A managerial approach, 5th edition*, John Wiley & Sons, New York

Miles, M.B., and Huberman, A.M. (1994) *Qualitative data analysis, 2nd edition*, Sage Publications, Thousands Oaks, CA

Misztal, B (1999) Informality*: Social theory and contemporary practice*, Routledge, London.

Morris, P.W.G. (2006) Afterword: Making the management of projects critical, in D. Hodgson and S. Cicmil (Eds.) *Making projects critical*, Palgrave Macmillan, Hampshire, pp 335-347

Morris, P.W.G., and Hough, G. H. (1987) *The anatomy of major projects: A study of the reality of project management*, John Wiley & Sons, Chicester

Morris, P.W.G., and Pinto J. K. (2004) *The Wiley Guide to managing projects*, John Wiley & Sons, London

Morris, P.W.G. (2006) How do we learn to manage projects better?, in S. Pryke and H. Smyth (Eds.), *The management of complex projects – a relationship approach*, Blackwell Publishing, Oxford, pp 58-77

Myers, M. (2000). Qualitative research and the generalizability question: Standing firm with Proteus. *The Qualitative Report*, Vol *4* No 3/4, (Online serial, available at: http://www.nova.edu/ssss/QR/QR4-3/myers.html

Nguyen, L. D., Ogulana, S. O., and Lan, D.T.X. (2004) A study on project success factors in large construction projects in Vietnam, *Engineering, Construction and Architectural Management*, Vol 11 No 6, pp 404-413

Ojasalo, J. (2001) Managing customer expectations in professional services, *Managing Service Quality*, Vol 11 No 3, pp. 200-212

Parfitt, M.K., and Sanvido, V.E. (1993) Checklist of critical success factors for building projects, *Journal of Management Engineering*, Vol 9 No 3, pp 243-249.

Parry, K.W. (1998) Grounded theory and social process: A new direction for leadership research, *The Leadership Quarterly*, Vol 9 No 1, pp 85-105

Paulson, B. C. (1976) Designing to reduce construction costs, *Journal of Construction Division, American Society of Civil Engineering*, Vol 102, pp 587-592

Phua, F.T.T., and Rowlinson, S. (2004) How important is cooperation to construction project success? A grounded empirical quantification, Engineering, *Construction and Architectural Management*, Vol 11 No 1, pp 45-54

Pinto, J.K. (1996) *Power and politics in project management*, Sylvia, NC: Project Management Institute.

Pinto, J.K., and Slevin, D.P. (1987) Critical factors in successful implementation, *IEEE Transactions on Engineering Management*, Vol 34 No 1, pp 22-27

Pinto, J.K., and Slevin, D.P. (1988) Project success: definitions and measurements techniques, *Project Management Journal*, Vol 19 No 1, pp 67-71

Rockart, J. F. (1979), Chief Executives define their own data needs, *Harvard Business Review*, Vol 57 No 2, pp 81-93.

Sanvido, V. R., Francois, G., Kevin, P, Moris, G., Michael, C. (1992) Critical success factors for construction projects, *Journal of Construction Engineering Management*, Vol 118 No 1, pp 94-111

Saunders, M., Thornhill, A., and Lewis, P. (2003) *Research methods for business students, 3rd edition*, Pearson Education, Essex

Sauser, B. J., Reilly, R., and Shenhar, A.J. (2009) Why projects fail? How contingency theory can provide new insights: A comparative analysis of NASA's Mars Climate Orbiter loss, *International Journal of Project Management*, Vol 27 No 7, pp 665-679

Schrage, M. (1989) *No more teams! Mastering the dynamics of creative collaboration*, Currency Doubleday, New York

Scott, H. M. P. (2007) *The temporal integration of connected study into a structured life: A grounded theory*, PhD Thesis, University of Portsmouth, Portsmouth

Shelbourn, M., Bouchlaghem, N. M., Anumba, C., and Carillo, P. (2005) Planning and implementation of effective collaboration in construction projects, *Construction Innovation*, Vol 7 No 4 pp 357-417

Silverman, D. (2000) *Doing qualitative research: A practical handbook*, Sage Publications, London.

Silverman, D. (2006) *Interpreting qualitative data: methods for analyzing talk, text and interaction, 3rd edition*, Sage Publications, London.

Standish Group (2003, Dec 5) *The CHAOS Chronicles*. Retrieved from http://www.standishgroup.com/chaos/introduction.pdf

Stapley, L. F. (2006) *Individuals, groups and organisations beneath the surface: An introduction*, Karnac Books, London

Stern, P.N. (1994) Eroding grounded theory, in J, M. Morse *Critical issues in qualitative research methods*, (Ed.). Sage Publications, Thousands Oaks, CA, pp 212-223

Strauss, A. L., and Corbin, J. (1990) *Basics of qualitative research: Grounded theory procedures and techniques*, Sage Publications, Newbury Park, California

Strauss, A. L., and Corbin, J. (1998) *Basics of qualitative research: Techniques and procedures for developing grounded theory*, Sage Publications, London

Sveiby, K. E., and Simons, R. (2002) Collaborative climate and effectiveness of knowledge work – An empirical study, *Journal of Knowledge Management*, Vol 6 No 5, pp 420-433

Toor, S., and Ogulana, S. O. (2009) Construction professionals' perception of critical success factors for large-scale construction projects, *Construction Innovation*, Vol 9 No 2, pp 149-167

Tuckman, B.W. (1965) Developmental sequence in small groups, *Psychological Bulletin*, Vol 63, pp 384-389

Turner, J. R. (2005) Forewords: Management of knowledge in project environments, in P. E.D Love, P.S.W. Fong, and Z. Irani (Eds.) *Management of Knowledge in Project Environments*, p ix

Vangen S.E., and Huxham, C. (2003) Nurturing collaborative relations, *The Journal of Behavioral Science*, Vol 39 No 1, pp 5-31

White, D. and Fortune, J. (2009) The project-specific Formal Systems model, *International Journal of Project Management in Business*, Vol 2 No 1, pp 36-52

Yeomans, S. (2005) *ICT enabled collaborative working methodologies in construction*, Unpublished thesis, Centre for Innovative and Collaborative Engineering, Loughborough University, Loughborough

Young, T. (1998) *The handbook of project management: A practical guide of effective policies and procedures*, Institute of Directors, Kogan Page, London

APPENDIX A PAPER 1

Koutsikouri, D., Austin, S.A., and Dainty, A.R.J. (2006) Critical success factors (CSFs) in a multidisciplinary engineering practice, *Proceedings of the 2nd CIB/ASCE Specialty Conference on Leadership and Management in Construction,* Grand Bahama Island, Bahamas, May 4-6, 2006

Critical success factors (CSFs) in a multidisciplinary engineering practice

D. Koutsikouri, [1] A. R .J. Dainty, S. A. Austin

[1] CICE, Department of Civil and Engineering, Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK; PH +44(0)1509 228 549; FAX +44 (0)1509 223 982; email: d.koutsikouri@lboro.ac.uk

Abstract
There is increasing interest in how organisations in construction manage, organise and deliver successful projects. In the project management literature these challenges are often defined in terms of better control of timescales, budgets and resource planning. Yet these are impoverished terms for conceptualising success, which is both multi-dimensional and contextual. The aim of the paper is to explore the perceptions of critical success factors (CSFs) in a multi-disciplinary engineering practice. The findings indicate that project success is related to five dimensions of work: individuals, teams, process, project and product. Understanding these elements and their interdependence may enable managers to identify strengths and weaknesses in current work practices. An important insight provided by this research is that CSFs is a form of knowing, which needs to be articulated and communicated more effectively within the project community.

1. Introduction

Construction organisations are facing a dramatic shift in having to develop new approaches in the way projects are conceptualised and implemented to deliver success. The recent interest in the intricacies of complex project environments and attempts to apply social science methods to analyse construction management problems confirm this (Cicmil & Marshall, 2005; Bresnen, Goussevskaia & Swan, 2005). Another important driver is the emergence of a more people-centred discourse around 'team integration', 'trust' and 'respect for people', as a means of improving work relationships and boosting performance. However, the extent to which these methodologies deal with today's project complexities, the new language of positive affirmations and universal urge to move 'from good to great' remains an area of conjecture. Research over the last four decades using the concept of critical success factors (CSFs) has made an important contribution in terms of establishing what 'must go right' for a business to reach its goals (e.g. De wit, 1988; Pinto & Slevin, 1988; Cooke-Davies, 2004). But what really constitutes project success? For the past 20 year or so textbooks have maintained that there are three critical factors are what define projects: a definite due date, a limited budget (including personnel resources), and a specified set of performance goals. However, researchers and practitioners alike now recognize that there are projects where these three items are not always clearly specified (Meredith & Mantel, 2006). In addition, there are often many implicit goals for projects, such as making a profit, not harming the reputation of the firm, extending the organization's sophistication in project management, and so on. Although the lists of success factors that may contribute to successful projects now also include a variety of human, organisation and technical variables, there are many critics to the CSF approach (Cooke-Davis, 2004). First there are many definitions of success, which makes it fundamentally difficult to assess and measure any set of factors that research has come up with. Further, empirical research have concluded that perceptions play a strong role of a project and therefore project success should be termed 'perceived project success' (Baker, Murphy & Fisher, 1988). A particularly important finding is that the factors associated with

project success are different for different industries (Baker et al, 1983) and cultures (Diallo & Thuillier, 2004). At the very least, success factors and their relative importance are idiosyncratic to the project type and the firm. Generalising a 'checklist' of factors derived from one project environment to another is therefore hardly worthwhile. The present study attempts to address this issue by focusing on CSFs in a construction design context, where current frameworks of success factors do not seem to apply. Second, recent findings overhaul the assumption that CSFs are independent of one another. Due to the complexity of the project implementation process, success factors are most likely to be dynamic, interdependent and change across time (Pinto & Prescott, 1988). Nevertheless, relationships between them are rarely explored in practice which renders them too simplistic to take account of complex construction project environments. Given the apparent drawbacks, the need for CSFs seems to remain and this has spurred new research efforts and a reconsideration of methodological issues (Cooke-Davies, 2004; Belout & Gauvreau, 2004). In this paper, the authors take the view that perceived CSFs can only be fully explored and understood in relation to one another. By understanding the interaction between the factors could provide insights into how organisations/practitioners can best meet all their CSFs (Ang, Sum & Yeo, 2002). This highlights the need to apply a more grounded CSF approach to explore CSFs in particularly complex project settings. The focus of the present study is a large multidisciplinary construction design practice. The daily life in an engineering practice is characterised by the uniqueness and temporality of project arrangements. The challenges that the various project participants (engineers, architects, clients, contractors) in design projects face are many and varied. For example, there is a high degree of complexity and interconnectedness of tasks, a high dependence on diverse skills and collective knowledge and little time to find out where relevant knowledge resides (Cicmil, 2004). It is suggested that teams such as these often have difficulty developing a shared project vision since they tend to create their own understandings of the project reality based on their background and world view (Dogherty, 1992). This paper aims to explore the cornerstones of successful multidisciplinary engineering projects. By capturing the perceptions of project success as experienced by the team members themselves, it is possible to make explicit the context specific CSFs that underpin consistent project success. This may be an effective framework to better understand the dynamics of project success; how different factors reinforce or impede each other during project stages. The initial findings serve as a basis for further investigation of CSFs and how they behave and function in actual construction project setting. It also responds to the expressed need for broader research methods in construction (Bresnen et al, 2005).

2. Methods

2.1. Approach

This study was analysed within a grounded theory framework. This inductive methodology enables issues relevant to the field of enquiry to emerge from the data and for theory to be generated by being grounded within the data itself. The methodology includes systematic open and axial coding (analysis), questioning of data, explanation of categories, their properties and the relationships among them (Strauss & Corbin, 1998).

2.2 Participants

Twenty two engineers and technicians (thirteen male and eight female) took part in this study, which was conducted in a UK based multidisciplinary engineering practice over a two month period. Specifically, it was located in one of the integrated business groups (IBGs), which employs more than 90 people. Since the aim was to reflect a broad spectrum of beliefs and values across the group, the sample was stratified to include individuals from different

disciplines such as structural, building services and façade engineering, but also CAD-technicians. Six job levels were represented: group manager, associates, senior engineer, engineer, graduate engineer and CAD-technician. There were eight structural engineers, three façade engineers, nine building services engineers and two CAD-technicians.

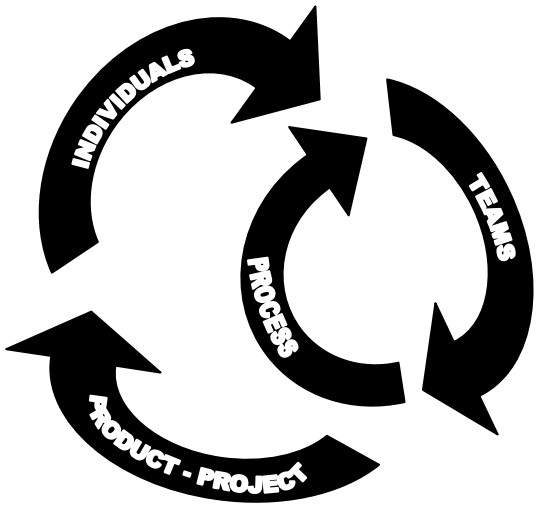
2.3 Data collection

2.3.1 Interviews

A series of semi-structured interviews were conducted with questions focusing on the informant's job role, experience of project work and examples of successful and less successful projects. The selected informants were e-mailed beforehand and asked to identify examples of a 'successful' and a 'less successful' project as the basis for discussion in the interviews. As part of the interview process, informants were asked to brainstorm critical success factors in project work. This was aimed to encourage individuals to 'make free associations' without being prompted, about factors they perceive as critical to project success. The exercise was useful because it helped to reveal two things: 1) some of the specific meanings that individuals attach to factors and, 2) their significance in context. The interviews were audio-recorded and transcribed verbatim. Categories produced by the researcher were validated through workshops, where staff from each engineering discipline including CAD-technicians, were recruited. The selected individuals were put in groups of 4-6 people according to their job level to allow data comparison across job levels. The informants were asked to group all of the initial categories (175) under larger categories so they would end up with a number of core categories. Each group was given 45 minutes to complete the task. The categorisation made by all six groups was then compared with the grounded analysis of the interview material. The analysis of the data included open coding (labelling segments of the interview material); asking questions such as 'What is going on here?' and 'What category does this incident indicate?'; axial coding to link categories and sub categories together, e.g. the category 'integration of disciplines' was placed under the larger category 'communication'; and selective coding to generate of core categories.

3. Results

Qualitative analysis of the interview material (brainstorming exercise) revealed five central constituents of project success: *individual*, *team*, *process*, *project and product*. An illustrated summary is provided in Figure 1. These core categories summarise the project team's perceptions of what is considered 'critical' in delivering successful projects or, more specifically, what needs continuous attention in day to day project implementation. Directional arrows within the model represent relationships between the categories as developed from the analysis.



INDIVIDUALS
Motivation, Values, Skills and competence, Leadership

TEAMS
Communication, Trust and mutual understanding, Respect, Wellbeing of project community, Culture, Clear roles and responsibilities, Relationships

PROCESS
Technology, Listening and feedback, Physical work environment, Supportive management, Resources and planning, Work process.

PROJECT – PRODUCT
Clear goals and project mission, Commercial awareness, Challenging project/task

Figure 1. The dynamics of five CSFs and their sub-categories

From a managerial point of view the project organisation need to have skilled, motivated and passionate individuals to carry out the task or the challenge; these individuals have to work together as a team to accomplish collaborative design that satisfy the client; the individuals and the teams need appropriate technology (tools and workspace), effective project management (planning, support and definition of roles and responsibilities) to operate in a structured way; and all these influence the central outcome of the *project*, the *product* itself. The model shows that project success relies heavily on the ability and behaviour of team members to work well together, but also how these relationships may be reinforced or impeded by other factors such as planning, availability of resources and style of leadership. Inherent in this way of thinking is the recursive interplay between the actors, e.g. project members, and the structure, e.g. organisational hierarchy and prevailing culture, which offers some important insight into how to understand project success. The interviews formed the basis for developing a preliminary hypothesis of core CSFs, which could be mapped onto the core categories created in the workshops. It is important to point out that these two sets of data are based on the open coded factors (175) elicited from the initial brainstorming exercise. In both instances, the primary task was to cluster the open coded CSFs into higher level categories and label them.

The initial set of high level categories, created by the researchers, comprised more detailed categories than those emerging from the workshops. Variations were also reflected in the number of core categories created, language used to label them and under which category each item would belong to. This can be explained as a consequence of *time*, *professional group* and *job role*. The researchers spent an unlimited time on categorising the 175 initial factors into a number of high level themes, whereas the workshop participants were given limited time. However, familiarity with the coded factors (e.g. 'effective project management', 'communication between disciplines', 'quality of contractor' etc) and an understanding what the words and sentences facilitated this task. Further, interpretation of text and talk is often influenced by background and professional discipline. For example: technicians created a high level group called 'satisfaction' and talked about it as part of being motivated, whereas managers talked about 'motivation' in terms of being motivated by the project itself. This emphasises the role of professional culture in an organisation (Kunda, 1992). In a similar vein, job role also seemed to influence the categorisation of factors. Associates talked about 'team factors' whereas senior engineers mentioned 'dynamics' which

may not reflect a real difference between these two groups in terms of what they are trying to articulate. Rather, it seems that they had to make a quick negotiation amongst themselves and decide what to go for. In this way, each group constructed CSFs through discussions, debate and negotiation around the high levels categories that the CFS would fall into. Based on these observations CSFs are taken to be socially constructed and socially recognised phenomena. The analysis of the workshop outcomes can be summarised as follows:

- Project success is seen as a *process* rather than an end-state across group levels.
- There is a preference to view success factors as *interrelated* and *mutually interdependent*; 'they cannot exist without each other'.
- Project success is seen as dependent on appreciating what lies beneath the exterior of the so called golden triangle, 'cost, time and to specification'.
- Success factors relating to *leadership/management*, *team work* and *competency/skills* were common to all groups.
- There is a high degree of consensus across groups on factors such as *communication, motivation* and *culture.* Communication which is usually seen as a top success factors in other studies, is not a consistent factor across the groups. Instead it was talked about as an overall important factor. For example, technicians talk about communication seemed to be related to being more integrated in the project process. The senior engineers across all disciplines summarised it as follows: 'communication is the catalyst in all good project work'.
- Communication is *the success factor* that influences work relationships and acts as a 'catalyst in good project work'.
- Variations between the groups appear to be a consequence of job roles rather than professional disciplines, indicating that junior levels (e.g. graduate engineers) perceive supportive environment as more critical than resource planning. Similarly, senior levels seem to place more focus on having the right people and manage the different and sometimes conflicting project demands rather than 'time to play with ideas'. Contrary to recent studies of CSFs in project work, client focus does not emerge as a consistent factor across the groups. There was little reference to 'the client', 'client satisfaction' or 'end-user'

The most striking observations indicate that project participants, regardless of background or role, hold an inward looking attitude of project success; mainly focusing on their own concerns such as timetables, their contribution to the project and so forth. This reflects the continuous regime of 'getting things done', or what has been termed the 'tyranny of projects'; a mentality that govern much of the work in the construction industry (Koch, 2004). One senior, male building services engineer expressed an important part of this condition: *'You just work, work, work, busy, busy, busy you know. I can organise my time but then somebody throws something in…something is coming from nowhere, which should not happen really'*. The situation is further complicated by the difficulty in juggling the demands of being involved in many projects which is common in consulting engineering (Koch & Bendixen, 2005). This presents a challenge that goes beyond time management; it is a matter of knowing where to direct attention.

Discussion

As was discussed above, the aim of this study was to explore project success as perceived by engineers and technicians in a multidisciplinary engineering practice. It is part of a number of research outputs regarding the social dynamics of construction team work. The study presents an ideal opportunity to make comparisons with existing success factors drawn from other

project settings. Five core success factors emerged from the interview data: individuals, teams, processes, project and product. Analysis of these factors shows that they both reinforce and impede each other in an iterative manner during the project life cycle. These findings add a number of dimensions to the current findings in the project management literature, which go beyond the short term goals of the manager, 'on time, on budget and to specification'. Specifically, suggested model implies that human as well as contextual factors contribute to the perception of project success. Another observation is that CSFs appear to be socially constructed among individuals as well as socially recognised phenomenon. In this way, project success is taken to be a process rather than a static concept. This way of conceptualising success is part of the new generation of research stating that project organisations should be studied as social arrangements in terms of locating what is working and what is not working in them (Bresnen et al, 2005; Cicmil et al, 2005). Another important observation in the study was that when given the freedom to state any success factor the majority of them emphasised variables relating to internal characteristics of the project process such as maintaining good relationships, passion for the project, and a clear understanding of their role. External characteristics of the product or service itself such as customer focus or product performance were not emerging as critical. This pattern of responses occurred in the subsequent workshop where the participants where asked to group the success factors derived from interviews with engineers and CAD-technicians. This is surprising considering the many published articles and books on the importance of the client in project success (e.g. Meredith et al, 2006), and brings attention to the somewhat inward-looking attitude of CSFs in project work. Assessment of these observations suggest two concurrent events: 1) engineers and technicians are more focused on getting the design right than focusing on product performance which can only be measured when the building is ready to use, and 2) the naturalised culture in construction seem to emphasise 'getting things done' rather than reflecting on what is getting done. These observations are to a great extent in line with conclusions based on a number of different project environments and industries (e.g. Slevin & Pinto, 2004). While the pressure to deliver on time and on budget are still dominant within the project organisation, team members themselves are more interested in whether a project is worthwhile doing, satisfying and is a good learning experience (i.e. they are focused on psycho-social outcomes). The workshops demonstrate that the differences in perception of project success, is a result of job role, rather than what professional group one belongs to. This was an expected outcome, but worth investigating since professionals cultures seems to be seen as major problem in multidisciplinary work (Dougherty, 1992). An important insight provided by this research is that CSFs is a form of knowing, which is not commonly articulated within the project community. At the same time CSFs must be made explicit in an organisation to have any effect on performance. This is reflected in the study, where communication was singled out as being the 'catalyst' for all CSFs. The constraint lies in the nature of design work; the involvement of architects and other subcontractor that represent organisations that operate outside of the engineering consultancy. Construction project work is communication based; efficient collaboration relies on effective diffusion of information throughout the project (Baiden, Price & Dainty, 2006, in press; Winch, 2001). What is required is a radical change in the way CSFs are conceptualised and measured for them to be useful for practitioners looking for ways to improve current project performance.

Conclusions

Project success depends on a range of human, organisational and technical variables. Yet there is no agreement in the literature what factors exactly contribute to success. Despite this, CSFs continue to be an important method of improving performance in project work. The

main conclusions from this study are that: 1) project success appears to be related to the opportunities and constraints of organisational behaviour, existing work processes and structures, causing an inward-looking view of success among project participants 2) CSFs are interrelated and mutually dependant and are likely to change across time, and 3) project success is a process rather than a static concept which relies on effective communication between individuals at all levels. Despite this, it is impossible to claim that all dimensions of project success in a multi-disciplinary project environment have been captured. Further empirical studies are needed to evaluate and further develop the presented intermediate model as basis for appropriate support to practitioners in the construction industry. An in-depth understanding of each project participant's influence and perception of project success is also beneficial.

References

Ang, J. S. K., Sum, C-C., and Yeo, L-N. (2002). "A multiple-case design methodology for studying MRP success and CSFs". *Inf. Managment*, 39, 271-281.

Baiden, B.K., Price, A. D. F., and Dainty, A. R. J. (2006 in press). "The extent of team integration within construction projects". *Int. J. Project Management.*

Belou, A., Gauvreau, C. (2004). "Factors influencing project success: the impact of human resource management." *Int. J. of Project Management*, 22, 1-11.

Bresnen, M., Goussevskaia, A., and Swan, J. (2005) "Managing projects as complex social settings." *Building, Research and Information*. 33 (6), 487-493.

Cicmil, S. (2005). "Reflection, participation and learning in project environments: a multiple perspective". In P. Love, S. W. Fong, and Z. Irani, eds, *Management of Knowledge in project environments*, Elsevier, Oxford.

Cicmil, S., and Marshal, D. (2005). "Insights into collaboration at the project level: complexity, social interaction and procurement mechanisms." *Building Research and Inf.* 33 (6), 523-535.

Cooke-Davies, T. (2004) "Project success." In *The Wiley guide to managing projects*, eds P. G.W. Morris, and J. K. Pinto, Wiley, New York, pp 99-122.

De Wit, A. (1988). "Measurement of project success." *Int. J. of Project Management*. 6(3), 164-170.

Diallo, A., and Thuillier, D. (2004). "The success dimensions of international development projects: the perceptions of African project coordinators." *Int. J. of Project Management,* 22, 19-31.

Dougherty, D. (1992). "Interpretative barriers to successful product innovation in large firms". *Org Science*, 3(2), 179-202.

Koch, C. (2004. "The tyranny of projects: teamworking, knowledge production and management in consulting enginering". *Economic and Industrial Democracy*, 25(2), 277-300.

Koch, C., and Bendixen. (2005). “Multiple perspectives on organizing: projects between tyranny and perforation.” *Building Research and Inf*, 33(6), 536-546.

Kunda, G. (1992). *Engineering culture. Control and commitment in a High Tech Corporation*, Temple University Press, Philadelphia, PA.

Pinto, J. K., Prescott, J. E. (1988). “Variations in the critical success factors over the stages in the project lify cycle.” *J. of Management*, 14(1), 5-18.

Pinto, J.K., and Slevin, D.P. (1988). ”Critical success factors across the project life cycle. ” *Project Management J*. 19(1), 67-72.

Meredith, J.R., and Mantel, S. (2006). *Project management: A managerialist approach, 6th ed,*. Wiley: New York.

Baker, B. N, Murphy, D. C, and Fisher, D. (1988). ” Factors affecting project success“. In D.I Cleland, W.R King, eds, *Project Management Handbook,* Van Nostrand Reinhold, pp 902-919.

Strauss, A., and Corbin, J. (1998). *Basics of qualitative research, 2nd edition*.
Sage, London.

Winch, G. M. (2001). *Managing construction projects*. Blackwell Publishing, Oxford.

APPENDIX B PAPER 2

Koutsikouri, D., Austin, S.A., and Dainty, A.R.J. (2006) Critical success factors for multidisciplinary engineering projects, *Proceedings in Association of Researchers in Construction Management (ARCOM), Twenty-second Annual Conference*, UCE, Birmingham, September 4-6, 2006

Critical success factors for multidisciplinary engineering

Dina Koutsikouri, Andy Dainty and Simon Austin

[1]CICE, Department of Civil and Engineering, Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK

Project success is an attractive idea but what factors lead to success remains an area of conjecture. In the project management literature the success has often been defined in terms of better control of timescales, budgets and resource planning. Yet these are impoverished terms for conceptualising success, which is both multi-dimensional and contextual. The study explores the perceptions of critical success factors (CSFs) in a multi-disciplinary engineering practice. Project success is seen to be related to five dimensions of work: *individuals*, *teams*, *process*, *project* and *product*. Understanding these elements and their interdependence may enable managers to identify strengths and weaknesses in current work practices. An important insight is that CSFs is a form of knowing, which needs to be articulated and communicated more effectively within the project community, emphasising the role of social capital and social networks.

Keywords: consulting engineering, critical success factors, multidisciplinary projects, project success, organisational behaviour, social capital, success factors.

1. INTRODUCTION

In an era when projects have become a means of enhancing organisational performance and competitiveness, defining and assessing project success is more relevant than ever (Shenhar, 2001), especially so in engineering and construction. Current success frameworks do not seem to apply in these project based environments where conflicting priorities exist between different projects and professional groups as well as the number of interfaces between the projects and their surrounding environments (Fong 2005). The success of individual projects impacts on the wider organisation in several dimensions and has a bearing on the future direction of project management (Jugdev & Muller 2005) as well as organisational longevity. Yet, project success appears to be something of an enigma. This is perhaps not surprising, since the terminology surrounding success has been widely criticised as both confusing and simplistic (see Guss 1998). Initially, the concept of critical success factors (CSFs) was used to identify information systems needs of managers and engineers in various industries (Daniel 1961; Rockart 1979). In this context, critical success factors were defined as ″the critical key areas where ‘things’ must go right for the business to flourish″ Rockart (1979: 85). Nevertheless, while CSF may be useful in pinpointing important areas for achieving desired goals, as a method it fails to fully answer the question: What factors really lead to successful projects? Over the past 20 years or so textbooks maintain that there are three critical factors that define project success, often referred to as the priorities of project management: a definite due date, a limited budget (including personnel resources), and a specified set of performance goals. However, academics and practitioners alike now recognise that there is more to success than fulfilling the goals of the project manager (Shenhar et al 2001; Meredith & Mantel 2006). From this perspective, two different aspects of projects are deemed essential in determining whether a project is a success or failure: 1) the internal characteristics of the project organisation such as time cost and performance goals, and 2) the external characteristics, such as customer satisfaction (Shenhar 1997; Agarwal & Rathod 2004;

Meredith et al 2006). Additionally, empirical research has shown that perceptions play a strong role of a project and therefore projects success should be 'perceived project success'(Baker, Murphy & Fisher, 1988). Put differently, success means different things to different people; 'trying to pin down what success means in the project context is akin to gaining consensus from a group of people on the definition of good art' (Jugdev & Muller 2005:19). Consequently, a project can be both a success and a failure. The Millennium Dome in Greenwich, London, for example was hailed as a success in engineering terms, but was more widely perceived to be a failure within the public and political domain (Cook 2005).An important finding is that the factors associated with project success are different for different industries (Baker et al 1983) as well as depending on the cultural context (Diallo & Thuillier 2004). At the very least, success factors and their relative importance are idiosyncratic to the project type and the firm. Generalising a 'checklist' of factors derived from one project environment to another is therefore hardly worthwhile. In their retrospective look at the evolving understanding of project success, Jugdev et al (2005) contend that project managers still have to answer the question 'How is your project doing?' which inevitably puts pressure on them to define success (p.19). In light of this, they stress that a diversified understanding of project success is necessary, particularly in settings where practitioners must manage multiple projects at various stages of their life cycles and face competing priorities on a daily basis (Jugdev & Muller 2005).According to Cooke-Davies (2002) a comprehensive answer to the question which factors are critical to project success depends on answering three separate questions: 'What *factors lead to project management success?*, *'What factors lead to a successful project?*', and '*What factors lead to consistently successful projects?'*. Drawing on empirical research he makes two major distinctions to explain the theory behind the proposition. Firstly, he distinguishes between *project success* (measured against the overall objectives of the project), and *project management success* (measured against traditional measures of performance such as cost, time and quality). Secondly, he distinguishes between *success criteria* (the measures by which success or failure of a project will be judged) and *success factors* (those inputs to the management system that lead directly to the success of the project). The most notable observation concerns the human dimension as embedded in the 'real' factors that lead to project success (Cooke-Davies 2002: 189). The 'discovery' that performance and success is achieved through people draws attention to the very core of what constitutes organisations: human and social capital. Empirically based findings in construction, although preliminary, support the notion that 'successful relationships' are key to overall project success (Abeyesekera & McLean 1991). However, the link between project success and relationships between the project stakeholders remains under explored. For purposes of clarity, this paper builds on Cooke-Davies (2002) assumptions on success factors by exploring the cornerstones of successful multidisciplinary engineering projects. This particular setting is characterised by the uniqueness and temporality of multi-project arrangements. So far there is little knowledge, if any, on project success in multi-project settings. The challenges that the various project participants (including engineers, architects, clients, contractors) in design projects face are many and varied. For example, there is a high degree of complexity and interconnectedness of tasks, a high dependence on diverse skills and collective knowledge and little time to find out where relevant knowledge resides (Cicmil 2004). It is suggested that teams such as these often have difficulty developing a shared project vision since they tend to create their own understandings of the project reality based on their background and world view (Dogherty 1992). By capturing the perceptions of project success as experienced by the team members themselves, it is possible to make explicit the context specific CSFs that underpin consistent project success. This may be an effective framework to better understand the dynamics of project success; how different factors

reinforce or impede each other during project stages. The initial findings serve as a basis for further investigation of CSFs and how they behave and function in actual construction project setting. It also responds to the expressed need for broader research methods in construction (Bresnen et al 2005).

1.1 METHODOLOGY

This study was analysed within a grounded theory framework. This inductive methodology enables issues relevant to the field of enquiry to emerge from the data and for theory to be generated by being grounded within the data itself. The methodology includes systematic open and axial coding (analysis), questioning of data, and explanation of categories, their properties as well as the relationships among them (Strauss & Corbin 1998).

Participants

Twenty two engineers and technicians (thirteen male and eight female) took part in this study, which was conducted in a UK based multidisciplinary engineering practice over a two month period. Specifically, it was located in one of the integrated business groups (IBGs), which employs more than 90 people. Since the aim was to reflect a broad spectrum of beliefs and values across the group, the sample was stratified to include individuals from different disciplines such as structural, building services and façade engineering, but also CAD-technicians. Six job levels were represented: group manager, associates, senior engineer, engineer, graduate engineer and CAD-technician. There were eight structural engineers, three façade engineers, nine building services engineers and two CAD-technicians. The sequence of the data collection was as follows: (1) interviewing individuals in the unit, (2) organising and implementing six workshops accommodating 4-6 people in each session, and (3) sending an electronic survey to all staff.

1.2 DATA COLLECTION

Interviews

A series of semi-structured interviews were conducted with questions focusing on the informant's job role, experience of project work and examples of successful and less successful projects. The selected informants were e-mailed beforehand and asked to identify examples of a 'successful' and a 'less successful' project as the basis for discussion in the interviews. As part of the interview process, informants were asked to brainstorm critical success factors in project work. This was aimed to encourage individuals to 'make free associations' without being prompted, about factors they perceive as critical to project success. The exercise was useful because it helped to reveal two things: 1) some of the specific meanings that individuals attach to factors and, 2) their significance in context. The interviews were audio-recorded and transcribed verbatim.

Workshops

The 175 categories identified were subsequently validated through work. Due to the high number of categories (some overlapping) they were grouped into a number of high level categories and named to reflect the emerging themes, for example, communication, leadership, team work and so on. The selected individuals, 36 in total, were put in to groups of 4-6 people according to their job level to allow data comparison across job levels. The informants were asked to group all of the initial categories (175) under larger categories so they would end up with a number of core categories. Each group was given 45 minutes to complete the task. The categorisation made by all six groups was then compared with the

grounded analysis of the interview material. The analysis of the data included open coding (labelling segments of the interview material); asking questions such as 'What is going on here?' and 'What category does this incident indicate?'; axial coding to link categories and sub categories together, e.g. the category 'integration of disciplines' was placed under the larger category 'communication'; and selective coding to generate of core categories. A list of 19 CSFs was distilled from the interviews and workshops: culture communication, project management, teamwork, technology, motivation, technical skills, social skills, social activities, leadership, roles and responsibilities, listening and feedback, trust shared values, office environment, resources, client focus, creativity and innovation, knowledge management. The data reduction, in terms of minimising the amount of high level categories, was made by comparing and contrasting the initial grouping of the 175 factors with the groupings made by the staff in the workshops.

Survey

The main focus of the survey was to establish whether there are any differences in perception of factors important for project success between different project members. Specifically, the respondents, 40 in total, were asked to review the 19 CSFs and select one factor that they think is of supreme importance and rate it 10, then choose the least important factor and rate it 1 (only using these values once); then rate the remainder of the factors on the list using a 2-9 rating scale. See survey results in Figure 1 below.

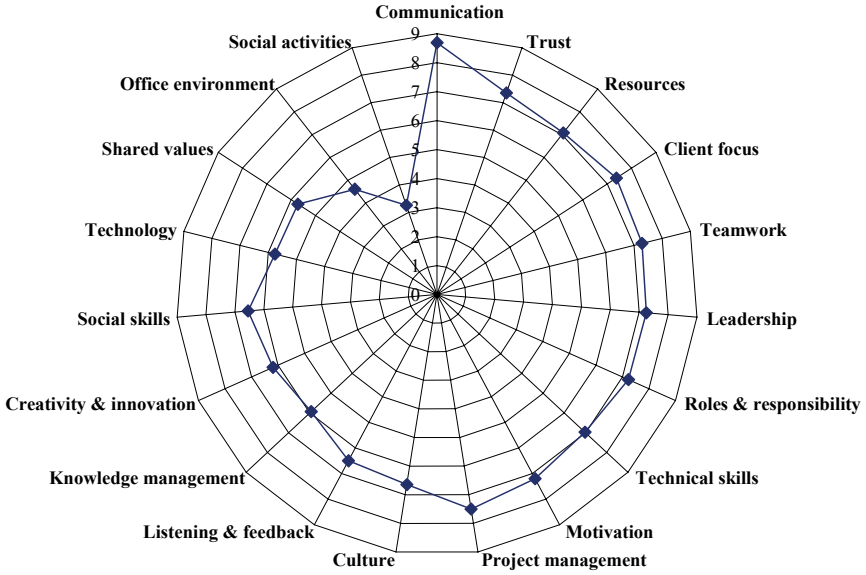


Figure 1. Response patterns from the CSFs survey.

1.3 RESULTS

Analysis of the interview material (brainstorming exercise), workshops and survey results revealed five central constituents of project success: *individuals*, *teams*, *process*, *project and product*. An illustrated summary is provided in Figure 2 below. These primary (core) categories, labelled in the final analysis, summarise the project team's perceptions of what is considered 'critical' in delivering successful projects or, more specifically, what needs continuous attention in day to day project implementation. From a managerial point of view the project organisation need to have skilled, motivated and passionate *individuals* to carry out the task or the challenge; these individuals have to work together as a *team* to accomplish collaborative design that satisfy the client; the individuals and the teams need appropriate

processes, including technology (tools and workspace) and effective project management (planning, support and definition of roles and responsibilities) to operate in a structured way; and all these influence the central outcome of the *project*, the *product* itself.

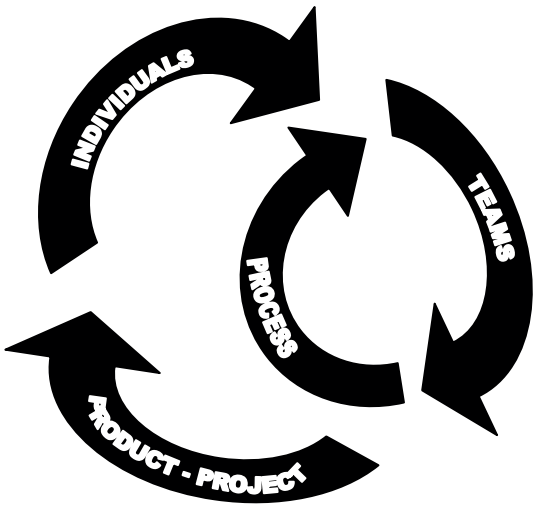


Figure 2. The dynamics of the five primary CSFs derived in the study.

The model shows that project success relies heavily on the ability and behaviour of team members to work well together, but also how these relationships may be reinforced or impeded by other factors such as planning, availability of resources and style of leadership. Inherent in this way of thinking is the recursive interplay between the actors, e.g. project members, and the structure, e.g. organisational hierarchy and prevailing culture, which offers some important insight into how to understand project success. The interviews formed the basis for developing a preliminary hypothesis of core CSFs, which could be mapped onto the core categories created in the workshops. It is important to point out that these two sets of data are based on the open coded factors (175) elicited from the initial brainstorming exercise. In both instances, the primary task was to cluster the open coded CSFs into higher level categories and label them. The analytical process of the workshop data is explained elsewhere (Koutsikouri et al 2006). In sum, the workshop outcomes can be summarised as follows:

1. Project success is seen as a *process* rather than an end-state across group levels
2. There is a preference to view success factors as *interrelated* and *mutually interdependent*; 'they cannot exist without each other'.
3. Project success is seen as dependent on appreciating what lies beneath the exterior of the so called golden triangle, 'cost, time and to specification'.
4. Success factors relating to *leadership/management*, *team work* and *competency/skills* were common to all groups.
5. There is a high degree of consensus across groups on factors such as *communication, motivation* and *culture.* Communication which is usually seen as a top success factor in other studies is not a consistent factor across the groups. Instead it was talked about as an overall important factor. For example, technicians talk about communication seemed to be related to being more integrated in the project process. The senior

engineers across all disciplines summarised it as follows: 'communication is the catalyst in all good project work'.

6. Variations between the groups appear to be a consequence of job roles rather than professional disciplines, indicating that junior levels (e.g. graduate engineers) perceive supportive environment as more critical than resource planning. Similarly, senior levels seem to place more focus on having the right people and manage the different and sometimes conflicting project demands rather than 'time to play with ideas'. Contrary to recent studies of CSFs in project work, client focus does not emerge as a consistent factor across the groups. There was little reference to 'the client', 'client satisfaction' or 'end-user'.

The most striking observations indicate that project participants, regardless of background or role, hold an inward looking attitude of project success, mainly focusing on their own concerns such as timetables, their contribution to the project and so forth. This reflects the continuous regime of 'getting things done', or what has been termed the 'tyranny of projects'; a mentality that governs much of the work in the construction industry (Koch 2004). One senior, male building services engineer expressed an important part of this condition: *'You just work, work, work, busy, busy, busy you know. I can organise my time but then somebody throws something in…something is coming from nowhere, which should not happen really'*. The situation is further complicated by the difficulty in juggling the demands of being involved in many projects which is common in consulting engineering (Koch & Bendixen 2005). This presents a challenge that goes beyond time management; it is a matter of knowing where to direct attention. The results of the survey validate the findings from both the interview study and workshops emphasising the importance of 'soft' factors in achieving project success. See Diagram above These are all related to the notion of social capital which is key in understanding how work really gets done in organisations (Cross & Parker 2004). Using descriptive statistics the survey outcomes show that there is variability in responses both within and across job levels and engineering disciplines, confirming that success means different things to different people even in a project where people may seemingly share the same background and organisation. However, there are extremely few significant differences between job levels and disciplines as to what factors are of supreme importance. There is a significant difference between job levels with regard to the factor *creativity and innovation*. This factor is rated higher among junior than senior job levels, with senior engineers scoring highest and associate director scoring lowest. The difference may be due to different responsibilities associated with each job level in that more senior staff must spend most of their time overseeing and managing the project level whereas more junior staff usually has more time at hand to be creative and express innovative thinking. But this should not be interpreted that senior staff has a lack of interest in creativity and innovation rather for this group it does not seem to be imperative in achieving project success. Overall, the statistical analysis reveals that there is variability in responses both within and across job levels and engineering disciplines, confirming that success means different things to different people even in a project where people may seemingly share the same background and organisation

1.4 DISCUSSION

The aim of the study was to explore project success as perceived by engineers and technicians in a multidisciplinary engineering consultancy. Five core success factors were distilled through a combined analysis of the interview, workshop and survey data: *individuals*, *team*s, *processes*, *project* and *product*. Analysis of these high level factors shows that they both reinforce and impede each other in an iterative manner during the different stages of the

project life cycle. In this way, the data confirms that there is a need to take a much wider view of project success, linking it to individual motivation, organisational culture and leadership. By understanding how project performance can be impeded and reinforced by individual's abilities, motivation and appropriate management support project success is dependent on structure. This will assist in setting up criteria for measuring project success and promote greater sensitivity among project managers and project members what really matters for project success. However, it is must be stressed that the model represents a way of thinking about success rather than a prescriptive framework. The assumption is that the concept of success is dynamic rather than static which means that it changes across time and space. The benefits of the intermediate model for articulating project success through primary categories grounded in qualitative and quantitative data thus provides a better understanding of the hard and soft dimensions of success and how they may 'play out' in project work. These findings support recent findings in the project management literature that there is a need for a more multidimensional view of success is needed (Baccarini 1999; Shenhar 20011). Specifically, suggested model implies that human as well as contextual factors contribute to the perception of project success. The most striking observation in the study was that when given the freedom to state any success factor the majority of interviewees emphasised variables relating to internal characteristics of the project process such as maintaining good relationships, passion for the project, and a clear understanding of their role. External characteristics of the product or service itself such as customer focus or product performance were not emerging as critical. This pattern of responses occurred in the subsequent workshop where the participants where asked to group the success factors derived from the in-depth interviews. This is surprising considering the many published articles and books on the importance of the customer satisfaction in project success (e.g. Meredith et al, 2006), and brings attention to the somewhat inward-looking attitude of what matters in achieving successful project work. Clearly, this internally focused attitude of what constitutes success is also found in contexts such as software development. While it appears possible to meet both internal (e.g. cost, time and to specification) and external goals (client satisfaction) when faced with pressure, project participants pursue their own goals sometimes without regard to the customer. Assessment of these observations suggest two concurrent events: 1) engineers and technicians are more focused on getting the design right than focusing on product performance which can only be measured when the building is ready to use, and 2) the naturalised culture in construction seem to emphasise 'getting things done' rather than reflecting on 'what is getting done'. These observations are to a great extent in line with conclusions based on a number of different project environments and industries (e.g. Baker et al, 1983; Slevin & Pinto, 2004). While the pressure to deliver on time and on budget are still dominant within the project organisation, team members themselves are more interested in whether a project is worthwhile doing, satisfying and is a good learning experience (i.e. they are focused on psycho-social outcomes). The problem seems to lie in the realities of working in intense multi-project environments such as engineering, where each project is unique in its design and construction. The workshops demonstrate that the differences in perception of project success, is a result of job role, rather than what professional group one belongs to. This was an expected outcome, but worth investigating since professionals cultures seems to be seen as major problem in multidisciplinary work (Dougherty, 1992). An important insight provided by this research is that CSFs is a form of knowing, which resides within the psyche of each project member but seldom commonly articulated within the project community. Indeed, while communication was singled out as being the 'catalyst' for all CSFs, failure to communicate seems to be the root of many project failures. Thus CSFs must be made explicit in an organisation to have any effect on performance. The constraint lies in the nature of

design work; the involvement of architects and other subcontractor that represent organisations that operate outside of the engineering consultancy. Construction project work is communication based; efficient collaboration relies on effective diffusion of information throughout the project (Baiden, Price & Dainty, 2006; Winch, 2001). What is required is a radical change in the way CSFs are conceptualised and measured for them to be useful for practitioners looking for ways to improve current project performance. Key in the evolving understanding of what leads to project success is that they are socially constructed among individuals and depend on the relationships that are created through the project stages. In this way, project success can hardly be understood in the same way by everyone. Consequently, success in a multidisciplinary practice depends on the socialisation of the project members in the different projects as well as the quality of interactions between team members across time and space as put forward by researchers in the social constructivist tradition (see Fong 2005; Cicmil, 2004). This draws attention to the very core of what constitutes organisations: human and social capital. Social capital, generally understood as the property of the group rather than the property of the individual (Halpern, 2004), has potential to provide important insights to the complex and social realities of work, not the least in project based organisations such as engineering and construction. It may help answer the question *why* success is more likely to occur in some settings and not in others. Clearly, there is a need to understand the dynamics of project structure in terms of informal and formal social networks, especially in multi-project environments, for project success. Exploring the quality of relationships in such organisations; how well individuals communicate, how much they trust each other and their senior manager, how they function as teams, whether effective cooperation exists (Zohar, 2004) and how this relates to individual and collective success presents a new interesting research topic worth investigating within construction management.

1.5 CONCLUSIONS

Project success is an attractive idea but what factors lead to success remains an area of conjecture. However, because there is no agreement what factors exactly contribute to success, and because its measurement continues do defy simplification, debates regarding its conceptualisation continue. Clearly, CSFs continue to be regarded as an important method of improving performance in project work. The main conclusions from this study are that: 1) project success appears to be related to the opportunities and constraints of organisational behaviour, existing work processes and structures, causing an inward-looking view of success among project participants 2) CSFs are interrelated and mutually dependant and are likely to change across time, and 3) project success is a process rather than a static concept which relies on effective communication between individuals at all levels. Despite this, it is impossible to claim that all dimensions of project success in a multi-disciplinary project environment have been captured. Further empirical studies are needed to evaluate and further develop the presented intermediate model as basis for appropriate support to practitioners in the construction industry. Exploring the hidden powers of social capital in complex project environments could further evolve current understanding of what really leads to project success in complex project environments.

REFERENCES

Abeysekera, V and McLean, C (2001) Project success and relationships from a stakeholder perspective: a pilot study. In Akintoye, A (Ed.) 17th Annual ARCOM *Conference, 5-7 September 2001,* University of Salford. Association of Researchers in Construction Management, Vol 1, 465-94.

Cicmil, S (2005) Reflection, participation and learning in project environments: a multiple perspective. In: P. Love, P. S. W. Fong, and Z. Irani (Eds.) *Management of Knowledge in project environments*, Oxford, Elsevier Butterworth Heinemann.

Cook, M. H (2005) *The relationship between management of projects and project performance from a building services engineering perspective*, Unpublished MSc Thesis, Department of Civil and Building Engineering, Loughborough University.

Cooke-Davies, T (2002) The 'real' success factors on projects, *International Journal of Project management*, **20**, 185-190.

Cross, R and Parker, A (2004) *The hidden power of social networks*, Harvard Business School Press, Massachusetts.

Baiden, B K, Price, A D F and Dainty, A R J (2006) The extent of team integration within construction projects, International Journal of Project Management, **24**(1), 13-23.
Baker, B N Murphy, D C and Fisher D (1988) Factors affecting project success. In D.I Cleland, W.R King, (Eds.), *Project Management Handbook,* Van Nostrand Reinhold, pp 902-919.

Bresnen, M Goussevskaia, A and Swan, J (2005) Managing projects as complex social settings, *Building, Research and Information*. **33**(6), 487-493.

Daniel, D R (1961) Management information crisis, *Harvard Business Review*, 39, 111-121.
Diallo, A and Thuillier, D (2004) The success dimensions of international development projects: the perceptions of African project coordinators, International Journal of Project Management, **22**, 19-31.

Dougherty, D (1992) Interpretative barriers to successful product innovation in large firms". *Organization Science*, **3**(2), 179-202.

Fong, P (2005) Co-creation of knowledge by multidisciplinary project teams. In: P. Love, P.S.W., Fong and Z, Irani (eds.) *Management of knowledge in project environments*. Oxford: Elsevier Butterworth Heinemann.

Guss, C (1998) Critical success factors from Scratch, *IEEE Transactions on Engineering Management*, EM**33**, 41-47.

Halpern, D (2004) *Social capital*. Polity Press, Cambridge.

Jugdev, K and Müller, R (2005) A retrospective look at our evolving understanding of project success, Project Management Journal, **36**(4), 19-31.

Koch, C (2004) The tyranny of projects: team working, knowledge production and management in consulting engineering. *Economic and Industrial Democracy*, **25**(2), 277-300.
Meredith, J R and Mantel, S (2006) *Project management: A managerialist approach, 6th ed,.* Wiley: New York.

Rockart, J F (1979) Chief Executives define their own data needs, Harvard Business Review, 57(2), 81-93.

Shenhar, A J Dvir, D Levy, O and Maltz, C (2001) Project success: A multidimensional strategic concept, Long Range Planning, **34**, 699-725.

Strauss, A and Corbin, J (1998). *Basics of qualitative research, 2nd edition*.
Sage, London.

Zohar, D and Marshall, I (2004) Spiritual capital: wealth we can live by, Bloomsbury, London.

APPENDIX C PAPER 3

Koutsikouri, D., Austin, S.A., Dainty, A.R.J. (2008) Critical success factors in collaborative multidisciplinary design projects, *Journal of Engineering, Design and Technology*, Vol 6 No 3, pp 198-226

Critical success factors in collaborative multidisciplinary design projects

Dina Koutsikouri, Simon Austin and Andrew Dainty
Department of Civil and Building Engineering, Loughborough University, Loughborough, UK

Abstract
Purpose – The purpose of this paper is to explore critical success factors (CSFs) in interdisciplinary building design projects from the view point of the project members themselves. Previous research on CSFs has only given a limited insight into such complex project environments and this paper seeks to redress this.
Design/methodology/approach – Semi-structured interviews, a survey and facilitated workshops were used to identify factors and their interrelationships within the project context.
Findings –Thirty one primary CSFs were distilled which were then further grouped into four interdependent group factors: management factors, design team factors, competencies and resources factors and project enablers. It would appear that there are factors that are particularly important in such project environments, which do not figure strongly in other project environments. These factors are related to the socio-political dynamics of inter-disciplinary team work such as passion and enthusiasm, shared values, creativity and innovation and represent so called 'super soft factors' which reflect personal success and its importance in achieving positive project outcomes.
Research limitations/implications – Although there has been significant research on critical success factors (CSF) in construction projects, little attention has been paid to those which are related to the actual design delivery phase of such projects..
Practical implications – The results suggest that it is worthwhile for managers in construction related organisations and beyond to recognise the interdependencies which exist between the project context, processes and the project members' experience and affinity to the project and the team itself in the project process to achieve desired outcomes.
Originality/value – This paper extends the CSF literature by identifying the nature of the primary factors and their interrelationships which influence project outcomes in collaborative design projects.

Key words: Construction management; Critical success factors; Interdisciplinary design; Project success.

Article type: Case study

INTRODUCTION

The study of critical success factors has contributed to a more comprehensive understanding of project success and failure across many industry sectors. According to Morris (2006) this research has broadened the scope of project management and what knowledge is needed to manage projects more effectively (see, e.g. APM BOK, 2005). In generic terms, this knowledge and associated information flow is essential to assist managers in directing their organisation to successful long-term existence and growth. Despite the abundance of tools and techniques to support the management of projects however, managers still struggle to deliver them successfully. In the architecture-engineering-construction (AEC) industry where projects depend on collaborative working between a variety of stakeholders the difficulty has been attributed to lack of time and ability to develop and maintain a team approach to the

management of projects (Bresnen, 1990). It has been argued that mainstream project management methods and techniques are not enough to guarantee improved performance in such multi-organisational settings (Thomas, 2006). Such claims reinforce the need for a more comprehensive and contextually embedded understanding of the pattern of success factors which underpin positive project outcomes and overall success (Cooke-Davies, 2001; Morris *et al.*, 2004). Thus, a more holistic understanding of how to manage complex projects is required which is grounded in research insights drawn from real world settings. It is against this background that the research began with case study organisation, a multi-disciplinary design engineering consultancy. The impetus for this research stems from a genuine interest to gain a better understanding of the drivers of project success as well as discovering real insights into collaborative working. The study explored CSFs inter-disciplinary design projects from the perspective of the project team members in order to establish perceptions of what it takes to achieve positive project outcomes in such collaborative endeavours. More importantly, the factors are mapped onto a generic systems model to reveal interrelationships between technical, human and organisational factors. There is a paucity of guidance for managing success in design projects which go beyond the global key performance indicators (KPIs) developed for the construction industry (see Egan, 1998; Latham, 1994; and Chan *et al*., 2004). In addition, previous studies on CSFs only have provided a limited insight into the unique project environments of building design. This research aims to bridge this gap by providing an initial template of context specific variables which are particularly important for managing inter-disciplinary design projects. In other words, the findings may influence the way inter-disciplinary work is conceptualised and managed in the future to stand a better chance of success, by providing a holistic view of the factors that are crucial to improve collaborative endeavours.

Critical success factors in project-based environments

Determining critical success factors (CSFs) is an established method for organisational analysis. The approach was first proposed by Rockart (1979) who defined it as a means of identifying the essential elements that need to be addressed for organisations to implement change more effectively. Within a project context, CSFs can be described as the factors that the manager needs to keep a firm eye on to achieve a successful delivery. The implication is that if critical success factors are not present or taken into consideration, problems will be experienced which may act as barriers to success (cf Andersen *et al*., 2006). Numerous studies have been conducted to identify these 'critical' factors, especially within information systems, R&D and various engineering environments.

There are several success models and frameworks available, but they are not particularly consistent in terms of classifying success factors, which reflects that context matters in understanding drivers of success. As noted by Jugdev and Müller (2005): 'project success is ambiguous and highly context dependent'. Consequently, what is considered to lead to success is coloured by personal perception and by the circumstances under which the judgement is made. Nonetheless, despite the ambiguities surrounding the term, the topic of CSFs continues to attract interest from the academic and professional communities.

According to Cooke-Davies (2002), a comprehensive answer to the question of which factors are critical depends on answering three separate questions: *What factors lead to project management success?*; *What factors lead to a successful project?;* and *What factors lead to consistently successful projects?* He also makes two major distinctions based on empirical findings. Firstly, he distinguishes between *project success* (measured against the

overall objectives of the project), and *project management success* (measured against traditional measures of performance such as cost, time and quality). Secondly, he distinguishes between *success criteria* (the measures by which success or failure of a project will be judged) and *success factors* (those inputs to the management system that lead directly to the success of the project). Because of this definitional complexity, it has been difficult to develop an appropriate way to measure 'success' as an holistic entity.

A recent review of the CSF literature (Fortune and White, 2006) demonstrates clearly that there is lack of consensus between authors and researchers regarding what factors affect project success. They found that the three most cited factors are: *the importance of a project receiving support from senior management*; *having clear and realistic objectives*; and *producing an efficient plan*. However, although 81% of the publications include at least one of these three factors, only 17 out of 63 cite all three. Perhaps their most interesting finding is that there is a lot of overlap between sets of CSFs but the factors selected for inclusion in individual lists vary to a considerable extent. Further, they highlight the main reservation that have been expressed about the CSFs approach; 'that the inter-relationships between factors are at least as important as the individual factors but the CSFs approach does not provide a mechanism for taking account of these inter-relationships (p. 54). Accordingly, a model, the Formal Systems Model (FSM) (see Fortune and Bignall, 1984) were used as a framing device to deliver the benefits of taking into account of the CSFs that were culled in the literature review whilst overcoming problems associated with their use. In other words, their research shows that it is possible to map most CSFs with the features of the FSM model. The model is featured in Figure 2.

Overall this stresses the importance of creating an environment in which projects can succeed (Newell *et al*., 2002; Pinto *et al*., 2004) rather than focusing on the success of single projects. It also brings attention to the strategic importance of linking project management effort to long-term organisational effectiveness. Additionally, although most studies emphasise different success factors, there seem to be relative consensus on the importance of human factors or 'people' for successful project outcomes (Lechler, 2000). The 'discovery' that performance and success is achieved through people draws attention to the role of individuals and their relationships in the project process. This implies that the management of people; ie the ability to influence, encourage and motivate individuals and teams, is becoming a necessary skill among the twenty first century project mangers (Pryke and Smyth, 2006).

In light of this, a diversified and much more holistic understanding of project success is necessary, particularly in settings where practitioners must manage multiple projects at various stages of their life cycles and face competing priorities on a daily basis (Jugdev *et al*., 2005; Morris, 2006; Cicmil and Hodgson, 2006). As a response to this a number of authors have argued that project success and failure can be best understood and dealt with through the use of systems thinking (eg., Bignell *et al*., 1984; Morris and Hough, 1987; Fortune and Peters, 2005). This line of research places the spotlight on the connection of 'hard' (e.g. cost, time and to specification; physical resources) and 'soft' (e.g. multiple perspectives, communication, emotional intelligence) factors and the wider managerial and social frameworks within which individuals work in making sense of project outcomes.

Critical success factors in construction projects

In recent years, researchers in construction and construction project management have become increasingly interested in critical success/failure factors (eg. Ashley *et al*., 1987; Sanvido et al, 1992; Chua, Kog and Loh, 1999; Dainty *et al*., 2003) but the myriad of variables that have been derived from these studies have not yet led to any general agreement as to what constitutes project success. Typically this research has resulted in normative frameworks of success factors and criteria (Phua, 2003) which have been criticised as being incomplete and not specific enough for managers to act on (Zwikael and Globerson, 2006). In addition, they tend to focus upon specific aspects of construction projects, for example project partnering, construction contracting methods, planning and project management (cf Chua *et al*., 1999). However, Phua (2003) notes that multi-firm success can be agreed, at least at an operational level, as the extent to which projects meet a combination of budget, timetable and technical specifications. This indicates that there is not much focus on the wider success dimensions such as meeting the client objectives and ensuring that external stakeholders are satisfied with the project outcome.

A recent review of the literature related to CSFs in the field of construction management (Chan *et al*., 2004), demonstrates that factors can be grouped into five independent groups: *human related factors* (experience, client characteristics, project team), *project factors* (type, complexity, size), *project procedures* (procurement, tendering), *project management actions* (communication system, planning, control mechanisms) and *external environment* (social, economical, political). In this way, their conceptual framework acknowledges the 'hard' and 'soft factors' inherent in projects.

Few studies focus on the design phase of construction projects. Current success frameworks do not seem to apply to this particular organisational setting which is often multi-disciplinary and characterised by creativity, iteration and the uniqueness and temporality of project arrangements. In other words, the challenges that the project participants (engineers, architects, clients, contractors) face providing demanding services are many and varied (Koch and Bendixen, 2005). For example, there is a high degree of complexity and interconnectedness of tasks, a high dependence on diverse skills and collective knowledge and little time to find out where relevant knowledge resides (Cicmil, 2004). Teams often have difficulty developing a shared project vision since they tend to create their own understandings of the project reality based on their background and world view (Dogherty, 1992). Some writers have, therefore, justifiably described this type of consultancy as part of a broader business service sector, which can be regarded as knowledge intensive (cf. Koch et al., 1995). This context is, in a sense, unusual in that gauging the success of building design is usually more subjective during the design and construction phases than at a later stage when the cost-benefit analysis and client feedback is available (Allinson, 1997).

METHODOLOGY

Research setting

The study was based in a UK based multi-disciplinary engineering consultancy in London, UK, which employs 2000 employees in ten countries. The main engineering disciplines include: structural, building services and a number of specialist disciplines such as façade, fire and civil engineering. The engineering consultancy runs concurrently a large portfolio of projects and has a strong commitment to innovative solutions including research into sustainability and renewable technologies. Specifically, the investigation was located in an office in the South East of England which employs over 100 engineers plus of support staff.

Typically each engineer is involved in two to seven projects simultaneously, reflecting a dynamic and busy work environment. Typically the firm will work with a separate architectural practice to provide the complete design team for a project. As a consequence of rapid growth over the past ten years, senior management has tried to find ways of improving the way projects and people are resourced and managed in order to improve performance and client satisfaction.

Defining interdisciplinary design projects

Design projects involve designers from various disciplines. According to Détienne (2006), two cooperative processes are of major importance in such multi-expertise tasks: coordination processes to manage task interdependencies (establishment of common ground) and negotiation mechanisms in order to manage the integration of multiple perspectives. Construction professionals often use the terms multi-disciplinary and inter-disciplinary interchangeable to describe the nature of their projects. The difference between the terms lies in the level of integration between professionals from different professional disciplines. According to MacMillan (2001, p. 187-188) a multi-disciplinary team denotes that there are several disciplines involved in a project, 'interdisciplinary design, by contrast may be thought of as occurring when problems are solved by the team as a whole, and where members are willing – and indeed are encouraged – to contribute… in areas beyond their own professions'.

In view of this, it becomes evident that building design is an outcome of inter-disciplinary collaboration. However, in large design practices, cooperative work is often hampered by lack of time and resource but also cultural and professional barriers which make the team function more in a multi-disciplinary (individual delivery) rather than inter-disciplinary (integrated delivery) mode. This stresses the importance of managing task interdependencies and managing multiple perspectives Détienne (2006) to achieve successful collaborative design projects.

Data collection

The research was carried out over an eleven month period: June 2005 – May 2006. A three-phase data collection strategy was employed comprising interviews, workshops and a survey. Initially, a series of semi-structured interviews were conducted with 22 engineers and CAD-technicians in order to examine the informants' current job roles and experience, employment history and time in the company and perceptions of what factors they think lead to project success. The sample selection was illustrative rather than representative, which is in line with the rationale of doing case study research (Yin, 1994).. All interviews were recorded and transcribed verbatim. Since the aim was to reflect a broad spectrum of beliefs and values across the group, the sample was stratified to include individuals from different disciplines such as structural, building services and façade engineering. Six job levels were represented: group manager, associate, senior engineer, engineer, graduate engineer and CAD-technician. As part of the interview process, informants were asked to openly brainstorm critical success factors in project work. This was aimed to encourage individuals to 'make free associations' without being prompted about factors they perceive as critical to project success. The exercise was useful because it helped to reveal both the specific meanings that individuals attach to factors and their significance in the project context. This yielded a raw list of success factors (175) which were grouped into 29 primary CSFs categories reflecting a number of 'hard' and 'soft' constituencies that may influence project success (see Table 1, column A).

Table 1. An illustration of the evolving understanding, grouping and labelling of CSFs.

A. Initial grouping of factors	**B. Workshops generic categorisation**	**C. Internal survey**	**D. Final synthesised list of primary CSFs**
Communication Listening and feedback	Communication	Communication	Rich communications Regular feedback on progress
Skills/expertise	Competencies (social and technical)	Social skills Technical skills	Social skills Technical skills
Motivation	Motivation	Motivation	Motivation
Passion and enthusiasm			Passion and enthusiasm
The challenge			Challenging projects
Recognition/appreciation			Recognition/appreciation
Quality of leadership	Leadership (high level, strategy, vision)	Leadership	Quality of leadership
	General management	Project management	Project management practices
Resources and planning	Resources stuff	Resources	Sufficient resources
Cooperation/collaboration	Team stuff	Teamwork	Effective inter-disciplinary team working
Relationships	External influences		Relationships
Group development	Social activities	Social activities	Team building process
Trust and respect Mutual understanding		Trust	Mutual trust and understanding
Team selection and composition			Team selection and composition
Clear roles and responsibilities		Roles and responsibilities	Defined roles and responsibilities
Defined/clear goals and project vision		Defined project goals	Defined project goals Shared project vision
Culture		Culture	Culture
		Shared values	Shared values
Organisational context/structure			Organisational structure
Technology	Supporting technologies	Technology	Appropriate technologies
Physical environment	Physical office environment	Office environment	Physical work environment
Profit and financial		Commercial awareness	Commercial awareness
Knowledge management		Knowledge management	Knowledge sharing
Innovative thinking/creativity	Creativity and innovation	Creativity and innovation	Creativity and innovation
Time management			Time management
Change and flexibility			Change management and flexibility
Perception/expectation			Management of expectations
Work processes			
Good contractor			

The main aim of the workshops was to validate the interview data in terms of the classification of success factors. However they also provided an opportunity to involve more engineers and CAD-technicians in the research. Thirty six participants were recruited to take part in the exercise. They were put into groups of 4-6 people according to their job level and given 45 minutes to complete the task of coming up with their own grouping and labelling of success categories, as shown in Table 2. The workshop outcomes and the 13 generic success categories created to summarise their result can be seen in Table 2, column A and also in Table 1, column B. Having completed the analysis of the workshops a new set of 21 primary CSFs was developed which appear in Table 1, column C.

The third phase of the data collection was to conduct a survey of the revised set of 21 CSFs . The purpose of the survey was to make a quick assessment of how the participants rate

these factors in terms of their importance for project success. In other words, the aim was to establish whether some factors are more relevant than others rather than making any statistical claims about the data themselves. In addition, it enabled the researchers to provide feedback to the wider group on the nature of the factors that are considered as 'critical' in order to achieve project success. The survey was sent out to all practitioners and managers within the multi-disciplinary business unit (108) via e-mail asking them to rate the factors using a 1-10 rating scale. The results (44% response rate) indicated that the factors are highly interrelated. For example, most factors were perceived as 'highly important'. The only factor that was rated as 'less important' was 'social activities'. The survey was an important step for consolidating the previous analysis and helpful in developing the final factor groups.

Table 2. Representing the grouping and labelling of CSFs by six different job levels.

A. Generic success categories	**B. Group managers**	**C. Associate engineers**	**D. Senior engineers**	**C. Engineers**	**E. Graduate engineers**	**F. CAD-technicians**
General management Leadership	Management (process) Management (people) Leadership	Management (process) Management /leadership Forward planning	Leadership/ management	Project management/ project delivery Leadership	 Management and leadership Strategy and direction	Project leadership Leadership
Communication	Communication	Communication	Communication		Communication	IT and information
Team stuff	Team working	Team factors	Team dynamics	Project team interaction The design team	Project team composition	The team
Motivation	Motivation	Motivation	Motivation	Incentives Wanting to be involved in the project		Work satisfaction Needs and understanding
Competencies (social and technical skills)	Competency	Individual skills		Skills and competencies	Individual capability	
Social activities	Social					
Physical work environment	Physical office environment	Office environment				
		Culture	Culture	Company/organisation	Culture	Culture
Client focus		Client brief/knowledge	Client focus			
Supporting technologies		Technology				
External influences		External influences			External	External relationships
Creativity and innovation			Innovation Engineering design			
Resources stuff				Time resource Technical resources	Time Physical resources	
					Human resources/support	Individual leadership and support
					Financial awareness	

Data analysis

The overall analytical approach of the interview data largely followed the steps of thematic analysis (c.f. Boyatzis, 1998), where the data is systematically coded and grouped into meaningful categories which represent the raw data. This iterative process (as shown in Figure 1) allowed the data to lead the study, so each step built upon and added data and enlightenment in a continuous process of re-visiting data, followed by analysis and better understanding.

The process of creating the raw list of CSFs, which comprised of 175 (some overlapping) factors, involved repeated rounds of reading the textual data (responses of the interviewees) to elicit and formulate appropriate codes. Most of the factors identified were descriptive, requiring little or no additional analysis although some were more interpretative and therefore harder to define clearly. These included issues relating to interviewees feelings about what is really important to them in achieving success (e.g. affiliation to the project,

ownership, intrinsic motivation). Once the coding process was completed and duplicate factors were removed, a revised list of factors was produced and subsequently grouped into the initial 29 high level categories as can be seen in Table 1, column A. Overall, the table depicts the process and thus the evolutionary understanding of what constitute success factors within interdisciplinary projects. Importantly, it shows that the final 31 CSFs were developed as a result of triangulating and making sense of the three data sets (see Table 1, column D).

The development of the four CSF factor groups was based on a synthesised interpretation of the overall data including comparison with existing recent literature reviews of CSFs and project success (Jugdev et al, 2005; Fortune et al, 2006). No particular relevance was given to frequency in terms or repetition of ideas or concepts. Often, the same participant referred to the same CSF more than once in his/her response by rearranging the words or emphasising a particular point. Equally important, although a particular factor was only mentioned by one participant this factor was not necessarily seen as irrelevant.

Figure 1 illustrates the process of creating the final sets of CSFs which underpin project success in such project endeavours. While the iterative process of refining and modifying the factors could not be adequately captured and shown graphically (ie the merging and/or splitting of factors), the table provides an overview of recurrent themes and idiosyncratic factors that are relevant in complex project settings such as inter-disciplinary design. The 31 primary CSFs emerged around four main factor types (or themes) explicated below; management factors, design team factors, competencies and resources factors and project enablers.

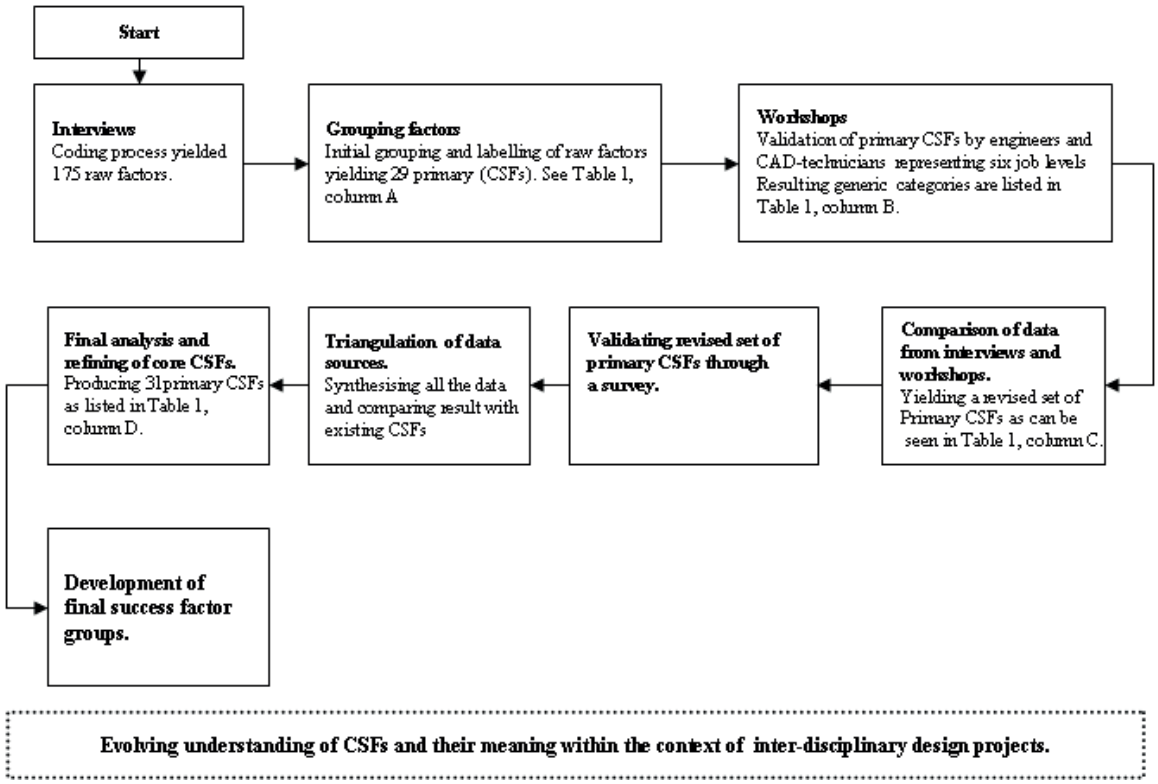


Figure 1 The research process

RESEARCH FINDINGS

To present the analysis of the overall results, the results are divided into five sections. The first section is concerned with providing an overview of the general perspectives on CSFs and the clustering of CSFs and the remaining four will cover the main CSF groups. The final grouping of CSFs into main factor groups is represented in Table 3, and is intended to show the factors that project participants (engineers and technicians) perceive as relevant to successful project delivery as a whole. Essentially, the final formulation of factor groups is based on an overall interpretation of the conditions that shape implementation and management of multi-disciplinary projects as identified by the practitioners themselves.

Table 3. A representation of the final four interdependent factor groups and the underlying CSFs.

Management issues	**Design team issues**	**Competencies and resources**	**Project catalysts**
Defined project goals	Shared project vision	Technical skills	Rich communications
Defined roles and responsibilities	Team selection and composition	Social skills	Passion and enthusiasm*
Project management practices	Team building process	Change management and flexibility	Challenging project
Quality of leadership	Inter-disciplinary team working*	Time management	Recognition
Management of expectations	Creativity and innovation*	Appropriate technologies	Motivation
Feedback on progress	Relationships		Organisational structure
Commercial awareness	Mutual trust and understanding		Culture
	Sufficient resources		Knowledge sharing
			Client focus
			Physical work environment
			Shared values*

** CSFs which are important in inter-disciplinary design projects that do not figure in other studies of project success factors.*

General observations on CSFs

When asked to openly brainstorm what factors are critical to project success, participants made reference to both CSFs (i.e. what they think is important to achieve project success), and success criteria (i.e. the standards by which they judge the completed project). These two concepts were used interchangeably in order to paint a broad picture of 'success', demonstrating that there is confusion as to what exactly defines 'critical success factors'. For example, reference to 'relationships' was used to illuminate both its strong influence in keeping the project participants interested and motivated in the project process, but also as an important indicator of whether the project was successful in terms of improving internal or external relationships. These results appear to confirm findings from other research projects in this area such as de Wit (1988) and Cooke-Davies (2002) that success factors and success criteria are interrelated. In addition, most practitioners identified a variety of factors by sharing their personal experiences of 'successful' and 'unsuccessful' design projects. Specifically, CSFs were talked about in terms of what 'must be in place' or actions that has to be taken; 'you must' lists; for example 'you must have agreed objectives and a shared project vision for it to work better'.

In line with existing research across different industry sectors the factors are highly interlinked, context-specific but also influenced by the practitioners' actions (Nandhakumar, 1996; Cooke-Davis, 2002). For example, issues concerned with the 'design team' are clearly related to those of management and communication. Similarly, issues of motivation in the design process are clearly related to those of leadership and shared project vision. Further, many of the wish list factors are themselves in tension with each other. For example, the

importance that practitioners place on ‘interdisciplinary collaboration’, tends in practice to be in tension with ‘contractual arrangements’ or ‘participant-personalities’. Analysis of the research data also reveal complexities in dimensions to do with inter-disciplinary projects which have not directly emerged from practitioners as themes but which cut across all of them. For example, the analysis of the CSFs revealed that inter-disciplinary projects are often ill defined, complex and inherently dynamic structures in which participants continually have to deal with uncertainty and emerging issues. This is significant because it impacts upon all of the other factors and contributes to making interdisciplinary design projects complex endeavours.

The main findings of the survey (rating of 19 factors) helped to further modify the list of salient CSFs distilled from the initial grouping and the workshops. By including new factors in the survey such as ‘project management’ and ‘benchmarking’ (later subsumed under ‘knowledge sharing’, see Table 1) it became evident that these were missing and should be incorporated in the list of CSFs. Above all, the survey highlighted factor interdependencies which may explain the difficulty in deciding which factors are more important than others. The only factor which was rated as less important for project success was ‘Social activities’. Although it was strongly implicated in the interviews, it is clearly seen as peripheral to the core activities of project work. Thus, social activities represent a ‘wish-for-factor’ rather than an ‘absolutely-necessary-factor’. However, since there is an obvious link with Group development (initial CSFs list in Table 1) it was modified and subsumed under Team building process (see primary CSFs in Table 1). An interesting finding was that ’client focus’ emerged as more important in the survey than it did in the interviews which may indicate that engineers and CAD-technician are more interested in the project task than the client. In reality, consulting engineers are appointed by the architect who then becomes the client handling the client(s); the person(s)/companie(s)/government who is commissioning the building. From this perspective, the client as well as other factors of the project environment such as supply chain, legislation and so on do not seem as critical until they are pointed out.

Perceptual differences of success factors

The study revealed areas of both differences and similarities in the perceptions of CSFs and success among project participants. Generally the perceptions of CSFs for project success vary little across the engineering disciplines as can be seen in Table 1. Variations between groups appear to be a consequence of job roles rather than professional disciplines. In broad terms, group managers and associates appear to look at what they want from their teams in terms of competencies and profit, the middle level (senior engineers and engineer level) are more focused on project delivery and operational issues, and the junior staff on learning and what they need to deliver as members of the team. Consequently, junior and middle level engineers seem more committed to the project as a career progression than to the organisation (company) itself. This may explain the importance that is placed on having the opportunity to work on different projects with different architects.

The technicians seemed to focus more on effective communication and project leadership as well as having the right technology to respond to client requirements. They also seem more concerned about working in a supportive environment where their needs of inclusion and being part of the team are being met. These observations suggest that even within the core engineering design team itself (excluding client, architect, contractor etc) practitioners have different perceptions of success and success factors.

A striking observation was that when given the freedom to state any success factor, most respondents emphasised variables relating to the internal characteristics of the project process such as team working, clear understanding of their role and responsibilities. There was little reference to external variables such as 'customer focus' or 'client satisfaction'. A similar pattern of responses was recorded in the subsequent workshops. Contrary to recent literature on project success factors (e.g. Meredith et al, 2006), client focus does not emerge as a priority for a successful project delivery. This brings attention to the specificities of multi-disciplinary project delivery in construction related organisations. While it appears possible to meet both internal (e.g. cost, time and to specification) and external goals (client satisfaction), when faced with pressure, project participants pursue their own goals sometimes with little explicit regard to the customer. This result resonates with findings in other engineering contexts such as systems development (e.g. Wateridge, 1995) and illustrates a common reality in the so called expert organisations (Lowendahl, 2005; Delong and Fahey, 2000). In other words, the structure of work and the pressures that most often plague design environments (e.g. being involved in two or more projects simultaneously), encourages *action* rather than *reflection*, meaning that the 'the client' is crowded out by more immediate concerns. One, senior building services engineer, expressed it as:

You just work, work, work, busy, busy, busy you know. I can organise my time but then somebody throws something in… something is coming from nowhere, which should not happen really.

In the excerpt above, the engineer depicts the challenges of achieving project success consisting of issues in the organisational context, which he describes as 'busy, busy'. This issue demonstrates a project-centric culture where there is an overwhelming tendency for managers to get caught up in 'fire-fighting'. Conversely, although the dynamics of design work undoubtedly influences project success, it appears that care for the client emerges as a result (by-product) of working together as a team. As expressed by an associate engineer:

'More client focus does not make the project anymore profitable but greater collaboration does'

Evidently, there is a willingness to collaborate among practitioners, which means that there is a belief that people and their ability to work together strongly influence project outcomes in many ways.

In generic terms, project participants tend to differentiate between what is important to keep the project momentum going which can be termed *organisational catalysts* and what appears important to keep the team close together throughout the troughs and peaks of the project which is summarised with the realm of *management practice*; clarifying the what (aims and goals), when (work schedule) and how (process and support) of the project is important. Therefore as is seen repeatedly through the following sections, there are many factors that impact on project success, but most importantly as participants talk about their perceptions of 'what must go right' there is also an honest and deep concern about 'how to get it right'. While there is an acknowledgement that management is important, there is also a perception that engineers lack the training to deal with the gray and vague issues of business management. As explained by a senior engineer:

'Most of the associates and beyond are engineers and not managers. I don't think that they have the techniques to manage and I don't thing they have the skills they need because like me they are brought up in an engineering environment'.

In other words, engineers and technicians are identifying the need for technical as well as management knowledge to achieve project success.

Overall, it was difficult to identify the potential contribution of each factor independently because many factors influence practitioners' activities at the same time. This is confirmed by studies in other project environments such as information systems implementation (e.g. Nandakumar, 1996). For instance, it is not possible to talk about clear goals without talking about communication or about creativity and innovation without mentioning resources. From this perspective, project outcomes are a result of mutually determining processes in the project environment. In brief, the factors relating to the design team processes incorporate the skills of the individuals as well as the functioning and development of the team. The factors linked to management process are related to leadership of the project and people as well as project planning and control. Finally, the catalyst factors are linked to elements that underpin the performance of the other CSFs. These are linked to communication, knowledge sharing, leadership and enjoyment/intrinsic motivation.

The next section delineates the four factor groups that are seen as integral to project success as a whole.

The main outcomes of the survey were that all factors except 'social activities' were rated as 'highly important' indicating that factors that are more directly related to completing the project are seen as more important than factors that are it is within the project context. Since the survey also provided an opportunity for respondents to add factors, this helped to consolidate and/or slightly modify the results from the interviews and workshops.

This was taken as enough evidence to suggest that any success framework has to be built on the idea that projects made up of different systems of activity that are constantly interacting and influenced by their environment.

Design team factors

Team work and relationships are used interchangeably to illustrate the importance of interaction between individuals in successful design projects. Specifically, it shows that one dimension of project success is measured in terms of team success or the outcomes of team work. For instance, even if the project has failed in terms of meeting the basic standards of success such as cost and time, the project may still be seen a success in terms of team work or 'forming good relationships with the architect'. From the accounts, especially from the senior engineers and above, it is clear that quality of relationships (that develops between project members) is perceived to indirectly influence project outcomes. It affects the team effort and is thus important to achieve the project objectives. This can be seen in the following extracts by two different group managers:

> *'You can have projects where you can look forward to the project meetings and it doesn't mean that the meetings are going to be easy but it means that you are going to enjoy the company and that is ok, because if the project is worth doing you don't mind*

it being tough. It is simple really, successful project benefits from a team that is enjoyable to be with'.

'I could easily persuade myself at the moment that if you have a good team, pulling in the same direction, it will go very well, but the building might not be any better...but you will have got there will less stress and probably would have made more money because the team members were not fighting amongst themselves'.

In this context, the notion of 'working as team' was a recurring theme. On a general level, achieving genuine integration between experts from different disciplines was defined as a critical ingredient in achieving both project and team success. However, the issue of teamwork and relationship building is often crowded out by the project tasks themselves. The paradox is that while it is the tasks that bring the different disciplines together, little time is spent in integrating the team effort as part of normal practice. An engineer explains:

Our projects are really good where we manage to achieve integration between structures, services and civil engineers, but unfortunately that does not always happen because there is no time to for it or there is change of personnel. I think that more effort is needed to foster good relationships from the beginning.

However, putting individuals from different backgrounds together will not automatically generate the synergy that will result in project success (Newell et al, 2002). Structural engineers, building services engineers, technologists and architects usually speak different 'languages' and do not readily understand the problems of the other (see, e.g. Dougherty, 1992). The complexities arising from collaborative working relationships are present in the interviewees' pre-occupations and concerns and were expressed in terms of CSFs such as: integration between disciplines, team building processes, relationships and mutual understanding and respect between people. In the literature relationships are increasingly cited as an important factor in for the successful management of projects across industries, not the least within construction (Pryke et al., 2006). Creating and maintaining effective relationships within a project team, however, depends on more than simply social skills which enable team to 'get along' with each other; it requires concerted action within the team. As expressed by an engineer:

'*It is important that the team bond together. It is about forming relationships. If you know somebody they are more likely to help you. Taking time to get to know people is important, eg having drinks after the first meeting etc'.*

On a deeper level, this reflects and affects the practice culture. As noted by Holland et al (2000) in their review of CSFs for cross functional team work: 'teams adapt to their environments, becoming the kind of a team that their organisation will tolerate, while through their boundary spanning activities, they also alter their context. In order to overcome the problems of collaborative team working, managers should not only focus on building attachment to personal and financial goals, they also need to ensure that they build a safe and secure environment in which individuals and teams can work effectively together (Staples, 2004). Generally, interviewees agreed that team building has to happen as early as possible in

the project life cycle to create mutual trust and respect as well as positive emotion. As noted by one senior engineer:

> '*You have to get an understanding between the architect and all the others; you have to work together as a team'.*

Further, the experiences of team work as an important factor for project success was not only described in terms of *'having a good team with individuals who complement each other'*, but also as a vehicle to improving communication, knowledge sharing, team bonding and getting project participants enthusiastic about the project. In this way, 'team work' is a factor that comprises the factors that make up the psycho-social environment, providing a sense of inclusion and emotional support to the project members (Stapley, 2006). However, collaboration and team work does not happen automatically, at least not in multi-disciplinary teams where individuals are located in different office spaces and issues of hierarchy and status matters.

Management factors

Practitioners identify leadership and project management as pivotal for successful project outcomes. The leadership dimensions were focus on people and focus on project processes and include effective project management, clear goals, roles and responsibilities, scope of work, regular feedback on progress, commercial focus and management support. The management dimensions include the operational running of the project as well as the direction of the project coalition as a whole. This is a particularly difficult process that requires strong and supportive leadership in term of giving the professionals' freedom and autonomy in the project process, rather than imposing too many rules and regulations which may constrain the 'work flow'. It is therefore not surprising that all interviewees identified CSFs in this cluster. As expressed by a group manager in the following extract:

'Important to success is those things than I call 'managementy' sort of things that actually make a real difference such as management of resources'.

The strong emphasis on management and leadership issues draws attention to the fact that, it is essential to acknowledge the influence that a leader has on the project process and levels of motivation. Here project members indicated that team leadership is not as strong as it could be. Implied in what the engineers and technicians report is that existing management practices or lack thereof have an effect on the psychological well being of the individual and the group. A sense of concern is expressed by particularly mid-level engineers and generally among CAD-technicians regarding leadership abilities, as shown in the following extract:

> *'Most of the associates and beyond are engineers and not managers. I don't think that they have the techniques to manage and I don't thing they have the skills they need because like me they are brought up in an engineering environment'.*

Further, most participants did not necessarily view project management as a set of techniques to deliver the project on time, within budget and to specification. From the accounts it is clear that they see it at as hands-on tasks that make the project delivery process smoother.
As one structural engineer explained:

'*To keep an eye out and knowing when to step in and support the team, to make sure you are getting down the right route, to be completely up to speed with the project and aid the coordination process and to help with the communication between the different disciplines'*

Of particular note here is that engineers and technicians differentiated between 'leadership functions' (establish direction, vision for the future, aligning people, motivating and inspiring, satisfies human needs); and 'management functions' (plans and budgets, decides actions and time tables, allocates resources, organising and staffing, procedures and monitoring projects, controlling, problem solving, takes corrective actions). Senior levels perceived these roles as integrated rather than separate whereas more junior staff viewed them as relating to organisational organisation and culture. This shows that project participants have different perceptions of these organisational concepts. Another interpretation may be that that there is a lack of understanding among engineers and technicians as to what management entails. This confusion may stem from the particular way that projects are structured in terms of accountability. Within the context of the case study company the management structure consists of a project leader, who is responsible for the operational running of the project internally and who reports to the project director. Below the project leader is the job leader who is responsible on a discipline level (e.g. structural, services engineering).

Although there was a strong perception that the introduction of more effective ways of planning and controlling of design projects may affect project success, the informal means of control, i.e. the ad hoc meetings and conversations rather than formal procedures, is the preferred way of managing the project. However, there was a tension between the need for more 'organisation' in terms of supporting technology for planning and work break down and the preference of individuals to run their projects as they are used to; through non-standard procedures. As one senior engineer explained:

> *'Project management is most often left to individualistic initiatives of engineers rather than the systems and procedures that are suggested by the quality management…'.*

Studies that focus on professional cultures such as engineering and other consulting environments have shown that 'experts' (knowledge workers) operating in such settings often pay little attention to management. They are often given managerial roles on the basis of their technical skills and merit rather than heir interest and appreciation of management (see, e.g. Lowendahl, 2005). Therefore, the role of project manager/leader has to be communicated more clearly to in order to get buy-in from the project community.

Competencies and resources factors

Engineers also regard technical skills as critical in achieving successful projects. Therefore, 'design competency' and experience were identified as CSFs. Simply put, technical expertise is perceived as the foundation for all creative design engineering work. However, successful engineering also depends on what happens in the early stages (conceptual and scheme) of design. At these stages the engineers and technicians have the opportunity to influence the architecture and fix the most important engineering fundamentals. Most importantly, the early design stages enable the engineer to think creatively and express workable solutions which makes it one of the most satisfying part of the design process. Thus being able to spend time

testing different ideas is seen as particularly important especially for junior to senior level engineers. As one structural engineer expressed:

> *Looking at my successful and unsuccessful projects, we seem to work better in projects where we do get to be a bit more innovative, where the architects will allow us to have a broad role in the project.*

But there was also recognition that social skills are important to achieve technical excellence. For example, given the way in which decisions are made within the team, political skills play an important part. This is reported as an important 'soft skill' that only a few engineers have. These results are not extraordinary and seem to reveal a certain degree of maturity in the field of engineering design projects. Engineers and CAD-technicians are well aware that most engineering output is governed by 'personalities' and relationships amongst the design team members. As senior engineer explains:

> *'You have to be a good engineer and know what you are doing and that includes other skills as well such as communication skills. Technical skills can only take you so far it I is not enough to achieve success…'.*

More junior engineers perceived technical skills as a broad category, including creativity and opportunities to produce innovative and sustainable design solutions. From the perspective of the most senior engineers competence is perceived as a competitive advantage; 'where we can differentiate ourselves from other companies'.

Having sufficient resources is also reported as extremely important and it refers to both human (enough people involved in the project) and physical resources such as technology and systems. This need is articulated across disciplines, which can also be interpreted as better management of resources. Further, it relates to team effectiveness and teams need time to pursue their tasks. From this perspective, organisations must provide support or the application of resources critical for individual to apply their expertise and team effectiveness. In this context, reference is also made to how much the client is prepared to spend on the project, which represents a resource factor outside the control of the engineers. There is always a tension between how much money can be spent on the project and the aspirations of the engineers. However, resources for the engineer is linked to adequate project fee, whereas for the technician is mostly related to having appropriate technology to complete the drawings. One structural engineer said:

> *Having enough time to do the design is crucial. Quality design comes out of having time to think about what you are doing. In a sense there is a need for more organisation [of the design activities] to free up more time.*

The pressure to deliver 'more for less' is described by many practitioners as 'the way the construction industry is going'. Consequently, there is a commonly held view by practitioners that there will always be a resource problem in design project work. However, there is also a tension between what can actually be delivered and the constraints of a small budget, as is observed by one senior engineer:

> *'How are we supposed to be successful when the fee is too low? That is a major constraint in a lot of project work and it means that we cannot spend much time on it; not to mention meeting the other people on the team'.*

Project enablers

This cluster encompasses the subset of CSFs that are perceived to influence all the other project success factors. The factors in this domain underpin the performance of other success factors and thus impact on the overall project success. In other words, they form the backbone of inter-disciplinary project performance. For example, communication is perceived as the essential enabler of managing change as well as the team and project members 'have to be able to communicate design' as it were. The problem in most projects is the lack of rich communications between project participants, which may lead to disintegration and low trust project coalitions. One of the most frequently used sub meanings in relation to communication was 'clarity'. This was defined by the participants as the level of information they have about the project, their responsibilities, and whether the project goals are readily understandable. Additionally, this relates to being clear about what the technical issues are, which presents an important 'support' mechanism for the individual engineer and technician in the on-going project process. As one of the associate structural engineers put it:

> *Clear scope of work, clear brief, clear programme, budget, timing /.../ it is kind of clear everything! So clarity is incredibly important for project success.*

Following this, unsurprisingly, communication was singled out as the major 'catalyst' for all CSFs. At the same time failure to communicate seems to be the root cause of many project failures. This means that there is a need to increase awareness of CSFs and their interrelationships within the project context. For example, communicating the project goals is not only important for the project it also has implications for how the group will interact. Having a clear idea of roles and responsibilities within the project early on is deemed important. The respondents, regardless of job level or discipline reported this as critical for the ability to prioritise their involvement in other projects as well as knowing what their particular contribution will be in a particular project.

However, practitioners also recognise that communication has to be embraced at all levels in practice. As one senior building services engineer explains:

> *One of the problems is that the management does not communicate amongst themselves which is not ideal when you are working across a number of projects which means that you get conflicting 'orders'.*

In light of this, rich communications is seen as intrinsically worthwhile within the team in order to create mutual trust between the different team members. For example, communication and integration were sometimes used interchangeably, across the job levels, which show that rich communications is believed to contribute to breaking down discipline as well as hierarchical barriers.

Another important catalyst which was widely expressed as a CSF was the project/task itself. This means that the more interesting the project is, or using the words of the practitioners; has the 'wow-factor', the more likely it is to engender commitment in terms of resources and enthusiasm is invested. Similarly, the opportunity to work across a number of

different interesting projects is seen as an important driver of success. One of the building services engineers mentions:

> *The type of project matters for project success. I don't like working common projects like ware houses or shopping centres.*

In a sense the on-going project has to satisfy the project members in certain ways, which inevitably impacts on the wider perceptions of project success (the completed building). But what motivates one individual does not necessarily motivate another. Budget and profit does not increase motivation per se but if it means that it allows the members to spend more time on refining and working on the design, it is critical to the design process. However, motivation can be affected by a number of external factors which are linked to 'project delays' and 'frequent changes of personnel'. Another important factor in this category is the motivation of the project members in terms of their willingness to work and feel 'passionate' about what they are doing.

> *'I think that a perfect project is one where you can somehow manage to get the engineer to be involved early on so that he or she ends up feeling passion for the project' (Associate structural engineer)*.

On a general level, the experience of 'passion for the project', 'enthusiasm' and 'having fun' emerges as critical to both individual and collective success. It represents the assortment of intangible CSFs which influences the way the total project success is perceived. These results seem to confirm findings from research projects in other organisational environments. For example, according to Gratton (2007) as people feel increasingly passionate about something, they really care, and they enjoy the emotional contagion as others becoming engaged and excited. This is shown in the following extracts:

> '*At the end of the day I guess you have to be enthusiastic about it…you have to want to do it'*. (Associate engineer)

> *There are difficult times in all projects even if you have all the CSFs in place, but if the team or the leaders of the team have the passion to want to do something better then you stand a higher chance of it to happen. You got to have passion to finish something that is worthwhile.* (Group manager)

In this way, achieving success in interdisciplinary projects is heavily dependent on the level of positive emotion as experienced by the project members.

Using Formal Systems Model to display factor interrelationships

Whilst the core of the study was to identify CSFs in inter-disciplinary projects, what surfaced time and time again in the research process was that it is impossible to reduce success to a number of finite factors. In addition, since it appeared difficult to isolate them, it was contended that it is more useful to view the factors as interdependent elements in the organisational environment. A systems model, the Formal Model was used to display these important interrelationships. This is based on the notion that becoming better in systems thinking helps people to 'see' underlying activity systems driving behaviour and performance (Senge, *et al*., 1994). Whilst the model does not take sufficient account of the socio-political

factors which reside within multi-disciplinary design projects it provides a holistic framework for making sense of project outcomes.

Table 4 shows a mapping of the components of the model and the identified CSFs identified in the present study. Figure 2 is an illustration of the FSM which will be essential in the follow up study of project success in interdisciplinary design environments. It shows the different levels of organisational systems and their interrelationships and the influence of the environment. From this perspective, the model may be used by practitioners as a way of diagnosing problems (soft and hard issues) in a specific project and improve future practice. However, as can be seen in the list of features of the FSM, it makes no specific reference to the subjective experience of people, i.e. 'super soft' factors such as passion and enthusiasm, creativity and innovation and culture and values which are particularly important within multi-disciplinary design projects. This limitation is acknowledged by the authors themselves (Pearce and Fortune, 2002) and more research is under way to address this issue.

Table 4
Critical success factors from the study mapped onto component of the Formal Systems Model (Fortune *et al*., 2006)

Component of FSM/ project attributes	**Critical success factors from the study**
Goals and objectives	Defined project goals Shared project vision Defined roles and responsibilities
Performance monitoring	Project management practices
Decision-maker(s)	Quality of leadership Team selection and composition Commercial awareness
Transformations	Technical skills Social skills Team building process Creativity and innovation Effective inter-disciplinary team working Time management
Communication	Rich communications Knowledge sharing Management of expectations Feedback on progress
Environment	Organisational structure Culture Physical office environment
Boundaries	Relationships
Resources	Sufficient resources Appropriate technologies
Continuity	Client focus
	Mutual trust and understanding
	Change management and flexibility
	Motivation
	Challenging task
	Passion and enthusiasm
	Shared values
	Recognition and appreciation

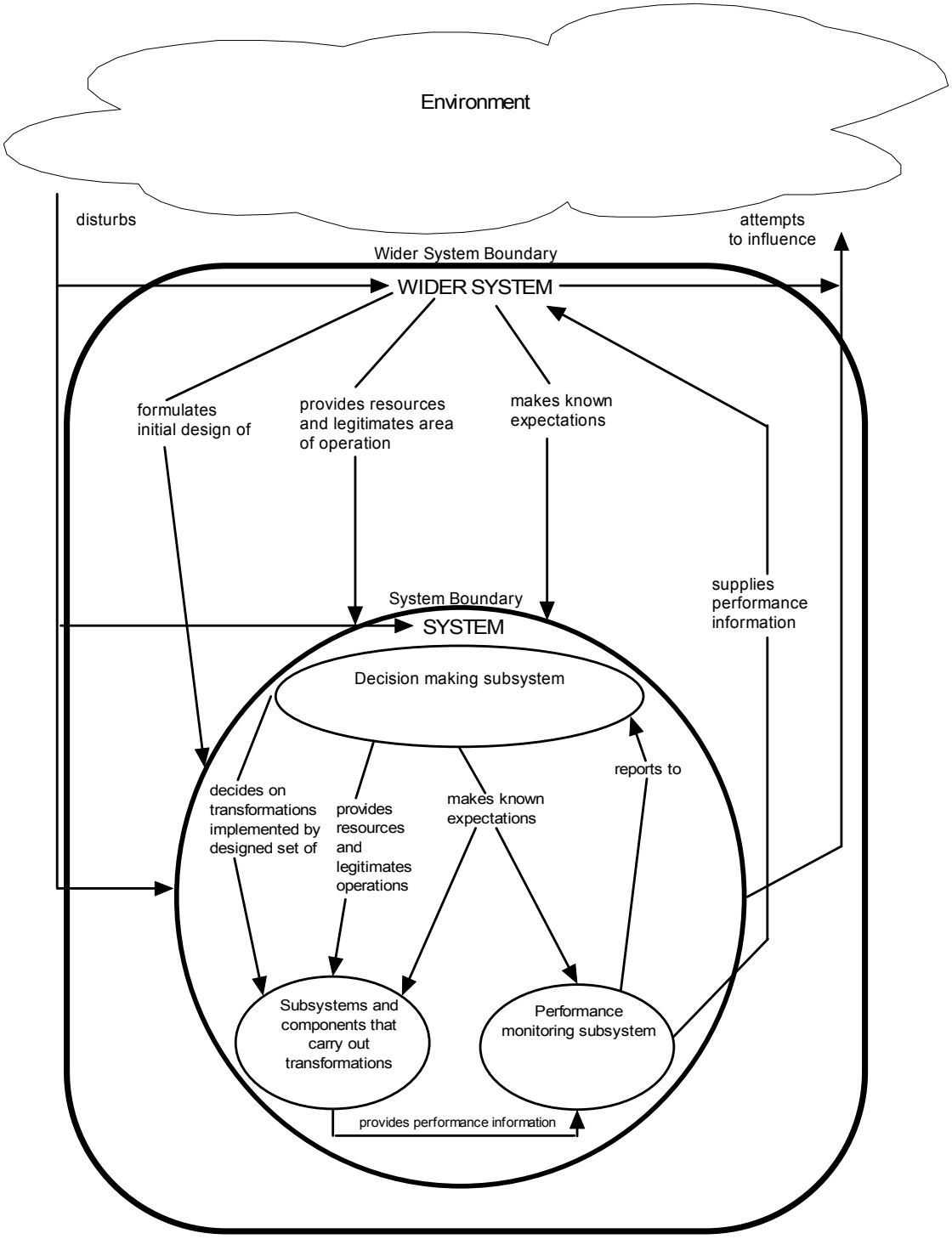


Figure 2. The Formal Systems Model (from Fortune et al, 2006)

DISCUSSION

The research described in this paper aimed to elicit perceptions of CSFs related to delivery multi-disciplinary design projects. More importantly, it goes beyond senior managements' conceptions of what 'has to go right' for success by including the perceptions of the team members themselves. There has been very little research into project success in such project settings, particularly in understanding the idiosyncratic context of design engineering and the

multiple perspectives of 'success' that exist within the project community. This is surprising since design is such a critical part of the creation of the built environment.

The results of interviews, workshops and the survey with engineers and technicians revealed four interdependent success factor groups: management factors, design team factors, competency and resource factors and project enablers. These factor groups represent a subset of factors that are highly interrelated; issues in one group affecting issues in all of the others.

In light of the preceding results, although it is possible to explain each success factor in its own right, the interpretation of the interview material shows that in practice it is difficult to focus on a particular factor without acknowledging the influence of others. The sheer number of factors that were mentioned as critical and the apparent difficulty to prioritise confirm this. Interestingly, as participants began to reflect and talk about project success factors they started to add more factors to their 'list', allowing them to think more deeply about what the true drivers of success might be. This indicates that there is knowledge and wisdom about what makes projects successful, but the pressures of work, usually perceived as lack of time and resource, makes it difficult to take time out to reflect on success and CSFs.

In short, the four factor groups which were discerned in the data could be termed 'managerial challenges' because they represent socio-political, rather than technical challenges: managing the team in an evolving situation, clarifying goals and 'who is doing what' and managing staff changes and dynamics. Paradoxically, while there is widespread support and acknowledgment of the value of management and leadership, it seems that there is confusion as to what managers *should* be doing and how they can add value to inter-disciplinary design projects.

The picture shown indicates that since all projects exist within a specific organisational context, it is clear that the organisation (people) has to power to facilitate, influence and even impede project performance. In this respect, a basic overview of CSFs (see Table 3) can assist practitioners in the early project stages to make initial assessments regarding the multiple 'hard' and 'soft' factors that invariable affect the project implementation process. However, in the face of the inevitable complexities within the organisational environment, design teams themselves and the individuals who constitute those teams; there are no simple prescriptions for implementing effective project management practices.

Whilst in general the CSFs and factor groups presented appear to support those within the literature within construction and project management in general, the findings of this study reveal a number of 'new' factors which do not figure strongly in other success frameworks. These factors that are related to the socio-political dynamics of inter-disciplinary team work such as passion and enthusiasm, shared values, and creativity and innovation. In a sense this highlights a component of project success which can be termed 'personal success'. From the viewpoint of the project members themselves, feelings of positive emotion, joy, interest and contentment (see e.g. Fredrickson, 1998) is critical for perceptions of overall project success. It highlights the importance of personal success as an important component of project success. For example, it would appear that designers and CAD-technicians ability to work together and be productive in the project process depends partly on the perceived level of personal success. More specifically, performance is an outcome of perceived sense of challenge in their work, opportunities to develop creative and innovative solutions and being supported in that process. According to Amabile (1997) maintaining a positive emotion in the project environment depends on maintaining good team relationships, applying a suitable leadership style and matching people to work that utilises their skills and is clearly valued by management. The idea of positive emotions or sense of enjoyment is identical to the experience of flow or being in the zone. A growing body of studies in the field of positive psychology suggests that the benefits of actually 'doing what you love' is extremely

important to individual and collective productivity and well being, and ultimately, organisational outcomes (Seligman, 2002; Csikszentmihalyi, 1990).

In other words, these variables are primarily related to human dimensions of work and thus act as enablers of project performance. Whilst practitioners are expected to deliver a successful project through people and relationships there often remains limited attention to the actual process of enabling individual and collective effort. As noted by Chinowsky et al (2001, p. 32) 'the traditional philosophy of management in architecture-engineering-construction (ACE) industry/…/places great emphasis on the ability to plan and execute projects'. This research suggest that multi-disciplinary project environments require emotionally intelligent or sensitive practitioners and project managers who can respond effectively to individual and team needs while at the same time ensuring that the project is delivered on time and within budget. Building design is a collaborative activity that requires cooperative behaviours and interpersonal skills, but the engineers value their independence and being self-managed (Lowendahl, 2005). This is understood to demonstrate two important dimensions for the management of socially complex projects: 1) the importance for both technical as well as soft skills and the propensity to evaluate technical input and performance as well as propensity to cooperate; and 2) the relevance of understanding the classic tension between the individual and the organisation and 'the wish to join together and the wish to be separate' dilemma (Stokes, 1994).

Due to time pressures in the multi-project environment too much of project management is focused only on meeting deadlines or submitting stage reports and fails to address the day to day nuances that are so important in practice. These include the needs of the people within the team, supporting the collaborative process and listening and providing feedback on progress. This situation is an example of what Frankenberger et al (1997) refers to as the economic pressure of engineering design practices where by engineering designers are struggling not so much with technical problems, but rather with difficulties related to their surroundings (e.g. effective organisation, management, communication) and colleagues. When given time to reflect on project work, practitioners become aware of the wider context in which they conduct their work. For instance, many of the perceived barriers to success relate to frustrations with the nature of construction industry. It is felt to be 'fragmented, risk averse and overly contractual'. The way in which projects are set up and run does not necessarily support team integration, communication flow and coordination of design information. Thus, the success of multi-disciplinary projects cannot be attributed solely to the team and the team members' competencies.

Consequently, success in a multidisciplinary practice depends on active and continuous management of process and people as well as an ability to improvise through frequent communication and reflection. Indeed, rich communications was singled out as the factor which underpins the performance of all success factors. According to Bales (1950) effective team communication focuses on what he termed both 'task' and 'maintenance behaviours'. Task behaviours are focusing on accomplishing the task at hand. These include such behaviours as asking or sharing information, and checking for comprehension. Maintenance behaviours focus on developing and preserving cooperative relationships among group members. Such behaviours include supporting and praising others and encouraging participation. In a multi-project organisation such as engineering consultancy, the communication culture is often such that information often gets lost in the process of 'getting the work done', increasing the likelihood of mistakes, repeat work and failing to meet the client's expectations. Therefore, ensuring that the right people are talking together is vital, which means that communication is not about passing paper from one point to another; it is about bringing the right information to the right person. The constraint lies in the nature of

design project work; the involvement of architects and other subcontractor that represent organisations that operate outside of the engineering consultancy. They are typically viewed as communication based (Winch, 2001); efficient collaboration relies on effective diffusion of information throughout the project (Baiden, *et al*., 2006).

This suggests that it is important to take a broader view of the factors that are considered to influence effectiveness, in particular, acknowledging the importance of extremely intangible factors such as creativity and emotional feelings which are often overlooked by practitioners. These factors are typically seen as important by everyone but are difficult to measure.

Taken together, the findings suggest project participants in inter-disciplinary projects view successful projects as largely deriving from project team and management characteristics; having very clear project goals, clear roles and responsibilities, an appropriate mix of skills people in the team, supportive management and effective, open communication throughout the project life cycle. Additionally, what is also seen as 'critical' is the project members' 'affinity' to the project itself (see Dainty *et al*., 2005), which shows that intrinsic motivation is an important aspect for understanding engineers and technicians' creativity and performance in project work. This was referred to as 'passion' for the project.

While the pressure to deliver on time and on budget are still dominant within the inter-disciplinary project organisation, team members themselves are also interested in whether a project is worthwhile doing, satisfying and is a good learning experience (i.e. they are focused on psycho-social outcomes).

Overall, perhaps the most significant finding is that the identification of CSFs only provides partial insights on how to improve the performance of projects. This is a reminder that projects are thoroughly social endeavours. This supports the notion that success is socially constructed among the project members, which has been found in studies of project managers in an R&D lab (Smith-Doerr et al, 2003). The message is that the management of inter-disciplinary projects requires an approach where the best way to manage all projects (including CSFs) is to 'identify the contingencies that matter and what to do about them' (Morris *et al*., 1987, p. 29). From a managerial perspective it is therefore relevant to identify CSFs that makes sense for the team rather than identifying one 'right' list.

CONCLUSIONS AND PRACTICAL IMPLICATIONS

Managers within the ACE industry consistently face the question of how to encourage high technical performance and greater collaboration among engineers and technologists. An added layer of complexity is that the everyday realities of managing design consist of being able to tackle 'the evolving nature of the situation' and the need to continually deal with emerging issues. The research indicates that while project success still depends on formal project management methods (planning and control of resources and costs), and availability of skilled people, the key point is that team members need to work with each other in a supportive context to achieve successful project outcomes. This is particularly pertinent for interdisciplinary projects such as building design which are characterised by their dynamism, iterative nature and non-linearity. Thus, facilitating project success within an inter-disciplinary design context necessitates a balancing of various factors relating to tensions and dynamics between individuals and within teams. The most interesting finding in the study is that factors peculiar to achieving successful project outcomes in collaborative design projects are closely related to the socio-political dynamics of inter-disciplinary team work such as passion and enthusiasm, shared values, creativity and innovation. These so-called super-soft factors are especially important in stimulating personal success which seems to be

inextricably linked to perceptions of project success. The implication is that project participant's sense of creative performance and affinity to the project as well as the team itself has to be taken seriously as levers to achieve positive project outcomes. Since engineering design is based on the creative energy of the engineers (and architects) this is perceived as a critical process in achieving a successful project. It highlights that multi-disciplinary project environments require leaders who are socially competent and engage in building teams, drawing attention to the socio-political factors as important enablers for success. From this perspective, it may be timely for managers and practitioners in construction to consider the emotional aspects of interdisciplinary teamwork and reflect on how this may enhance positive project outcomes.

Overall, the results of the study have a relatively simple but important implication: managers who wish to achieve inter-disciplinary project success must pay careful attention to their own everyday practices and behaviour within the project context. In other words, by recognising that they *have* the power to influence, motivate and enhance positive feelings and creative performance the 'right' success model can be developed over time through continuous learning and reflection. Thus if CSFs are seen as an integral part of managing projects, it may have a more profound effect on people, practice and performance. Long term this implies developing individuals with an engineering background to take on a more comprehensive management role one which includes the management of multi-disciplinary teams, requires investment and further research. However, the concept of multi-disciplinary team leadership remains a relatively new one. Crucially, it may be that inter-disciplinary team leadership may be a critical role for construction professionals.

Ultimately the study shows that simply attempting to identify and classify CSFs is not enough in understanding how project success can be achieved in complex projects. While the authors acknowledge this limitation in the study the work provides an insight into the peculiar context of inter-disciplinary design projects and thus adds to the existing literature on CSFs and project success in construction related organisations and beyond. It supports the growing trend to use systems thinking in the management of projects. The promise of applying systems thinking lies in developing a (mental) model which may enable practitioners and managers to become more attuned to the inherent interdependencies of the contextual factors which influence positive project outcomes including their own potential to influence everyday practices. However, there seems to be something missing in the existing ways of understanding the concept of CSFs regardless of how they are being framed by various researchers. Work is under way to carry out a real time study of group of inter-disciplinary projects with the view to gaining a more comprehensive understanding of 'what is going on' in complex projects and their implications for management practice and project success. The aim is to develop a theory which explains what happens when project participants collaborate to produce inter-disciplinary projects.

In particular, to the aim is to develop the Formal Systems Model (FSM) so that it incorporates the 'super soft' factors which are important in fluid and agile project environments. This will be achieved using grounded theory (GT) which offers a potentially powerful methodology for discovering and conceptualising

REFERENCES

Allinson, K. (1997), Getting there by design: An architect's guide to design and project management, Architectural Press, Oxford.

Amabile, T. M. (1997) Motivating Creativity in Organizations: On Doing What You Love and Loving What You Do, *California Management Review*, Vol 40 No 1, pp 39-58.

Andersen, E. S., Birchall, D., Jessen, S.A., and Money, A. H. (2006), Exploring critical success factors, Baltic Journal of Management, Vol. No 2, pp. 127-147.

Boyatzis, R. (1998) *Transforming qualitative information: Thematic analysis and code development*, Sage, Thousand Oaks.

Bresenen, M. (1990), Organising construction: Project Organisation and matrix Management, Routledge, London.

Bresnen, M., Goussevskaia, A. and Swan, J (2005) Managing projects as complex social settings, Building, Research and Information, Vol 33 No 6, 487-493.

Busseri, A. and Palmer (2000) Improving teamwork: the effect of self-assessment on construction design teams, Design Studies, Vol 2, pp. 223-238.

Cicmil, S. (2005), Reflection, participation and learning in project environments: a multiple perspective. In: P. Love, P. S. W. Fong, and Z. Irani (Eds.) Management of Knowledge in project environments, Oxford, Elsevier Butterworth Heinemann.

Cooke-Davies, T. (2002), 'The 'real' success factors on projects', International Journal of Project management, 20, pp.185-190.

Cooke-Davies, T. (2004), Project Success, in Pinto, J.K and Morris, W.G., (Eds.), The Wiley Guide to project management, Wiley & Sons Inc, Hoboken, New Jersey.

Csikszentmihalyi, M. (1990), Flow: The Psychology of Optimal Experience. Harper and Row, New York.

Baker, B. N. Murphy, D. C. and Fisher D. (1988), 'Factors affecting project success'. In D.I Cleland, W.R King, (Eds.), Project Management Handbook, Van Nostrand Reinhold, pp. 902-919.

Chan, P.C., Scott, D., and Chan, P.L (2004) Factors affecting the success of a construction project, Journal of Construction Engineering and Management, Jan/Feb, pp. 153-155.

Chan A.P.C. and Chan A.P.L. (2004) Key performance indicators for measuring construction success, Benchmarking: An International Journal, Vol 11, No 2, pp. 203-221.

Détienne, F. (2006) Collaborative design: Managing task interdependencies and multiple perspectives, Interacting with Computers, Vol 18 No1, pp. 1-20.

Dainty, A. R., Alan Bryman, A., Price, A. D. F., Greasley, K., Soetanto, R, and King, N. (2005), 'Project affinity: the role of emotional attachment in construction projects', Construction Management and Economics, Vol 23 No 3, pp. 241–244.
De Long, D.W. and Fahey, L. (2000), 'Diagnosing cultural barriers to knowledge management', Academy of Management Executive, Vol. 14 No 4, pp.113-27.

Dougherty, D. (1992), 'Interpretative barriers to successful product innovation in large firms'. Organization Science, Vol 3 No 2, 179-202.

Egan Report: Sir John (1998), Rethinking Construction: The Report of the Construction Task Force to the Deputy Prime Minister on the Scope for Improving the Quality and Efficiency of UK Construction. The Stationary Office, London.

Fong, P. (2005), 'Co-creation of knowledge by multidisciplinary project teams'. In: P. Love, P.S.W., Fong and Z, Irani (eds.) Management of knowledge in project environments. Oxford: Elsevier Butterworth Heinemann.

Fredrickson, B. (1998), What good are positive emotion?, Review of general psychology, Vol. 2, No 3, pp. 300-319.

Fortune, J. and White, D. (2006), 'Framing of project critical success factors by a systems model', International Journal of Project Management, Vol 24, No 1, pp. 53-65.
Frankenberger, E. and Auer, P. (1997), 'Standardized observation of team-work in design', Research in Engineering Design, Vol. 9, pp. 1-9.

Jugdev, K and Müller, R. (2005), 'A retrospective look at our evolving understanding of project success', Project Management Journal, Vol 36 No 4, pp. 19-31.

Kunda, G. (1992), Engineering culture. Control and commitment in a High-Tech corporation, Temple University Press, Philadelphia.

Koch, C. (2004), 'The tyranny of projects: team working, knowledge production and management in consulting engineering'. Economic and Industrial Democracy, Vol 25 No 2, pp. 277-300.

Koch, C. and Bendixen, M. (2005), 'Multiple perspectives on organizing, projects between tyranny and perforation', Building research & Information, Vol 33 No 6, pp 536-546.

Latham Report: Sir Michael Latham (1994), Constructing the Team: The final report of the government/industry review of procurement and contractual arrangements in the UK construction industry. HMSO, London.

Lowendahl, B. R. (2005), Strategic Management of Professional Service Firms, Copenhagen Business School Press.

Meredith, J. R. and Mantel, S. (2006), Project management: A managerialist approach, 6th ed,. Wiley: New York.

Morris, P. (2006), Afterword: making the management of projects critical, in Hodgson, D and Cicmil, C (Eds.), Making projects critical, Palgrave Macmillan, Hampshire, pp. 335-347.
Nandhakumar, J. (1996), Design for Success?: Critical Success Factors in Executive Information Systems Development, European Journal of Information Systems, Vol 5, No 1, pp. 62-72.

Newell, S., Robertson., Scarrough, H. and Swan, J. (2002), Managing knowledge work, Palgrave Macmillan, Hampshire.

Obholzer, A. and Roberts, V.V (1994), The unconscious at work: individual and organisational stress in the human services, Routledge: London.

Pinto, J.K. and Morris, W.G. (2004), The Wiley Guide to managing projects, John Wiley & Sons Inc., Hoboken, New Jersey.

Pryke, S. and Smyth, H. (2006), The management of complex projects: A Relationship approach, Blackwell Publishing, Oxford.

Rockart, J. F. (1979), Chief Executives define their own data needs, Harvard Business Review, Vol 57 No 2, 81-93.

Seligman, M.E.P (2002) Authentic happiness. Free Press: New York.

Shenhar, A. J. Dvir, D., Levy, O. and Maltz, C. (2001), 'Project success: A multidimensional strategic concept', Long Range Planning, Vol 34, No 6, pp. 699-725.

Stapley, L. F. (2006), Individuals, groups and organisations beneath the surface: An introduction, Karnac Books, London.

Stokes, J. (1994), 'The unconscious at work in groups and teams', in Obholzer, A. and Roberts, V. Z (Eds.), The Unconscious at Work: Individual and Organizational Stress in the Human Services, Routledge, London, pp. 19-27.

Thomas, J. (2006),. 'Problematising project management', in Hodgson, D and Cicmil, S, Making projects critical, Palgrave MacMillan, London.

Winch, G. M. (2002), Managing construction projects: An information processing approach, Publishing, Oxford.

Zwikael, O. and Globerson, S. (2006), 'From critical success factors to critical success processes. International Journal of Production Research, Vol 44 No17, 3433 – 3449.

APPENDIX D PAPER 4

Koutsikouri, D., Austin, S.A., Dainty, A.R.J., and Guthrie, W. (2009) Informalising: A grounded theory of multidisciplinary collaborative design. *Submitted to Design Studies in August 2009 and currently under review.*

Informalising: A grounded theory of multidisciplinary collaborative working

Dina Koutsikouri, Simon A. Austin, Andrew R. J. Dainty and Wendy Guthrie
Department of Civil and Building Engineering, Loughborough University,
Loughborough, UK.

Abstract
Despite the importance attached to effective team working in construction design projects, surprisingly little research has been focused on the actual processes of such joint endeavours. Given the continued emphasis on collaborative working within construction and the difficulties in reconciling multiple perspectives, there is clearly more to discover about its nature and dynamics. Glaserian grounded theory research methodology was used in this study to reveal the main concerns of project participants working in multi-disciplinary design teams to generate a theory of the informalising. This explains the processes by which practice problems are resolved; how people routinely deal with multiple, often unforeseen, demands that pervade the collaborative design environment by managing expectations and value-judging to cultivate relationships for positive outcomes in fast paced contexts. These emergent and improvisational strategies offer new insights into the working of design projects and their effective management.

Key words: Collaborative Design, Grounded Theory, Managing expectations, Multidisciplinary teams, Value-judging

1 Introduction

Effective team working is widely considered a *sine non qua* to solve the technical and managerial problems of delivering projects in construction (e.g., Egan, 1998; Spencer et al., 2001). Whilst generally regarded a means of fostering inter-professional collaboration and integration (McCallin, 2007), organisations are increasingly relying on it to attain organisational goals (Tannenbaum and Cannon-Bowers, 1996). The underpinning assumption is that collective goodwill (Naphaiet and Ghosal, 1998) holds the key to organisational survival and sustained competitiveness (Bennis and Biederman, 1997) but research suggests that the diverse teams typical of construction are difficult to manage and the likelihood of disappointing outputs is high (Vangen, 2003). Therefore a better understanding of 'working together' in practice is needed. Specifically, what is often overlooked in the literature (see review in Huxham et al., 2005) is the social process of working together in an increasingly complex and changing context. How collaborative projects get done and how professionals resolve the daily challenges of working together in a fast-paced practice context are fundamental considerations, yet the reality of inter-professional team work is rarely conceptualised and articulated in a manner that has practical relevance for practitioners and managers.

Our intention is to explore the pressures and dynamics of inter-professional team working in multi-disciplinary design projects. The aim is two-fold: 1) to elucidate the experiences and consequences of collaboration in such projects; and 2) to formulate an explanatory theory of the particular dynamics that pervade such temporary work settings. By identifying the social processes (or behavioural patterns) that can account for how people collaborate or otherwise, opportunities arise to manage the process more effectively.

2 Perspectives of collaboration

The literature across the fields of psychology, economics, sociology and organisational sciences has offered different conceptualisations and interpretations of multi-agency collaboration. Most studies are based on specific theoretical perspectives and cover a range of collaborative relations, including, for example, public-partner-partnerships, industrial networks and strategic alliances (Vangen et al., 2003). The theory of 'collaborative advantage' developed by Huxham et al (2005), based on continuous interaction in the field, presents one of the most useful contributions to the understanding of the challenges of collaboration or the 'themes' that concern practitioners. Themes include learning, common aims, communication and language, resources, power, compromise, trust, working processes, membership structures, identity leadership, culture, social capital, accountability, democracy and equality, and risk. The emphasis is on the *complexity* of working within and across professional and organisational boundaries, rather than unravelling the underlying processes that explain how practitioners collaborate.

Few field studies have been conducted within construction, to investigate multi-agency collaboration in practice. A notable exception, being Shelbourn et al (2005), who argue that practitioners should pay more attention to 'softer' issues (business process and the people of an organisation) rather than technology. Whilst offering an array of insights into the challenges and possibilities the research masks the formal and informal aspects of how people handle and respond to demands associated with collaboration. Studies in the field of design activity have been more successful in explaining some of the social processes that underpin (interdisciplinary) team work in projects. For instance, Cross et al (1995) identify the skilful ways in which project participants interact, plan, gather and share information as well as identify, avoid and resolve conflicts. Other researchers have investigated how design professionals undertake collaborative design in practice (e.g. Austin et al., 2001). Although this work is focused on the design activity rather than the social processes of interdisciplinary design teams, it provides important insights into the challenges of achieving interdisciplinary interaction, especially in the conceptual design phase of projects. More generally, the literature points to a number of barriers around professional and structural constraints. According to Newell et al (2002) putting people together from different disciplines will not inevitably generate creative collaboration because professional groups employ their own interpretations in making their assessments in projects, highlighting the existence of impermeable professional boundaries, or 'thought worlds' as a potential threat to organisational effectiveness (Dougherty, 1992). Achieving team cohesion among members in a group, where individuals come from different occupations and organisations is well documented especially within health care (McCallin 2001; Fay et al., 2006) and public sector partnership (Huxham and Vangen, 2003; Ellis and Fortune, 2007). Despite this available knowledge, the dynamics of multi-disciplinary team working are not fully understood and therefore prescriptions about how to manage are often problematic (McCallin, 2007). Traditional models of effective teamwork which prescribe communication, team building and strong leadership as the basic tenets of good team working are not sufficient to cultivate and facilitate multi-disciplinary team work. Research into inter-disciplinary teams demonstrates that team working is often a result of trial and error learning, rather than something that happens from the start. Furthermore, team members are often involved in several projects simultaneously, increasing the demand for improvised leadership (Koch and Bendixen, 2005) whereas the temporary nature of most construction projects and teams (Baiden et al., 2005) make it difficult to cultivate trust.

The psychological demands in this dynamic and transient context, inevitably generates a high pressure environment. To cope individuals often end up compensating through 'hyper-flexibility' and improvised actions to maintain continuity and control (Sennett, 1998). As a consequence, the time available for interaction and relationship building is reduced making it difficult to promote cooperation. The typically ambiguous, complex and dynamic structure of collaborative work requires practitioners to engage in a 'continuous process of nurturing' (Huxham and Vangen, 2000c). This suggests that participation and therefore effort and productivity in collaborative projects is largely discretionary, rendering the conditions in which individuals are willing to expend additional effort important to the outcomes achieved (Belanger, 2000).

While the issue of context has been given some attention in organisation theory (e.g., Johns, 2001) and project management (Morris and Pinto, 2004; Cicmil et al., 2006; Maaninen-Olson and Müllern, 2009), clearly more research is needed to conceptualise context and how it reinforces and impacts upon behaviour. For example, although there is an increasing recognition of the need to develop useful project management theories (Morris, 2005), to date there is very little research that provides concepts that are helpful and recognised by practitioners. This study contributes to filling that gap from a grounded perspective of multi-disciplinary design.

3 Methodology

Classic grounded theory research methodology based on the work of Glaser and Strauss (1967) and subsequently Glaser (1978, 1992, 1998, 2001, 2003, 2005) was chosen because the primary purpose was to generate rather than testing theory. Despite some apparent similarity with the grounded theory approach presented by Strauss and Corbin (1990, 1998), the research rationales attached to these two different sets of grounded theory are clearly different. Glaser (1992) contends that Strauss and Corbin's procedures force data analysis into preconceived categories, and thus, contradicts the fundamental tenets of grounded theory. The goal of classic grounded theory methodology is to discover patterns of behaviour that are relevant and problematic, focusing on 'what is going on' from the viewpoint of those involved (Glaser, 1998). This means that the researcher must strive to generate theory without being influenced by a priori theoretical assumptions or what the research community deems relevant. Specifically, it requires the researcher to remain open to exploring the substantive area (e.g., project setting) and allowing the concerns of those actively involved to guide the emergence of a core issue (e.g., coping with change). Getting 'through and beyond conjecture and preconception' is one of the fundamental ideas underpinning the generation of grounded theory as detailed in Glaser's work (1978, 1992). The methodology is powerful because it helps researchers to explain behaviour beyond a simple description of what people (Andriopolous and Lowe, 2000) to help practitioners understand, for example, why certain patterns always seem to emerge, why particular people respond in certain ways and why their own actions produce particular results. Thus grounded theory methodology is well suited to understanding the social processes in multi-disciplinary project work and implications for management.

The setting for data generation was the London office of a multi-national, multi-disciplinary engineering design organisation that focuses on integrated building solutions, innovation, sustainability and renewable technologies, usually working with a separate architectural practice to provide the complete design team for a project. The office employed over 400 engineers and support staff, where each engineer is involved typically in two to seven projects

simultaneously. As a consequence of rapid growth over the past ten years, coupled with changes in the way projects are procured, senior management were looking for practical tools and techniques to improve project delivery. Furthermore, there was a growing recognition that to achieve exceptional performance, practitioners have to better understand the 'whole picture' of work and life within a multi-disciplinary project environment. This research aims to clarify and advance knowledge of the subsurface dynamics that influence project processes. The primary data came from interviewing thirty two engineers and four architects across six projects. Additional data were obtained from observations of design reviews, design workshops and ad hoc meetings at various project stages. All interviews were recorded and notes taken after each team gathering or meeting.

The analysis started with open coding of each interview transcript. Constant comparative analysis (Glaser and Strauss, 1967) was used to see if the data continue to support emerging categories. This involves relating data or indices to emerging ideas, then relating these to other concepts or their properties. In this way all concepts earn their relevance. Guiding questions; 'What is this data a study of? ('What category or property of a category does this incident indicate? and 'What is actually happening in the data?' (Glaser, 1978) shaped the analytic process.

The emergence of categories was the trigger for selective coding i.e. delimiting the coding to concepts related to the core variable Discovery of possible relationships between categories was facilitated by sorting printed memos (Glaser, 1998). During the theoretical coding process, the focus was on conceptualising how the substantive codes (of processes) were interrelated. Once the core category emerged ('informalising'), the interrelationships between the sub-categories (managing expectations and value judging) and their relationship to the core became visible. The procedure of sorting memos became a key activity in integrating the theory. This sorting is conceptual sorting, not data sorting, and helps the researcher to see where each concept fits and works within the emerging theory (Holton, 2008).

Because the grounded theory research process is characteristically complex in practise, punctuated by feelings of overwhelming intellectual challenge – the discovery of the core variable was not straightforward, nor easily apparent. Elucidating the social processes that people engage in to get their work done is fundamental to understanding what gets done and what is not getting done in the project context. The rest of this paper explains the current interpretation of what goes on in these settings, grounded in the perspectives provided by the practitioners themselves, exploring the nature and conditions of team based multi-disciplinary project work.

4 Theory of Informalising

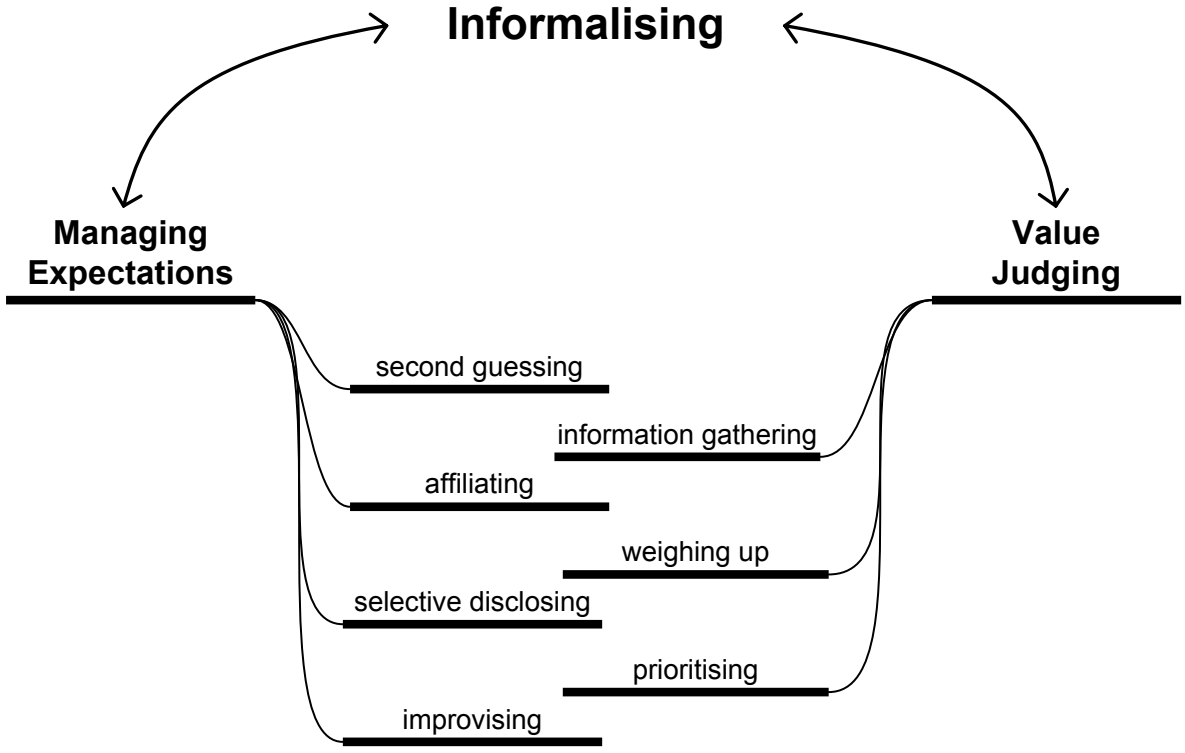
Informalising has emerged as the core variable in this study explaining how participants routinely cope with complexity, change and ambiguity within the ephemeral context of multi-disciplinary building design projects. The process of informalising helps practitioners cope with multiple and unforeseen demands in a manner consistent with their personal needs, professional goals and values, and in a way which enables them to deliver within such a 'time precious' environment. Put simply it explains how they overcome the fundamental challenges of coordination and delivery. Informalising occurs alongside the explicit procedures, is emergent, embedded and tacit. Thus, informalising helps maintain continuity and counterbalances discontinuity and loss of control experienced in the face of persistent and

unpredictable change. The resultant sense of progress and being in control renews energy and builds morale.

It was clear, however, that designers in multidisciplinary teams often struggled to pull together diverse views as they planned action, sometimes 'keeping their heads down' by focusing on the task, sidelining issues engendered by incompatible goals and personalities. This demonstrates that practitioners informalise to manipulate behaviours (their own and others) and events in response to their main concern of how to cope with multiple demands. The design professionals were continuously exposed to situations requiring speedy action, quick decision making and a continuous balancing of needs and resources. They were frequently observed engaging in informal and ad-hoc activities such as conversing in corridors, sketching in taxis, liaising by the coffee machine, stepping in to help colleagues and dealing with unexpected events. Thus, informalising guided actions and behaviours.

Practitioners in multi-disciplinary projects are continuously involved in many parallel activities reflecting differing aspects of informalising. These typically go on unseen without conscious effort. Intuition, creativity and expertise help deal with impermeable professional boundaries, multiple role demands, uncertain or changing scope of work and balancing varied pressures/goals. Informal routines are commonplace in organisational life, and pervade inter-disciplinary practice. *Informalising* consists of two dimensions, *managing expectations* and *value judging* (Figure 1) which are interrelated. In brief, the output of managing expectation – the propensity to develop trust, forms a feedback loop to value judging and impacts on the time and energy expended in keeping clients happy.

Figure 1. Informalising and its components



Managing expectations

We will now characterize this aspect before expanding on its four sub-processes. It is the process through which individuals skilfully attempt to modify the behaviour of others, to operate effectively, maintain relationships and satisfy clients. It is continuous because stakeholder needs and involvement change during the project life cycle, producing new sets of conditions. Through managing expectations, individuals negotiate project deliverables by variously engaging in second-guessing, affiliating, selective disclosing and improvising behaviours, conditioned by contextual constraints. These comprise forces in the project environment that they cannot influence on a daily basis, e.g. legislation, political activity and changes in the economic market. Other limitations at play concern the resources and world views of designers, specifically their personal values, beliefs, understanding and competencies which develop and change through experience and social interaction. Constraints impact the quality of collaborative process and output; namely teamwork and design quality. Managing expectations is therefore vital for perceived project success.

Differences in project performance can be associated with how practitioners manage expectations. Project participants (especially the engineers) describe it as an important part of creating a shared understanding about the deliverables. Managing expectations also reflects the perpetual challenge of juggling multiple perspectives (world views) and 'keeping people happy' (e.g. engineers' aim to meet the aspirations of the architect; and the architect meeting the expectations of the engineer). Grappling with differing mind-sets is an integral skill in managing expectations as expressed by the practitioners themselves:

"The architect was 'playing with rooms' in the concept stage and could not see the value in looking into the details of pipes and whether they fit…it just seemed irrelevant for them to understand the building services at that stage."

Consequently, participants have to keep stakeholders in line by managing their expectations and compromises about the deliverables (scope of work, time frames, and budget), demanding constant weighing of resources, planning and communications.

A frequent and positive feature was found to be a genuine sense of duty to 'see things through' ('taking due care'), a commitment to 'go that extra mile' founded upon personal values. It became clear that professionals working in multi-disciplinary teams were often trying to fulfil expectations rather than managing them. In other words they were attempting to satisfy stakeholders including the client by fulfilling expectations, whereas managing expectations is the strategy for re-balancing relationships and correcting mistakes. Managing expectations usually happens towards the end of the project process when changes and turbulence in the multi-project environment affect or threaten outcomes.

One aspect of stakeholder management is interpreting the nature of stakeholders' expectations and weighing their appropriateness against the mission of the client, the experts' professional norms and the individuals own interpretations. Consequently, professionals have some discretion in how they manage expectations (or stakeholder relations) but also offers the option to modify expectations by withdrawing their efforts.

Movement between formal and informal ways of managing expectations depends upon experience and awareness. For example, scoping design work is often documented in contracts, but often there is evidence of unmet expectations as a result of stakeholders,

including engineers, architects and clients 'vaguing out' what they will deliver. By keeping things vague participants seize the opportunity to exercise greater control over their input, ownership and resources. In this way, practitioners can respond more flexibly in the face of comparative urgency of other projects, temporal and/or financial constraints. But inconsistent management of expectations inevitably leads to frustration, de-motivation and resorting to more contractual relationships. How managing expectations is done will now be outlined.

Second-guessing

Second guessing is sensing what the client or other stakeholders really need and hence being one step ahead. This requires experience, skills and confidence – the ability to pick up subtle cues impacts on the project progress. Another important trigger is to get into the 'yes I can do it' mode and commit themselves to do things that might be beyond their abilities, or even discipline. The aim of this manoeuvre is to establish competence and take ownership. The degree to which individuals second-guess varies; it depends on information availability, experience and context.

Second-guessing is the generation of predictions based on limited information regarding the situation, and is required at any project stage to reduce uncertainty to resolve a problem or query. It is thus of particular importance when it comes to most kinds of rapid decision-making where there is limited information about a particular project issue, or uncertainty about available options or lack of information about stakeholders positioning. The validity is crucial to the degree of iteration and hence re-work. Multi-disciplinary work involves a great deal of second guessing because of the complex network of information flows and the interpretative barriers between disciplines.

Second-guessing is emergent on many levels. Professionalizing is one widespread type, demonstrating competence outwardly to others to progress a meeting, filling in the information gaps and rescuing the project from collaborative inertia. This means that project participants consciously or unconsciously respond to questions outside their field of expertise to achieve short-terms wins (satisfying stakeholders, maintaining morale and so forth). Conversely, when there are major gaps in the information needed they use questioning or other information gathering techniques (such as workshops or asking other experts).

Modifying behaviours to progress the project in this way can also generate problems and frustrations. When time is short, second-guessing can become a 'blinding' activity that prevents practitioners from gaining necessary information and understanding, leading to further problems down the line. Being able to arrive at a key decision requires a holistic understanding of the situation. Second-guessing is an interpretative process and is therefore dependent on experience, values and context. It evidences the importance of informal processing; that people have strategies for' cutting through' and 'thinking through' matters to 'keeping it together' and maintaining progress.

Affiliating

Affiliating refers to the way people communicate and relate to other members or stakeholders over time. It is characterised by informal conversations, ad-hoc meetings and moments of support. The latter facilitate progress and deepen project interaction and learning. Importantly, it is founded on a commitment to 'making it work'. Affiliating thus plays a central role in the process of managing expectations; to pick up on changes, lack of progression and keeping team members actively involved, facilitating a smooth progression through the formal stages.

It is self-activated by highly motivated practitioners who are committed to meeting the client brief and a highly latent pattern.

"In keeping the project together you do all those things that nobody sees… For example, talking to people, give somebody a ring to get them involved."

The process is critical to gaining buy-in as too often practitioners rush into implementation without communicating what the project is about and what is expected from each player. The degree to which it occurred varied across projects. A pre-requisite is knowing what is expected and how to deal with disagreements without undermining collaboration. In many situations practitioners seek enough agreement to make progress, but failure to affiliate effectively due to constant changes to the team and design heightens emotional tensions.

"To work effectively together all parties have to be on-board and be related to, otherwise people will lack in engagement. This has to be reinforced through communication. Real collaboration takes a lot of effort and that can only happen through communication, but that has to be a two-way street and those links have to be maintained".

The desire to maintain channels of communication is both personal and professional, enabling sharing of expertise. Where there is lack of opportunities for mutual engagement designers including the client experience frustration and resort to wishful thinking e.g. 'if we only had a process in place…',. The consequence is avoidance of the realities of working: one senior specialist described how he spends a lot of time 'rescuing' the project from various problems as a result of competing demands on resources and lack of communication between different layers in the organisation.

"People cut corners all the time in the face of pressure. For example, not everybody goes to design meetings so things start to drift and then we end up with loose ends everywhere. It comes down to one core thing, we don't have enough time to see things through…."

Affiliating counters the effects of change, lack of communication, confidence and trust. It depends on discretionary effort which in turn reflects the degree of affinity that the practitioners have for the project and the rest of the team. The outcome of the affiliating process is a sense of ownership in the project, stimulating commitment and creating the depth and meaning so desirable to individuals working in transient project organisations.

Selective disclosing

Disclosure is a fundamental communicative activity of everyday team working involving information exchange. Selective disclosure of the outflow of information controls expectations as well as protecting from claims further down the line, providing sufficient information to keep the recipient happy by weigh-up options with personal and professional consideration. According to Glaser (1965) practitioners constantly utilise selective disclosing to manipulate the awareness context in which they operate. As one engineer recalled:

"I spend a lot of time trying to pace the information to the architects. You cannot give them everything they want at once because they usually change things around anyway."

From this perspective it is a powerful social tactic to set boundaries around roles and responsibilities, overcome opposition and create trust. It is also helps maintain

professionalism which is a strategy to 'calm things down' and cope with feeling overwhelmed by the task and expectations. It is an incremental process linked to experience and confidence. Uncertainty about the project brief, responsibilities, contract arrangements and pending approvals create expectations that have to be wrestled with at any one time. The way practitioners disclose project information (schedules, budgets, changes etc) varies depending on the project characteristics including client aspirations and conditions relating to professional boundaries, personality, organisational priorities, and management styles, temporal and financial constraints.

The many expectations pressure team members who then use selective disclosing to modify behaviours to suit their own needs, particularly by slowing down (or occasionally speeding up) the process. Personal pacing is generated by the constant switching between projects, tasks and adjusting to changes in the internal and external project environment. Time is of essence so they must keep themselves productive and compensate for the time loss that occurs when alternating between tasks.

Improvising
It is common to improvise and adopt ad-hoc solutions where conditions change rapidly, and is therefore a critical strategy in complex projects. It also allows practitioners to respond more creatively to stated and unstated wishes, often ambiguous,, picking up subtle cues to adopt informal behaviours.

"I think we are very informal in the way work. But again, we are formal when we need to be and informal when we don't. If we need architectural drawings or any other information we may say right get that design finished on time, we need it by this day and that will be down on an e-mail or a letter which is a formal process".

Improvisation helps us grapple with different mind-sets and perspectives, opening dialogue and reducing the risk of collaborative inertia. In the current atmosphere of time and resource pressure, practitioners find themselves making compromises and practical adjustments; they must manage expectations based on what they want to accomplish.

"You trim your cloth according to your needs. Say if you have six metre of cloth and you are expected to do 10 skirts and the cloth is dimensioned for six skirts, then you really have to manage your expectations. You end up pushing away certain responsibilities and you have to short-cut. This is very frustrating for engineers who want to spend time on doing the design. You have to be more expedient with how you deal with things."

The statement shows that it is usually triggered to gain time or make compromises, propelling the project forward. Improvising reflects the nature of *informalising* that was commonly illustrated by the metaphors of 'making the cogs turn' and 'staying in motion'.
Improvisational behaviour demonstrates the fundamental necessity of being able to find an emerging solution in highly individuated ways. In its essence, improvising is about how professionals in multi-disciplinary settings switch modes of working to create more dynamic structures and 'smooth out' professional and personal differences within the team. Intuition and creativity are just as important as formal practices.

Improvising has a catalytic effect on both affiliating and selective disclosing, generating confidence and improving cross-discipline dialogue and coordination, although its deeply

personal nature poses challenges to the management of expectations and the project process. For example, much of the improvised activity in multi-disciplinary project working often takes place 'below the surface' and is rarely documented or required by the formal project plan. Improvising is a means for practitioners to maintain continuity in the face of unpredictable and changing circumstances. Practitioners are therefore continually engaged in attempting to mitigate unintended consequences of their own and other people's actions.

Value judging

Value judging refers to conscious and unconscious decision-making processes through which practitioners evaluate and resolve various process and product issues, particularly to meet stakeholders and personal expectations - a form of opportunity costing through which people select a course of action in preference of other possible alternatives to achieve desired objectives. Design iterations influence the value-judging process which is an important learning process in multi-disciplinary design projects. It is therefore inherently difficult to get right. To make 'good judgements' is an important social activity in engineering design, and so practitioners have developed patterns of behaviour to sense and prioritise situations and events. It facilitates the productive processing of tasks and, since design development is characterised by myriad of choices by various disciplines, it is also important for relationship maintenance. The outcome of value-judging is either enabling or stifling the process of managing expectations. In this study, practitioners were referring to value judging as a recursive process based on trial and error and adaptation.

"You have to be pro-active. You have to take a lot of unnecessary tasks on your shoulder to smooth out the process. You also have to adapt your tactics so that you learn to prioritise, adapt, participate and anticipate much better."

This reflects how professionals develop specific, unspoken norms and unwritten rules for what is deemed acceptable, preserving professional integrity. Project members tune in to their own experiences and 'cues' relating to stakeholders or other aspects in the project environment, mitigating the effects of change, lack of communication, 'forgetting' as a result of cognition overload. It depends on discretionary effort which in turn reflects the level of attachment /affiliation that the practitioners experience and have for the project and the rest of the team. It also helps to keep people happy. In reality, value-judging is fundamental to all kinds of project work. It is done continuously and clearly affects further actions. Overall, the process of value judging emphasises the importance of knowledge and experience where the outcome of the cycle is conditioned by personal and professional filters or framings which are the values and beliefs that people hold.

Information gathering

This represents the ongoing checking of the state of each project in terms of time, budget and deliverables; reviewing pieces of information such as resource schedules, financial information, drawings and meeting minutes and balancing conflicting demands. It also involves attuning and sensitising to unwritten rules and implicit needs of internal and external stakeholders, weighing them up against the resources available to meet them. It is a necessary precondition for making judgements. As such, practitioners' value-judge by routinely prioritising projects and gauging them against personal and professional (subjective and objective) measures. Designers (and indeed practitioners in general) achieve this through the skilful use of information and knowledge – the necessary components for modifying time scales, resources and human interaction – that may give rise to unintended conflicts which

may, in turn, affect the project trajectory. From this perspective value-judging is also about avoiding negative consequences by taking charge/responsibility of the situation; modifying the self and others' behaviour to escape blame and/or criticism.

Weighing up
Weighing up entails a careful evaluation of potential risks and opportunities by monitoring feedback and is heavily influenced by an individual's latent of understanding, beliefs and values. Moreover, practitioners sense which pieces of information are central and which are peripheral; they develop (over time) a pivotal ability to see the perspective of others in the team. The extent and degree to which weighing up happens varies with personal and professional factors. For example, what gets 'juggled out' to cope with multiple demands is based on how it will impact day-to-day activities as well as personal agenda and emotions. Weighing up is also affected by external limitations such as legislation, funding agreements, working schedules, organisational resources and the likes.

"The questions I ask myself is how important is it?...will I lose the client? ... will it affect my reputation as a person?"

Value-judging is inextricably linked to degree of affiliation between the project members and stakeholders and the project itself (desire and identity). It therefore involves weighing personal, project and organisational resources against needs and wishes of internal and external stakeholders.

Prioritising
The third step in making a successful value-judgement is prioritising –- a means of shifting time, re-allocating resources to meet the many, sometimes competing, demands of the various projects. Practitioners prioritise variously during design iteration to resolve issues blocking progress based on previous experience and/or knowledge of working around issues ('keeping the eyes on the ball'). The concept relates to the internal dialogue and thinking pattern that designers constantly have with themselves and which influence their actions and framing of situations. The degree of accommodating behaviours depends on the stakeholder/client importance, time and available resources.

"Clients and other stakeholders come with a number of demands that I have to meet and these are related to drawings, detail designs and attending meetings which are time consuming…so I have to take responsibility that we meet the minimal requirements by making the right judgements…you need to have skills, knowledge and confidence to handle this process successfully."

Prioritising is often intuitive, even if people think they are using rational heuristics to decision-make. It is based on the experience, training and preparation (including values and beliefs) of the practitioners, which renders weighing up of different scenarios a heavily tacit process. Poor value judging can therefore have a detrimental effect on relationships and team work, leading to conflict, frustration and collaboration inertia, especially in transient contexts such as multi-disciplinary settings. The process of determining 'the best way' of resolving a project issue can also be compromised by power asymmetry and hidden agendas:

"If we are working with high profile architects then obviously our decisions are going to be clouded by the fact that we have to go with what they want..."

Value judging is a momentum gaining activity, an expedient way to achieve short and long term deliverables. Thus, central to all prioritising is the wish to make a 'robust decision' based on available information, balancing needs and wishes against available resources.

5 Discussion

The aim of this research was to search for a grounded theory that can help explain, in a non-instrumental way the underlying processes team members use to continually resolve design practice problems. Little is known about what people actually do in these complex organisations, with more limited insights into the lived experience of practitioners in inter-professional team work. Many aspects of 'working together' are taken for granted and as such tend not to be conceptualised. In this study, it became clear that team working did not evolve in a purist or predictable manner. While there was evidence of team work – pooling of information, intense conversations and review workshops – the practitioners were constantly pre-occupied with trying to meet internal and external requirements and expectations.

The social process we have termed *informalising* was found to be the pervasive strategy for managing change, uncertainty and complexity in collaborative projects. By employing informalising tactics designers, amongst others, were able to cope with multiple and unforeseen demands to facilitate the project passage and create a sense of continuity. There appears to be no other way to manage the tensions around multiple pressures that are intrinsic to multi-project environments and to enable those involved to act in a manner consistent with their personal and professional needs, goals and values. It explains how practitioners respond to emerging situations as they seek new ways of fulfilling functional responsibilities for the formal organisation through managing expectations and value judging.

Managing expectations provides an informal mechanism by which practitioners try to fulfil stakeholder needs and goals, especially those requiring cross-disciplinary working to resolve complex technical requirements. It fills a gap in the existing project management body of knowledge in terms of explaining the underlying social phenomena in complex projects. Opportunities and progress are governed by the dynamic forces inherent in multi-disciplinary team work: diversity and individual thinking, competing priorities and impermeable professional boundaries. Gutierrez and Haig Firedman (2005, p: 521) capture the essence eloquently: *'When the project begins to develop inertia because the progress is slow, the effective project manager steps in to bring some balance, the most critical element of success.'* This highlights monitoring and informing as the most effective ways of handling expectations, allowing practitioners to sense the conditions surrounding project as well as adjusting to changing requirements. In their terms 'promises' made in the project allow individuals and organisations to manage expectations. The difference lies in how our emerging theory explains how practitioners routinely engage in potentially undesirable dimensions of coping with multiple demands, while at the same time revealing favourable perceptions. For example, engineers often engage in various tactics to pace architects' expectations by providing some, but not all information (e.g., drawings). This demonstrates that much of what practitioners do to meet stakeholder requirements (and getting their work done) is hidden from view. Uncertainty about the project status, responsibilities and how to manage relationships with others impinges on the project trajectory and subsequent behaviours. This phenomenon is mirrored in theories about communication and uncertainty management within health care (Babrow, 1992; Brashers, et al., 2000). Brashers (2001, p: 491) suggests that understanding the nature and forms of uncertainty reveals a great deal

about human communication. He states that '*across contexts, people engage in or avoid communication so that they can manipulate uncertainty to suit their needs*'. A comparison to the metaphor of 'office underground' seems relevant here because it illuminates informality as the real engine of work in complex organisations; and how it fuels progress and strengthens formal rules and procedures ((Misztal, 2000).

The process of value judging aids the management of expectations and is very much part of optimising time and human resources in the face of constant changes. It describes how experts use their personal and professional filters to 'think' and 'cut through' (monitor feedback, weighing up and prioritising) physical and social information in the project environment. Design professionals are constantly making valuations regarding competing priorities during design development while trying to re-appraise information (drawings, reports etc) to accommodate changes and feedback.

An interesting finding was that individuals use/engage in value judging as an essential tactic or most expedient way of achieving short term or long term goals. While it may seem that practitioners make value judgements in accordance with stated objectives, much of the process is tacit, resolving design coordination, delays or unmet expectations through a combination of personal preference and external demands. Thus, the process of value-judging is triggered by time pressure and by the particular conditions of work generated by multi-project organisations as places of work. This challenges to some extent conventional wisdom regarding judgements including value judgements in design (Holt, 1997; Thomson et al., 2003; Le Dantec, 2009). Design professionals, while giving the impression of taking into account the values of the stakeholders including the client (s), may well bypass the client orientation which is regarded as fundamental to service delivery, by covertly focusing on 'getting the project out of the door'. From this perspective, the concept of value-judging as presented here offers a new understanding of building design work both to practitioners and researchers.

Vicker's (1983) reference to judgements as instrumental to human activity is relevant here, with a similarity to his terms 'appreciation' through which individuals create and modify patterns to maintain stability in the social world. In brief, in maintaining 'the actual course of affairs' individuals' actions are based on what is significant to them, accommodating shifting interests, values and concerns. Vickers proposed that judgments arise from social interaction. Similarly human judgment involves appreciation of reality and value and thus, decisions about action (cf. Holt, 1997).

The pre-occupation with productive processing in ongoing projects, termed time tyranny (Koch, 2004), impinges significantly on decision making, creativity and the provenance to facilitate relationship building. Overall, this 'survival syndrome' is governing much of what is being said and done in project based environments, compromising collaborative creativity and the quality of what is produced. Ultimately it reveals the dehumanising effects of knowledge workers in temporary organisations where time constraints result in a lack of opportunity to consult with others. Through informalising practitioners cope with the temporal demands that are part of organisational life in multi-project environments, opening up for re-humanising knowledge work to sustain energy and commitment (Holton, 2007).

Researchers agree that informal routines are an inevitable part of organisational life; informality is a natural consequence of people interacting and adjusting to continuous

changes. This study has, however, identified informality as a critical coping mechanism that people resort to unknowingly in order to manage their time, modifying behaviours and protect themselves from negative consequences. Of particular note is that informalising does not only concern informal chats and interaction, it is clearly also about self-monitoring, learning and mistake making. For example, in smoothing out troughs and peaks of a project, practitioners in design projects often have to spend time being vigilant and picking up issues, hidden agendas and spending time to get junior engineers 'up to speed'. An important characteristic is therefore discretionary behaviour; individuals oscillate between informality and formality to fulfil requirements of work, showing that formally instituted and informally emerging patterns are practically interwoven and mutually dependent on one another (cf. Misztal, 2000). From this perspective, it is clear that social order can sometimes be achieved by relying on 'informal practices, while on other occasions there is a need for more 'formal procedures'. The continuing process of interaction modifies and changes individuals' typical knowledge of others. In other words, as work and collaborations progress good will (or social capital) is either built or eroded. This in turn acknowledges the role of social interactions, roles and relationships in the analysis of design activity in multi-disciplinary projects (e.g., Cross and Clayborn, 1995).

Lending further credibility to the prevalence of informalising, and the salience of informal routines, are studies documenting the extent of informal communication and problem solving activities in practice (Mangrum et al., 2001).

6 Conclusions and Implications

This research has revealed a grounded theory of *informalising* as a process for coping with multiple and unforeseen demands in collaborative design projects. The need to informalise highlights the relevance of managing expectations and value judging to remain effective in a fast paced practice context. Overall, informalising provides an expanded understanding of the reality of multi-disciplinary team working in construction that challenges traditional project management approaches, particularly universal 'best practice' prescriptions for project success. It contributes to the body of knowledge regarding the informal organisation by illuminating informality as the real engine of work in complex organisations. In other words, it is sometimes only by stepping outside the formal structures that trust and cooperation can be created and continuity maintained in transient work environments.

But what are the tangible benefits? Informal activities can help improve organisational efficiency in projects in a number of ways. For example, it can reduce uncertainty regarding deliverables, time schedules and potential risks, and help to unblock project progress. In this study, this has been manifested through the interrelated social processes of managing expectations and value judging. In addition, informal routines fulfil a social function. Informal communication and socialisation can help work groups develop more cohesion and provide opportunities for human contact. However, when individuals 'run counter' or bypass the official procedures it may not always be beneficial for the overall organisation. Derailing the formal system may be a sign of unclear role boundaries and responsibilities.

The implications for management praxis are significant in terms of productivity, work motivation and growth of social capital in temporary project environments. Knowledge of informal routines and their importance to organisational effectiveness may enable managers to understanding their functionality in resolving project members' concerns and needs in response to change and uncertainty. Above all, it offers a conceptual framework for

understanding interaction, and in particular why certain patterns repeatedly emerge and why particular project members respond in certain ways. It also offers insight into an intrinsically human world, where personal values ride the waves with legitimacy; it offers hope that these vital dimensions of interaction will be given the attention they deserve, not sidelined as inconsequential.

In view of this, the study's significance for building design practice relates to the development of capabilities for developing and sustaining relationships. Such a focus could prepare designers to deal more effectively with emergent and sometimes troubling project situations, for example delays, budget overruns and unmet client expectations. A key message to design professionals (e.g., engineers, architects) is that the strategies of informalising offer an additional resource to improve the management of the design process and quality of multi-disciplinary design team work. If practitioners are aware of the potential of managing expectations and value judging in advance, they will be more likely to make better decision, thus directly improving the quality of project delivery. Knowledge of this form of emergent and improvisational strategy could enable managers to alter patterns of behavior that could negatively affect project outcomes in terms of perceived value and profit. Long term it may also enable human resource managers to create more effective strategies for recruitment, retention and professional development in project based working environments.

Analysis of how practitioners routinely deal with their daily realities has largely been neglected in the field of project management research, in spite of greater interest in the social reality of projects. In a recent special issue of The International Journal of Project management, the EPSRC-funded Rethinking Project Management research network of academics and practitioners called for new thinking in the areas of project complexity, social process, value creation, project concept and practitioner development (e.g., Winter et al., 2006; Morris et al., 2006). The push for theories which recognise and illuminate the complexity and dynamics of contemporary project management requires a research strategy that is well suited to capture social reality. This paper suggests that the grounded theory approach of Glaser and Strauss (Glaser, 1978; Glaser and Strauss, 1967) is eminently suited to achieve this and such studies are being acknowledged for their contribution to understanding of the subtleties of the processes at play within commercial organisations (Parry, 1998; Partington, 2002; Gummesson, 2002; Christiansen, 2006). The methodology enables researchers to hone in upon the root of participants' concerns and their resolution in practice (Holton, 2006).

There is clearly scope to develop the emergent theory of informalising. The various concepts that have emerged provide opportunities in many directions. The concept of managing expectations that facilitates and cultivates mutual engagement and value judging that provides the necessary information for prioritising work merits further exploration and study. Additionally, future research might examine informality in diverse work contexts. An interesting work context would be the virtual project working context which is becoming increasingly popular across the private and public sectors.

REFERENCES

Andriopolous, C and Lowe, A (2000) Enhancing organisational creativity: the process of perpetual challenging, *Management Decision*, Vo 38 No 10, pp 734-742

Austin S, Steele J, Macmillan S, Kirby P and Spence R (2001) Mapping the conceptual design activity of interdisciplinary teams, Design Studies, Vol 22 No 3, pp 211-232

Babrow, A S (1992) Communication and problematic integration: Understanding diverging probability and value, ambiguity, ambivalence, and impossibility, *Communication Theory*, Vol 2 pp 95-130

Baiden, B K, Price A D F and Dainty A R J (2006) The extent of team integration within construction projects, *International Journal of Project Management*, Vol 24 No 1 pp 12-23

Belanger, J (2000) The influence of employee involvement in productivity: A review of research, *Workplace Gazette* Vol 4, No 4 pp 65-75

Brashers, D E (2001) Communication and uncertainty management, *Journal of Communication*, Vol 51 No 3 pp 477-491

Christiansen, O (2006) Opportunizing: A classic grounded theory study on business and management, *Grounded Theory Review*, Vol 6 No 1, pp 109-133

Cicmil, S, Williams, T and Marshall, D (2006) Rethinking project management: Researching the actuality of projects, *International Journal of Project Management*, Vol 24 Vol 8 No pp 675-686

Cross, N and Clayburn Cross, A (1995) Observations of teamwork and social processes in design, *Design Studies*, Vol 16 pp 143-170

Dougherty, D (1992) Interpretative barriers to successful product innovation in large firms, *Organization Science* Vol 3 No 2 pp 179-202

Egan, J. Sir (1998) *Rethinking Construction, The report of the Construction Task Force*, Department of the Environment, Transport and the Regions, DETR, July, London
Ellis, E., and Fortune, J. (2007)

Ellis, E., Fortune, J., and Peters, G. (2007) Partnerships problems: Analysis and re-design, *Crime Prevention and Community Safety*, vol 9, pp 34-51

Fay, D, Borrill, C, Amir, Z, Haward, R and West, M A (2006) 'Getting the most out of multidisciplinary teams: A multi-sample study of team innovation in health care', Journal of Occupational and organizational Psychology, Vol 79 No 4 pp 553-567

Glaser, B G (1965) *Awareness of dying,* Aldine, New York

Glaser, B G and Strauss, A L (1967) *The Discovery of Grounded Theory: Strategies for Qualitative Research*, Aldine Transaction, New Jersey

Glaser, B G (1978) *Theoretical sensitivity: Advances in the methodology of Grounded Theory*, Sociology Press, Mill Valley, California
Glaser, B G (1992) *Basics of Grounded Theory Analysis*. Sociology Press, Mill Valley, California

Glaser, B G (1998) *Doing Grounded Theory: Issues and discussions*, Sociology Press, Mill Valley, California

Glaser, B G (2001) *The Grounded Theory perspective: Conceptualization contrasted with description*, Sociology Press, Mill Valley, California

Glaser, B G (2003) *The Grounded Theory perspective II*, Sociology Press, Mill Valley, California

Glaser, B G (2005) *The Grounded Theory perspective III*, Sociology Press, Mill Valley, California

Gummesson, E (2002) Relationship marketing and the New Economy: It's time for de-programming, *Journal of Services Marketing*, Vol 16 No 7 pp 585-589

Gutierrez, O and Haig Friedman (2005) Managing project expectations in human services information systems implementations: The case of homeless management information systems, *International Journal of Project Management* Vol 23 No 7 pp 513-523

Holt, J E A (1997) The designer's judgement, *Design Studies*, Vol 18 No 1 pp 113-123
Holton, J A (2007) Rehumanising knowledge work through fluctuating support networks: a grounded theory, *Grounded Theory Review*, Vol 6 No 6 pp 23-46

Holton, J A (2008) The coding process and its challenges, A Bryant and K Charmaz (eds), *The Sage Handbook of Grounded Theory,* Sage Publications, London, pp 265-290

Huxham, C and Vangen, S (2005) *Managing to collaborate: The theory and practice of collaborative advantage*, Routledge, London

Johns, G (2001) In praise of context, *Journal of Organizational Behaviour* Vol 22 No 1 pp 31-42

Koch C (2004) The tyranny of projects: Team working, knowledge production and management in consulting engineering, *Economic and Industrial Democracy* Vol 25 No 2 pp 277-300

Koch, C and Bendixen M (2005) Multiple perspectives on organizing, projects between tyranny and perforation, *Building Research & Information*, Vol 6 No 6 pp 536-546

Le Dantec, C A and Yi-Lien E (2009) 'The mechanisms of value transfer in design team meetings', *Design Studies* Vol 30 No 2, 119-137

Maaninen-Olson, E and Müllern, T (2009) A contextual understanding of projects – The importance of space and time*, Scandinavian Journal of Management* Vol 25 No 3 pp 327-339

Mangrum, F G, Fairley, M S and Wieder, D L (2001) Informal problem solving in the technology-mediated workplace, *Journal of Business Communication* Vol 38 No 3, pp 315-336

Misztal, M. (2000) Informality – Social theory and contemporary practice, Routledge, London

Morris, P W G and Pinto J K (2004) *The Wiley Guide to managing projects*, John Wiley, London

Morris, P W G, Crawford L, Hodgson, D, Shepherd, M M and Thomas J (2006) Exploring the role of formal bodies in defining a profession – The case of project management, *International Journal of Project Management* Vol 24 pp 710-721

McCallin, A (2007) Pluralistic dialoguing: A theory of interdisciplinary teamworking, in B G Glaser and J A Holton (eds), *The Grounded Theory Seminar Reader*, Sociology Press, California, pp 37-54

Misztal, B A (2000) *Informality: Social theory and contemporary practice*, Routledge, New York

Naphaiet J and Ghosal S (1998) Social capital, intellectual capital and the organizational advantage, *Academy of Management Review*, Vol 23 No 2 pp 242-266

Newell, S, Robertson, M, H Scarborough and Swan J (2002) *Managing knowledge work*, Palgrave Macmillan, Basingstoke

Partington, D (ed) (2002) *Essential skills for management research*, Sage Publications, London

Shelbourn, M, Bouchlaghem, N M, Anumba, C and Carillo, P (2005) Planning and implementation of effective collaboration in construction projects, *Construction Innovation* Vol 7 No 4 pp 357-417

Spencer, J S, MacMillan, S and Kirby, P (2001) *Interdisciplinary design in practice*, Thomas Telford,

Strauss, A L and Corbin, J (1990) *Basics of qualitative research. Grounded theory procedures and techniques*, Sage Publications, Newbury Park, California

Strauss, A L and Corbin, J (1998) *Basics of qualitative research: Techniques and procedures for developing grounded theory*, Sage Publications, London

Tannenbaum, S I and Cannon-Bowers, J A (1996) Promoting team effectiveness in M A West (ed.), *Handbook of Work Group Psychology*, John Wiley & Sons, London, pp. 503-519

Thomson, D S, Austin, S A, Devine-Wright, H and Mills, G R (2003) Managing value and quality in design, *Building Research & Information* Vol 31 No 5 pp 334-345

Winter, M, Smith, C, Morris, P and Cicmil, S (2006) Directions for future research in project management: the work findings of a UK government-funded research network, *International Journal of Project Management*, Vol 2 No 4, pp 638-649

Vangen, S and Huxham, C (2003) Nurturing collaborative relations – Building trust in interorganizational collaboration, *The Journal of Behavioural Science* Vol 29 No 1 pp 5-31

Vickers, G V (1983) *The art of judgment*, Harper & Row, London

APPENDIX E – EXAMPLING MEMOS[10]

Memoing talk with I. M. 5 September 2008

I. says that managing expectations is important and has many dimensions in project work. If those expectations are not there in the first place, then you can provide delight. They didn't expect it so it becomes a bonus. It seems that engineers in general are not thinking about managing expectations. They are thinking in linear ways; they don't see the advantage of managing expectations. They want to sit down and decide on the finite amount of work. Managing expectations is done too crudely and therefore it gives rise to frustrations. Sometimes this is dependent on lack of time or lack of intellectual capacity.

Value-judging is also seems to be pertinent... how easily I am going to achieve what I have to do? The dynamics of the project environment makes this more or less difficult to do. I. says that 'In the beginning of the week I did not know how to resolve the question, but towards the end something happened, i.e I got some unexpected resources'. As a decision maker you are trying to keep up morale by getting short term wins. You do this to improve morale and feel more in control and less at the mercy of outside forces, and master of your own destiny.

Memoing talk with D.Y. 7 October 2008

Informalising does seem to make sense in the context of multidisciplinary design Discussing the main concern of engineers as coping with multiple demands (ranging from competing commitments, time scales and impermeable professional boundaries to mention a few), and how these are resolved it seems that having to improvise to 'sort out' ongoing practical issues is key in order to be able to 'move through' the project process. In other words, one has to 'informalise' the process (meaning one's own behaviour as well) to progress the design and 'get to the end' (completion).

There are many priorities to juggle, which means that individuals have to prioritise on an ongoing basis. This seems to be intrinsic to working in multi-project environments. Things rarely stay the same, and this means that resource schedules are continuously changing, which have an impact on productivity and decisions. This may have consequences for social relations within the design team, including the client.

My talk with D.Y. revealed that he engages in managing expectations and value judging on an on-going basis. He articulated that managing expectations is definitely something that is important in the design process. This is probably more so on the senior levels, but ultimately everyone has to do it more or less. Managing expectations is not only done to pace external expectations, but is extremely important within the internal BH team as well.

[10] In total the RE wrote more than 100 memos which formed the basis for the write up of the grounded theory of informalising.