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A conceptual framework for improving value generation in complex construction projects

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A CONCEPTUAL FRAMEWORK FOR IMPROVING VALUE GENERATION IN COMPLEX CONSTRUCTION PROJECTS

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ABSTRACT

TILLMANN, P.A. A **Conceptual Framework to Improve Value Generation in Complex Construction Projects.** 2012. Doctoral Thesis (Doctor of Engineering) – Civil Engineering School, Post graduate Programme in Civil Engineering, Federal University of Rio Grande do Sul, Porto Alegre.

This research was motivated by a practical problem with potential theoretical contributions. The problem in hand is the difficulty to generate value in complex construction projects, a problem observed in a large urban regeneration programme in Porto Alegre. Past research indicate that in the last decades there was an increase in project complexity, posing challenges to traditional managerial practices. According to some authors, such complexity is partially due to an increasing concern to understand how project's outputs contribute to generating change and delivering benefits to different stakeholder groups. Within this context, the lack of managerial support provided by traditional project management approaches is pointed out. Firstly because such approaches generally focus on the delivery of a physical product, within time and budget. Secondly, they do not provide support for dealing with the conflicting interests of multiple stakeholders. And thirdly because they do not properly consider that projects are susceptible to their economic, social and political context and subject to changes in such environment. In this research, two managerial approaches that are being used in the construction industry were identified as having potential contributions to improve value generation in complex projects: the Benefits Realisation Approach (BeReal) and the Lean Project Delivery System (LPDS). The literature available about these approaches is mainly prescriptive. Thus, there is still a need to understand why and how such approaches contribute for value generation. A third approach, the Logical Framework Approach (LFA) used where the problem was identified, was also analysed, as the literature suggests it also offers contributions to deal with some aspects of complexity. This research followed a Design Science Research process: finding a practical problem with potential theoretical contributions, framing the problem and searching for potential solutions, understanding how and why the solutions contribute for solving the problem and analyse the theoretical contributions of the solutions. In this study, emphasis was given to the evaluation of potential solutions identified. Three empirical cases were realised: the first one was in a urban regeneration programme in Brazil, aiming to understand the problem; the second was realised in a healthcare infrastructure programme in the UK, to analyse the adoption of BeReal; and the third in a healthcare infrastructure programme in the US, to analyse the adoption of LPDS. The three studies presented different managerial contributions to support value generation. Such contributions are analysed based on a conceptual framework that was devised. The model reveals the underlying concepts of observed managerial practices that contribute towards the improvement of value generation.

Keywords: value generation, project management, complex projects, design science research

RESUMO

TILLMANN, P.A. **Proposta de um modelo conceitual para a melhoria do suporte à geração de valor em projetos complexos.** 2012. Tese (Doutorado em Engenharia) – Escola de Engenharia, Programa de Pós-Graduação em Engenharia Civil, UFRGS, Porto Alegre.

Esta pesquisa foi motivada pela observação de um problema prático com potenciais contribuições teóricas. O problema em questão é a dificuldade de gerenciar projetos complexos de construção de modo que os objetivos estratégicos de sua implementação sejam alcançados, problema observado em um complexo programa de reestruturação urbana na cidade de Porto Alegre. Estudos indicam que nas últimas décadas houve um aumento na complexidade de gestão de projetos que resultou em desafios para as práticas gerenciais tradicionalmente adotadas. Alguns autores relacionam esse aumento de complexidade com uma demanda, cada vez maior, de compreender como projetos estão alinhados com os objetivos estratégicos e como irão contribuir para a geração dos benefícios esperados pelos diversos agentes intervenientes de um projeto. Dentro deste contexto, a falta de suporte dado pelas tradicionais praticas gerenciais é apontada. As críticas focam não só na falta de alinhamento estratégico e na dificuldade de gerenciar interesses conflitantes, mas também na dificuldade de lidar com a susceptibilidade desses projetos ao contexto politico, econômico e social no qual se inserem, e com a dinâmica desse contexto. Dentro deste contexto, foram identificadas duas abordagens gerenciais que emergem no contexto da construção civil em resposta às deficiências observadas: a *Benefits Realisation Approach (*BeReal*)* e o *Lean Project Delivery System (LPDS).* O foco da literatura existente sobre essas abordagens é predominantemente de caráter prescritivo, oferecendo modelos e métodos para sua aplicação. Identificou-se portanto a necessidade de avaliar a contribuição dessas abordagens para lidar com os desafios observados e contribuir para a melhoria do suporte a geração de valor em projetos complexos. Uma terceira abordagem, a *Logical Framework Approach (LFA)*, utilizada no programa onde o problema foi identificado, também foi avaliada, pois é sugerido na literatura que ela oferece suporte para lidar com alguns aspectos da complexidade dos projetos. O processo de pesquisa envolveu as principais etapas de *Design Science Research:* encontrar um problema prático e com potencial para contribuição teórica, obter um entendimento deste problema, desenvolver ou identificar potencial solução, testar a solução, avaliando sua utilidade, e avaliar a contribuição teórica desta solução. Neste estudo, ênfase foi dada à avaliação das potenciais soluções identificadas. Três estudos empíricos foram realizados: o primeiro teve como objetivo entender o problema - programa de reestruturação urbana em Porto Alegre/Brasil; o segundo para avaliar as contribuições da adoção da BeReal em um programa de reestruturação de um campus hospitalar em Brighton/Inglaterra; e o terceiro para avaliar as contribuições do LPDS em um projeto de um hospital em San Carlos/Estados Unidos. Os três estudos apresentam diferentes contribuições gerenciais para o suporte a geração de valor em projetos complexos de construção. Tais contribuições são explicadas com base em um referencial teórico desenvolvido, formando um modelo conceitual que explica as mudanças necessárias no contexto de gestão de empreendimentos complexos para um melhor foco na geração de valor e como as diferentes praticas observadas e mecanismos de suporte contribuem para esta mudança.

Palavras-chave: geração de valor; gestão de projetos; gestão de empreendimentos; empreendimentos complexos; design science research

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LIST OF ABBREVIATIONS

3T – Tertiary, Trauma and Teaching

5S – *Seiri, Seiton, Seiso, Seiketsu, Shitsuke* (Sort, Set in order, Shine, Standardise, Sustain)

ADA – American Disability Act

AEDET – Achieving Excellence in Design Evaluation Toolkit

AIA – American Institute of Architects

AUSAID - Australian Government Overseas Aid Program

BDP – Building Design Partnership

BNDES – *Banco Nacional do Desenvolvimento* (Brazilian Development Bank)

BRA – Benefits Realisation Approach

BREEAM - Building Research Establishment Environmental Assessment Method

BSUH – Brighton and Sussex University Hospitals

CBA – Choosing By Advantages

CDRA - Community Development Resource Association

CEPA – *Centro de Estudios y Proyectos del Ambiente* (Centre for the Study and Development of Environmental Projects)

CEQA – California Environmental Quality Act

CONCEPA - *Concessionária da Rodovia Osório-Porto Alegre* (Road Concession for Porto Alegre and Osório)

CRAP – *Comissão Regional de Acompanhamento do Projeto* (Regional Commission for Monitoring Project Implementation)

DDCS – Design Development Cost Study

DEMHAB – *Departamento Municipal de Habitação* (Housing Department)

DMLU – *Departamento Municipal de Limpeza* Urbana (Urban Cleanning Department)

DTF – Department of Treasury and Finance

EIR – Environmental Impact Report

EMP – Estimated Maximum Price

FBC – Full Business Case

FONPLATA – *Fundo Financeiro para o Desenvolvimento da Bacia do Prata* (Financial Fund for the Development of the River Plate Basin)

GMP – Guaranteed Maximum Price

HaCIRIC – Health and Care Infrastructure Research and Innovation Centre

HBB – Programa Habitar Brasil-BID [Banco Interamericano de Desenvolvimento] (*Habitar Brasil-BID Programme – Inter-american Development Bank)*

IFOA – Integrated Form of Agreement

IMEC – International Research Programme on the Management of Large Engineer and Construction Projects

INFRAERO – *Empresa Brasileira de Infraestrutura Aeroportuária* (Brazilian Company for Airport Infrastructure)

IPD – Integrated Project Delivery

IS/IT - Information Systems and Technology

LFA – Logical Framework Approach

LPDS – Lean Project Delivery System

LPS – Last Planner System

MaST-LIFT – Manchester Salford and Trafford - Local Improvement Finance Trust

MBM – Management By Means

MBR – Management By Results

MEP – Mechanical, Electrical and Plumbing

NHS – National Health Service

OBC – Outline Business Case

OGC – Office of Government Commerce

OP – *Orçamento Participativo* (Participatory Budget)

OSHPD – Office of Statewide Health Planning and Development

P2SL - Project Production Systems Laboratory

PAMF – Palo Alto Medical Foundation

PCI – Practical Concepts Incorporated

PCT - Strategic Health Authority

PCT – Primary Care Trust

PDCA – Plan-Do-Check-Act

PFI – Private Finance Initiative

PIEC – City Entrance Integrated Programme

PMBOK - Project Management Body of Knowledge

PMPA – *Prefeitura Municipal de Porto Alegre* (Porto Alegre City Council)

POE – Post-Occupancy Evaluation

PPI – Patient Public Initiative

SCC – San Carlos Centre

SHA – Primary Care Trust

SMAM – *Secretaria Municipal do Meio Ambiente* (Department of Natural Environment)

SMIC – *Secretaria Municipal de Indústria e Comércio* (Department of Industry and Commerce)

SMOV – *Secretaria Municipal de Obras e Viação* (Road Infrastructure Department)

SMT – Senior Management Team

SOC – Strategic Outline Case

TFV – Transformation-Flow-Value

TVD – Target Value Design

UEP – *Unidade Executora do Programa* (Programme Execution Unit)

UMN – University of Minnesota

USAID - United States Agency for International Development

USAID – United States Agency for International Development

VE – Value Engineering

1. INTRODUCTION

This first chapter presents the research background, describing a context in which construction projects have increasing complexity as the industry faces the challenge to move its focus towards value generation. It is also described in this chapter the problem that this research attempted to solve, which is the fact that current managerial approaches do not provide the adequate support for focusing on value generation. The research questions, objectives and the expected outcomes of this research are also described in this chapter, as well as how this thesis is structured.

1.1. RESEARCH BACKGROUND

Projects have been the dominant model for different initiatives, such as strategy implementation, business transformation, and product development: from infrastructure renewal, urban regeneration to community development (WINTER *et al*., 2006). Despite efforts to clearly define projects with different levels of complexity (e.g. programmes, project portfolios), the boundaries between these terms are still unclear, due to the increased complexity underlying the subject of project management (ATKINSON *et al*., 2006). The concept of project is broadening, from an initial focus on large individual projects, with clearly defined objectives, to include projects that are multidisciplinary, whose objectives are not so clearly defined, are permeable and more subject to negotiation (ATKINSON *et al*., 2006).

The complexity of projects may come from different sources: the involvement of multiple stakeholders, the wide scope of the product being created, as well as the existence of multiple goals (WILLIAMS, 2002). According to Williams (2002), the greater the differentiation and interdependency (or connectivity) of the varied interrelated parts that constitutes a project, the more complex the project is. In addition, the assumptions upon which the tasks of a project are based are often unstable (JONES; DECKRO, 1993), leading to uncertainty, which is also an important component of project complexity (WILLIAMS, 2002).

Winter *et al.* (2006) argue that the complexity of projects is also increasing because organisations are facing the challenge to shift from the delivery of products to the generation of value and benefits. For

many organisations, the main concern now is no longer the capital asset, system or facility, but increasingly the challenge of linking business strategy to projects, maximising revenue generation and managing the delivery of benefits in relation to different stakeholder groups (WINTER *et al.,* 2006).

In the construction industry, the challenge of changing the focus to value generation has been increasingly discussed (SAXON, 2005). In order to achieve greater value, some companies are extending the traditional project lifecycle to include pre-bid and post implementation activities (BRADY; DAVIES; GANN, 2005). In traditional projects, the providers receive a request and their role is simply to deliver a built facility, which indicates the end of the project. By contrast, in some innovative project arrangements the providers have assumed new roles, such as supporting customers on the definition of what they want (BALLARD, 2008), and improving the product or system in use after delivery (BRADY; DAVIES; GANN, 2005). In this context, such organisations need to engage in a close dialogue with their clients to develop conceptual solutions based on their requirements. According Brady, Davies and Gann (2005), responsibility for success is shared, since providers and clients work jointly to plan, implement a solution and in some cases monitor on-going performance.

The focus on pursuing value has demanded different ways of organising projects and the need to rethink the role of construction projects in value generation. Winter *et al.* (2006) argue that the role of the industry in generating value is traditionally related to the creation and delivery of physical products: the development or improvement of a physical product, system or facility to specification, cost and time. The same authors argue that the understanding of value should exceed the boundaries of product creation and include the understanding of how these products contribute to client's business strategy and generate benefits also in relation to other stakeholder groups.

As a result, focusing on value generation poses a challenge to traditional project management approaches (THORP, 1998). While they focus on the delivery of a physical product, within time and budget; the expectation is that alternative approaches emerge to provide a better support in delivering projects that contribute to achieving strategic aims and generating benefits to different stakeholder groups (THORP, 1998; WINTER *et al*., 2006).

1.2. RESEARCH PROBLEM

This thesis was initially motivated by the identification of a practical problem with theoretical relevance. An urban regeneration programme being implemented in Porto Alegre, Brazil by the City Council, named City Entrance Integrated Programme (PIEC) was conceived with a focus on generating

outcomes. PIEC's major goal was to improve the quality of life of families living in a segregated area near the city entrance. In order to achieve that, this programme was divided into five projects that should be implemented simultaneously: housing, income generation, road infrastructure, landscaping and community development.

PIEC was planned by using the Logical Framework Approach (LFA), which have been developed for supporting the management of projects that have some degree of complexity. In fact, this approach attempts to integrate all the different parts of a complex project into a single coherent framework that can be discussed among key stakeholders for consensus reaching during the inception phase (SAVAYA; WAYSMAN, 2005). This approach aims to achieve a systemic understanding of the actions as well as external changes that need to happen to generate the desired outcomes (AUSTRALIAN GOVERNMENT OVERSEAS AID PROGRAMME - AUSAID, 2000). Based on that, a monitoring system is created to make sure outcomes are generated throughout project implementation (GRANT, 1997).

However, empirical observation of PIEC's implementation pointed out some major difficulties to achieve the expected outcomes. These were:

- Each project was being implemented in a separate and counterproductive manner, with expected effects of interdependent actions not being realised;
- The programme's organisational structure were not designed to deal with the high degree of interdependency between activities from different projects;
- Bureaucratic process for solving problems was a barrier for teams to collaborate;
- It was difficult to evaluate the programme's impact since the performance metrics used in programme emphasised the measurement of physical implementation;
- There was no monitoring system to support learning and the refinement of means to generate expected results;
- The City Council had no technical support from the supply chain, when changes needed to happen after suppliers have delivered their packages; and
- The intervention of some stakeholders whose perspectives were not considered in early design phases, caused rework and delays on project execution.

Some of these issues have been observed elsewhere. According to Bradley (2006) and Thorp (1998), a major reason for organisations failing to generate the expected benefits of investment is the difficulty of dealing with high levels of complexity. There is usually little understanding of the means to generate value, and little awareness that other interdependent changes are necessary for expected outcomes to

be achieved (WARD; DANIEL, 2006). The role of individuals in contributing for value generation is also generally poorly considered (THORP, 1998), as well as how some stakeholders can influence and even threaten projects' expected outcomes (WARD; DANIEL, 2006).

The complex relationship between project implementation and value generation represents challenges for traditional project management practices, which generally focus on deliverables rather than generating outcomes, or change (THORP, 1998). While traditional project management approaches have extensively contributed to the management of certain types of construction projects, these are not sufficient to deal with complex circumstances (WILLIAMS, 2002; KURTZ; SNOWDEN, 2003). Traditional managerial approaches do not properly consider that projects are situated in a social and political context, susceptible to an ever-changing sequence of events (WINTER *et al*., 2006). The complexity of social interaction and human action are overlooked, as well as the need to frame and reframe projects within an evolving array of social agenda, practices, stakeholder relations, politics and power (WINTER *et al*., 2006).

According to Koskela and Howell (2001; 2002), traditional project management approaches, mostly based on the PMBOK (Project Management Body of Knowledge) guide, are grounded on theoretical assumptions that are not adequate to cope with the current project management reality. The traditional view of project management considers that a group of sequential activities are necessary to achieve pre-defined objectives. Thus, project management is mainly dedicated to controlling those activities and reducing uncertainty that may affect the achievement of expected objectives (KOSKELA; HOWELL, 2001; ATKINSON *et al*., 2006; WINTER *et al*., 2006).

Forgues and Koskela (2008) also observe that many challenges to generate value from construction projects are also related to the way the industry traditionally operates. The same authors point out that the management of construction projects is based on highly fragmented sequential steps. Although a joint effort of different project participants is required to generate value, traditional project delivery approaches do not provide the structure or incentives for supply chain members to collaborate with each other (KOSKELA *et al*., 2006).

The understanding that alternative value management approaches were necessary to deal with complex projects led to the investigation of potential solutions being developed and implemented in the construction industry. The first one to be identified was the BeReal model, being developed and tested in the construction of healthcare facilities in the UK by Sapountzis *et al*. (2008; 2010) in a research project of the Health and Care Infrastructure Research and Innovation Centre (HaCIRIC), at the University of Salford, UK. The BeReal Model is based on the Benefits Realisation Approach (BRA), an

alternative approach to project management initially developed in the Information Systems and Technology (IS/IT) sector. The BRA emphasises the need to active manage the realisation of benefits expected from investments. In order to do so a continuous cycle is recommended: (a) envisioning outcomes; (b) implementing the necessary actions to achieve the outputs that will contribute for expected outcomes; (c) checking intermediate results; and (d) dynamically adjusting the path leading from investment to outcomes (SAPOUNTZIS *et al*., 2008). Thus, the BeReal model is an approach specifically developed for the construction industry, and brings the contributions of BRA to the management of construction projects. One contribution of the BRA to deal with project complexity is concerned with the systemic understanding of interdependent elements to generate a desired outcome (THORP, 1998). Also, the BRA suggests focusing on the aligning stakeholder interests through discussion and agreement and supporting project governance through monitoring benefits realisation (WARD; DANIEL, 2006). It is also recognised that the value proposition and means for achieving it are subject to change and further refinement, thus monitoring has also an important role in supporting learning and adaptation (FARBEY; LAND; TARGETT, 1999).

Another approach identified as a potential solution that was a set of managerial practices combined together under the name of Lean Project Delivery System (LPDS), which was being implemented mostly in the U.S. The LPDS has been implemented in the development of a number of projects with the support of the Project Production Systems Laboratory (P2SL) from the University of California. LPDS prescribes a set of core production management concepts and principles, in addition to computer modelling and relational forms of contracts (BALLARD, 2008). In the early phases of LPDS, Target Value Design (TVD) was the main technique used for value generation, being later combined with other managerial methods and tools (e.g. Set Based Design, team Co-location, Choosing by Advantages and Building Information Modelling). Together, those practices support teamwork, and highlight the importance of considering the iterative nature of the conceptual design, suggesting the simultaneous consideration of ends, means and constraints and incentivise teams to pursue continuous improvement (BALLARD, 2011). Also, the use of relational contracts provides a legal support for the collaboration among architects, general contractors, building owners and other key members of the supply chain, which enables early engagement, alignment of commercial interests, and the establishment of an integrated decision-making body (LICHTIG, 2006).

The approach used in the PIEC (project where the problem was identified) was also evaluated. According to the literature, the Logical Framework Approach (LFA) should provide support to deal with some kinds of project complexity (e.g. SAVAYA; WAYSMAN, 2005). Therefore, an evaluation was

carried out to identify to each extend the LFA provided support to generating value in such complex project.

Since the Logical Framework Approach started to be disseminated in the early 1970s, some empirical studies, e.g. Crawford and Bryce (2003) have been attempted to understand its contributions and limitations in terms of supporting value generation in complex construction projects. However, the same has not been observed for the Benefits Realisation Approach or the Lean Project Delivery System. As they are relatively new approaches, little evidence is found in the literature explaining why and how these approaches contribute to achieve greater value from complex projects (BALLARD, 2008). Ballard (2011) explain that the underlying concepts behind these approaches have not yet been fully described; neither the relationship between these concepts has been explained. In this sense, this research aims to contribute for the improvement of value generation in complex construction projects by analysing and revealing the conceptual contributions of those emerging approaches.

1.3. RESEARCH QUESTIONS

This research intended to answer the following questions:

- What are the challenges posed by project complexity regarding value generation in complex construction projects?
- How the three managerial approaches (LFA, BeReal, LPDS) may contribute for the advancement of the project management discipline, especially regarding value generation in complex construction projects?

1.4. RESEARCH OBJECTIVES

The main objectives of this research were:

- Develop a conceptual framework that reveals the conceptual contributions of three selected managerial approaches to improve value generation in complex construction projects; and
- Indicate the necessary changes for improving project management support to value generation in complex construction projects.

1.5. THESIS STRUCTURE

This thesis is organised in seven chapters. Chapter one presents the research background, the identified problem that motivated this research, the research questions and objectives. Chapter two describes the challenges to focus on value generation posed by traditional project management approaches. The chapter also indicates the necessary changes in project management for achieving greater value from complex projects. Chapter three presents the identified solutions in the literature and their potential contributions to deal with value generation in complex projects. Chapter four describes the method utilised in this research. Chapter five presents the findings of each empirical case, from problem identification and understanding to the evaluation of potential solutions. Chapter six presents the conceptual framework that reveals the underlying conceptual contributions of emerging practices to value generation in complex projects. Finally, chapter seven presents the conclusions and opportunities for future research.

2. VALUE GENERATION AND IMPLICATIONS FOR PROJECT MANAGEMENT

This chapter describes and explains the challenges for generating value from construction projects. First, the concept of value is discussed, as well as the challenges that focusing on value generation pose to project management practices. The need to improve managerial support for generating value is explained from a theoretical standpoint and the recommendations drawn from the literature are presented in a framework that summarises the required changes for improving value generation in complex construction projects.

2.1 THE VALUE CONCEPT

The concept of value has been discussed for a long time. More than 2300 years ago, Plato and later Aristotle were already debating about what is the true value of an object (HANEMANN, 2006). Nowadays, contributions to the value concept are myriad and studied under different disciplines, i.e. marketing, architecture, psychology, economy. In the construction literature, the value concept has been also discussed from different perspectives, i.e. architectural value, customer value, organisational values.

Regarding the economic perspective, Hanemann (2006) presents a brief historical perspective of the value concept. The same author emphasises that economic value was traditionally associated with market price. However, from 1970s, non-market valuation started to gain importance. Market price reflects the fluctuating circumstances of daily life, whether the vagaries of supply or demand, while *true value* is something more basic, enduring and stable (HANEMANN, 2006). According to the same author the definition of *true value* goes back to Plato: "*true value is intrinsic to the ideal form underlying the item"* and Aristotle: *"true value is intrinsic to the natural end the item serves".* According to Aristotle, the intrinsic value of an item arises from its inherent usefulness and ability to please man according to rules of reason. However, in 1588 Italian humanists started stressing the subjective human preference rather than objective human needs as the basis of true value (HANEMANN, 2006). Davanzati (1588) wrote that *"men seek happiness by satisfying their wants and desires, and they value items as these contribute to this end"*.

Aristotle also made a distinction between value in use and value in exchange. Nowadays, the modern concept of value in economics is mostly based on value in use and reflects a trade-off that has its roots on Dupuit (1844) and Marshall (1879) *apud* Hanemann (2006). According to Dupuit (1844) total value of a commodity is *"the maximum sacrifice expressed in money which each customer would be willing to make in order to acquire an object".* Similarly, Marshall (1879) defined the economic measure of a satisfaction as "*that which a person would be just willing to pay for any satisfaction rather than go without it".* Such definition was later brought by Monroe (1990) as a trade-off between benefits and sacrifices: *"buyers' perception of value represent a trade-off between the quality or benefits they perceive in the product relative to the sacrifice they perceive by paying the price"* (MONROE, 1990). Such definition establishes a relationship between value in use and value in exchange.

The discussion on non-market valuation has contributed to the development of different ways for measuring value. Hanemann (2006) points out that it became feasible to valuate resources that are difficult to assign value to, such as, for example, projects involving natural resources in the U.S. According to the same author, since the mid 1980s it has not been acceptable in the U.S. any more to perform a cost-benefit assessment of major water projects without including some non-market valuation of the project's environmental impacts. In some cases, public consultations led to decisions that valued environmental benefits over expanding capacity for water supply (WEGGE *et al*., 1996).

Within the context of governmental projects, other conceptualisations of value that consider their impact on society have been discussed: *option value* (WEISBROD, 1964), *bequest value* and *existence value* (KRUTILLA, 1967). Weisbrod (1964) explains that *option value* is related to uncertainty. The same authors illustrates such concept with the case of projects for preserving national parks in the U.S. Weisbrod (1964) observed that although some people do not use the parks they may still be willing to pay money to protect natural resources to preserve their option of using the park in the future. Using a similar example, Krutilla (1967) explains that *bequest value* brings the notion that people would be willing to pay because they want to preserve the park for future generations, whereas with *existence value* the notion is that some people obtain satisfaction from the mere knowledge that part of the wilderness remains.

The focus on generating benefits from projects for different stakeholder groups is also widespread in the programme and change management literature. Bradley (2006) and Ward and Daniel (2006) argue that benefits from projects can be defined as the outcome of a change that is perceived as an advantage by a particular project stakeholder or group of stakeholders. Winter and Szczepanek (2010) add that benefits for future generations should also be considered. According to Payne (2007), benefits can be

understood as improvements resulting from the implementation of projects towards one or more strategic objectives (OGC, 2007). Reiss *et al.* (2006) highlight that not only the realisation of benefits, but also the emergency of unexpected benefits or dis-benefits that are side effects of achieving the desired outcomes, needs to be managed.

The concept of *externalities* has also been discussed in economics in the context of project implementation. Rossi-Hanberg *et al.* (2008) evaluated the externalities of a residential urban revitalisation programme, providing evidence that sites that were outside but close to the targeted neighbourhood, also benefited from the increase in land value. Thus, the concept of externalities can be understood as the indirect effects (positive or negative) of a consumption or production activity on agents that were not directly involved in the activity (DURLAUF; BLUME, 2008).

Thorp (1998) emphasise that projects do not automatically generate benefits. There is a path from projects to benefits: projects create deliverables and the combination of these deliverables generates the capabilities that enable the desired benefits to be achieved (REISS *et al*., 2006). Programmes are vehicles for coordinating different projects and activities (REISS *et al*., 2006), and their success often depends on an adequate coordination among different projects and activities, as one project might only be successful if others are complete in a certain way (BARTLETT *et al*., 2006). Bartlett *et al.* suggest that projects are limited to delivering capabilities, which can be used to achieve the expected benefits. Those capabilities, when used, will contribute to project purpose, helping to fulfil one or more strategic objectives of organisations. If the purpose is fulfilled, then the benefits of investing in the project will be perceived. Conversely, if capabilities are not used they remain only a potential source of benefits (MAYLOR et al., 2006). Reiss *et al.* (2006) presents a diagram that shows the complex relationship between projects and the generation of benefits (Figure 1).

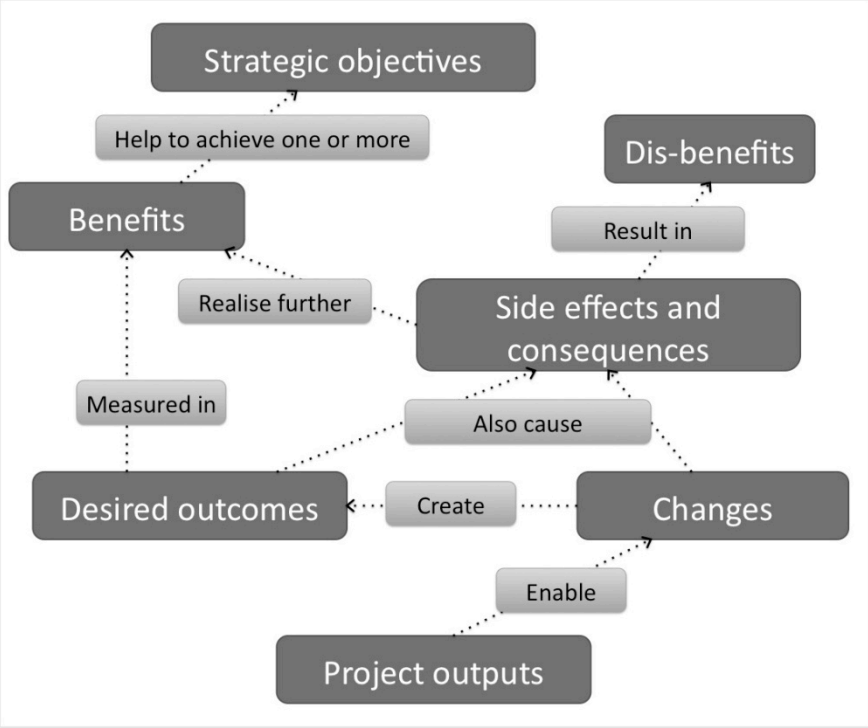

Figure 1: Path from project outputs to strategic objectves (Reiss *et al.*, 2006)

Zwikael and Smyrk (2009) argue that one of the causes for the lack of support to generate value from projects is the current understanding of the role of projects. According to the same authors, even though projects are central to the implementation of changes and generation of benefits for different stakeholder groups, there is still an understanding of projects as the delivery of an output (or artefact) with agreed quality, on time and within budget. A definition of projects as means for achieving an agreed goal and generating change, suggested more than 50 years ago, has been ignored since (ZWIKAEL; SMYRK, 2009). Only recently, the literature is offering a definition of projects in which meeting objectives, realising expected benefits from investments and effecting change represent the real rationale for a project (ZWIKAEL; SMYRK, 2009). Zwikael and Smyrk (2009) thus make a distinction between project outputs, which are the physical deliverables, and project outcomes that represent the change expected to happen when agreed goals are achieved.

Winter and Szczepanek (2010) suggest that projects should be understood as value creating systems. According to the same authors, projects are motivated by a purpose and that value generation should be understood beyond the traditional quality, time and cost triangle of traditional project management. Figure 2 presents a summary of the discussion about the need to shift the current understanding of the role of projects in generating value, based on Zwikael and Smyrk (2009) and Winter and Szczepanek (2008), illustrating how the different terms brought in the literature relate to each other. It shows the

traditional scope of projects and indicates that the fulfilment of a purpose is only achieved when project outputs or deliverables are used.

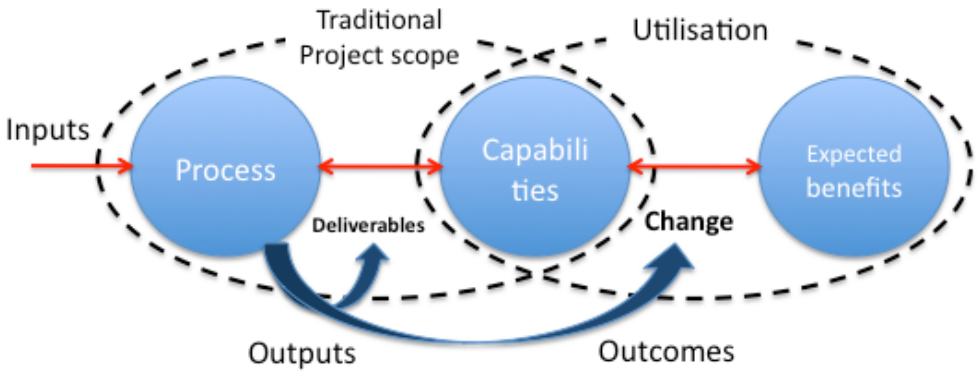

Figure 2: Difference between project outputs and outcomes (based on Zwikael and Smyrk, 2009 and Winter and Szczepanek, 2008)

In this sense, it is observed that the project management literature suggests a shift on the current understanding of the role of projects in generating value. Figure 3 summarises the change expected by the authors discussed in this section. The role of construction projects in generating value is discussed next.

Current understanding of the role of projects	Desired understanding of the role of projects	Ref.
Deliver products within agreed quality, time, costs Focus on what and how	Contribute to fulfilling the purpose of projects Understand why projects are being done	Winter and Szczepanek (2010)
Generate outputs (deliverables)	Contribute for generating outcomes (resulting from change)	Zwikael and Smyrk (2009)
Create capabilities from deliverables (possibility to use deliverables in a beneficial way)	Generate benefits from capabilities created (benefits are perceived when capabilities are used) to the different stakeholder groups	Thorp (1998); Bradley (2006)
Physical product is the end goal	Contribute to the strategic aim of organisations	Reiss *et al.* (2006)

Figure 3: Difference between project outputs and outcomes (based on Zwikael and Smyrk, 2009 and Winter and Szczepanek, 2008)

2.2 VALUE GENERATION IN CONSTRUCTION AND MANUFACTURING

The value generation concept in the construction industry has much influence from manufacturing. The rationale of the value generation concept of production is that the value of a product can be determined only in reference to the customer, and the goal of production is satisfying customer needs (LEVITT, 1960). The conceptual roots of the value concept from a production perspective emerged in the quality movement (KOSKELA, 2000). The customer-supplier relation, as described by Shewhart (1931) *apud* Koskela (2000), presents a relationship between customers, who have requirements, wishes and expectations; and suppliers, who deliver value to these customers by providing products and services that fulfill those needs (Figure 4). In construction, the design phase is critical for understanding customer's purposes and transforming them into product specifications (KOSKELA, 2000).

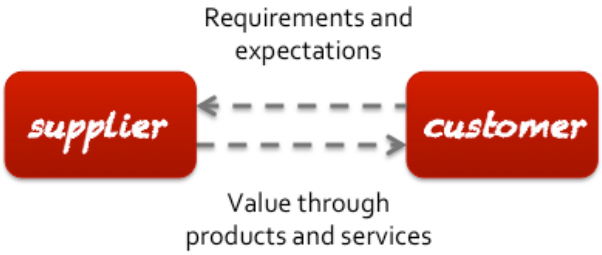

Figure 4: Conceptual scheme of supplier-customer relation

For Koskela and Ballard (2006), the role of project teams in construction should be to help clients to clarify their needs and purposes and fulfil them within project constraints, e.g. time, costs. Winch (2006) observes that perspectives of value may be contradictory among the different actors in a construction project coalition and between the project team and external stakeholders. In this sense, Emmit and Christoffersen (2009) stress the importance of discussing the expectations that each stakeholder have regarding a construction project. The definition of project purpose should be a collaborative effort in which suppliers help key stakeholders making better decisions about their needs, understanding constraints and the consequences of their requests (BALLARD, 2008). Client's needs should be understood as the purposes behind the investment in a construction project and, when defined, purpose fulfilment throughout the entire building lifecycle needs to be taken into consideration (BALLARD, 2008).

In manufacturing, a greater focus on the customer started to gain importance in 1980s (WOODRUFF, 1997). During that period, companies shifted from improving internal processes as the basis for

competition to understanding customer demand and focusing on fulfilling their needs. Gann *et al.* (2003) argue that in the 1990s, the construction sector in the UK was following a similar route. At the time, the measurement of project performance emphasised production efficiency. Thus, among the efforts to focus on value generation, was a research project to also include the quality of design as a way to assess performance (GANN *et al*., 2003). Such research resulted on a framework to evaluate project design based on their ability to meet a variety of physical, aspirational and emotional needs of occupants and users. Criteria for evaluating the projects were developed based on Vitruvius's definition of architectural values (GANN *et al*., 2003).

However, along with the design of the product, the design of the production system should also be considered as a vehicle for value generation. Womack and Jones (1996) pointed out the relationship between value generation and production efficiency. According to the same authors, for any product there is a price the market is willing to pay. By determining the market price and identifying the cost of production, producers became aware that their profit was a result of price less cost of production, rather than understanding price as the sum of cost of production plus profit. Fixing the price rather than the cost of production generated awareness that cost of production could be reduced to increase profit. By reducing the cost of production, greater benefits are generated downstream, either by increasing the producer's profit or by enabling them to offer the same product for a lower price. As a result, designing a production system based on increased efficiency can be a means of improving value generation. Other type of benefits that can be generated with increased efficiency in production is a reduction on environmental impact (KOSKELA; TOMMELEIN, 2009). Koskela and Tommelein (2009) suggest that by improving the efficiency of production systems in construction, less material ir wasted during the construction process, consequently reducing the environmental impact.

The relationship between value generation and production efficiency is, however, poorly discussed in the literature. One theoretical contribution that aligns the concepts of transformation, customer value and waste in production is the Transformation-Flow-Value (TFV) theory proposed by Koskela (2000) as opposed to the view of production only as a transformation of inputs into outputs.

Winch *et al.* (2003) and Saxon (2005) also point out the value of projects generated for those participating in the construction process. Saxon (2005) suggests that construction projects can contribute for generating value in different ways: value created by good product, the value released by good processes and the improved skills required of people to release both. Similarly, Winch *et al*. (2003) identified three different ways of perceiving value in construction processes: (a) the contribution that the building asset makes to the client's business processes; (b) the contribution that the construction

process makes to the supplier's business processes; and (c) the indirect contribution that the construction process and the building asset makes to the society as a whole. Emmit and Christoffersen (2009) illustrate different types of value that can be perceived from construction projects, distinguishing values perceived by those undertaking the construction effort, i.e. work ethics, communication, conflict solving, trust and by those assessing the final product, i.e. beauty, functionality, durability, suitability for the site and community, sustainability. Emmit and Christoffersen (2009) and Thomson and Austin (2006) developed different methods to support the elicitation of stakeholders' perspectives in construction projects. These methods were developed to support the discussion about the different types of value expected from a construction project, including value generated by the product and value created by the construction process. These methods were implemented in construction projects in the UK (THOMSON; AUSTIN, 2006) and in Denmark (EMMIT; CHRISTOFFERSEN, 2009).

Pearce (2003; 2006) also emphasise the social and economic value of construction projects. According to the same author, built infrastructure is an important asset that provides the capabilities to generate a nation's wealth and well-being. Pearce (2003) stresses the role that good design has on human health and increased quality of life, *i.e.* health improvements, sense of identity, good social relationships, reduced crime, higher productivity. The same author also illustrates externalities of construction projects that can represent negative impacts to society, such as carbon emissions and depreciation of human wealth because of accidents. Figure 5 presents a summary of examples discussed in the literature of different ways to perceive value from construction projects throughout its life cycle.

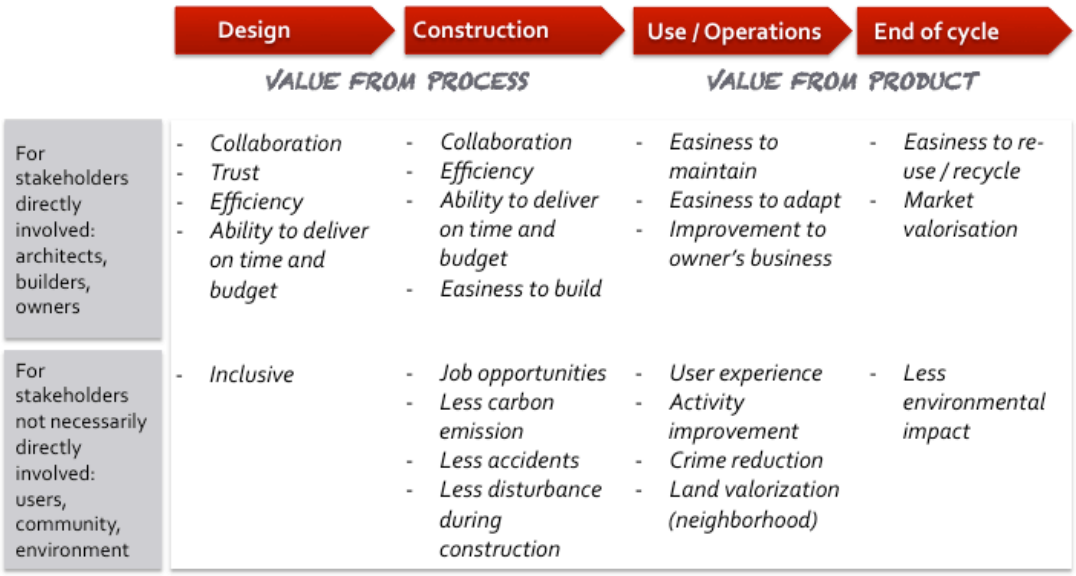

Figure 5: Ways to perceive value in the different stages of a construction project

The multi-facetted concept of value and the different vehicles that enable its generation pose implications to the management of projects. Challenges increase when projects present increased complexity (THORP, 1998). The characteristics of a complex construction project are discussed next.

2.3 COMPLEX CONSTRUCTION PROJECTS

Construction projects are typically characterised by the engagement of several separate and diverse organisations, such as consultants and contractors, for a finite period of time (BACCARINI, 1996). According to the same author, the greater the differentiation and interdependency (or connectivity) of the varied interrelated parts that constitutes a project, the more complex the project is. Williams (2002) suggests Thompson's work (1967) to understand the types of interdependencies (Figure 6): (a) pooled, in which each element gives a discrete contribution to the project, each element proceeding irrespective of the other elements; (b) sequential, where one element's output becomes another's input; and (c) reciprocal, where each element's output becomes inputs for other elements, so the actions of each must be modified to the actions of others. According to Williams (2002), the reciprocal interdependency is the one that intensifies project complexity, as they produce feedback effects that are counterproductive to the steady progress of a project as a whole.

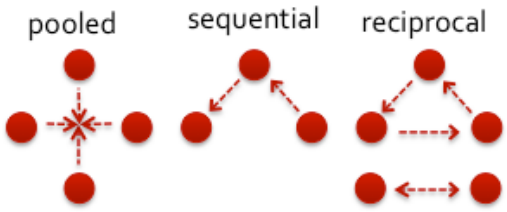

Figure 6: Types of interdependencies (THOMPSON, 1967)

According to Williams (2002), the complexity of projects can be understood in terms of structural complexity and uncertainty. Williams (2002) explain that structural complexity includes product complexity, objectives complexity and stakeholder complexity. Product complexity can be understood as the number of sub-systems of a product and their inter-relationships. Moreover, projects are generally multi-stakeholder, multi-objective and with conflicting goals. Uncertainty is another fundamental component of complexity (WILLIAMS, 2002). Uncertainty can be understood as the instability of the assumptions upon which the tasks are based (JONES; DECKRO, 1993).

There are two types of uncertainty that adds complexity to projects: how well defined the goals are and how well defined are the means for achieving those goals (TURNER; COCHRANE, 1993). When project

requirements are not frozen, uncertainty and change in requirements will mean that interfacing elements also need to change, leading to cross-impacts, rework and feedback loops, thus, increasing complexity (WILLIAMS, 2002).

Kurtz and Snowden (2003) summarise the characteristics of a complex system:

- It involves large numbers of interacting elements;
- The interactions are nonlinear, and minor changes can product disproportionately major consequences;
- The system is dynamic, the whole is greater than the sum of its parts, and solutions can't be imposed; rather, they arise from the circumstances. Referred frequently as emergence;
- The system has a history, and the past is integrated with the present; the elements evolve with one another and with the environment; and evolution is irreversible;
- Though a complex system may, in retrospect, appear to be ordered and predictable, hindsight does not lead to foresight because the external conditions and systems constantly change; and

Unlike in ordered systems (where the system constrains the agents), or chaotic systems (where there are no constraints), in a complex system the agents and the system constrain one another, especially over time. This means that we cannot forecast or predict what will happen.

Figure 7 illustrates some of the characteristics of highly complex infrastructure projects, based on Miller and Hobbs (2005). It summarises findings of the International Research Programme on the Management of Large Engineer and Construction Projects (IMEC), which included the examination of 60 large infrastructure projects, and reveal some major challenges for managing projects in complex situations.

	Description
Long front end	Long, complex and critical front-end phase of projects, which was observed to have significantly more impact on project performance than the downstream phases.
Developed in episodes	Front end was not a linear process, but involved iterative loops of formulating, testing, challenging and reformulating the project through a series of episodes (moments of investment and high level of activity and moments of low level of activity).
Embedded in institutional frameworks	Embedded in institutional frameworks and contribute for their creation and modification and vice versa. Important regulatory or institutional changes were a critical part of the project development process. Both become embedded in a co-determination process.
Governed by a dynamic social network	Absence of a binary relationship between project sponsor and the governing body. Project development, execution and delivery involve a large number of stakeholders in coalitions and alliances typically facing a series of governing bodies that play a role in project approval. A dynamic social network was observed, involving the different stakeholders engaged in the development, approval and project delivery.
High uncertainty	High level of uncertainty and high risk related to the innovativeness of projects and the length of time, which increases the exposure of emergent risks. Observed unforeseen high risk events include economic crisis, changes in the political landscape and partners encountering financial difficulties.
Multiple strategies	The absence of one unique stream of strategic resources to be deployed. Projects presented a variety of strategies deployed or a level of strategic depth that increased project performance. Such strategies for policy deployment however have to be flexible and adapt to emergent situations.
Strong leadership	The capability of the project sponsor/developer also influenced on project performance. Sponsors have to be strong, presenting ability to evaluate complex systems from multiple perspectives, have a integrative business perspective, present political and negotiating skills, the possibility of diversifying risk through different activities, will to abandon bad projects and ensure resources to support long development processes.
Intense scrutiny	Subjectivity to intense scrutiny, including evaluations by those providing funding and environmental and social acceptability evaluations through diverse mechanisms of public consultation.

Figure 7: Type Characteristics of large infrastructure projects (MILLER; HOBBS, 2005)

According to Miller and Hobbs (2005), large infrastructure projects are highly embedded on their contexts and influenced by a myriad stakeholders and different events. Project definition and planning processes have many iterative loops and do not follow a linear and continuous progression. Appropriate managerial approaches for such type of projects cannot detach the object of management and should see both project and its environment as a unique object of analysis. The decision-making structures are complex and uncertainty can be associated to the innovativeness of the proposals as well as to the length of development and implementation. Project managers rely on a collection of strategies to improve project performance, strong leadership and are subject to intense scrutiny, which needs to be properly managed (MILLER; HOBBS, 2005).

Rittel and Webber (1973) explain that one key characteristic of complex projects is the nature of the problem to be solved. Generally the exercise of planning complex projects involves dealing with better or worst solutions instead of right and wrong ones. In such projects, the nature of the problem frequently changes from the original one (RITTEL; WEBBER, 1973). Therefore, it is difficult to know whether the problem actually has been solved, as there is no stopping rule or ultimate test for the solution (RITTEL; WEBBER, 1973).

A similar discussion was brought by Simon (1981), arguing that humans have a limited cognitive capacity for reasoning when searching for a solution within a problem space at a given period of time. In the early 1950's, the term *bounded rationality* emerged to explain the idea that in decision-making, rationality of individuals is limited by the information they have, the cognitive limitations of their minds, and the finite amount of time they have to make a decision. Thus, in complex projects, decision makers tend to make their decisions based on satisfying solutions rather than the optimum solutions based on the limitations of the circumstances in a certain period of time and the information that they have (MARCH, 1978; SIMON, 1981).

2.4 CHALLENGES THAT COMPLEXITY POSE TO PROJECT MANAGEMENT

Traditional project management approaches consider that a group of sequential activities are necessary to achieve pre-defined objectives (ATKINSON *et al*., 2006; WINTER *et al*., 2006; KOSKELA; HOWELL, 2002). According to those authors, the assumption of a stable environment result in a focus on controlling these activities and attempting to reduce uncertainty that may affect the achievement of expected objectives. However, Atkinson *et al.* (2006) suggest that relevant solutions are easily identified in projects that present clearly understood objectives. Conversely, in complex circumstances, the scope is generally unbounded, the objectives are unclear and there tends to be little agreement on objectives amongst the parties involved, being difficult to determine what constitutes a good solution. A major problem with current project management approaches is that such complexity is not properly considered. The support given by project management textbooks, such as the PMBOK, assume that every project can be treated the same and prescribed with a standard managerial approach (WINTER *et al*., 2006; ATKINSON *et al*., 2006). Nonetheless, according to the same authors, such approaches do not provide the sufficient support to deal with the emergent nature of front-end work and human issues (WINTER *et al*., 2006). Project management should consider projects situated in a social and political context, highlighting the need to deal with the dynamics of this context, the complexity of social

interaction and human action and the framing and reframing of projects within an evolving array of social agenda, practices, stakeholder relations, politics and power (WINTER *et al*., 2006).

Crawford and Pollack (2004) use a *hard* and *soft* dichotomy to emphasise that projects have different natures and thus should be treated differently (Figure 8). While projects with well-defined objectives can be classified as *hard*, projects with objectives open to negotiation can be understood as *soft*. Crawford and Pollack (2004) explain that traditional project management approaches are generally focused on the *hard* characteristics of projects: objectivist, scientific approaches that are rooted in positivist and realist philosophies; while the soft characteristics are neglected: approaches based on interpretivist and constructivist schools of thought. According to the same authors, projects leaning towards a hard systems model generally present clearly defined and tangible objectives and generally are not susceptible to external influences. In such projects, technical performance and efficiency are priorities and managerial practices can be focused on monitoring and controlling. Conversely, projects leaning towards a soft systems model generally present intangible and ambiguously defined objectives, some might be highly subject to external influences or might present a variety of solutions. Generally there are multiple stakeholders involved and much negotiation and discussion are involved in the management of projects (CRAWFORD; POLLACK, 2004).

	Hard characteristics	Soft characteristics
Goal clarity	Clearly defined objectives	Objectives ambiguously defined
Goal tangibility	Tangible end product	Intangible results
Success measures	Quantitative measures	Qualitative measures
Project permeability	Not subject to external influences	Highly subject to external influences
Number of solution options	Refinement of single solution	Exploration of many alternative solutions
Participation and practitioner role	Expert practitioner, no stakeholder participation	Facilitative practitioner, high stakeholder involvement
Stakeholder expectations	Values technical performance and efficiency, manages by monitoring and control	Values relationships, culture and meaning, manages by negotiation and discussion

Figure 8: Hard and soft characteristics of projects (based on CRAWFORD; POLLACK, 2004)

Snowden and Boone (2007) explain that the fundamental problem of traditional managerial approaches is that they are based on assumptions grounded on Newtonian science and encourages simplifications that are only useful in ordered circumstances. By assuming a certain level of predictability and order in the world, those approaches fail when facing complex circumstances (SNOWDEN; BOONE, 2007).

Recognising that project managers have to face different types of circumstances, Kurtz and Snowden (2003) developed the *cynefin* framework. *Cynefin* is a Welsh word that means the multiple factors in the environment that influence our decisions in ways that are hard to understand (KURTZ; SNOWDEN, 2003). This conceptual framework was developed to support managers making sense of the complexities made visible by relaxing three assumptions that are not always true: order, rational choice and intentional capability (that the acquisition of a capability indicates intention to use it). Kurtz and Snowden (2003) explain that in ordered contexts the study of physical conditions enables the discovery of general rules that can be tested empirically to build a body of reliable knowledge, while in un-order contexts, such rules cannot be extracted. Such contexts are dynamic and constantly changing, so it is possible to pattern un-order, but not to assume order.

2.4.1 Contributions to project management theory

Koskela and Kagioglou (2005) explain that since the pre-Socratic period of philosophy, there have been two basic metaphysical standpoints: one holds that there are substances or things in the world; and the other suggests that there are processes, or intrinsically temporal phenomena. The Newtonian science is in alignment with a thing-based view of metaphysics, while Einstein inventions on relativity theory and quantum theory are aligned with a process-based view of metaphysics (KOSKELA; KAGIOGLOU, 2005). Thus, complexity science is also in alignment with Einstein's inventions and the process-based metaphysical standpoint (KURTZ; SNOWDEN, 2003). The fundamental problem of current managerial approaches is that these are based on assumptions grounded on a substance view of metaphysics (KOSKELA; KAGIOGLOU, 2005). Such a view emphasises mainly the decomposition of things to understand how they work, without properly considering how they are interconnected and change through time. Koskela and Kagioglou (2005) provide a list of knowledge domains related to the 'substance' and 'process' dichotomy. Figure 9 was developed based on that list emphasising the relevant domains that are discussed in this research:

Knowledge domain	Substance metaphysics	Process metaphysics
Contracts	Transitional contracts	Relational contract
Strategy	Strategy deployment	Emergent strategy
Decision making	Rational system	Emergent solutions
Planning & Execution	Action as plan realisation (push)	Action as response to context (pull)
Monitoring	Checking for deviations from plan	Monitoring for learning

Figure 9: Alternative domains based on substance/process dichotomy (based on KOSKELA; KAGIOGLOU, 2005)

According to Koskela and Ballard (2006), the underlying theory of management can be understood in terms of planning, execution and control. Such theory is traditionally grounded on the Newtonian science and considers planning as the core task of management; execution realised as a one-way communication (orders), and control based on the thermostat model, which suggests changing the performance level for achieving a predetermined goal in case of deviation (KOSKELA; BALLARD, 2006).

Koskela and Howell (2002) contend that *management-as-planning* is the approach prescribed in traditional project management guides, i.e. PMBOK. According to the same authors, *management-as-planning* establishes planning is the core function of management and the main assumption is that intentional activity is based on a representation of the world. Thus, management consist of the creation, revision and implementation of plans. This approach assumes a strong causal connection between the actions of management and outcomes of the organisation. By assuming that translating a plan into action is a simple process, it takes production plans to be essentially synonymous with action. An alternative approach is called *management-as-organising*. Here it is assumed that human activity is inherently situated, i.e. it is a response to the situation in question. Thus, the structured nature of the environment should contribute to purposeful acting. In this approach, management involves design, co-ordination and enabling of otherwise autonomous activities (KOSKELA; HOWELL, 2002), being focused on structuring the physical, political and cultural setting of action (KOSKELA; HOWELL, 2002).

Koskela and Ballard (2006) argue that project management theorists have been based mainly in the concept and principles of economics and social science. Such theories neglect the management of operational activities (KOSKELA; BALLARD, 2006). Thus, these authors support a production-based approach to projects, which offers theoretical foundations for projects (as production systems) and management. Johnson (2002) argues that while some managerial models conceive management as consisting of goal setting before the act of production, monitoring and correcting in a *management by result* (MBR) approach; production-based management considers a management by means approach – MBM (JOHNSON, 2002). In the MBM emphasis is on establishing the production system design before, managing its operation during and improving it after production (BALLARD; HOWELL, 2004).

Based on a production-based approach to project management, Koskela (2000) suggests a theoretical framework in which projects are not only considered from a transformation perspective, but also from a flow and value perspectives, which take into account time, variability and customer (KOSKELA, 2000). Nonetheless, Koskela and Kagioglou (2005) argue that production should be seen as a process, which is not the sum of activities but a continuum where the product (in its broad sense) changes states, which

are defined by human expectation, ability and technological capability. By conceptualising production in such a way, the focus is not only on the activity, but also on the interactions between activities, people and technology, which form a pattern that is governed by a multitude of factors.

Koskela (2008) suggests that Aristotle's proposal of a production science gives better support for understanding construction management. In the core of Aristotelian science of production lays the method of analysis and synthesis, as used by ancient Greek geometers (KOSKELA; KAGIOGLOU, 2005). Aristotle suggests a method of analysis, in which first the end is assumed and then it is considered how and by what means it is to be attained. This is a continuous process of envisioning the results or desired effects and searching for the means to achieve the desired effects.

Koskela and Kagioglou (2007) explain that the work of Simon (1981) have its roots on the Aristotelian science of production. Simon (1981) states that goals are only determined to motivate activity, which in turn will generate new goals. Thus, it is beside the point to ask whether the later stages of the development are consistent with the initial one. Each step of implementation creates a new situation; and the new situation provides a starting point for a fresh design activity (SIMON, 1981).

Simon (1981) argues that humans have a limited cognitive capacity for reasoning when searching for a solution within a problem space. The problem space faced by a project manager depends on how he/she represents the situation. The first step in any problem-solving episode is representing the problem, and to a large extent, that representation has the solution hidden in it (SIMON, 1981). A decision attitude carries with it a default representation of the problem whereas a design attitude begins by questioning the way the problem is being represented (SIMON, 1981).

Schön (1991) explains that design is as "a reflective conversation with the situation". This reflective practice is a process of active sense-making, in which actions are shaped to respond to a perceived situation and, in turn, reveal further knowledge of that situation. Thus, while in the process for developing a solution, new knowledge about the problem can be revealed, also changing the problem perspective and again the solution scope (SIMON, 1981).

Definition of goals is important as they supply the value premises that underlie decisions (SIMON, 1981). Value premises are assumptions about what ends are preferred or desirable. They help decision makers to make a distinction between better and worst alternatives. Value premises are combined in decisions with factual premises, which are assumptions about the observable world and the way in which it operates. Generally, participants higher in the hierarchy make decisions with a larger value component (what is going to be done), whereas lower participants are more apt to make decision having

a larger factual component (how it is going to be done). While goals can be validated only by consensus, means can be validated empirically. March and Simon (1958) argue that the definition of goals and means to achieve these goals can serve as a starting point for the construction of *means-ends chain*: defining goals, identifying the means, establishing those means as sub-goals and identifying the means to achieve these sub-goals and so on

Similarly, Koskela and Kagioglou (2007) explain the method of analysis and synthesis underlying Aristotle's theory of production. Aristotle suggests a method of analysis, in which first the end is assumed and then it is considered how and by what means it is to be attained. This is a continuous process of envisioning the results or desired effects and searching for the means to achieve the desired effects. In this sense, what is last in the order of analysis seems to be first in the order of becoming. Synthesis, in turn, provides the proof that the desired thing is possible. Differently, in this case, it is supposed that which was reached last in analysis to be already done, and arranging in their natural order as consequences, until the construction of the thing sought is achieved (KOSKELA; KAGIOGLOU, 2007). Thus, in analysis and synthesis, there are two directions of reasoning: backward for solution (analysis, resolution) and forward for proof (synthesis, composition).

Based on the work of Simon (1981), Boland and Collopy (2004) argue that management has too long been seen as consisting of decision making, whereas the alternative conceptualisation of management as design has been neglected. The decision attitude towards problems assumes it is easy to come up with alternatives to consider, but difficult to choose among them. The design attitude, in contrast, assumes that it is difficult to design a good alternative, but once you have developed a very good one, the decision about which alternative to select becomes trivial. While the rational decision making process, which assumes that all alternatives are known and are useful in stable situations, a design attitude should be adopted when such circumstances do not hold and all the feasible alternatives are not known (BOLAND; COLLOPY, 2004).

Considering a process view of metaphysics provides a better support to manage the interdependent activities in a construction project and steer the project to generate the desired results. The application of production-based concepts to construction and further development based on particular problems of that context led to the proposition of a lean approach for construction project management, which regards projects as temporary production systems (BALLARD; HOWELL, 2003; KOSKELA; BALLARD, 2006). Figure 10 summarises main differences from a production-based approach to project management to a non production-based approach project management perspective. Potential advantages that can be offered to deal with complex situations are highlighted.

Non production-based approaches	Production-based approach	Potential advantages in complex circumstances
Focused on transactions and contracts	Focused on the production system	Better considers how the project should be carried out and not only what should be carried out
Production as transformation	Production as transformation, flow and customer perspective	Enables to view interdependency among activities, understand inefficiencies and only produce what is valuable to a customer
Product and process defined sequentially	Product and process defined together	Enables to reduce error during project execution and design to improve construction efficiency
Decisions are made sequentially by specialists	Downstream players involved in upstream decisions	Enables the formulation of better assumptions based on experienced players, reducing uncertainty downstream
Not all product life cycle stages are considered	Design considering the entire product lifecycle	Better considers how design choices can affect future performance – better assumptions to guide design
Activities performed as soon as possible (pushed)	Activities performed as late as possible (pulled)	Accommodates uncertainty better as the later it gets in the process the more information becomes available about the circumstances
Buffers are located for local optimisation	Buffers are located to absorb variability	Focus on improving overall efficiency by considering the interdependency among activities
Separate organisations linked together through the market	Systematic efforts to reduce supply-chain lead time	Considers the interdependency among different suppliers to reach the desired results
Stakeholder interests are not aligned	Stakeholder interests are aligned	Efforts focused on the same direction, different parties contribute towards a common goal
Learning occurs sporadically	Learning is incorporated in project, firm and suppliers	Possibility to adapt to better cope with circumstances

Figure 10: Main difference between lean versus non-lean project management perspectives (based on BALLARD; HOWELL, 2003)

2.4.2 Contributions to the organisation of projects

Literature on organisational studies suggests that organisations can be means for achieving agreed goals (SCOTT; DAVIES, 2007). Scott and Davies (2007) explain that, from a rational system perspective[1], there are two characteristics that help distinguishing organisations from other types of groups: (a) the orientation to pursue relatively specific goals, in the sense that activities and interactions among participants are coordinated to achieve a clearly defined goal; and (b) a relatively high degree of formalisation, meaning that the rules governing behaviour are precisely and explicitly formulated to the extent that roles and role relation are prescribed independently of personal attributes and relations of individuals occupying positions in the structure.

[1] Scott and Davies (2007) explain that there are different strands of work in organisations studies: the rational, the natural

Through goal specificity and formalisation, organisations play a role of simplifying the decision-making process and supporting participants in the decisions they need to make (SIMON, 1997). A primary way in which organisations simplify decisions is to restrict the ends towards which activity is directed. An organisational framework limits individual options to a certain solution space, supporting rational behaviour (SIMON, 1997).

Scott and Davies (2007) explain that the main contribution to understand the problem of who should set the goals in an organisation was given by Cyert and March (1963). Cyert and March (1963) *apud* Scott and Davies (2007) argue that the goals of an organisation are set by a negotiation process that occurs among members of the dominant coalition. Coalitions are groups of individuals pursuing similar interests. Each group attempts to impose its preferences. Group members seek out as allies other groups whose interests are compatible and they negotiate and bargain with those groups whose interests are divergent, but whose participation is necessary. Each group whose interests must be taken into account helps to define the goals of the organisation (CYERT; MARCH, 1963).

In construction, challenges to generate value from construction projects are related to way the industry traditionally operates. Forgues and Koskela (2009) point out the historically fragmented and sequential approach to construction. Koskela *et al*. (2006) contend that the incapacity of the industry to move from a sequential to integrated design resides in the adversarial business context created by transactional contracting methods. In a transaction, the seller is bound to delivering to the buyer a specified outcome for an agreed price. Risk and responsibility of results are on the shoulder of the seller, who has no incentive for collaboration with other contract parties in defining the solutions that will best meet expected results. Matthews and Howell (2005) state that maximising value at the project level is difficult when the type of contract inhibits coordination, stifles cooperation and innovation, and rewards individual contractors for both reserving good ideas, and optimising their performance at the expense of others. Holding back good ideas, limiting cooperation and innovation, coordination difficulties and the pressure for local optimisation are some of the major problems with the traditional contracting approach (MATTHEWS; HOWELL, 2005).

Collaborative construction project arrangements have been the subject of many development efforts in response to the frustration toward the opportunism inherent in traditional contracting (LAHDENPERÄ, 2012). Lahdenperä, (2012) describes three multi-party contractual arrangements that are currently predominant in the industry: (a) project partnering, emerging in the US in the late 1980s and then used in the UK and Australia; (b) project alliancing, emerging in the UK in the mid 1990s and disseminated to

Australia; and (c) Integrated Project Delivery (IPD), emerging around 2005 and mostly popular in the US. These arrangements are based on relational contracting.

MacNeil (1969) *apud* Ballard and Howell (2005) introduced relational contracting as a transaction mechanism in which, responsibilities and benefits of the contract are apportioned fairly and transparently, with mechanisms for delivery that focus on trust and relationship. Colledge (2005) states that the shift towards more relational contracting relationships has been evident in the increase of project partnering agreements as a tool, together with the development of construction process relational tools such as project team goals, meetings and reviews. More importantly, the development of team-based incentives or reward mechanisms are often a feature of relational contracts, placing value on successful outcome rather than in cost, or quality reduction by one of the parties (COLLEDGE, 2005).

Multi-party contractual arrangements take a variety of approaches to change the commercial framework of risk allocation and compensation in order to better align the parties' commercial interests. By doing so, organisations are encouraged and rewarded to behave as a team towards the overall improvement of project performance (THOMSEN *et al.*, 2009). DTF (2006) summarises the key expected benefits of multi-party contractual arrangements:

- Focus on what is best for the project as a whole, since it creates incentives to align participant objectives;
- Improved ability to manage risks due to shared responsibility and incentive to be proactive in managing risks, in addition to collaboration between pool of resources;
- Early involvement of expertise leads to more informed decision making;
- Resources once used to administer contractual activities can now be used to achieve project objectives;
- Environment that encourages high performance and innovation;
- Collaboration among organisations provides development opportunity as they exposed to phases (and roles) not normally managed by their organisations;
- Owners can be more confident about the budget, as pricing of the project is more transparent and objectives are more likely to be achieved as partners are incentivised to achieve them; and

- Suppliers get superior returns for outstanding performance; a cap on exposure to risks; a broader and more effective level of influence on the project; and enhanced reputation if the coalition performs well.

In addition to that, such arrangements also establish an integrated governance structure in which integrated leadership play a critical role in turning aspirations and commitments of project participants into reality (DEPARTMENT of TREASURY and FINANCE – DTF, 2006). Project governance is concerned with the deployment of key players in workable organisational models. The World Bank defines governance as the process by which authority is conferred on rulers, by which they make the rules, and by which those rules are enforced and modified (THE WORLD BANK, 2012). Thus, Zwikael and Smyrk (2011) argue that effective governance demands the assignment of roles, responsibilities and accountability. Project leaders play an important role in deploying the project's vision and making sure expected benefits from investments are generated (ZWIKAEL; SMYRK, 2011).

Another contribution of relational contracts is to help mitigating socio-cognitive barriers between different teams (FORGUES; KOSKELA, 2009). Forgues and Koskela (2009) demonstrated that relational types of contracts can transform the dynamics of relationships between the client and the members of the supply chain and has a positive impact on the team's performance. Integrated projects need members of distinct organisations to solve particular problems of common concern and the alignment of commercial terms play an important role in establishing a common ground and a shared understanding of goals for the different contract parties (KOSKINEN; MAKINEN, 2009).

Moreover, according to Thomsen *et al*. (2009), bringing designers and the general contractor earlier on also creates a productive relationship as they work side-by-side, solving problems together and gaining insight into the other's workings. Forgues and Koskela (2008) points out that in such integrated models of project delivery the use of technology such as computer modelling can also support collaboration. Computer modelling can assist the effort for an integrated team, as people across disciplines are required to converge around this digital conglomeration to understand the interdependencies among building systems, i.e. structural, electrical, plumbing; and better coordinate them (THOMSEN *et al*., 2009). Bringing the key players in the supply chain together with the owner from the early stages of the project allow major players to develop a much higher level of common understanding of project goals (THOMSEN *et al*., 2009). The design moves forward with continuous input from builders and owners about cost, constructability, maintainability and value, which enable the formulation of better assumptions about the behavior of the system.

2.5 DISCUSSION

In this Chapter, some important aspects of value concept were identified:

- True value is perceived when a purpose is fulfilled (According to Aristotle's perspective presented by HANEMANN, 2006). Thus, in a construction project, there are myriad interdependent elements that need to be considered in a cause-effect relationship to fulfil the purpose of a project and achieve true value;

- Saxon (2005) and Winch et al. (2003) also make a distinction about value generated by the process, i.e. increased jobs for society, and by the product, i.e. improved user satisfaction;

- Reiss *et al.* (2006) alert for the possible side-effects to external stakeholders, or externalities, that can be generated while a purpose is being fulfilled;

- The perception of value is relative and subjective to individual perspectives (Bernando Davanzati cited by HANEMANN, 2006). The perspectives of different project stakeholders within the project coalition need to be considered and negotiated (CYERT; MARCH, 1963);

- The perception of value can be understood as a trade-off relationship between the benefits of use and sacrifices of acquiring a product (MARSHALL, 1879). This statement establishes a relationship between the means and goals of a construction project, as demonstrated by Womack and Jones (1996) and Koskela and Tommelein (2009); and

- Value should be understood as purpose fulfilment. The fulfilment of a purpose can be interpreted as the solution of a problem. Simon (1981) explains that if the understanding of the problem changes, the solution will change and with that the project's value proposition. Simon (1981) points out that the means for achieving a purpose are also subject to further refinement.

Challenges for focusing on value depend however on the complexity of the project. Complex projects require the use of managerial approaches that can cope with the structural complexity and uncertainty (WILLIAMS, 2002), which can be originated from different sources. Necessary changes to project management are suggested in the literature. These recommendations are summarised in Figure 11, which present and overview of the current vs. desired states of project management, regarding its support to value generation. Recommendations were categorised in four different dimensions:

Current state	Desired state	References	Dimensions
Role of project management is on delivering a physical asset within agreed quality, time and costs	Role of project management includes understanding how the physical asset will contribute to desired outcomes	Winter and Szczepanek (2010)	***VISION*** *Understanding value as purpose fulfillment*
Consider the perception of value at the point of acquisition	Consider whole life cycle of a project as means to generating value	Ballard (2008)	
Value as product quality	Considering constraints (e.g. time, costs) as part of solution scope	Ballard (2008)	
Understanding the role of projects as the delivery of outputs	Understanding the role of projects as means for achieving agreed goals (purpose fulfillment)	Zwikael and Smyrk (2009)	
Value as benefits	Value as a trade-off between benefits and sacrifices	Marshal (1879); Monroe (1990);	
Establishing a goal and breaking down into activities	Understanding the interdependency and flow among activities	Koskela; Kagioglou (2005)	***MEANS-ENDS CHAIN*** *Considering a means-ends chain to achieve goals (what and how)*
Product and process defined sequentially	Product and process defined together	Ballard and Howell (2003)	
Transformation model	Transformation - flow - value	Koskela (2000)	
Thing based metaphysics	Process based metaphysics	Koskela and Kagioglou (2005)	
Stakeholders that will be affected by change not involved	Negotiation of conflicting interests among different stakeholders	Winch (2006)	***BUILDING & SUSTAINING COMMITMENTS*** *Create a unit of purpose and common set of commitments*
Governance structures that reward individual organisations	Alignment of commercial interests	Matthews and Howell (2005)	
Managing as planning	Managing as organising	Koskela and Howell (2002);	
Team members motivated by self interests	Goals are negotiated	Cyert and March (1963)	
Objective human needs as the basis of true value	Recognising subjectivity of human preferences	Davanzati (1588)	
Goals are defined from the outset as final vision	Goals are set as starting points and refined as the project progresses	Simon (1969)	***REFINEMENT*** *Recognise that value proposition and means to achieve them are subject to further refinement*
Managing as plan execution and avoiding deviations	Managing supporting learning and continuous improvement	Koskela and Ballard (2006)	
Management as decision making	Management as designing	Boland and Collopy (2004)	
Understanding projects as linear systems, assumption of order	Recognising that some projects assume characteristics of a complex system	Kurtz and Snowden (2003); Williams (2002)	

desired change to focus on value generation

theoretical underppinings

Figure 11: Necessary changes to project management (comparison of current vs. desired state)

(a) VISION – Understanding value as purpose fulfilment

The literature suggests a new understanding for the role of construction projects in value generation: from the delivery of a physical asset to the contribution of change and generation of benefits to different stakeholder's groups (WINTER; SZCZEPANEK, 2010). Value generation should be understood as purpose fulfilment and the fulfilment of such purpose needs to be considered throughout the whole life of a construction project given the constraints imposed by available resources and time (BALLARD, 2008).

(b) MEANS-ENDS CHAIN - Considering a means-ends chain to achieve goals (what and how)

To understand the means-ends chain, Koskela and Kagioglou (2007) suggest the adoption of a method of analysis and synthesis, developed originally by Greek geometers. Simon (1981) suggests a similar method. The exercise involves understanding the cause-effect chain from means to desired results (SIMON, 1981). In order to support the development of cause-effect chains, assumptions about the behaviour of systems have to be made (SIMON, 1981). Thus, such process involves establishing the means to achieve an expected results and also confirming if selected means are generating the expected result, in a back and forth process (KOSKELA; KAGIOGLOU, 2007).

However, Koskela and Kagioglou (2005) alert to avoid substance view of metaphysics in which things are decomposed into parts to understand how they work. A production-based approach to management, as suggested by Koskela (2000) considers not only the transformation concept of production, but also flow and value. It considers not only what should be put in place for the results to happen but also how they should be arranged, considering their interdependencies and how they might change through time.

(c) BUILDING & SUSTAINING COMMITMENTS- Create a unit of purpose and common set of commitments

Forgues and Koskela (2009) also explain that the construction industry should move from the traditional sequential and fragmented approach to construction into a more collaborative one in which the industry is willing to the risk of proposing innovative solutions. Such scenario is being pursued through the alignment of commercial terms among different partners, including the adequate allocation of risks (MACNEIL; 1969); the use of tools that support collaboration among teams (THOMSEN *et al*., 2009); and joint decision making through an executive council which integrates representatives from the key parties involved (THOMSEN *et al*., 2009). The role of management should be in structuring the environment to support purposeful action (KOSKELA; HOWELL, 2002), Commitment here also includes the need to consider and manage the diverging interest of different stakeholders, within and outside the project coalition (WINCH, 2006).

(d) REFINEMENT - Recognise that value proposition and means to achieve them are subject to further refinement

Simon (1981) argue that a solution (or purpose fulfilment) is defined in relation to the problem it is trying to solve. If the understanding of the problem changes, the solution is subject to refinement. Similarly, the means to generate the desired solution are also subject to further refinement. As argued by Koskela and Kagioglou (2005) it should be recognised that a product, in its broad sense, is a continuum that changes state, defined by human expectation, ability and technological capability. In order to support change, the role of management should not be seen as plan implementation and avoiding deviations from plan, but incentivising teams to learn and pursue continuous improvement (KOSKELA; BALLARD, 2006).

3. MANAGERIAL APPROACHES TO IMPROVE VALUE GENERATION

This chapter presents the three managerial approaches investigated in this research project: the Logical Framework Approach, the Benefits Realisation Approach, which brings the underlying concepts of the BeReal model, and the Lean Project Delivery System. The approaches are described, their differences highlighted and contributions to value generation discussed in the end of this chapter.

3.1 LOGICAL FRAMEWORK APPROACH

3.1.1 Background and Description

The United States Agency for International Development (USAID), Practical Concepts Incorporated (PCI), and Team Technologies Incorporated were among the early designers and users of the Logical Framework Approach (LFA), in the early 1970's (GRANT, 1997). The LFA has become widely used by aid agencies as a project planning and appraisal tool (CIDA, 1997) and is now a pre-requisite for funding from many of the major bilateral and multilateral donor agencies (AUSAID, 2000).

According to AusAID (2000), the origins of LFA can be traced back to the 1960s, when Peter Drucker popularised the expression ''management by objectives''. Grant (1997) explains that the LFA provides an analytical tool for objectives-oriented project planning and management. The framework describes the logic behind the means for achieving the expected objectives. "*It is the 'If-then' sequence of changes that the program intends to set in motion through its inputs, activities, and outputs"* (AUSAID, 2000). As a result, this approach supports the production of a 5x4 matrix, known as the *LogFrame*, which organises the main steps necessary to achieve the planned objectives.

The *LogFrame* shows the most important aspects of a project for a quick and easy visualisation (GRANT, 1997), including: (1) Overall goal - higher-level objective towards which the project will contribute; (2) Purpose - the effect which is expected to be achieved as the result of the project; (3) Outputs - the result that the project management should be able to guarantee; (4) Activities - activities that have to be undertaken in order to produce the outputs; (5) Monitoring indicators - metrics to track if

the outcomes are being achieved; (6) Means of verification - what will be measured and how; and (7) Assumptions - events outside the project's control, but necessary for achieving objectives (Figure 12).

Narrative summary	Monitoring indicators	Means of verification	Assumptions
GOAL The higher-level objective towards which the project is expected to contribute			
PURPOSE The effect which is expected to be achieved as the result of the project			
OUTPUTS/RESULTS The result that the project management should be able to guarantee			
ACTIVITIES The activities that have to be undertaken by the project in order to produce the outputs			

Figure 12: The *LogFrame*

Although there have been numerous variations and adaptations since its conception, the fundamental structure and purpose of the *LogFrame* has remained unchanged (CRAWFORD; BRYCE, 2003). The vertical axis of the matrix presents a hierarchy of objectives and assumptions (or preconditions) based on cause-and-effect logic known as the ''vertical logic'' of the project. The horizontal axis of the matrix defines the means by which project progress can be verified at each level in the vertical logic and is known as the ''horizontal logic'' of the project.

The vertical logic of a strategy is tested by starting at the top of the first column of the *LogFrame* matrix and asking the question ''how is each level in the hierarchy to be achieved?'' or by starting at the bottom of the first column and asking the question ''why is this objective/action being undertaken?'' (JACKSON, 2001). The assumptions listed at each level in the vertical logic of the fourth column inject preconditions into the otherwise theoretical causality. In this way, the *LogFrame* indicates the assumptions for outcomes to be achieved, highlighting external factors that can threat the achievement of expected outcomes. At the outcome level, project management can be expected to exert some influence, however goal achievement requires an interaction of effective project management, effective project design and the accommodation of externalities. Another way of expressing this issue is the notion of necessary and sufficient conditions (AUSAID, 2000):

- Meeting the project outcomes is a necessary but not sufficient condition to attain the goal since the project is but one of a number of initiatives that may be required to address complex development issues;
- Producing the outputs is necessary but may not be sufficient to achieve the outcomes since other factors beyond the project's control are likely to have an influence; and
- Carrying out activities is necessary and should be sufficient to produce the required outputs, although some risks always exist.

The project description can be derived from the matrix by breaking down the chain of cause and effects (AUSAID, 2000). Figure 13 represents the "If-then" relationship that underpins the logic of the *LogFrame*.

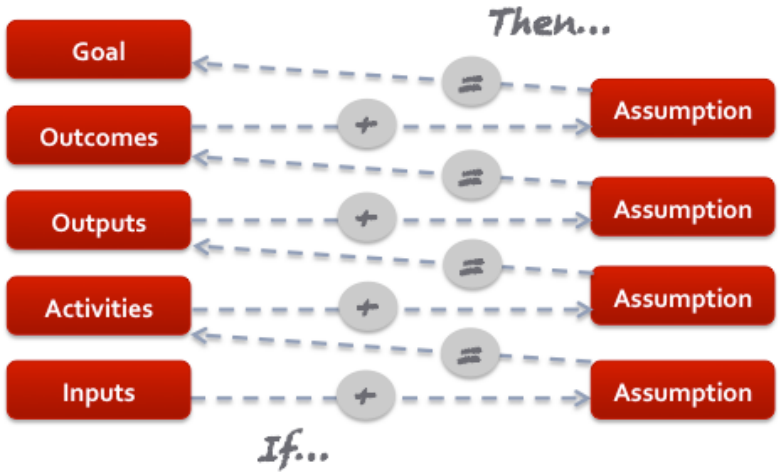

Figure 13: "If-then" relationship underlying the *LogFrame* (AUSAID, 2000)

AusAID (2000) explains that "If" inputs are provided, and the input-activity assumptions hold, "then" the activities can be undertaken. "If" the activities are undertaken, and the activity-output assumptions hold, "then" the project outputs will be produced. "If" the project outputs are produced, and the output-outcome assumptions hold, "then" the outcomes should be realised. "If" the outcomes are realised, and the outcome-goal assumptions hold, "then" the goal is likely to be achieved.

3.1.2 Advantages

According to Savaya and Waysman (2005), the *LogFrame* captures the linkages that exist in a programme, helping to uncover, articulate, present and evaluate a programme's assumptions. By making the logic explicit, practitioners not only improve the quality of their proposals but enable external

funding agents to have an understanding of their goals and how they intent to achieve them (SAVAYA; WAYSMAN, 2005). The same authors explain that the *LogFrame* helps stakeholders to reach consensus about the project plan as during the development of the framework, the need for aligning stakeholder interests can be revealed by the disagreements among them.

Savaya and Waysman (2005) explain that the main contribution of the LFA is the attempt to integrate all the different parts of a complex programme into a single coherent framework. The same author lists a series of expected advantages of using the LFA:

- It supports the analysis of fundamental questions and weaknesses of the implementation;
- It guides systematic and logical analysis of the inter-related key elements that constitute a project;
- It highlights the linkages among project elements and external factors
- It provides better basis for analysing the effects of projects
- It facilitates common understanding and better communication among the different stakeholders;
- If provides standardised procedures for collecting and assessing project information;
- It supports the continuity of projects when the original organisation staff is replaced;
- As more institutions use the framework, it facilitates communication among different governments and aid organisations; and
- The widespread use of the approach enables comparative studies to be carried out.

In a publication from the European Commission (2002), the LFA is presented as a support for the management of multiple projects within an aid programmes. That organisation follows a programme implementation in six phases: programming, identification, appraisal, financing, implementation and evaluation (EUROPEAN COMMISSION, 2002). The way in which aid projects are planned and carried out follows a sequence beginning with an agreed strategy, which leads to an idea for specific actions that are oriented towards achieving a set of objectives. The actions are formulated, implemented, and evaluated in order to support the improvement of future strategy formulation and further action (EUROPEAN COMMISSION, 2002). The methodology applied for planning, managing and evaluating projects is the Logical Framework Approach. The European Commission (2002) explains that the rationale for using the LFA is to:

- Analyse project's alignment an contributions for overarching policy objectives of the European Commission;
- Analyse project's relevance to an agreed strategy and to the real needs of target groups;
- Analyse project's feasibility, in the sense of proposing achievable objectives within the constraints of operating environment and capabilities of implementing agencies; and
- Analyse if projects will generate benefits that can be sustained.

3.1.3 Limitations

The widespread use of the LFA has enabled the realisation of studies to evaluate its adoption in practice (GRANT, 1997). Crawford and Bryce (2003) argue that generally, the LFA is used for designing programmes but abandoned after project financing. The same authors point out some reasons for that. Firstly, Crawford and Bryce (2003) criticise the absence of a schedule for implementation, which is crucial for monitoring. Secondly, the conventional *LogFrame* requires the project planner to establish indicators for tracking both project means (inputs, activities, outputs) and ends (outcomes, impacts). In practice, the selection of indicators to measure means is conceptually difficult and has observed to be meaningless. Crawford and Bryce (2003) give the example of a water and sanitation project in which one output was "20 boreholes drilled". The indicator is the *LogFrame* was "number of boreholes drilled". The same authors also criticise the absence of a baseline to compare the results.

Crawford and Bryce (2003) explain that the means of verification established in the *LogFrame* does not incentivise the project planner to think through the practicalities of the indicators selected. Both the indicators and the means of verification are set in such simplistic way that they may mask the complexity underpinning a monitoring system. Aspects such as who should be responsible for capturing data, how it will be collected and analysed, in what form and to whom it will be reported and the schedule for its collection are all frequently left undefined (CRAWFORD; BRYCE, 2003).

Savaya and Waysman (2005) also criticise the fact that the LFA is generally built at the beginning of project development and not revised or adjusted during the course of project implementation. The *LogFrame* generally represents a snapshot of the project strategy as foreseen during the planning phase (CRAWFORD; BRYCE, 2003). This problem is intensified by the nature of some projects in which many stakeholders are involved. In many projects, particularly aid ones, stakeholders that implement/monitor the progression and evaluate project impacts are different and might also change over time. The *LogFrame* do not support the creation of a common language nor a common tool for these different stakeholders to support organisational learning (CRAWFORD; BRYCE, 2003).

The Community Development Resource Association (CDRA), a non-governmental organisation for the implementation of social development programmes in South Africa explains that also points out the limitations of the LFA to deal with a complex situation. According to the CDRA, although the logical framework offers a comprehensive approach to tackling the management of complex projects, it is more effective when the final goal of projects is to deliver material products and resources rather than enabling change through social development.

The CDRA (2001) points out four major difficulties of using the LFA. Firstly, development projects are highly susceptible to the external environment, which is constantly changing. Such changes are very difficult anticipate. Using the LFA demands a great effort to simultaneously understand what is really happening and what would happen if things unfold according to plan. Secondly, the LFA suggests that by implementing the *LogFrame*, the expected impact will be achieved. Thus, checking if the planned activities in the *LogFrame* were implemented enables the measurement of impact. A stable environment is assumed, in which predictability is possible. However, those projects are generally implemented in very unstable environments and even changes in the organisation might happen during the implementation of a project. Thirdly, the measures provided for in the logical framework are ultimately concerned with quantity. There is little provision for a measure of impact beyond what can be counted. The focus of measurement is generally on the activity level. Finally, the LFA assumes that all the knowledge necessary for implementing the project can be hold in the framework. After the planning activity is carried out and documented in the framework, work is divided into the organisation's different functionalities and deployed in parts, even if the framework was devised in a participatory way. The nature of the LFA is to break elements of an intervention into smaller and smaller parts, with no subsequent practical or conceptual reintegration. Thus, the approach does not properly consider the need for further judgment, reflection, decisions and the need to view the wider picture during the implementation process.

3.2 BENEFITS REALISATION APPROACH

3.2.1 Background and Description

In the early 1990s, an approach named Benefits Realisation emerged in the Information Systems and Technology (IS/IT) sector, focusing the management of projects on the delivery of business benefits resulting from investments in technology (THORP, 1998). The Benefits Realisation Approach (BRA) intents to bring a greater awareness for stakeholders of what are the project benefits, who should be

involved in their realisation and what are the actions that need to be performed in order to achieve and maximise them (THORP, 1998).

Benefits Realisation is also an alternative way to perform investment appraisal, since investment proposals are generally assessed based on financial return, leading to a lack of support for project evaluation (WARD; DANIEL, 2006; FARBEY; LAND; TARGETT, 1999; IRANI; SHARIF; LOVE, 2001). Ward and Daniel (2006) explain that BRA is an approach that aims to implement the investments required for realising intended strategic objectives. The same authors argue that organisations tend to prioritise projects that provide short-term financial savings, over important project to achieve long-term strategic goals, but that provide intangible and non-financial benefits (WARD; DANIEL, 2006).

Farbey, Land and Targett (1999) argue that benefits realisation is the process whereby organisations attempt to predict, plan for, achieve and appropriate benefits which flow from the capabilities created by projects. It includes a process for appraisal and evaluation during the lifetime of a project. According to the same authors, benefits realisation management comprises a range of managerial activities designed to ensure that the organisation achieves the benefits that are expected from investments, while being able to recognise and manage unexpected ones.

Thorp (1998) explain that he need for managing benefits realisation is based on three premises:

- Benefits do not just happen. They don't just automatically appear when a new technology, for instance, is delivered. A benefits stream flows and evolves over time as people learn to use this technology.
- Benefits rarely happen according to plan: a forecast of benefits to support the business case for an investment is just an early estimate. It is unlikely to turn out as expected, much like corporate earnings forecasts. It is necessary to keep checking, just as with financial investments, that fluctuates in value on the securities market.
- Benefits realisation is a continuous process: it involves envisioning results, implementing, checking intermediate results, and dynamically adjusting the path leading from investments to business results.

Benefits realisation suggests a back-to-front approach, in which target benefits are determined to justify the proposed investment (BRADLEY, 2006). Bradley (2006) argues that although most organisations envision an end goal, frequently goals are stated reflecting the delivery of a capability, rather than fulfilling business objectives.

In addition, stakeholder commitment in this back-to-front approach is essential (BRADLEY, 2006). According to the same author, success is much more likely when stakeholders are engaged in formulating the vision or at least influencing the shape of the change, and where they can see clear value, either for themselves, or for the whole organisation.

According to Thorp (1998; 2003), a benefits realisation process goes beyond the design-develop-test-deliver cycle of conventional project management. It also includes the conceptual stage from upstream and the ultimate harvesting of end results at the other end of the cycle. Thorp (1998; 2003) and Ward, Taylor and Bond (1996) suggests that BRA is a continuous process of envisioning results, implementing, checking intermediate results and dynamically adjusting the path leading from investments to business results (Figure 14). This process includes all phases: investment decision-making, project management, delivery, implementation, monitoring and continuous adjustment. In contrast to traditional project management cycles, it reaches from "concept to cash" rather than from "design to delivery" (THORP, 2003).

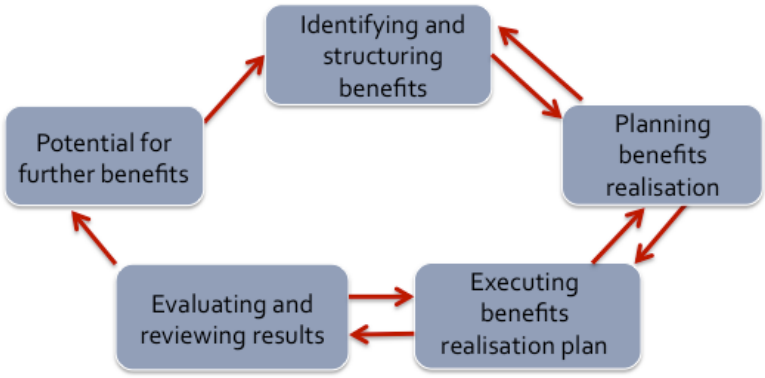

Figure 14: Cranfield Process Model of Benefits Management (Adapted from WARD; TAYLOR; BOND, 1996)

Thorp (1998; 2003) also suggests two main techniques to support a benefits realisation process: the development of a map showing the "result chain" and a period evaluation using the "Four Ares" framework.

The result chain supports programme design by improving the understanding of the linkages between investments and benefits in the benefits realisation process, and through the identification of the organisational changes that are necessary to occur (THORP. 2003). Figure 15 illustrates a result chain, which provides a road map for change.

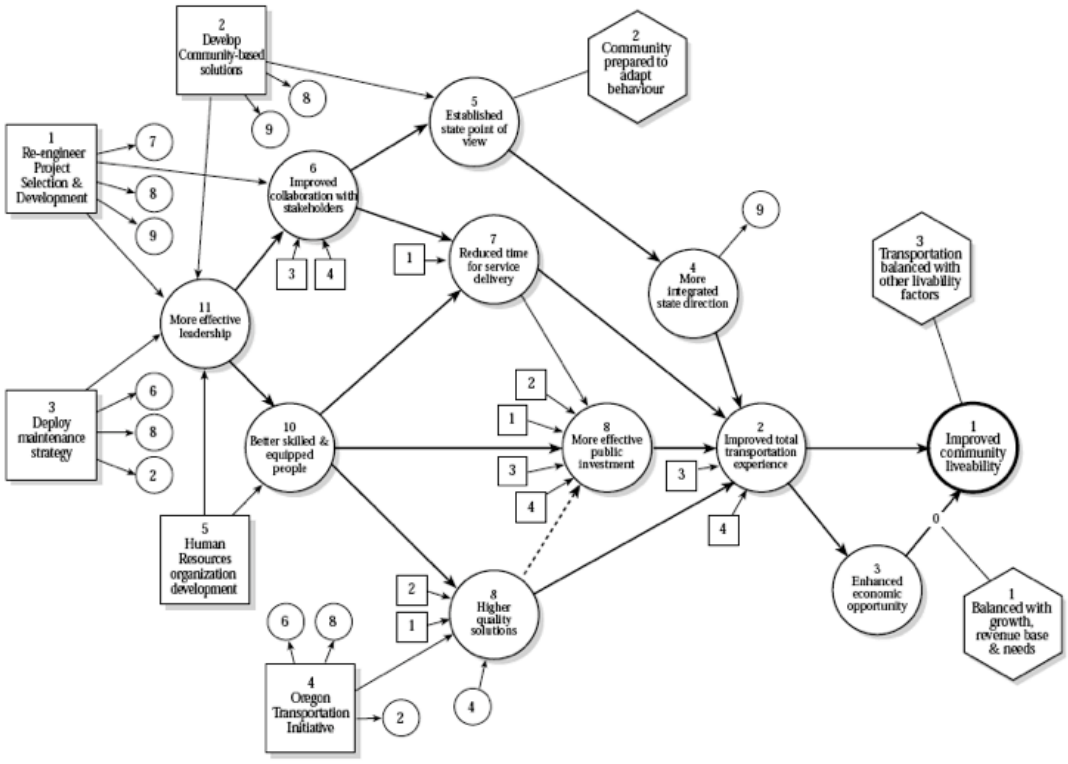

Figure 15: Result Chain (THORP, 2003)

In Figure 15, the circles represent the outcomes, including intermediate outcomes in the chain, as well as final expected outcomes (the result sought). The squares represent initiatives, or actions that contribute to one or more outcomes. The arrows represent the contributions, the roles played by elements in the result chain. And, finally, the hexagons represent assumptions regarding conditions necessary for the realisation of outcomes or initiatives but over which the organisation has little or no control. Assumptions represent risks in the achievement of desired outcomes.

The other suggested technique is the *Four Ares framework* to support decision-making regarding the relative value, including the opportunities and risks of the various paths within a programme. A structured framework is suggested in the form of four basic questions, the “Four Ares” (Figure 16). Thorp (2003) argues that organisations often base their decisions on superficial answers to the wrong questions. According to the same author, taking the time to formulate and ask the right questions and continuing to ask them throughout project implementation is critical to an effective benefits realisation process.

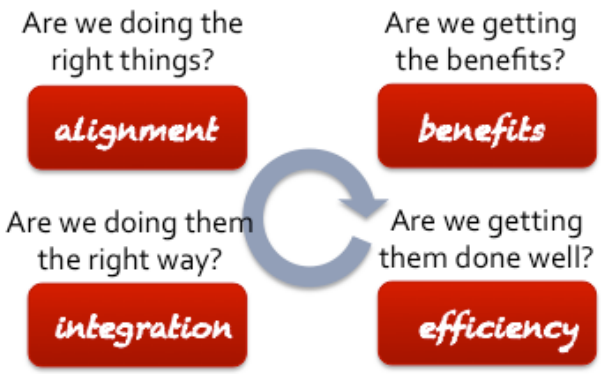

Figure 16: The Four Ares framework (Adapted from THORP, 2003)

Remenyi and Sherwood-Smith (1998) summarise the fundamentals of a benefits realisation approach into three distinct phases:

- Setting the course: this involves the development of sets of precise requirements under the headings of a business picture, a financial picture, and a project picture. Once these three pictures have been produced, a decision is made and an agreement reached as to whether or not to launch the project.
- Formative evaluation: this involves assessing the progress of the project. All stakeholders are able to develop views as to how the project is progressing and to exchange these views in open and constructive discussion. There are three possible outcomes: (a) updating the three initial pictures; (b) reforming the project if there are not sufficient funds, time or skills available; and (c) terminating the project if the project has, for one or more reasons became irrelevant to the organization's business requirements.
- Moving forward: this provides a feedback loop that should be available, not only during development, but also throughout the entire life of the project.

3.2.2 Guidelines to adopt BRA

At least eight different models for adopting BRA were identified in the literature, including the BeReal model developed by Sapountzis *et al*. (2008) for construction:

- Active Benefits Management by Leyton (1995) *apud* Farbey, Land and Targett (1999);
- The Cranfield Process Model of Benefits Management by Ward, Taylor and Bond (1996);
- DMR consulting's Benefits Realisation Model (1997) in Lin and Pervan (2001);
- The Active Benefits Realisation Approach by Remenyi and Sherwood-Smith (1998);

- Benefits Realisation Management in Managing Successful Programmes by the Office of Government Commerce - OGC (2007);
- Sigma's approach to Benefits Realisation Management (BRADLEY, 2006);
- Benefits Realisation in Integrated Service Improvement – NHS (2005); and
- The BeReal Model for healthcare infrastructure projects by Sapountzis *et al.* (2008; 2010).

Each model prescribes different techniques and tools for implementing BRA. The prescriptions suggested by these models and found in several textbooks about programme management and benefits realisation were summarised in Figure 17. By assigning different colours to similar prescriptions, three general topics were identified: (a) identify, engage stakeholders and agree on expected benefits and possible disbenefits; (b) develop and deploy plan to realise benefits; (c) maximise benefits through learning and adaptation. These major identified topics are further described below:

Considerations to manage benefits	Truax 1997	Ward et al 1996	CCTA 1999	Alhurst & Doherty 2003	Ward et al 2004	Mantzana & Themistocleous 2004	Farbey et al 1999	Bradley 2006	Barlett 2006	Ward & Daniel 2006	Glynne 2007	OGC 2007	Fox 2008	Ward & Griffiths 1996	Thorp 1998	Sakar & Widestadh 2005	Remenyi & Sherwood-Smith 1998	OGC 2003	Payne 2007	Reiss et al 2006	Bennington & Baccarini (2004)	NHS ISIP 2005
Ensure outcomes are related to strategic objectives									x			x			x							
Clearly define benefits at the outset		x										x			x							x
Ensure stakeholders are committed in realising benefits		x									x	x				x					x	
Ensure stakeholders will search for opportunities to maximize benefits												x								x		x
Drive the process based on measurements				x								x										
Track and report realisation of benefits and other achievements												x								x		
Use expected benefits as a roadmap for change												x										
Align programme benefits with stakeholders strategic objectives						x			x	x	x	x										
Ensure stakeholders are aware of and agree to face disbenefits		x			x								x									
Track disbenefits in order to reduce their impact			x										x	x								
Identify the nature of benefits through classification (enabling deeper analysis)						x		x														
Include assessment on intangible benefits on investment evaluation													x									
Track and proactively manage the emergence of unplanned benefits/disbenefits			x	x			x							x								
Proactive management of change	x														x					x		
Measure things that really count															x							
Making forecasts come true rather than making good forecasts		x																				
Engage stakeholders throughout the entire process																x	x					
Continuous evaluation if process is adequate to deliver benefits				x													x					
Identify opportunities to realise further benefits (and maximize them)			x	x										x	x					x		
Traslate objectives into measurable benefits that can be tracked		x										x						x	x	x		x
Ensure expected benefits of investments are achieved		x					x	x				x										x
Review and evaluate results and feedback into the process		x		x										x						x		
Review and evaluate results and feedback next projects				x																		
The path from investment to benefits must be effectvely planned		x									x	x										x
Identify how internal and external changes may affect the process		x																				
Continuously review the list of expected benefits to check strategic fit									x			x										

Figure 17: Benefits management prescriptions compiled

a) Identify, engage stakeholders and agree on expected benefits and possible disbenefits

Firstly, there is a need to prepare the organisation for benefits realisation, locating the project within the organisation strategy, examining business processes and identifying stakeholders and their

relationships, including external stakeholders that will be affected by the expected change (FARBEY; LAND; TARGETT, 1999). According to Bradley (2006), envisioning results should be a collective activity, since achieving success is much easier if all stakeholders are committed. The same author argues that the earlier this commitment is accomplished, smoother is the path to a successful outcome. People that will be affected by the change should be motivated and prepared for it (THORP, 1998).

The process of benefits identification should start when the project is initiated (FARBEY; LAND; TARGETT, 1999). According to the same authors, the organisation's strategies are the primary source for defining benefits. The role of project deliverables as a means of achieving specific benefits should be clear, as the focus of benefits realisation is on the extent to which benefits are being achieved rather than if the new capability is being delivered (KIPPENBERGER, 2000).

Ward, Taylor and Bond (1996) emphasise that not only benefits should be considered but what the authors call *disbenefits* of an investment, or the adverse impacts on a business or an organisation (WARD; TAYLOR; BOND, 1996). Fox (2008) criticises current investment evaluation techniques, which focus upon benefits and neglect the negative impacts.

For defining benefits, the OGC (2007) suggests the development of a Benefits Map and a Benefits Profile. The Benefits Map contains projects output or enablers to generate benefits, business change, intermediate benefits, end benefits and their link to strategic objectives. The Benefits Profile provides the baseline before measurement and details for the measurement their realisation.

b) Develop and deploy plan to realise benefits

OGC (2007) argues that the ultimate success of a programme should be judged by its ability to realise benefits and the continuing relevance of these benefits to the strategic context. Thus, benefits management moves forward from traditional investment appraisal approaches and focus on the active planning of how benefits will be realised and measured (GLYNNE, 2006). Making the link between project activities, deliverables and benefits is important to explicit the roadmap for change (THORP, 1998).

Ward, Taylor and Bond (1996) argue that the purpose of benefits realisation, when this process was introduced in IT *was not to make good forecasts but to make them come true*. In this sense, the Benefits Realisation Plan - including key assumptions and sensitivity and risk analysis of those benefits expected to contribute most to outcomes - should be seen as a major component of this decision-making process, being a roadmap for the programme and providing focus for delivering change (THORP, 2007). It is also important to set the aggregate of achieved benefits, expected benefits, costs-to-date and expected cost

against the business case; providing a crucial test of the on-going viability of the programme (OGC, 2007). OGC (2007) emphasises the importance of ensuring that business areas are committed to realising their defined benefits with ownership and responsibility for adding value (identifying opportunities for more or different benefits) through the realisation process.

There is a need to assess benefits both qualitatively and quantitatively (FARBEY; LAND; TARGETT, 1999). The same authors suggest a procedure of setting a baseline by measuring existing practice and then monitoring progress, and emphasise the need for prioritising benefits before monitoring, due to the costs of measurement. It is necessary to analyse when benefits will occur and define how they will be measured (WARD; TAYLOR; BOND, 1996). OGC (2007) highlights that providing realistic and usable measures for benefit realisation is not straightforward. Benefits may be owned by different parts of the organisation. Some benefits can be tracked using financial measures; others will need more complex measures, or indicators, to demonstrate their realisation. According to the same author, the main issues to be considered when establishing benefits measurement are: currency, accuracy and relevance, as well as the measurement of the before state in order to compare later on. The process of realising benefits should be driven, including benefit measurement, tracking and recording benefits (and other notable achievements) as they are realised (OGC, 2007).

Benefits monitoring compares project results with the benefits realisation plan during the project and assesses if any internal or external changes have occurred that will affect the delivery of planned benefits (WARD; TAYLOR; BOND, 1996). Thus, reviewing benefits is the process by which the success of the project in terms of benefit delivery is addressed; opportunities for the realisation of further benefits are identified; and lessons learned and opportunities for improvement in future projects are identified (ASHURST; DOHERTY, 2003).

When monitoring the realisation of benefits, Reiss *et al*. (2006) highlights the importance of considering tangible and intangible benefits. Also according to Bartholomew (1999) *apud* Sedera *et al.* (2001) tangible measures such as financial figures can very often be confusing and deceptive as the intangible assets of a business can often be worth more than those which are tangible. Reiss *et al*. (2006) state that whether relying on hard or soft benefits to justify the success of a programme the analysis must be rigorous, comprehensive and agreed by all key stakeholders. Furthermore, the same author argues that it should be possible to express all benefits in such way that their ultimate achievement can be established.

It is often difficult to convert a policy vision or a business strategy into detailed and measurable statements of expected benefits (BRADLEY, 2006). It can also be hard to realise and measure all benefits from an investment or change (BRADLEY, 2006). Some of the benefits may be secondary ones that were not expected and resulted indirectly from the changes that were made (FARBEY; LAND; TARGETT, 1999).

Ward and Daniel (2006) suggest that governance should be effective to support the organisation in a way that it does not waste its fund and resources on investments that do not adequately contribute to business. Governance should be applied to an organisation's investment in change, to support the realisation of benefits (BRADLEY, 2006).

c) Maximise benefits through learning and adaptation

According to Bartlett (2006), benefits monitoring is a long cycle: it starts with benefits planning and ends with benefits realisation. The benefits stated in the programme's business case are the result of an often-protracted period of benefits planning. Thus, by the time the business case has been signed off, the benefits as originally conceived may have been significantly diluted (BARTLETT, 2006). For this reason, a successful benefits management cycle needs to include periodic reviews to reconfirm the alignment of the project or programme with the organisation's strategic priorities and whether or not the anticipated benefits are sufficient to accomplish to organisations' strategic goals (NOGESTE, 2006). The Business Cases at both programme and project levels should be constantly monitored, reviewed regularly and updated as necessary (PELLEGRINELLI *et al*., 2007).

Progress should be monitored against business case, programme plan, benefits realisation plan and blueprint to identify potential improvements to enhance benefits achievement or minimise dis-benefits (OGC, 2007). According to the same author, there is also a need to confirm the alignment and integrity of the blueprint against the projects, activities and associated business changes needed to deliver the new capabilities and benefits. Adjustments may be identified from (OGC, 2007): (a) business operations that will use the project outputs are unstable, (b) forward plans are no longer realistic based on experience to-date, (c) external circumstances have changed, affecting the future course of the programme, (d) the programmes objectives have changed or been refocused.

In addition, the Benefits Profile should be managed and controlled as rigorously as costs, as it will need to be reassessed and adjusted as necessary during the programme (OGC, 2007). The same author suggests conducting regular reviews of the main benefits led by key stakeholders from the business or operational areas and facilitated by the programme. However, some projects may not contribute to

benefits in their own right, but they may be providing prerequisites for other projects that will contribute to realisation of benefits. Thus, linkages between enablers, improved capability and business outcomes should be clearly mapped and tracked over time (OGC, 2007).

Some benefits may not mature for some time after programme closure. A continuous improvement philosophy should be established such that the organisation is able to encourage further improvements in performance (OGC, 2007). There is a need to ensure that means are in place to continue to measure the benefits. Ward, Taylor and Bond (1996) highlights the importance of providing continuous feedback between the different steps within the process, as well as reviewing benefits and identifying potential for delivering further benefits.

3.2.3 The BeReal model

The BeReal model is being developed and implemented by Sapountzis *et al.* (2008; 2010) since 2006. According to Rooke *et al*. (2010), the BeReal model was designed to address a series of problems that arise on construction projects, including: (a) to identify customer needs correctly; (b) to optimise design to deliver best value to the customer; (c) to deliver a finished product that conforms to the optimum design; and (d) to evaluate the process and finished product and to use the evaluation as a basis for future improvement. The framework attempts to mitigate the need to manage the knowledge required to transform benefits into requirements in the project design phase, making sure such knowledge then is used to govern the production phase, and the project is properly monitored and evaluated based on the expected benefits and feedback provided with useful information (ROOKE *et al*., 2010).

A simplified version of the model, highlighting its different phases and where they are situated in a traditional construction project lifecycle is represented in Figure 18. The model is then described below, based on BeReal (2010).

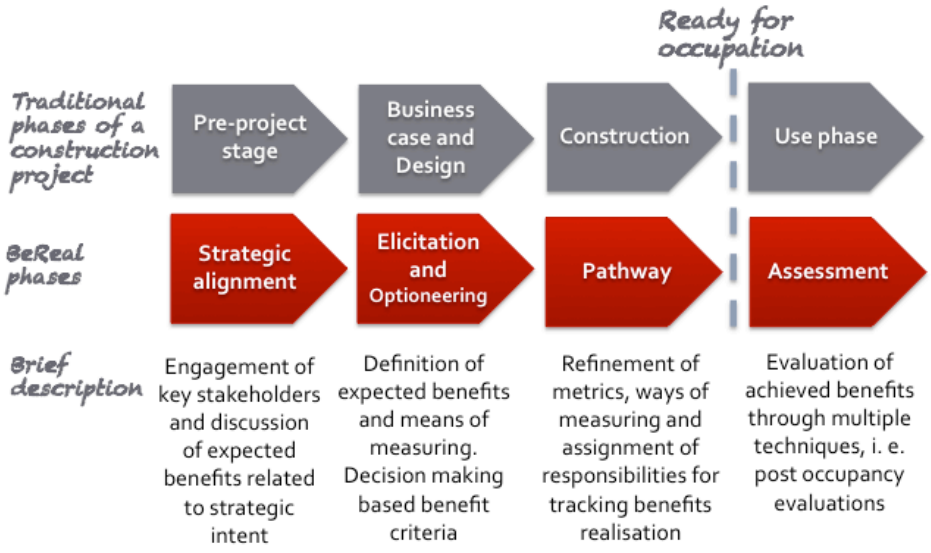

Figure 18: BeReal Process Lifecycle (based on BeReal, 2010)

a) Strategy Alignment Phase:

This phase brings together key stakeholder to build a collective vision of potential outputs and their impact on the programme and other business activities. A group of stakeholders is formed to translate high-level policy into realistic specific aims. A common understanding of the individual stakeholder potential benefits and disbenefits is pursuit in this phase. As a result, stakeholders get a list of strategic benefits, which characterise the purpose of the programme or project and provide an overall guide for its success. Criteria for the design brief are set based on strategic benefits, also providing focus for the project team.

b) Elicitation Phase:

The aim of this phase is to breakdown the strategic benefits into sub and end benefits. *Sub Benefits* are specific targets linked to the strategic benefits that support the evaluation of design options, while *End Benefits* are specific targets that enable performance to be measured. Such level of benefits is defined through workshops with targeted groups of stakeholders. As a result, benefits of different levels (and disbenefits) are classified and characterised. Also, interdependencies among them are shown. This enables to create an evaluation structure for design options.

c) Optioneering Phase:

At this phase, design options are judged based on expected benefits and availability of funding. Stakeholders work on optimising their requirements, by weighting and ranking them. Then, the result is

used to select a design option, understanding and agreeing on compromises within an identified timeline to realise benefits.

d) Pathway Phase:

At this phase, resources are allocated to specific benefits and associated activities. Stakeholders are engaged to agree on the pathway plan and set ownership for measuring and monitoring the realisation of benefits. The "*BeReal Case"* is a document that guides the pathway, it evolves during the delivery stage, can be used for a design assurance review, and also for guiding the operational phase.

e) Assessment Phase:

At the assessment phase, benefits are tracked and remedial action is taken as required. The assessment is carried out by interviews, questionnaires, post occupancy evaluation and other techniques. The *BeReal Case* is then updated with emerging measuring and monitoring outcomes. This phase should be seen as an on-going activity where stakeholders are engaged to assess the realisation of benefits.

3.2.4 Limitations

The literature on Benefits Realisation is mainly dedicated on prescribing methods and techniques to support its implementation. As it is a relatively new approach, emerging in the early 1990s, it was not found in the literature studies that evaluate its contributions to managerial practices (as found for the LFA). Only one limitation was found in the literature, pointed out by Farbey, Land and Targett (1999).

Farbey, Land and Targett (1999) observe that some BRA implementations have failed to generate the desired results. The reason for that was because benefits were planned *ex ante*, and evaluated *ex post*, assuming a stable environment (FARBEY; LAND; TARGETT, 1999). Farbey, Land and Targett (1999) argue that in a dynamic environment, where stakeholders values change, what is required is a process that includes a proactive search for opportunities and threats to benefits realisation. Thus, the same authors suggest that such approach should not only provide procedures for accountability and control, but also should enable the maximisation of benefits through learning and coping with contingencies (FARBEY; LAND; TARGETT, 1999). In this sense, two types of evaluations are indicated: summative evaluations, or evaluations for accountability, and formative evaluations, evaluations for learning (FARBEY; LAND; TARGETT, 1999).

3.3 LEAN PROJECT DELIVERY SYSTEM

3.3.1 Background and definition

The Lean Project Delivery System (LPDS) is a model for managing construction projects (Figure 19), which has been developed through research and application in the U.S. since 2000 (BALLARD, 2008). Recently, the model started focusing on the definition and design phases of projects, applying concepts and methods drawn from the Toyota Product Development System, most especially target costing and set based design. Those concepts have been adapted for use in the construction industry and integrated with computer modelling and relational forms of contract (BALLARD, 2008). In Figure 19, the scope of LPDS that was the focus of this investigation is pointed out. It is limited to the early phases of LPDS (named project definition and lean design).

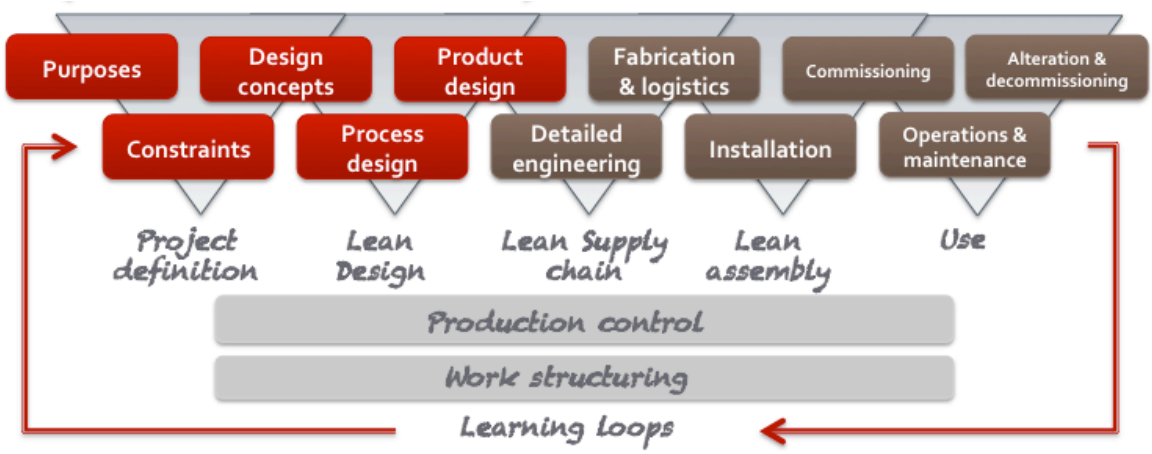

Figure 19: Lean Project Delivery System (BALLARD 2008)

3.3.2 Project definition

Project definition is the project phase that identifies the needs and values of project stakeholders, and develops appropriate design solutions to satisfy them (WHENTON, 2004). Project purposes are constructed through the interconnected relationships of stakeholder needs and values, the means to achieve their purposes and their constraints (Figure 20). Whelton (2004) explain that project definition is a learning process that requires a shared understanding in order to build a collective statement of project purpose. Ballard (2008) explains that alignment is achieved through a conversation that starts with the customer stating what they want to accomplish (or the project purpose) and the constraints on the means to achieving the ends. It is assumed that the project delivery team is not only responsible to provide what the customer wants, but also help the customer decide what they want. The facility and its delivery process are designed together to better reveal and support customer purposes. Thus, it is

necessary to understand customer purpose and constraints, to expose them to alternative means for accomplishing their purposes beyond those they have previously considered, and to help them understand the consequences of their requests. As a result, the process becomes iterative, in which the variables ends, means and constraints may change.

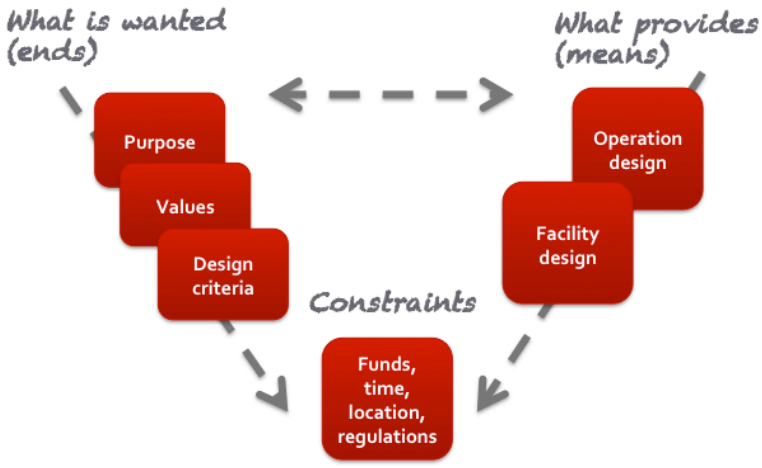

Figure 20: Project Definition Process (BALLARD 2008)

It is important to understand costumer's purposes to determine what features of the product are valuable and link them to design criteria and specifications. In order to identify the means for achieving a specific purpose, there is a need to understand how the facility will be used. Thus, ends, means and constraints are mutually determined and become progressively clearer through conversation (BALLARD, 2008). The project definition phase comprises business planning and validating the business plan and is realised through intensive collaboration and learning (WHELTON, 2004). The same author alerts for the role of the project manager in steering the process and insuring that all different stakeholder perspectives are properly considered.

The definition phase ends with the client decision to fund or not the project. If the project is funded, target values and constraints are set, and the design phase starts, guided by those targets (Figure 21). Ballard (2008) also explains that if the team is unable to develop a design that delivers value within constraints, business planning and validation should be reengaged. Also, problems with permits or licenses may require return to business planning.

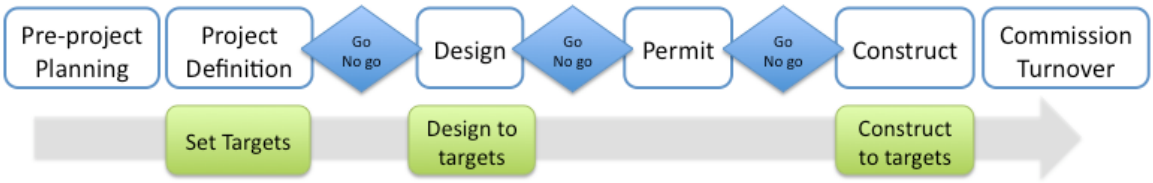

Figure 21: Project Phases and Targets (addapted from BALLARD, 2008)

3.3.3 Target value design

The origins of Target Value Design can be traced back to Toyota's Target costing approach. Originally introduced in Japan under the name of *Genka Kikaku*, Target costing is an approach to reduce the overall cost of a product over its entire life cycle, with the help of all the firm's department and the active contribution from the supply chain (KATO, 1993). Target costing has been defined as a *"system of profit planning and cost management that is price led, customer focused, design centered, and cross functional*" (ANSARI *et al*., 1997). In target costing, market price for a new product is not determined by adding a profit margin to cost (e.g. cost-plus approach), instead, an allowable cost is determined by a target price less an appropriate profit margin (KATO, 1993). Figure 22 illustrates the steps for determining and achieving the target cost.

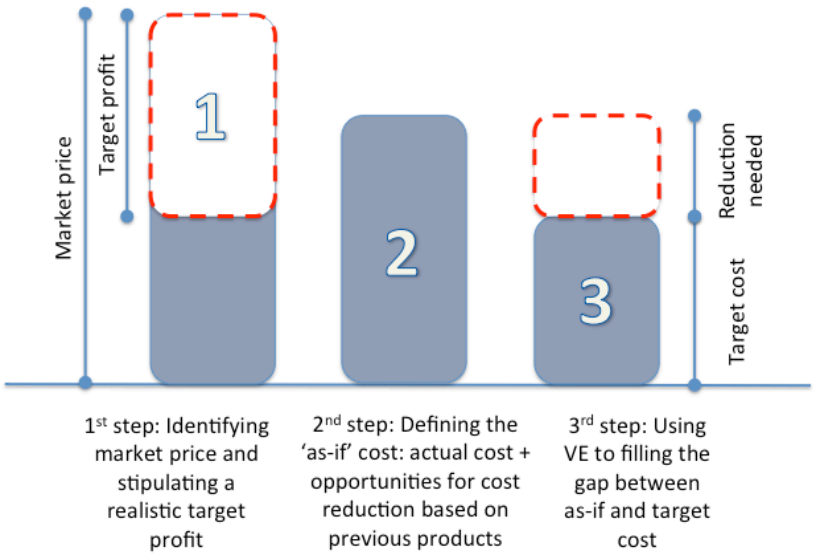

Figure 22: Steps for determining and achieving a target cost (based on KATO, 1993)

One fundamental technique supporting that approach is Value Engineering (VE). Nicolini *et al.* (2000) explains that VE is a systematic and multidisciplinary effort directed toward analysing the functions of a product, which provides a language for a client to collaborate with the supply chain in defining what

value is attached to different aspects of the performance specification, and then offers a structured way for pooling information on the cost and functional impact of design options, so that collective decisions can be made.

In the construction industry, one of the first attempts to implement target costing was in the UK, on two military housing projects (NICOLINI *et al*., 2000). The same authors argue that it is a challenge to implement such an approach in the construction industry, given the industry-level fragmentation, the culture of companies being "adversaries" and the traditional cost-plus approach used in construction industry.

One of the first successful cases reported was the construction of St. Olaf's College in Northfield, Minnesota, completed in 2002 (BALLARD; REISER, 2004). The successful implementation of such approach by US companies has lead to the publication and revision of Target Value Design benchmarks since 2005 (e.g. BALLARD, 2008; 2011).

In the US, the construction industry adopted the name of Target Value Design (TVD). Macomber *et al.* (2007) explain that the term "cost" was replaced by "value design" to emphasise that construction projects are not limited to cost and that the delivery of value to customers is paramount. Ballard (2008) also describe the role of TVD on contributing for a better consideration of operational costs and the efficiency of buildings through life. However, despite of the attempts to expand the focus of TVD beyond costs, the targets on a TVD process, as applied in the construction industry in the U.S. are generally set according to what the client is able and willing to spend.

The Target Cost is what the team commits to deliver and is typically set below the expected cost in order to spur innovation beyond current best practice (BALLARD, 2008), design and construction are then driven to meet those costs. Institutional clients often are less concerned to recover funds once budgeted, and so tend to set targets in terms of value-adding scope to be delivered for a given cost (BALLARD, 2008).

The TVD process starts with clients identifying allowable cost based on minimum acceptable return on investment or maximum available funds, preferably derived from an operations model (BALLARD, 2008). Clients must specify how much money and time they are able and willing to spend to obtain life cycle benefits. The expected cost is then the estimated cost of the project based on current best practice and is calculated through market benchmarking during business case validation study. The expected cost should not exceed the allowable cost. If it does, the business case has to be either

revisited and revised, or abandoned. Finally, the target cost is set below the expected cost to spur design innovation (BALLARD, 2008):

Allowable cost ≥ *Expected cost* ≥ *Target cost*

Target Value Design (TVD) proposes a set of changes in the traditional design process (MACOMBER; HOWELL; BARBERIO, 2008):

- Rather than estimate cost based on a detailed design, design based on a detailed cost estimate;
- Rather than evaluate the constructability of a design, design for what is constructible;
- Rather than design alone and then come together for group reviews and decisions, work together to define the issues and produce decisions then design to those decisions;
- Rather than narrow choices to proceed with design, carry solution sets far into the design process; and
- Rather than work alone in separate rooms, work in pairs or a larger group, face to face.

Ballard (2011) explain that in practice, TVD is implemented with the support of other managerial concepts drawn from the Toyota Production System and used in the early phases of the LPDS. However their relation to TVD has not yet been described or assessed in the literature. Among these practices, Ballard (2011) highlights Set-Based Concurrent Engineering; the application of principles behind the Last Planner System in the design phase; tools such as Choosing by Advantages to support the selection of design alternatives and A3 reports as a format to present proposals and the role of computer modeling. A literature review of past case studies that included the analysis of the LPDS early phases in practice enabled the identification of relevant concepts and tools, which are described below.

3.3.4 Set-Based design

Ward *et al.* (2005) explain that set-based design is a reverse approach from what is currently done in the manufacturing industry. Generally, design is carried out in a point-based-approach, or in a sequential manner, in which the one single satisfactory design solution is chosen upfront to be refined (Figure 23). Conversely, in set-based design, decisions are delayed to allow multiple alternatives to be developed. These set of alternatives are gradually narrowed down by eliminating inferior alternatives until a satisfactory solution emerges (WARD *et al*., 1995).

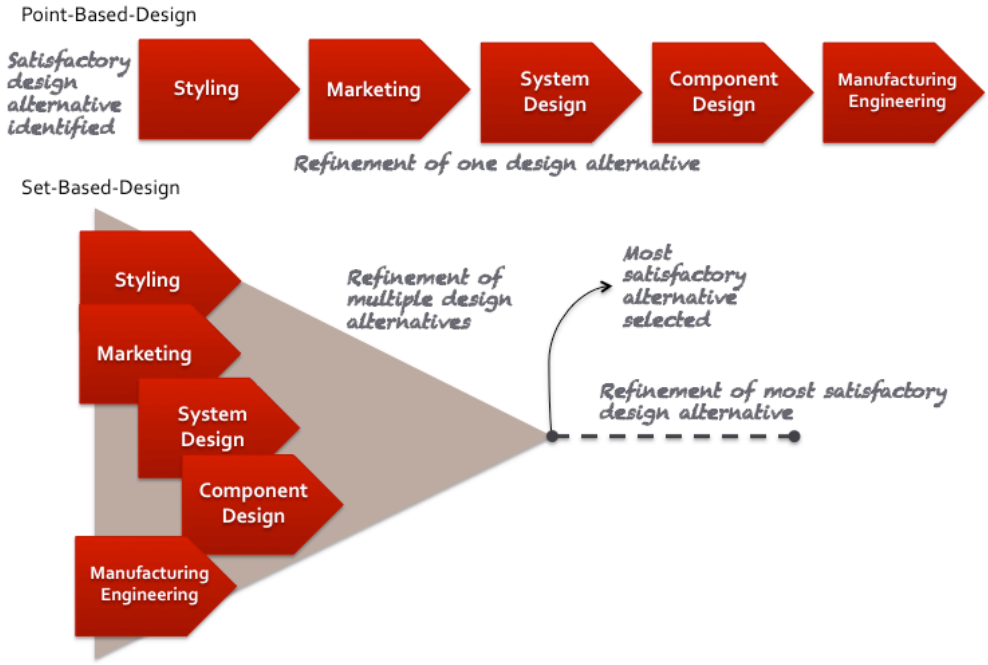

Figure 23: Point-based-design vs Set-based-design (based on Ward *et al*., 1995)

In point-based-design, the team generally commits to one design option upfront and the chosen solution is gradually detailed in a sequential process. The feedback loops occur, but feedback from downstream teams can only contribute for incremental modifications as the team has committed to that single option early in the beginning of the design process (SOBEK II *et al*., 1999). Conversely, the Set-Based Concurrent Engineering approach is based on three underlying principles (SOBEK II *et al*., 1999): (a) definition of a scope of possible solutions based on satisfaction criteria agreed by stakeholders and exploration of multiple alternatives within that scope; (b) finding the best solution for the overall system and developing solutions that are robust, so design can progress and adjustments be made downstream; and (c) fully evaluate the feasibility of solutions before making a commitment.

3.3.5 Choosing by Advantages and A3 reports

Parish (2009) explains and describes how A3 reports and Choosing by Advantages (CBA) have been used in the development of a healthcare project in the U.S. to support the adoption of LPDS during the design phase. A3s and CBA helped the project team navigate the set-based design process, both in terms of generating alternatives and eliminating them (PARISH, 2009).

Choosing by advantages is an approach to support sound decision-making using specific comparisons of advantages of alternatives (SUHR, 1999). The approach was developed by Suhr (1999) for the Forest Service with the intent to support resource allocation decisions involving multiple stakeholders.

CBA is a system for a team to evaluate alternatives based on the context of the decision (SUHR, 1999). CBA forces the team to anchor their decisions to relevant facts (SUHR, 1999). Thus, when sufficient detail exists to distinguish differences between alternatives, the team can begin to make evaluations. Moreover, CBA requires use of a single scale of importance, so the team can understand trade-offs of the importance of one advantage relative to another, and on that basis compare alternatives. Choosing by advantages is an approach that enables the consideration of the need to consider multiple alternatives and reach consensus among stakeholders on what is the most satisfactory solution that will contribute for the project as a whole, which are principles suggested by Set-based concurrent engineering.

A3 reports are used by Toyota as communication tools (MORGAN; LIKER, 2006). At Toyota, developing an A3 report is a discipline. Its purpose is not only to produce a piece of paper that documents a Plan-Do-Check-Act cycle (the scientific method); more importantly, it is to support people within an organization as they explore options and develop arguments for discussion. The intent of A3 reports is to document, support learning and support the implementation of the scientific method (SHOOK, 2008). Parish (2009) describes how A3 reports have been used to support the decision making process in the design phase of healthcare facilities in the U.S. by engaging different stakeholders to discuss an specific issue during the design phase, and documenting on a A3 format, which summarises the issue encountered, the solutions explored and the decision taken to solve the problem.

3.3.6 Co-location of teams

Ballard (2011) emphasise the role of co-locating teams to improve communication and collaboration during design efforts. An explanation for the improvements in collaboration and communication due to co-location was found in Emmitt and Gorse (2007). Emmitt and Gorse (2007) define communication as ‘the sharing of meaning to reach a mutual understanding and to gain a response’. Thus, there is a need for interaction between parties and a specific context for the interaction to become meaningful (EMMITT; GORSE, 2007). Thus, specialists within the same profession communicate effectively because a special language or context has been developed (a system of meaning). However, given the organisation of construction projects with multiple specialist and stakeholders, who often meet for the first time, communicating is much more challenging. Knowledge about other participants’ knowledge must first be established and relationships must be built before effective communication can take place (EMMITT; GORSE, 2007). Research suggests that face-to-face meetings are still the preferred communication form to resolve problems and conflict (EMMITT; GORSE, 2007). In order to work effectively, project participants need to spend some time interacting and thereby gain knowledge of

other participants' expertise, so that roles and responsibilities for problem solving can be established (EMMITT; GORSE, 2007). Over time, groups develop norms and agreed rules, which to a large extent can structure behaviour and seem vital for effective group work (EMMITT; GORSE, 2007).

3.3.7 Adoption of Last planner system to coordinate design efforts

The Last Planner system (LPS) of production control is used to support the management of construction projects. Although it has originated as an attempt to control production in construction projects, the LPS functions align closely with the theory and practice of production control in manufacturing and in product development, especially with Toyota's Production System and Product Development System (BALLARD *et al*., 2009). According to the same authors, the principles of the LPS can be summarised as follows: (a) plan in greater detail as you get closer to doing the work; (b) produce plans collaboratively with those who will do the work; (c) reveal and remove constraints on planned tasks as a team; (d) make and secure reliable promises; and (e) learn from plan failures.

The Last Planner System originated in 1992, in the discovery that only 54% of tasks on weekly work plans were completed on average on numerous projects of seven highly regarded construction companies (BALLARD; HOWELL, 1998) and the realisation that the root cause was poor work flow reliability. The need for personal commitments was then identified, to make sure that tasks that were prerequisites for subsequent tasks would be performed in a timely manner, improving the reliability of workflow.

Applying the principles "to plan in greater detail as you get closer to doing the work" and "to produce plans collaboratively with those will do the work" led to collaborative production of phase schedules. Incorporating the experience and knowledge of those responsible for doing the work being scheduled was expected to yield schedules with higher anticipation of needed tasks and better sequence of tasks. Thus, the LPS have been used in the design phase to properly coordinate the involvement of the diverse parties that need to collaborate in order to develop design solutions (BALLARD, 2011).

3.3.8 The role of computer modelling

According to Eastman *et al.* (2008), the use of computer modelling in construction enables the simulation of later stages of building use and thus is contributing to a more holistic analysis of building performance through time. Due to better appreciation of design at an early stage, and also due to the early functional evaluation of design against performance requirements such as energy, acoustics, wind, thermal, etc, Computer modelling is allowing the achievement of a higher quality end product, which is also more consistent with design intent (EASTMAN *et al*., 2008). It is not only being used to better

predict the behaviour of the building during use phase but enables to simulate construction phase and solve potential problems prior hand, e.g. constructability analysis (GANAH *et al*., 2005) and resource management (AKINCI *et al*., 2003). Eastman *et al*. (2008) also observe that technology can support collaborative work by linking distributed work within an integrated virtual environment. Similarly, Thomsen *et al.* (2009) also suggest that collaboration can be improved with computer modelling.

3.3.9 The role of relational type of contracts

Along with the prescription of managerial concepts and methods, the LPDS also prescribes the adoption of relational forms of contracting for the construction industry through an integrated delivery method: the Integrated Project Delivery (IPD) (BALLARD, 2011). In the U.S., IPD emerged in early 2000s, with six construction and design firms in Florida joining together to form a new company: Integrated Project Delivery, Inc (MATTHEWS, 2001). IPD uses relational contract structure in which risks are pooled with each party contributing contingency and sharing any unused element at the end (THOMSEN *et al*., 2009). Thomsen *et al*. (2009) define IPD as composed by three different dimensions: Organisation, Operating System and Commercial terms (Figure 24).

DIMENSION	ELEMENTS AND DESCRIPTION
Organisation	*Integrated teams*: all relevant partners are involved upfront, in early phases of design assisted by technology (computer modelling) *Integrated governance*: key stakeholders (at least owner, general contractor and architect) make decisions by consensus *High performance teams*: emphasis on trust, collaboration and learning. Goals are mutually agreed and performance measured and improved throughout the project
Operating system	*Managerial concepts of LPDS:* TVD, Set-based design, PDCA (continuous improvement) and A3 reports, computer modelling, the Last Planner System and computer modelling
Commercial terms	*Painsharing and Gainsharing system*: system to benefit as a team from project savings and share costs overruns

Figure 24: Key elements of IPD according to Thomsen *et al*. (2009)

However, IPD definitions differ in the literature, i.e. AIA (2007) does not include the prescription of LPDS concepts as part of IPD. According to Thomsen *et al.* (2009), of the various types of IPD, only a few projects address the operating system other than to provide for executive committee governance and constructor-involvement in the design. The same authors point that that at least one common element is shared: constructor managers and key trade contractors are involved in the project with the owner and designers from the early stages of design. The American Institute of Architects and the University of

Minnesota – AIA-UMN (2012) analysed 12 different case studies around the U.S. and identified 17 different elements that differ one IPD implementation from another. AIA-UMN (2012) observed that from the 12 cases analysed, only eight adopted LPDS in some level.

3.4 DISCUSSION

In this chapter, different approaches for improving value generation in project management were presented. The first approach was the Logical Framework, which has been implemented since 1970's. Thus, many lessons could be learned from its evaluation in practice, such as: (a) the absence of the time dimension; (b) insufficiency of relying only on the framework as the main mean to implement the project; (c) the inadequacy of indicators for monitoring the realisation of outcomes and the non-assessment of impacts beyond what can be counted; and (c) the framework's lack of flexibility, representing a snapshot of the project's logic from when it was planned.

However, some advantages of using the LFA have also been pointed out in the literature. The LFA provides a mean for stakeholders to discuss and agree on the expected outcomes of a project. The LFA supports managers to think about the expected change rather than only the project deliverables, being distinct from traditional managerial approaches in which the focus is on understanding project deliverables in terms of quality, costs and schedule (ZWIKAEL; SMYRK, 2009; WINTER; SCZESPANECK, 2010). It helps managers to understand the links between project deliverables and expected outcomes, as well as setting metrics to track the realisation of such outcomes.

Its simplicity and visual character make it easier to share information about the project's underlying logic as well as expected outcomes, so it can be discussed and agreed. Simon (1997) advocates that LFA provides the means for an institution to support collective decision making, and achieve an agreed goal (SIMON, 1997). It also provides the *means-result* chain necessary to understand how a problem will be solved (MARCH; SIMON, 1958; KOSKEKA; KAGLIOGOU, 2007), which is the fundamental nature of a planning activity.

Thus, according to the literature, the contributions of LFA to improving value generation are summarised based on the current vs. desired scenario presented in Chapter 2 (see session 2.5):

(a) Contributions for understanding value as purpose fulfilment (Vision):

- The LFA clarifies the link between project outputs and outcomes as it integrates all the different parts of a complex programme into a single coherent framework, showing the relationship between project's results and outcomes (SAVAYA; WAYSMAN, 2005); and
- It establishes monitoring indicators and ways of measurement the effected change (GRANT, 1997).

(b) Contribution for considering a means-ends chain to achieve goals (Means-ends chain):

- It makes explicit the logic behind the programme as a matrix is used to document the cause-effect relationship among activities, results and outcomes (SAVAYA; WAYSMAN, 2005). However, the concern about interdependencies and flow among these activities is not included (time dimension is abstracted away);
- It also helps identifying the assumptions, or external changes that need to happen for achieving expected outcomes (SAVAYA; WAYSMAN, 2005; AUSAID, 2000); and

(c) Contribution for creating a unit of purpose and common set of commitments (Shared commitments):

- By making the programme's logic explicit, the LFA facilitates communication among different stakeholders, within and outside the project (SAVAYA; WAYSMAN, 2005).

The Benefits Realisation (BRA) approach has been introduced in the IT sector since mid 1990s, but only recently has implemented tested in the construction industry (SAPOUNTZIS *et al.,* 2008). One aspect pointed out in the literature about the adoption of BRA is the fact that some of the early implementations of BRA assumed a stable environment, in which expected benefits of investments and means for achieving them do not change over time. Farbey *et al.* (1999) argue that this perspective has been changed, and organisations are more aware of the need to review a project's value proposition and planned means for achieving them.

Despite the early implementation problems observed by Farbey *et al*. (1999), the contributions of BRA to improving value generation are summarised based on the current vs. desired scenario presented in Chapter 2 (see session 2.5):

(a) Contributions for understanding value as purpose fulfilment (Vision):

- There should be a clear link between capabilities delivered and the expected benefits there are expected to contribute (KIPPENBERGER, 2000), (in fact, this is the main justification for the development of BRA); and

- Ward, Taylor and Bond (1996) also emphasise that not only benefits but also potential negative impacts should be analysed.

(b) Contribution for considering a means-ends chain to achieve goals (Means-ends chain):

- BRA suggests that making the link between project activities, deliverables and benefits is important to explicit the roadmap for change (THORP, 1998).

(c) Contribution for creating a unit of purpose and common set of commitments (Shared commitments):

- BRA prescribes the engagement of all stakeholders that will be affected to create the commitment to realise benefits (BRADLEY, 2006);

(d) Contributions for recognising that value proposition and means to achieve them are subject to further refinement (Refinement):

- BRA suggests focusing not only on accountability but also on formative evaluation, considering the possibility of maximising benefits through learning and adaptation (FARBEY, LAND; TARGETT, 1999); and
- Also, benefits stated on the business case should be constantly monitored, reviewed regularly and updated as necessary (PELLEGRINELLI *et al*., 2007).

Similarly to LFA, the BRA suggests that the focus of value generation should be on understanding the cause-effect relationships between project activities, deliverables and the generation of expected outcomes (THORP, 1998), setting up a measurement system to make sure the right path is being followed. Both the LFA and the BRA support organisations to set the conditions for individuals to make rational decisions by focusing on the specificity of goals and formalisation, which is an important role of organisations (SIMON, 1997). Thus, both approaches support the role of institutional environments on empowering people to make collective decisions to achieve an agreed goal (SIMON, 1997).

However, what distinguishes the BRA from the LFA is that it promises more than contributions for the specificity and formalisation of goals to steer collective decision-making. The literature on BRA also emphasises the importance of the organisational structure and the assignment of responsibilities for the realisation of benefits through the structures of governance. Moreover, it also highlights the need of engaging stakeholders in the early stages of projects to agree on the benefits and evaluate the potential negative impacts resulting from their plan (WARD; DANIEL, 2006).

Nonetheless, the literature on BRA points out the importance of constantly reviewing the alignment of plans to the strategic intent (NOGESTE, 2006). It is highlighted that the assumptions regarding what is necessary to achieve the expected benefits might be instable, as well as the expected benefits formalised during the planning phase might be not sufficient also to reflect the strategic aims of the organisation during the implementation stage (BRADLEY, 2006). Thus, such approach considers the iterative nature of design better than the LFA as it suggests that the benefits stated during the business plan phase should be seen only as a starting point for planning and execution. As argued by March and Simon (1958) and Koskeka and Kagliogou (2007) the fundamental nature of planning and design consists of two directions of reasoning: backwards for solution, envisioning the future picture and the expected benefits of investments; and forwards for proof, tracking the realisation of benefits and reviewing their sufficiency in reflecting strategic intent.

The BRA emphasises the aspects of learning in management and the importance of the scientific approach, in which plans should be implemented, checked, reviewed and action should be informed and steered by the lessons learned (FARBEY *et al.,* 1999). The same authors criticise approaches that assume a stable world and highlight the importance of using the results of evaluations to inform action.

Thus, differently from the LFA approach, BRA promises a better consideration of the instabilities of assumptions that are made during the planning phase, providing a better way to deal with complex situations in which stability and predictability cannot be assumed. The BRA can then be situated differently from the LFA approach regarding its metaphysical standpoint and underlying paradigm. The BRA is based on a process view of metaphysics and it brings considerations on how to organise the work, assigning different roles for project participants, to achieve the expected outcomes.

The third approach, LPDS, has its roots on a managerial paradigm that understands projects as temporary production systems (BALLARD, 2008). Set based concurrent engineering, target value design, choosing by advantages, using A3 reports, team co-location, are methods and techniques that prescribe how work should be organised in projects. The main contributions of LPDS for improving value generation in complex construction projects based on the current and desired scenarios devised in Chapter 2 (see session 2.5), are:

(a) Contributions for understanding value as purpose fulfilment (Vision):

- Sets targets to achieve expected outcomes, clarifying conditions of satisfaction and identify constraints (i.e. time and costs). Targets should consider the entire building lifecycle e.g. cost of operations, cost of construction, etc. (BALLARD, 2008).

(b) Contribution for considering a means-ends chain to achieve goals (Means-ends chain):

- Use computer modelling to understand system behaviour (building use and construction techniques) (THOMSEN *et al*., 2009); and
- The facility and its delivery process are designed together to better reveal and support customer purposes. (BALLARD; HOWELL, 2003).

(c) Contribution for creating a unit of purpose and common set of commitments (Shared commitments):

- Defining the project purpose is a teamwork effort that involves clients and suppliers (BALLARD, 2008);
- Setting integrated governance structures, allowing key stakeholders to make decisions by consensus (THOMSEN *et al*., 2009). Note: external stakeholders (e.g. users, community, environment) are not mentioned in the literature;
- Partners' interests are aligned by sharing risks and rewards (THOMSEN *et al*., 2009);
- Early engagement of teams that traditionally are involved separately and sequentially (THOMSEN *et al*., 2009);
- Co-location of teams to increase communication and improve collaboration (BALLARD, 2011);
- Organising project activity based on principles from production theory (BALLARD *et al*., 2009); and
- Using computer modelling to support collaboration (THOMSEN *et al*., 2009).

(d) Contributions of recognising that value proposition and means to achieve them are subject to further refinement (Refinement):

- Challenging targets are set to spur innovation (BALLARD, 2008); and
- Decisions are delayed as much as possible and multiple design alternatives are carried out concurrently (BALLARD, 2011).

The LPDS suggests that the project definition phase is a process in which means, ends and constraints are variables that should be defined together with the clients (BALLARD, 2008). Engaging the clients in the planning phase and helping them to define their goals is a step forward from the traditional practices in which the assumption is that clients have a clear definition of their purposes from the outset. Whelton (2002) suggests that defining projects goals through collaboration and learning is an important process

of project definition phase. Such argument is aligned with the statement that project goals should be seen as a starting point for planning and that planning should be seen as a design activity (SIMON, 1981). By doing so, project definition is treated as an emerging process, in which multiple stakeholder perspectives need to be taken into account, and where goals are defined through learning and collaboration.

The support of experienced suppliers in helping customers define and clarify the project purpose result in better informed assumptions on how to achieve expected goals. Nonetheless, as argued by Eastman *et al.* (2008), computer modeling is also enabling the formulation of better assumptions during the planning phase and supporting the process of analysis and synthesis that underlies a planning activity (KOSKELA; KAGIOGLOU, 2005; SIMON, 1981).

The principles suggested by Toyota's set based concurrent engineering also reflect a better way to deal with the complexity of projects, both in terms of structural complexity and uncertainty, by defining the boundaries of the design space, making sure stakeholders are engaged in discussing the possibilities and ensuring feasibility before committing to an option. The TVD also suggests that criteria should be used to set some boundaries for design solutions. In practice, such boundaries are generally set in terms of target cost (BALLARD, 2008). By restricting only some variables, project team can think of better ways to achieve the defined goals.

The successful implementation of lean methods and concepts in construction projects has been supported by the adoption of a relational contract. Within such context, not only the alignment of commercial interests, but also organisational aspects plays an important role (THOMSEN *et al*., 2009). IPD establishes an institutional framework that, as suggested by Simon (1997), supports the unit of purpose and common set of commitments.

The analysed approaches provide different perspectives to support value generation in complex projects (Figure 25). The major difference identified among the analysed approaches is their means to support purposeful action to achieve agreed goals. The LFA and BRA provide contributions for the specificity and formalisation of goals as the main mean to steer collective decision-making and provide accountability to external stakeholders. In addition, the BRA also emphasises the importance of the organisational structure and the assignment of responsibilities for the realisation of benefits through the structures of governance, focusing on defining the role of people in making sure project purpose is achieved. Differently from these two approaches, the LPDS does not emphasise the formalisation of goals but prescribes how the context should be organised to support purposeful action.

Dimensions (Chapter 2)	LFA	BRA	LPDS
VISION *Understanding value as purpose fulfillment*	Clarifies the link between project outputs and outcomes in a single coherent framework, showing the relationship between project's results and outcomes; and it establishes monitoring indicators and ways of measurement the expected change	There should be a clear link between capabilities delivered and the expected benefits there are expected to contribute (in fact, this is the main justification for the development of BRA); and It is also emphasised that not only benefits but also potential negative impacts should be analysed.	Sets targets to achieve expected outcomes, clarifying conditions of satisfaction and identify constraints (i.e. time and costs). Targets should consider the entire building lifecycle e.g. cost of operations, cost of construction, etc.
MEANS-ENDS CHAIN *Considering a means-ends chain to achieve goals (what and how)*	It makes explicit the logic behind the programme in a cause-effect relationship among activities, results and outcomes (however, time dimension is abstracted away); and it helps identifying the assumptions, or external changes that need to happen for achieving expected outcomes	Making the link between project activities, deliverables and benefits is important to explicit the roadmap for change	Use computer modelling to understand system behaviour (building use and construction techniques); and The facility and its delivery process are designed together to better reveal and support customer purposes.
BUILDING & SUSTAINING COMMITMENTS *Creating a unit of purpose and common set of commitments*	By making the programme's logic explicit, the LFA facilitates communication among different stakeholders, within and outside the project	Prescribes the engagement of all stakeholders that will be affected to create the commitment to realise benefits	Defining the project purpose is a teamwork effort that involves clients and suppliers; Setting integrated governance structures, allowing key stakeholders to make decisions by consensus; Partners' interests are aligned by sharing risks and rewards; Early engagement of teams that traditionally are involved separately and sequentially; Co-location of teams to increase communication and improve collaboration; Organising project activity based on principles from production theory; Using computer modelling to support collaboration
REFINEMENT *Recognising that value proposition and means are subject to refinement*		Suggests focusing not only on accountability but also on formative evaluation, considering the possibility of maximising benefits through learning and adaptation; and benefits stated on the business case should be constantly monitored, reviewed regularly and updated as necessary	Challenging targets are set to spur innovation; and Decisions are delayed as much as possible and multiple design alternatives are carried out concurrently

Figure 25: Summary of potential contributions from analysed approaches

4. RESEARCH METHOD

A range of different theoretical underpinnings has been used in Construction Management research. As a consequence, the *status quo* of construction management as a scientific discipline is increasingly discussed (VOORDJIK, 2009). Koskela (2008) suggests repositioning construction management as design science research. In this Chapter, design science research is first introduced and its main phases presented. This research is then positioned, as emphasis was given to a particular phase of the design research science process. Finally, the empirical cases are described, as well as the procedures for gathering and analysing data.

4.1 DESIGN SCIENCE RESEARCH

According to March and Smith (1995), choosing the appropriate research method depends on the intent of the research: while natural science is descriptive and has an explanatory intent, design science offers prescriptions and creates artifacts that embody those prescriptions. Design science research has been presented in the literature as a different mode of generating scientific knowledge, in comparison to the explanatory sciences (VAN AKEN, 2004), such as natural sciences and social sciences (MARCH, SMITH, 1995).

According to March and Smith (1995), natural sciences aim to understand the real world, by proposing scientific claims and testing their validity, whereas design sciences attempt to create artificial objects that serve human purposes. Van Aken (2004) explain that the mission of formal sciences is to build systems of propositions whose main test is their internal logical consistency, whereas explanatory science aims to describe, explain and possibly predict observable phenomena. Conversely, design science research aim at developing valid and reliable knowledge to be used in devising solutions to classes of problems (VAN AKEN, 2004). Design science research is prescription-driven rather than description-driven (MARCH, SMITH, 1995).

Van Aken (2004) explains that design science research is particularly relevant for the practice of management, since it aims to produce instrumental knowledge, or knowledge that can be applied in practice to solve managerial problems rather than only understanding them. However, the same author

emphasise that design science research is not concerned with the actual application of scientific knowledge to solve a specific managerial problem, but with the development of scientific knowledge, at an abstract level, that can be used in the process of designing solutions to problems in the field in question.

Van Aken (2004) and Holmstrom and Ketokivi (2009) advocate that design science research has its roots on Simon (1981)'s work: *The Sciences of the Artificial.* However, Koskela and Kagioglou (2007) point out that Aristotle has brought a very similar idea more than 2000 years ago in his discourse about a science of production (KOSKELA; KAGIOGLOU, 2007). Both Aristotelian science of production and Simon (1981)'s work were discussed in Chapter 2. According to Simon (1981), the first step in a problem-solving episode is representing the problem, and to a large extent, that representation has the solution hidden in itself. The problem is not discovered but constructed (SIMON, 1981). Thus, while new knowledge about the problem can be revealed in the process for developing a solution, this can also happen when the problem perspective or the solution scope is changed (SIMON, 1981). Koskela and Kagioglou (2007) explain that the method of analysis which is in the core of Aristotle's science of production present a similar idea, in which there is a continuous process of envisioning the results or desired effects, searching for the means to achieve the desired effects and checking to se if expected effects are achieved.

At the beginning of a design science research effort, a means-ends analysis should be devised to represent the present state, the desired state, and the difference between those two. Design science research focus on providing the details of how this change can happen. (HOLMSTROM; KETOKIVI, 2009). In this sense, March and Smith (1995) suggests that there are two fundamental activities in design science research: building a solution and evaluating the solution. The same authors explain that building is the process of constructing an artefact for a specific purpose, and evaluation is the process of determining how well the artefact performs in fulfilling its purpose.

Holmstrom and Ketokivi (2009) explain that along with the development and testing of the solution, the theoretical relevance of the solution design must be established. The same authors suggest two other stages along with the development and test of a solution. The third stage is development of a substantive theory and the fourth stage is the development of a formal theory. Substantive theory is a context-dependent theory that is developed for a narrowly defined context and empirical application, where the contextual boundaries of the theoretical argument are important, i.e. the solution is more applicable in some contexts than others (GLASER; STRAUSS, 1967). The intent of formal theory is to draw broader generalisations beyond the limits of the empirical context being analysed.

Regarding the final outputs of a design research process, March and Smith (1995) suggest that four types of artifacts or outputs can be created: (a) *constructs:* constitute a conceptualisation used to describe problems within a domain and to specify their solutions; (b) *model:* a set of propositions or statements expressing relationships among constructs; (c) *method*: a set of steps for performing a task; and (d) *implementations or instantiations*: the operationalisation of construct, models, and methods.

4.2 RESEARCH STRATEGY

Holmstrom and Ketokivi (2009) argue that the means-ends analysis is the central method through which goal-directed scientific inquiry can be conducted and suggest a process for design science research that involves four stages: (a) framing the problem and developing the rudiments of a potential solution design; (b) implementing and evaluating the solution to confirm intended consequences; (c) demonstrating the theoretical contributions of the solution by analysing it from a theoretical perspective; and (d) developing a formal theory which is applicable beyond the limits of the empirical context under study.

This research followed some of the stages proposed by Holmstrom and Ketokivi (2009). However, the focus of this research was not on devising new artefacts. Rather, the research focused on identifying artefacts that have already been devised and used in practice and evaluate their contributions to solve the problem in hand. Figure 26 positions the scope of this research within the different stages described by Holmstrom and Ketokivi (2009).

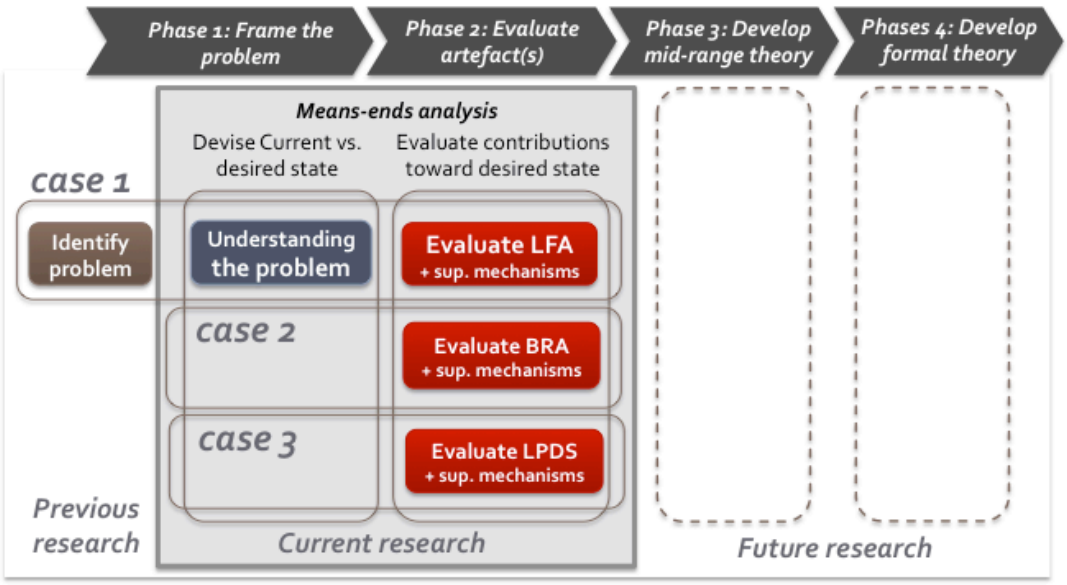

Figure 26: Positioning the research within the stages of design science research

The study started with understanding a problem that was identified even prior to this research. A means-ends analysis was realised in which a problem was framed and potential solutions analysed. Two artefacts that presented potential contributions for moving towards the desired state were evaluated, namely BRA and LPDS. Another artefact that was evaluated was the LFA, used in in the first empirical case in which the nature of the real problem was explored. According to the literature, LFA should also offer contributions to moving towards the desired change. The phases of developing a full mid-range theory (applicable to the specific empirical context) and development of formal theory (beyond the empirical context observed) were not realised in this research.

According to Van Aken (2004), the typical research strategy adopted in design science research is multiple case studies. However, the same author explains that there are two types of multiple case studies: *extracting multiple case studies* and *developing multiple case studies*. The developing type of multiple case studies focus on developing prescriptions in close collaboration with people in the field, while the extracting type of multiple case studies is a kind of best-practice research aimed at uncovering prescriptions that are already used in practice, as opposed to developing new ones (VAN AKEN, 2004). In this research, extracting case studies were carried out to reveal the contributions of artefacts that were already being used in practice.

4.3 OVERVIEW OF RESEARCH PROCESS

Figure 27 presents an overview of the research process followed in this thesis:

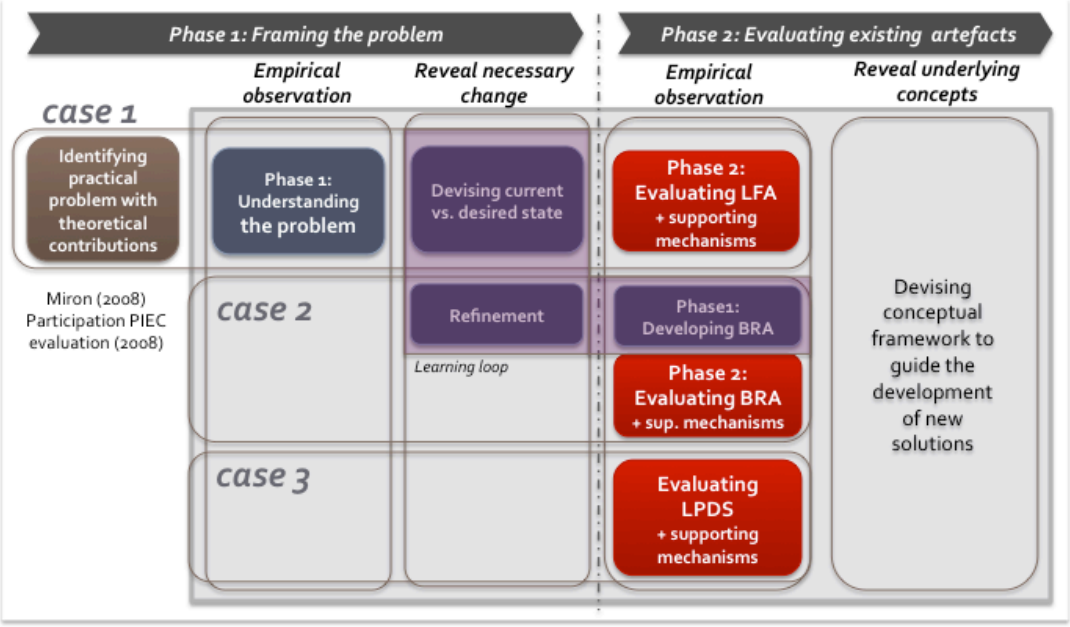

Figure 27: Overview of Research Process

Phase 1 – Framing the problem

Holmstrom and Ketokivi (2009) suggest that design science research starts with the identification of a relevant problem with potential theoretical contribution. The identification of the problem started in a study carried out by Miron (2008) and in the PIEC evaluation realised in 2008, in which the researcher participated prior to this research effort. In June 2008, there was a demand coming from the City Council in Porto Alegre, Brazil for an interim evaluation of PIEC. A team of researchers from the Faculty of Architecture and the School of Engineering from the Federal University of Rio Grande do Sul was in charge of this evaluation. The preliminary results of such evaluation indicated problems in the Programme implementation, as expected outcomes were not being achieved. Thus, the first step of this research was to gather data to understand the managerial challenges for generating value in the PIEC.

At the beginning of 2009, after the analysis of data gathered about the PIEC, a literature review was carried out to support the task of framing the problem: defining the current state, the desired change and identifying managerial approaches already being used in practice that could contribute for improving value generation in complex projects: the BRA and LPDS. This literature review was focused on publications that point out limitations of traditional approaches to project management. Different studies suggest changes towards a scenario that would provide greater support to value generation. The recommendations in the literature were grouped together by similarity, resulting in four large groups indicated in the current vs. desired scenario (see Figure 11). During this stage, the researcher had the opportunity to go to the UK and participate for 6 months on the development of the BeReal. Such participation enabled to observe empirically the adoption of BeReal in different case studies. Such observation provided further understanding of the problem (see learning loop indicated in Figure 27). Holmstrom and Ketokivi (2009) explain that such a process is typical of design science research, as it is not a hypothetico-deductive type of research and initially ill-structured problems are constructed and solved in an iterative research process. The outcome of this phase was a current versus a desired scenario, indicating the necessary change that needed to happen in project management to improve value generation in complex projects.

Phase 2 – Evaluating existing solutions

Observing empirically the adoption of the managerial approaches allowed the confirmation of intended consequences and observation of unintended consequences (HOLMSTROM; KETOKIVI, 2009). The evaluations included not only the managerial approaches but also the context in which they were being utilised, including other managerial practices that also made contributions towards the desired change.

As explained by Van Aken (2004), describing the work of Pawson and Tilly (1997), the key in observing the adoption of artefacts is not so much whether they work, but what is it about the context that makes them work. In this phase, three empirical studies were carried out. The main characteristics of the empirical cases are summarised in Figure 28.

	Case 1: Brazil	Case 2: UK	Case 3: US
Type of project	Urban regeneration programme	Healthcare redevelopment programme	Healthcare project (in 2 phases)
Type of Initiative	Public	Public	Private
Main approaches used to support value generation	Logical Framework Approach (LFA)	Benefits Realisation Approach (BRA)	Lean Project Delivery System (LPDS)
Project Organisation	Responsibilities distributed by departments In-house planning and management, Private sector execution	Responsibilities shared to accomplish work packages In-house management, In-house + private sector planning Private sector execution	Responsibilities shared to accomplish work packages In-house + private sector management and planning Private sector execution
Delivery method	Design-Bid-Build	Procure21	Integrated Project Delivery
Type of contract	Transactional contract	Relational procurement	Relational contract
Managerial driving forces	Established by international funding agency	Established by Office of Government Commerce	Lean Project Delivery System

Figure 28: Main characteristics of empirical cases

The empirical cases were chosen based on the possibility to evaluate the contributions of the identified artefacts. They were characterised by complex construction projects, but were however located in different countries and thus presenting different contexts. This has brought richness for this research but also the challenge to understanding the contextual influence on the adoption of the managerial practices being evaluated.

The results of each evaluation enabled the development of a conceptual framework based on an attempt to abstract from observed practices. Some of these concepts adopted were devised along this research project, while others were refined and adapted to the specific context of complex construction projects. The intent of the proposed framework was to provide prescriptive knowledge that can be used in the development of value management approaches for improving value generation in complex construction projects, taken into consideration particular characteristics or a specific context, as suggested by Van Aken (2004).

4.4 DESCRIPTION OF EMPIRICAL CASES

4.4.1 Empirical Case 1: The City Entrance Integrated Programme

Project Description

The PIEC was a large urban regeneration programme that comprised 870 km² around the main entrance of Porto Alegre, Brazil (Figure 29). The programme location was indicated in the city's master plan as an area of strategic development, as it plays an important role of linking Porto Alegre, which is the state's capital, to other towns in the metropolitan region (PMPA, 1999). The area is provided with important transport connections being surrounded by the airport, the city docks, a suburban train system, and the interstate highway. Irregular settlements[2] were established in that location along the years, occupying spaces once designated to the implementation of new roads and enlargement of existing ones (PMPA, 2002). These irregular settlements do not have adequate urban infrastructure and families are living on insalubrious conditions (PMPA, 2002).

Figure 29: PIEC area

The Programme was an initiative of the City Council. The intent was to improve the quality of life of 3.775 families that lived in the analysed area. To participate in the Programme, families should have an income of 0 to 3 minimum wages per month (approximately 680 dollars in 2008). The Programme aimed to tackle the problem with urban infrastructure and environmental recovery. In order to generate the expected outcomes, the programme was divided in 5 interdependent projects: (a) housing project, (b) landscaping, (c) road infrastructure, (d) income generation, and (e) community development.

The programme passed through several changes during its implementation. Figure 30 provides an overview of the different stakeholders groups identified in the Programme Implementation in the second semester of 2008.

[2] Irregular settlements are defined by PMPA (2002) as those in which the occupants are not land owners and do not have any legal contract assuring their permanence in that land. In the PIEC region 33% of settlements were irregular in 2000, representing 4.53% of total irregular settlements in the city.

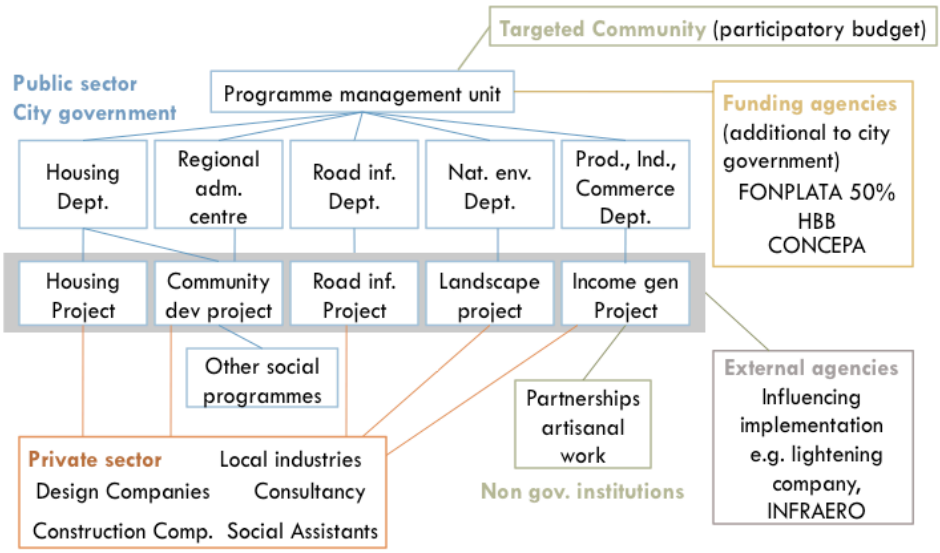

Figure 30: Programme's stakeholders in 2008

The City Council represented the owner's and the project management group. The City Council was responsible for envisioning the expected outcomes, planning the actions to be implemented, signing the financial contract with funding agencies and monitoring Programme implementation.

As required by funding agencies, the City Council created the Programme Execution Unit (UEP) since the early phases of programme implementation. The UEP was the project core team, responsible for designing, planning, budgeting, bidding, monitoring construction and monitoring occupation to provide adequate maintenance. Another task of the UEP was to provide accountability for the funding agencies, through periodic progress reports.

The UEP was formed by the programme overall manager and managers for each different project. Project managers were assigned from the different city departments and these departments became responsible for each different project, as follows:

- The Housing Department (DEMHAB) was responsible for the housing project and also shares responsibility with the Regional Administrative Centre for the community development projects, acting mainly on the provision of social work and moving families to the new homes;
- The Road Infrastructure Department (SMOV) was responsible for implementing the road infrastructure project;
- The Department of Natural Environment (SMAM) was responsible for the landscape project; and

- The Department of Industry and Commerce (SMIC) was responsible for the income generation project.

Although the UEP was created, people involved in the PIEC kept their responsibilities within the departments. Their assignment to the Programme did not exempt them from realising routine activities within the department. Only part of their time was dedicated to work for the PIEC.

For some of the activities planned by the UEP, in-house capabilities were used. In some cases, external stakeholders were involved, such as private sector companies, e.g. consultancy companies, design firms, construction companies and private partners for the income generation project; or non-governmental institutions that participate on the income generation project, offering professional courses.

Due to changes that happened in the programme, some activities that were previously performed in-house were outsourced and new stakeholders were involved. Those activities include part of the housing project design (electrical and pluming systems) and the social work (previously performed by the DEMHAB). New stakeholders also joined the Income Generation Project, including partners for the development of artisanal work courses and the Urban Cleaning Department (DMLU).

Some external stakeholders also played an important role in the delivery of projects. Among them, is the company responsible for providing public lighting, which is an interdependent activity to the provision of road infrastructure. Another important external stakeholder in the road infrastructure project was the INFRAERO, which is a public sector company linked to the Ministry of Defence and among its responsibilities is the approval of built infrastructure in areas close to the national airports.

The targeted community was involved the programme through different participatory mechanisms. Those mechanisms included meetings related to the participatory budget, the socialising design and construction meetings, and other meetings organised by the CRAP (regional commission for monitoring project implementation).

Finally, in the investors group, there were different funding agencies involved. The main one was the FONPLATA, contributing with half of the investments (U$ 27 million). Other investors are the HBB (*Habitar Brasil-BID Programme – Inter-american Development Bank)*, which provided funding for implementing the programme's initial phase, and other agencies such as the Road Concession for Porto Alegre and Osório (CONCEPA) and the Brazilian Development Bank (BNDES), involved later on in the

process. The city government was also responsible for providing part of the resources for the Programme implementation earned from tax collection.

Research Process

Official documents were used to understand the context and the Programme's objectives. The PIEC team developed different documents, including documents to justify the investments for the funding agencies. Such documents described the expected benefits for society and the Programme's plan through the Logical Framework Matrices.

Data gathered from the analysis of documents were discussed during interviews with project teams and the programme manager, to identify any changes in the programme and project scopes. The main objective of these interviews was to understand the managerial difficulties and the challenges for generating value in a complex and dynamic programme. Ten semi-structured interviews were carried out (see Figure 31). See interview protocol on Appendix A. All the interviews were recorded and transcribed to facilitate the data analysis.

Date	Interviewees
24/4/2008	Social workers involved in the Housing project
28/5/2008	PIEC Programme Manager
24/6/2008	Project manager for the Income Generation project
26/6/2008	Project manager landscaping project
1/7/2008	Project manager for the Road Infrastructure project
3/7/2008	Programme Manager for PIEC
7/7/2008	Architects involved in the Housing project
7/7/2008	Member of city cleaning department involved in the Income Generation Project after internal changes
8/7/2008	Social workers outsourced for the Housing project after internal changes
15/7/2008	Programme manager for PIEC

Figure 31: List of interviews - first empirical case

The interviews enabled the identification of obstacles to the generation of expected outcomes, as well as the observation of how the programme team was overcoming them. Data from the interviews was also used to map the programme implementation process.

Progress reports, which were sent to the financial institution every three months, were another source of evidence for analysing the programme implementation progress and identify major difficulties. The

report provided details on task status, how difficulties were being solved, money allocated for bidding companies, and their expected date for delivering the work.

A Post Occupancy Evaluation (POE) was also carried out in three housing schemes that were delivered up to 2008 (MIRON, 2008). A survey was carried out with users, with the aim of identifying their profile, levels of satisfaction (regarding housing schemes and community development activities), as well as perceived changes comparing to their previous place of living. The application of questionnaires provided a database with information about 288 families. For the purpose of this research, data from this database was summarised through frequency tables and correspondence analysis, which was used to facilitate the visualisation of the degree of satisfaction and perceived improvements by the targeted community.

Four workshops were also carried out to discuss the findings. The most relevant workshop for this research was carried out in 23/09/2008, which brought together the entire research team, the programme manager, project managers and team members from specific projects. This workshop was set up to discuss the preliminary findings from the POE and the analysis of the implementation process. It helped in the clarification of a number of issues pointed out by the research team.

In order to analyse the adoption of the LFA during the programme design phase, additional secondary data was analysed, including documents produced at the Programme's planning phase, and 18 semi-structured interviews carried in the study by Miron (2008) in 2006, which contained information about the programme's planning phase were analysed.

4.4.2 Empirical Case 2: The 3T Redevelopment Programme

Along the duration of this investigation, the BeReal model was implemented in three different projects. The project chosen to the empirical was the 3T programme in Brighton, UK. The 3T programme was chosen because it had a set of desired complexity characteristics, and was also due to the fact that BRA had been adopted since early project stages.

Project Description

Brighton and Sussex University Hospitals (BSUH) is a regional teaching hospital divided in two different sites providing complimentary services: the Royal Sussex County Hospital in Brighton and the Princess Royal Hospital is in Haywards Heath (Figure 32). The site in Brighton includes the Royal Alexandra Children's Hospital and the Sussex Eye Hospital, and the Haywards Heath campus includes the Hurstwood Park Regional Centre for Neurosciences.

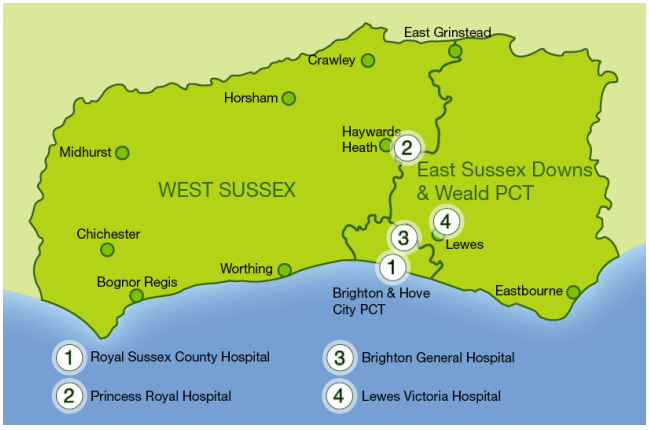

Figure 32: Hospitals locations (1 and 2)

The BSUH provides general acute services to local population in and around the City of Brighton and Hove, Mid Sussex and the western part of East Sussex, and more specialist and tertiary services for patients across Sussex and the south east of England. Both hospitals provide many acute services for local populations. In addition, the Princess Royal Hospital is the centre for elective surgery and the Royal Sussex County Hospital is the centre for emergency and critical care. Specialist and tertiary services include neurosciences, paediatrics, cardiac, cancer, renal, infectious diseases and HIV medicine. The Trust was formed in 2001 by the merger of Brighton Healthcare Trust and Mid Sussex Healthcare Trust. At the same time, the new Trust became one of the newly established Teaching Hospitals that were created in 2001 to increase access to medical education and provide additional teaching centres outside London (BSUH, 2009).

Figure 33 shows the Royal Sussex County Hospital site in Brighton, with the highlighted area being occupied by old buildings that require modernisation. The Barry and Jubilee Buildings (Figure 34) were built in 1828 and 1887, respectively and are no longer fit for purpose. The buildings that were currently in use did not provide enough single rooms or enough toilets, and the wards in both buildings are very small, with not enough beds. Thus, the redevelopment programme aimed to address mainly the need for more adequate and modern healthcare facilities.

Figure 33: The 3T redevelopment site (source: 3T website)

Figure 34: Barry and Jubilee Buildings

The Brighton and Sussex University Hospitals NHS Trust (BSUH) is investing £420.1m through public funding in the development of the Regional Centre for Teaching, Trauma and Tertiary Care. The 3Ts programme is expected to be completed in 2019.

Figure 35 presents the range of stakeholders involved in the 3Ts programme. In order to be approved, the Programme needed to receive a letter of support from all the relevant stakeholders.

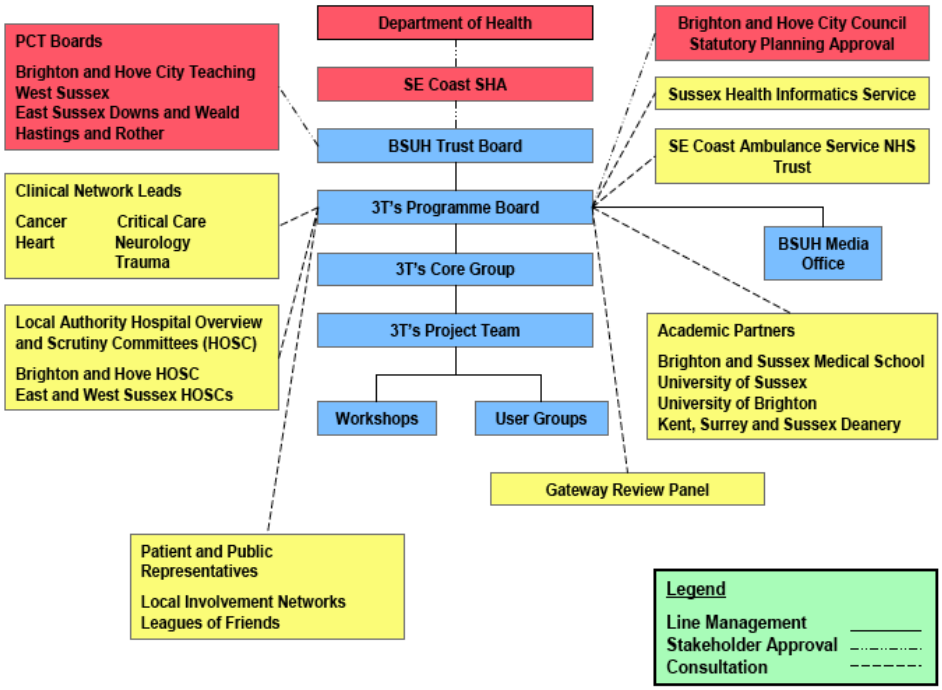

Figure 35: Range of stakeholders (source: OBC)

The BSUH trust is one of the National Health Service (NHS) foundation trusts created as part of public health decentralisation efforts in the UK. Trusts have greater local ownership and less control from the Department of Health (NHS, 2011). By law, they are Public Benefit Corporations, independent legal entities that have their unique governance arrangements and freedom to raise capital from both public and private sector, as well as retain financial surplus to invest in delivering NHS services. Yet, such organisations are subject to NHS standards, performance ratings and systems of inspection (NHS, 2011). Their primary purpose is to provide NHS care to NHS patients according to NHS quality standards and principles.

The BSUH Trust board acts as the investment decision maker. The 3T programme has a board, which is chaired by the overall project sponsor (Chief Executive) and members of Primary Care Trusts (PCT) commissioners, a Trust non-executive director and other key stakeholders such as the medical school, the ambulance service, neighbouring NHS Trusts, Brighton & Hove City Council, and is attended by a representative from South Coast Audit (which is responsible for providing internal audit appraisal of the programme's processes and adherence to established guidance). The programme board is the decision-making body. This includes resource and management across all the tasks necessary to successfully deliver the programme.

The programme also has a core group, which supports and advises the programme director in undertaking activities and responsibilities delegated by the board. The 3Ts director is responsible for reporting on progress and management of risk at each board meeting.

Figure 36 presents a representation of the 3T Programme's tem. A main director and a lead for each different project compose the Programme Team. There are three main associate directors: one for the Management of the Programme Office & Governance and controls assurance, which makes sure the programme is delivered according to best practice; one for the capital and Facilities & Estates project and a lead for Service Modernisation, responsible for managing the services input for the programme.

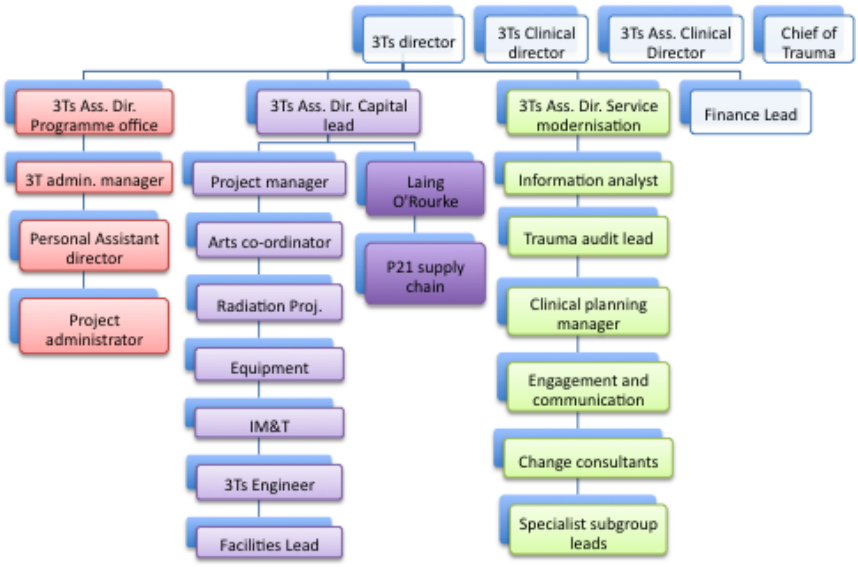

Figure 36: The 3Ts Programme's team

Clinical input is also provided through a dedicated Clinical Director and user groups who work on the detail of design development and clinical care pathways. Internal and external advisors also contribute for the programme. Among the internal advisors are specialists in infection control, in facilities and estates, in human resources, arts, procurement and equipping, medical physics, specialist services, nursing and IT. Regarding the external advisors, the trust has appointed Laing O'Rourke to support programme planning through the ProCure 21 framework, a type of relational procurement that was used in this project. Under ProCure 21, the contractor appoints and manages the external advisors required through its approved supply chain. The range of advisors varies over time depending on the scope of activities. During the development of this research, the appointed advisors included: the architects (Building Design Partnership – BDP), the cost consultants (Cyril Sweett - CS), health planners (CS), business case support (CS), CDM coordinator (CS), structural engineers (WSP), mechanical and

electrical (BDP), equipping (MTS consulting), town planning consultants (BDP) and strategic IM&T planning (PTS consulting).

Research Process

Phase 1 – Participating on BeReal model development

From March to September 2009, the researcher was able to participate in the model development as a member of the HaCIRIC research team at the University of Salford. During 6 months, the research team and two external consultants met regularly (usually every other week) to discuss and evaluate the model. Four workshops involving the research team and project stakeholders were carried out in this period, including: workshops for defining the expected benefits, workshops for defining the means to measure benefits and workshops to prepare for the model implementation. The model was being implemented and tested in three different cases:

- Tertiary, Trauma and Teaching (3Ts) hospital development programme by Brighton and Sussex University Hospitals: during March-Sept 2009 the project was in the design approval phase and *BeReal* was implemented since early stages of design development, including the identification of expected benefits and development of benefit criteria to support selection of design options.
- Manchester Salford & Trafford (MaST) Local Improvement Finance Trust (LIFT): during March-Sept 2009 the project was in the post-occupancy phase and *BeReal* was implemented in a post occupancy phase to evaluate three schemes.
- Stockport NHS Primary Care Trust: During March-Sept 2009 the project was in the inception phase and *BeReal* was supporting the definition of expected benefits during that phase.

During the participation on the BeReal model development, governmental publications were analysed to understand the context. Those publications included the NHS reforming programme describing the strategic aims and policies to be deployed, documents describing major procurement routes for healthcare delivery and the governmental recommendations regarding the implementation of a Benefits Realisation Approach in the delivery of such projects. Also, during this first phase, a large amount of documents regarding the BeReal model was analysed. Such documents contained evidences from the three cases in which BeReal was being implemented and included presentations and progress reports developed by the research team. These are the main documents analysed: templates used to register the identified benefits by stakeholders, the meeting minutes and reports from workshops carried out to identify expected benefits, and the website produced by the HaCIRIC research team with descriptive information about each case study.

Phase 2 – Evaluating the adoption of BeReal model in the 3T programme

Data analysis was carried out from February to May 2011. Two sources of evidence were used: analysis of documents, and semi-structured interviews. A set of documents was first analysed in order to understand the context of the 3T redevelopment programme, including but not limited to procurements documents, the programme business case, public consultations.

The interviews were carried out with different project team members. In total, 8 members from the 3T team were interviewed (Figure 37). The protocol for the interviews is presented in Appendix B. The duration of the interviews varied between one to one and a half hours. The focus of the interviews was the evaluation of the BeReal model from the team's perspective. Also, the main challenges regarding value generation in that project was analysed, as well as the value management practices that have supported the work of the product development team.

Date	Interviewees
12/04/2011	The 3Ts Programme Director
13/04/2011	Associate Director (Head of 3Ts Programme Office & Governance) responsible for accountability and for leading the benefits realisation process,
13/04/2011	Associate Director for 3Ts Service Modernisation, responsible for healthcare service modernisation and was involved in defining the programme strategy
13/04/2011	Design and development leader, responsible for facilitating and coordinating the user group meetings during the design phase
19/04/2011	General Contractor project leader for pre-construction phase
20/04/2011	Associate director of Capital and Facilities & Estates, responsible for selecting the supply chain and procurement issues
20/04/2011	Head of Environment Support Services, responsible for facilities management
20/04/2011	Major Trauma Centre Programme Leader, responsible for developing the trauma centre which was added in the programme's scope during the development

Figure 37: List of interviewees from the 3T programme

Some meetings were also held with the HaCIRIC team (Figure 38). The first two meetings were carried out to understand the scope of intervention in the 3T programme. The main activities with the 3T team were listed and analysed in terms of participants and major outcomes. A timeline was built based on the data gathered in those meetings. A third meeting was carried out to discuss the results from the interviews with the HaCIRIC team.

Date	Aim of meeting
1/04/2011	Draw a timeline of actions BeReal x 3T
8/04/2011	Draw a timeline of actions BeReal x 3T
3/05/2011	Discussion of data gathered

Figure 38: List of meeting with HaCIRIC team

4.4.3 Empirical Case 3 - the San Carlos Project

The San Carlos Centre, located in San Carlos, CA, in the U.S. was the project chosen for empirical case 3. The rationale for selecting this case was that this project was going on, adopted several LPDS practices, and had a high level of complexity. This provided an opportunity of doing an evaluation of the implementation of LPDS, based on a direct involvement of the researcher with the project team, as opposed to a project that had been concluded.

Project Description

The project sponsor is the Palo Alto Medical Foundation for Health Care, Research, and Education (PAMF), a not-for-profit foundation organised under Section 1206(I) of the California Health and Safety Code[3]. PAMF is a network of community-based health care providers that serves more than 100 northern California communities. PAMF was formed in 1981, and in 1993 became one of over 30 affiliates of Sutter Health. Sutter Health is a support company based in Sacramento that provides treasury and financial reporting; information technology; clinical integration and quality of care monitoring; and purchasing, contracting, and strategic development functions for companies that provide healthcare in California.

PAMF developed a business case for the San Carlos Centre (SCC), based on their regional strategic plan and market analysis within its region of operation, which was approved by Sutter. An investment of U$550 million was estimated in 2006 to build the San Carlos Centre (Figure 39). The project passed through a partial suspension from mid-2009 to mid-2010, result of the economic downturn in the U.S. in 2008. In 2010, the scope was re-evaluated and a decision was made to build the hospital in two phases. When this case study started, in mid-2011, the project was in design and pre-construction services for phase 1. Construction of phase 1 and design of phase 2 initiated mid-2012, when the case study was concluded.

[3] The California Health and Safety Code defines a medical foundation as a clinic operated by a not-for-profit corporation exempt from federal income taxation that conducts medical research and health education and provides health care to its patients through a group of 40 or more physicians and surgeons.

Figure 39: San Carlos Centre

Sutter Health, which plays a project manager role, emphasises the adoption of LPDS in their projects to, among other aims, increase efficiency, quality and safety in their construction projects. After 1994's earthquake in California, the California Legislature enacted SB 1953[4], the Hospital Facilities Seismic Safety Act. As a response, Sutter started a building programme, which included $5.5 billion to invest in design and construction of projects to be completed by 2012. In order to successfully achieve increased efficiency, safety, quality and reduced claims, which were goals of this building programme, Sutter established an executive management team to put systems in place to manage the task (LICHTIG, 2005). Lichtig (2005) explains that standards were created within Sutter Health to manage the construction projects. Such standards were created with the support of Lean Project Consulting, Inc. and included the implementation of Lean Project Delivery System (LPDS) and the adoption of relational contracting model based on the Integrated Project Delivery (IPD). The Integrated Form of Agreement (IFOA) is the contract used by Sutter with its vendors to deploy the strategic aims of Sutter's building programme into project delivery.

In the San Carlos project, the first IFOA was signed in 2006 (a revised version of the IFOA was signed again in 2010). The IFOA establishes how risks and rewards will be shared by the integrated team, it sets guidelines about how the team should be organised and the managerial tools and techniques that should be adopted. Not all companies participating in the SCC project signed the IFOA. Suppliers of finishing materials for instance did not, as they thought to pose a low risk to the project. Companies in the IFOA (the integrated team), were:

- NBBJ (architects) and engineering consultants: Mazzetti (MEP); KPFF (Structural); BKF (land surveying) and Office of Cheryl Barton (landscaping); and

[4] Senate Bill 1953 is a state law in California. It requires that healthcare facilities considered hazardous and at risk of collapse or significant loss of life in the event of an earthquake to be replaced or retrofitted to higher seismic safety standards by 2013. Otherwise, acute care services may no longer be allowed to be provided in these facilities. Source: http://www.oshpd.ca.gov/FDD/seismic_compliance/SB1953/index.html.

- Skanska (general contractor) and trade partners: Walters & Wolfe (cladding); McGuire & Hester; Southland Industries (MEP); KHS&S (pre-fab walls and ceiling); Redwood City Electric; Royal Glass; Shuff Steel; Superior Fire Sprinkler; and Pankow (contractor).

The IFOA also determines the project organisation. Figure 40 shows a schematic representation of how the integrated team was organised during the pre-construction period. The IFOA suggests the organisation of pre-construction phase in a Senior Management Group (SMT), a Core Group and Clusters. Figure 40 illustrates the engagement of the Core Group in the three different managerial levels. The role of each group is described as follows.

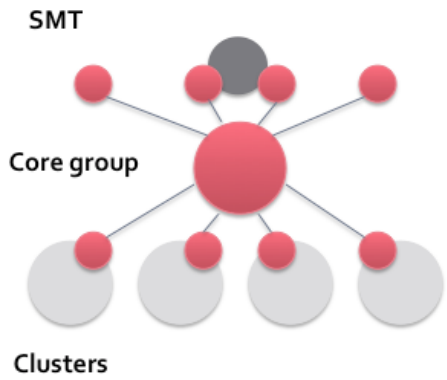

Figure 40: Organisation of integrated team in SCC project

The SMT was formed by senior representatives from PAMF, Sutter Health, the general contractor firm and the architect firm. One representative from each of those companies involved in the SMT was also a member of the Core Group. According to the IFOA, the role of the SMT is to make a decision whenever the project team cannot reach consensus. The SMT meetings were focused on discussing the project progress, cost expenditures, schedule, the approval process and negotiation with external stakeholders, entitlements and strategic issues related to the client's business intent. The group met once a month during the pre-construction phase.

During the pre-construction phase, the Core Group met once a week, and was formed by: (a) one project executive and one project manager from the architecture firm, which join the meetings via conference calls; (b) one project executive and one project manager from Sutter Health; (c) the director of facilities and the director of facilities management from PAMF; and (d) one project executive and one project manager from the general contractor firm. According to the IFOA, the Core Group is responsible for the coordination, overall management of the project and leadership. It operates on a consensus basis and is responsible to make sure that the strategic aims and values are achieved through the

project. The core group is responsible not only for making sure the best possible results for the project are achieved but also making sure that they are achieved through the best possible means. The Core group is the decision making body for the project and as the project was in the detailed design phase during the research period, most part of the meetings was used to discuss design alternatives and entitlement issues with the City Council and other regulatory agencies.

During the pre-construction phase, there were eight Clusters Groups, one for each building sub-system: Site, Structural Systems, Building Envelope, Planning and Interior Architecture, Agencies and Permitting, MEP (Mechanical, Electrical and Plumbing) systems, Medical Equipment, and Garage. For every cluster, there was a representative from Sutter, PAMF, the architecture firm, and general contractor firms. Each cluster met once a week. Also, there was a cross-cluster meeting every week as well.

The integrated team was co-located in a large office area provided by the owners and had an overall meeting once a month. Those meetings were full day sessions (lasting 6 to 7 hours with lunch break). Representatives from the different parties (Skanska, NBBJ, PAMF, Sutter and trade partners) participate in this meeting, including team members that are based in different cities, e.g. core group members from NBBJ based in Seattle. Issues discussed are schedule and cost updates, external events affecting the project including on going negotiations with stakeholders, visualisation of BIM model and discussion on coordination efforts, updates on lean endeavours and discussion about a LPDS topic.

Research Process

In the initial part of the study, data was gathered to understand the project's context. This included understanding the owner's motivation for funding such project, how the project was linked to the owner organisations' vision and strategic aims, as well as the influence of external stakeholders on project definition and approval.

Data to understand the project's approval process and the influence of external stakeholders was primarily gathered through the analysis of documents. The city of San Carlos provides online access to the main documents delivered by construction projects through their approval process. This includes environmental impact studies, urban impact studies, the project's business case and expected benefits to the city, as well as documents resulting from the public hearings, i.e. letters of concern and the project team's reply with clarification of issues or proposal for mitigation.

In order to understand the programme's value proposition, and other strategic intents, documents provided by PAMF and Sutter were analysed. These documents included the project's business case developed by PAMF, PAMF's development plan describing the design principles that should guide the development of their facilities, the validation study realised by the IFOA members in 2010, the reviewed version of the IFOA signed in 2010, the suspension manual describing the project status when it was suspended in 2009 and Sutter's lean manifesto, which provides a justification for the adoption of LPDS as a means to increase efficiency.

The evaluation of the adoption of LPDS was carried out mainly through participant observation from 10/25/2011 to 06/28/2012. A temporary desk was provided for the researcher in the project's office, where the integrated team was co-located, and the observation was carried out through participation in meetings and involvement in the project activities. The researcher was physically present at the office for at least once a week. The list of meetings attended by the researcher during the period of this case study is provided in Figure 41. Different meetings were attended to understand how the LPDS was supporting value generation: from the SMT meetings to understand how strategic decisions affected and were deployed in the project to the cluster meetings to observe how LPDS was supporting the team to focus on value generation.

Date	Core Group meetings
11/22/2011	Core group
11/29/2011	Core group
12/06/2011	Core group
12/13/2011	Core group
01/17/2012	Core group
01/24/2012	Core group
01/31/1012	Core group
02/07/2012	Core group
02/07/2012	Lessons Learned Workshop
02/14/2012	Core group
02/14/2012	Lessons Learned Workshop
02/28/2012	Core group
02/28/2012	Lessons Learned Workshop
03/06/2012	Core group
03/20/2012	Core group
04/03/2012	Core group
04/10/2012	Core group
04/17/2012	Core group
05/15/2012	Core group
05/22/2012	Core group

Date	Other meetings
10/25/2011	Interiors cluster
11/01/2011	Interiors cluster
11/08/2011	Interiors cluster
11/08/2011	MEP cluster
11/22/2011	SMT meeting
12/13/2011	MEP cluster
12/20/2011	Interiors cluster
12/20/2011	Vapor barrier solution
01/17/2012	MEP cluster
02/02/2012	Discuss Project Metrics
03/20/2012	Kick off construction
03/27/2012	SMT meeting
04/03/2012	Research and Development Skanska visit
05/15/2012	Validation study 2

Figure 41: Timeline of meetings attended

The focus of the participant observation was however on the core group. During the development of the research, the researcher also played a role in supporting the adoption of LPDS concepts in the decision making process within the core group. The core group allocated a 10 minutes period, at the end of each meeting, to receive feedback from the researcher. A cycle was established, in which the researcher would analyse data gathered in the previous week and discuss with the core group. The discussion included also data gathered in the other meetings and through interviews. Data collection was focus on evaluating the contributions of the LPDS bus also on identifying the difficulties of its implementation.

Fifteen members from the integrated project team were interviewed (Figure 42). See interviews protocol in Appendix C. The intent of the interviews was to understand the contributions of LPDS from the team's perspective and also identify difficulties for its implementation. These were semi-structured interviews and their duration varied between one to one and a half hours.

Date	Interviewees
11/22/2012	Owner (project management / capital funding) – Programme manager (core group member)
11/22/2012	Trade partner – BIM manager
11/08/2012	General Contractor – Design manager
11/08/2012	General Contractor - Estimator
11/08/2012	Owner (project management / capital funding) – Project manager (core group member)
01/18/2012	Owner (user organisation) – Director of Facilities (core group member)
11/08/2012	General Contractor – BIM coordinator
11/29/2012	Trade partner - MEP systems
03/20/2012	General Contractor – project manager (core group member)
01/19/2012	Architect - Senior Associate (core group member)
05/22/2012	Owner (user organisation) - Director Facility Planning (core group member)
05/25/2012	Owner (user organisation) - Construction Project Manager, Facility Planning (core group member)
05/25/2012	Owner (user organisation) - Vice President, Clinical Integration, Facility Planning, Business Planning and Development (SMT member)
11/01/2011	General Contractor – Lean facilitator
11/01/2011	General Contractor – Project Engineer

Figure 42: List of interviewees

In 2010, there was a decision to divide this project into two phases. This separation enabled an opportunity to review the lessons learned in the design process of phase 1 to improve the new design process starting for phase 2. The transition from design phase 1 to design phase 2 happened in

February and March 2012. The core group decided to undertake a series of three lessons-learned workshops, facilitated by the researcher. Each workshop lasted for 1 hour and a half. The lessons learned workshops combined the request to answer individually to questions sent previously to workshops by email and group discussion during the workshops. Along with opportunities for improvement, the team also devised a value proposition for the project and discussed the different priorities among project stakeholders.

5. RESEARCH FINDINGS

This section describes the three empirical cases realised in this research. In the first case, it is explained how the practical problem was first identified and then investigated. The problem was framed from the perspective of project management and value generation in construction. The results of the three evaluated approaches are discussed in this chapter. The final conceptual framework, compiling the results from the three evaluations are presented and discussed at the end.

5.1 CASE 1: THE CITY ENTRANCE INTEGRATED PROGRAMME

5.1.1 Programme's value proposition

In 1999, the area was indicated in the city's master plan as a priority area for low-income housing intervention, with the intent to relocate those families living there irregularly, bringing them to the formal city. This was the beginning of Programme's inception. A study was carried out by the Housing Department to analyse the living conditions in the Programme's area (DEMHAB, 2001). Three groups with different characteristics were identified (Figure 43):

- In Group 1, houses are located in an area along the highway. The area is characterised by provisory occupancy of homes and high mobility rates, with occupants living there for an average of three years;
- Group 2 is more consolidated. The area has been occupied for more than 13 years. Occupants are socially organised and are active participants of community organisations and politics; and
- Group 3 was analysed separately because of its peculiar characteristics, as the majority of families live from collecting and sorting waste. The area presents high mobility rates and very bad living conditions.

Figure 43: Groups of irregular settlements

The study also showed that many houses were located in flooded areas without water supply, proper sewage system and waste collection. The settlements were insalubrious and the community presented several health issues, including respiratory problems, skin diseases and mental illness (DEMHAB, 2001).

Benefits were expected not only to the targeted community, but also to neighbouring communities and the city as a whole, through the provision of better urban infrastructure and job opportunities. Figure 44 describes the programme's goal, the purpose of each project and the benefits expected from their implementation (PMPA, 2002).

Programme aim	Projects	Projects purpose	Expected benefits	Direct beneficiaries	Indirect beneficiaries
Improve quality of life through urban infrastructure and environmental recovery in the north zone of Porto Alegre	Social Housing	Improve living conditions for 3.775 families of three neighbourhoods	Better living conditions	14.700	81.600
			More access to public education and health services	31.964	-
	Landscaping	Add value to current neighbourhood's landscape	Access to places for leisure	31.964	-
			Better appearance	31.964	81.600
	Road infrastructure	Improve roads infrastructure in the neighbourhoods	Better circulation	31.964	81.600
			Less flooding	31.964	-
	Income generation	Provide alternative sources for income generation	Job posts	450	1.290
			Professional qualification	840	2.410
	Community development	Support community development	Community organisation	14.700	-
			Access to social policies	31.964	-

Figure 44: Programme vision - aims, purposes and expected benefits

5.1.2 Programme Timeline and Definition Process

The Figure 45 below shows an overview of the Programme's timeline, from the beginning of its inception to the evaluation in 2008. Major influences and events that helped shaping the Programme are described below.

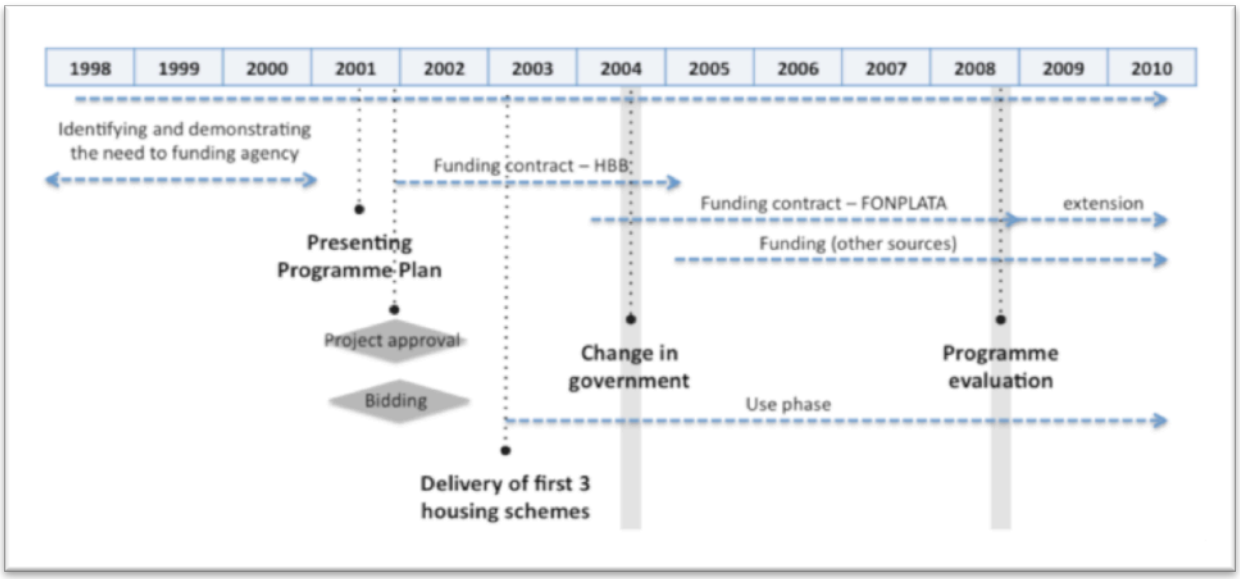

Figure 45: Programme implementation overview

The Programme started out primarily as a housing project with a strong emphasis on social work financed by the Inter-American Development Bank within the *Habitar Brasil BID Programme* (HBB). The PIEC was an initiative of Porto Alegre's Department of Housing in 1999 and its conception was strongly influenced by the HBB, which was the City's main source of funding for social housing projects in that period.

In the beginning of the programme's inception, the HBB facilitated a consultancy with the Argentinean Centre for the Study and Development of Environmental Projects (CEPA), which suggested that the scope of housing projects should be broadened, addressing urban development issues and not only the need for shelter. The PIEC was part of a group of initiatives of the City Council to tackle the housing deficit problem in a more holistic way.

The project aimed to provide adequate housing but yet keeping the community in the same neighbourhood. The target was to build 3.061 new units and provide adequate urban infrastructure for 295 existing houses. It was also included the provision of urban infrastructure to other 298 dwellings in the neighbourhood and the opening of 138 local markets to maintain existing commercial activity that was carried out informally in the settlements.

Housing units were designed larger than in previous programmes because it was observed that families usually make extensions to increase internal space. The design consists of one kitchen, one bathroom, one living room and two bedrooms, in a total of 42m^2. Three different types of dwellings were planned. All of them considered the possibility to grow vertically. The allocation of families was planned according to their needs. One-store dwellings are reserved for the families that own carthorses for waste collection or families in which someone has mobility difficulties. These dwellings can also be adapted in case of physical disabilities.

The strong emphasis on social work and community involvement included a close connection with the City's Participatory Budget (OP). The OP was implemented in Porto Alegre in 1989 and since then, it has been a way of considering the public perspective on public investment decisions with up to 1000 organisations and more than 20.000 persons per year have participated in local governmental decisions. The OP divides the city into 16 regions and gathers public requests by each region. From 1999 to 2007, the neighborhood in which the PIEC was implemented made 229 requests (Figure 46). Those requests were taken into consideration during the project's inception.

Classification	Requests	Nº
Transport, infrastructure	Execution and maintenance of road pavement and public illumination	76
Housing	Regularisation of settlements, urban infrastructure, sewage and housing	28
Transport, infrastructure	Protected bus stops, more bus routes and better traffic management (including signalling)	22
Education	Increased capacity of existing schools and provision of nurseries	14
Urban infrastructure	Maintenance and increase capacity of existing sewage and water systems.	13
Housing, infrastructure	Pavement, sewage and regularisation of settlements	12
Leisure	Renewal of Parks	8
Education	Increased capacity of existing schools and provision of educative work.	8
Health	New primary care centres and maintenance of existing ones	5
Employment	Professional development courses	5
Leisure	Maintenance of gym equipments in the Park	1
Leisure	Dance courses for the youth	1
Total		229

Figure 46: Requirements captured through the Participatory Budget, Region 1

Besides the OP, a percentage of the funding received from the HBB was designated for realising social work with families. The social work included income generation, community development and environmental and sanitary education. The aim of this social work was to engage the targeted community in the programme, making sure they would remain on the new housing schemes (HBB required families to sign a contract for occupying the new houses).

Funding for the social work was also utilised to analyse the target community current conditions (some results were presented in the previous section). The study included an analysis of every family that would benefit from the project. Data such as the type and size of family, as well as the material and size of current homes were gathered. This data was used to support project planning.

In order to engage the community on the design of housing schemes, a group called “leadership development” was created. This group met every month during the design phase to discuss design options for the housing project and to visit other similar projects in which the community could visualise the new way of living that was being proposed to them. During the construction of the first housing schemes, site visits were also organised by the social workers. This group of actions that intended to

engage the community on the project were called *"socialising the design and construction process"* effort.

Another contractual requirement was that the new houses, when delivered, would remain as public property, belonging to the City Council. Consequently, the users were not allowed to sell or modify the houses without the City's authorisation. Modifications had to pass through the housing department's technical approval. Predicting that users would request modifications, the Programme team prepared guidelines to adequately modify the houses after occupation and established a technical team to give support to families that wanted to modify their houses.

Building on the capabilities provided by this first phase, in December 2003, a larger funding contract was signed with the Financial Fund for the Development of the River Plate Basin (FONPLATA). FONPLATA became the project's main funding agency with 50% of the total investments. The Programme's scope was broadened, to include road infrastructure, landscaping, and income opportunities and community development. The new scope was added to previous actions. In this addition, it was also considered other interdependent projects that were already under construction. The road infrastructure project is one example, in which the team had to take into consideration a previous project that was already being implemented in an adjacent area.

During the project's implementation, there was a drastic reduction in the US dollar exchange rate (currency used by FONPLATA). As a result, the total amount of money received for implementing the project was largely reduced comparing to the original amount requested. Consequently, the scope of intervention had to be re-evaluated, and alternatives sources of funding explored. This meant new participating stakeholders in the process and new rules to be followed (e.g. procedures prescribed by funding agencies).

Also, in 2004 there was a change in the city government, and consequently on the Programme organisational structure. These changes included the admission of new personnel and the reorganisation of responsibilities. The Programme initiated under the governance of one political party and in 2004, another party was starting their four-year mandate in the City Council. In 2004, there was a change in the city government, and consequently in the project's structure.

According to interviewees, the previous team did not leave sufficient instructions for the new participants. Consequently, the implementation activities slowed down for some time and changes were made. The new project participants had different priorities and a different understanding of how activities

should be performed. In 2008, close to elections, the City Council requested an evaluation of the Programme's intermediate outcomes.

5.1.3 Programme Evaluation in 2008

Post Occupancy Evaluation

In order to summarise data from the post occupancy evaluation, which is fully presented in Miron (2008), a few variables were selected to illustrate satisfaction with the community's satisfaction with the programme and the improvements perceived. Figure 47 shows a correspondence analysis carried out to provide an overview about users' satisfaction and perceived improvements.

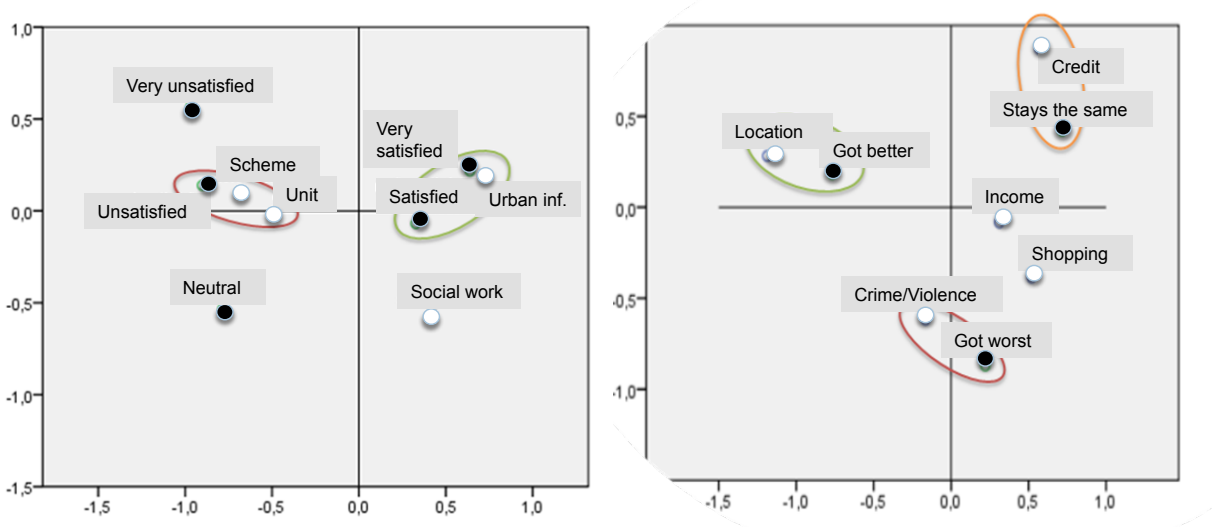

Figure 47: Correspondence analysis – satisfaction and perceived improvements

It can be observed that there is a high level of satisfaction with the urban infrastructure provided, which includes water supply, sewage and pavement on the street and sidewalks. Interviewed families stated that they were very satisfied by the fact that they no longer lived in a settlement that is constantly flooded and with insalubrious conditions. Other positive impact was on the location of new housing schemes. Interviewees explained that not only they remained close to their original settlement but now they also are closer to the city centre and access to public transportation.

Conversely, it was observed a low satisfaction with house units and housing schemes, and neutral satisfaction with social work. Other non-positive impacts observed were an increase in crime and violence and no changes on income. Some interviewees explained the low satisfaction with houses. According to their opinion, one main issue was the absence of an adequate space for carthorses.

Families that owned a carthorse complained about having to leave their horses outside the housing schemes and having the horses stolen. Another reason mentioned was the size of the new homes. Miron (2008) observed a high degree of spatial modification in the occupancy stage. Such modifications were made without any notice to the government, despite the fact that the government had specialists to support the adaptability of houses. Neither the occupants knew that housing units were planned to be adapted nor the government was informed about their needs to modify the space.

Increased levels of crime and violence were explained by the social workers. People from different settlements were brought together in the same housing scheme, which might have contributed for the increase of crime and violence. Despite the fact that the team had planned to allocate the families in specific locations, the social work, which included the proper allocation of families, was not executed as planned. One reason for that were the changes that happened in that project. Once executed by the Housing Department and later outsourced. Another aspect that contributed for increased crimes was the fact that the road infrastructure project was not implemented in the same pace as the housing project. As a consequence, unfinished roads created spaces in which thieves could easily hide.

The incomplete execution of the social work led to other problems observed in the use phase. Figure 48 shows an aerial view of one housing scheme where the social workers observed most behaviour problems in the use phase: even though a waste sorting unit was built in the proximities of the housing schemes, some families kept the habit of sorting waste inside or on locations close to their homes, bringing back the insalubrious conditions of the irregular settlements. This behaviour is also related to the fact that there was no perceived improvement on income or access to credit. The target community did not engage on the job opportunity project as it was expected. Instead of working as a group, many families continued to work individually and did not want to trade their weekly or daily income for a monthly income plus the duties of being formal employees. According to the social assistants, this situation could have been avoided with the adequate implementation of the social work.

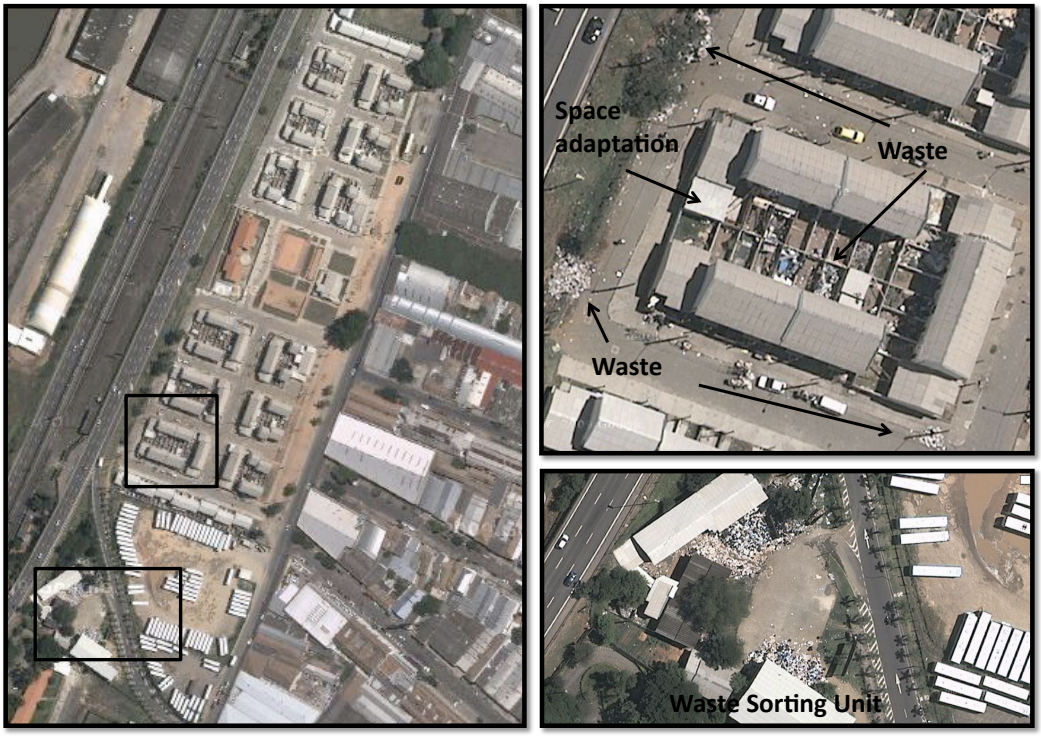

Figure 48: Aerial View – housing scheme 5

The social workers also point out that the incomplete execution of the social actions might have also contributed for the high percentage of mobility rates. Families' mobility[5] rates analysed in Miron (2008) (see Figure 49) was explained as a consequence of an adaptation problem to the new way of living.

Housing schemes	1	2	3	4	5
Housing mobility rates	33%	31%	29%	30%	28%

Figure 49: Permanence of families in new housing schemes

According to interviewed community members, many families were selling their houses and going back to irregular settlements. The social workers explained that one of the reasons for that was the difficulty of families to pay for lightning and water bills due to an intense use of those resources (families were not used to have lightening or water supply and did not know how to proper use it). Also, there were other behaviour issues that were making it difficult for families to adapt to this new way of living. One of the objectives of the social work was to teach the community how to adequately use their homes. However when analysing the database collected by Miron (2008), it was observed a high rate of missing values in

[5] Miron (2008) observed, during interviews with social assistants, that families were abandoning the new homes, selling it for others and coming back to informal assessments. The author decided to analyse quantitatively if families were indeed abandoning their new homes. In order to do that, it was made an assumption that if families were living in the scheme since the date it has been delivered, then they are the original owners; however, if families live there less than the expected period, the house might have being sold, and they are not the original owners. Asking families where they use to live before and checking if they were from the right irregular settlement was also used confirm family permanence.

the question about the attendance to courses on how to proper use the house (68%) and attendance to professional qualification courses offered in the programme (88%). These numbers are additional evidence that the social work and the income generation projects were not fully contributing to generate the expected programme outcomes because the target population was not receiving them.

Programme Implementation Status

Figure 50 is a graphic representation of the programme's implementation status in August 2008.

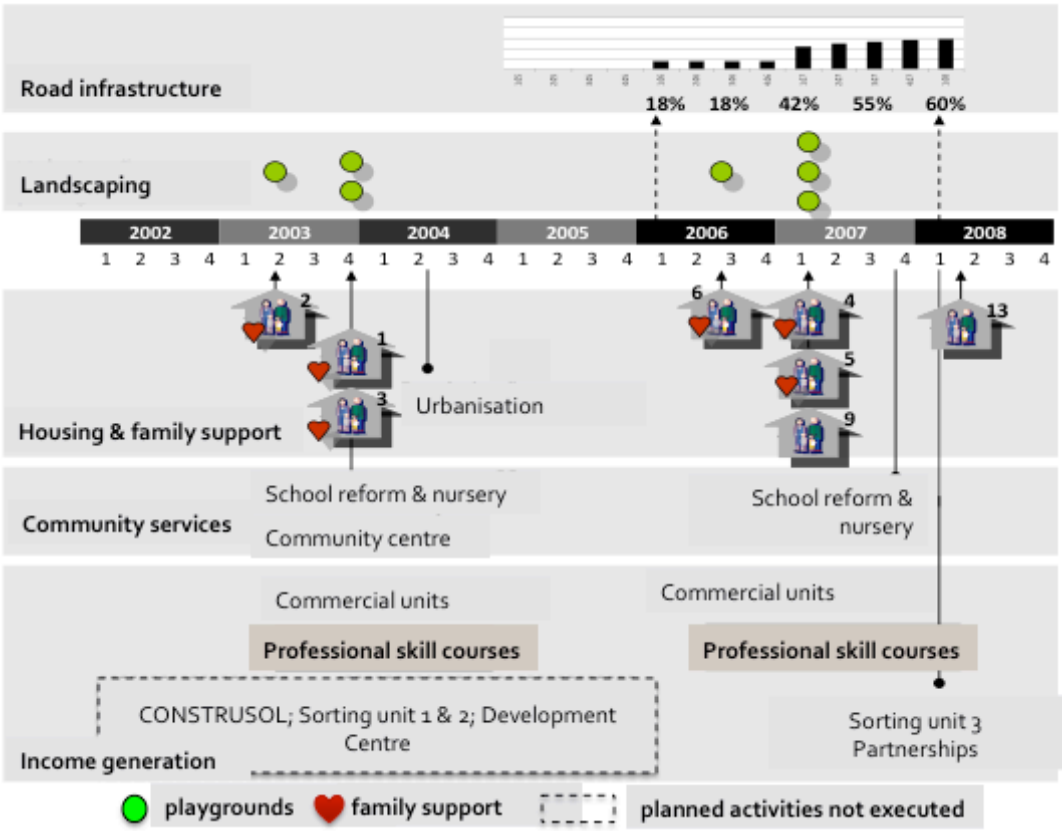

Figure 50: Programme implementation status

It can be observed that the first project to be executed was the housing project, with the first three schemes being delivered in 2003 and 2004. In those schemes, the social work with families was also carried out. In this period, the school reform and the urbanisation of selected areas was also initiated, a phase one of two was realised. For that period it was also part of the plan to execute different activities to help the target community to improve their income, however, many obstacles were faced and the team could only provide skill courses.

It was only after the election period that the road infrastructure project and the landscape project started to be executed. In the post election period five more housing schemes were delivered, different

countermeasures were taken to fulfil the gap in the income generation project, the road infrastructure project started to be executed and the activities related to the landscaping project were focused on complementing the housing and the road infrastructure projects.

The Figure 51 below shows a more detailed timeline of project activities that reveals some of the causes behind the lack of synchronisation in the programme execution process. The timeline was built based on the progress reports, and for that reason it is segmented in periods of three months. The diagram shows the period in which the activities were being performed. A distinction was made between preparatory activities, such as planning and solving regularisation issues and the actual activities for physical intervention.

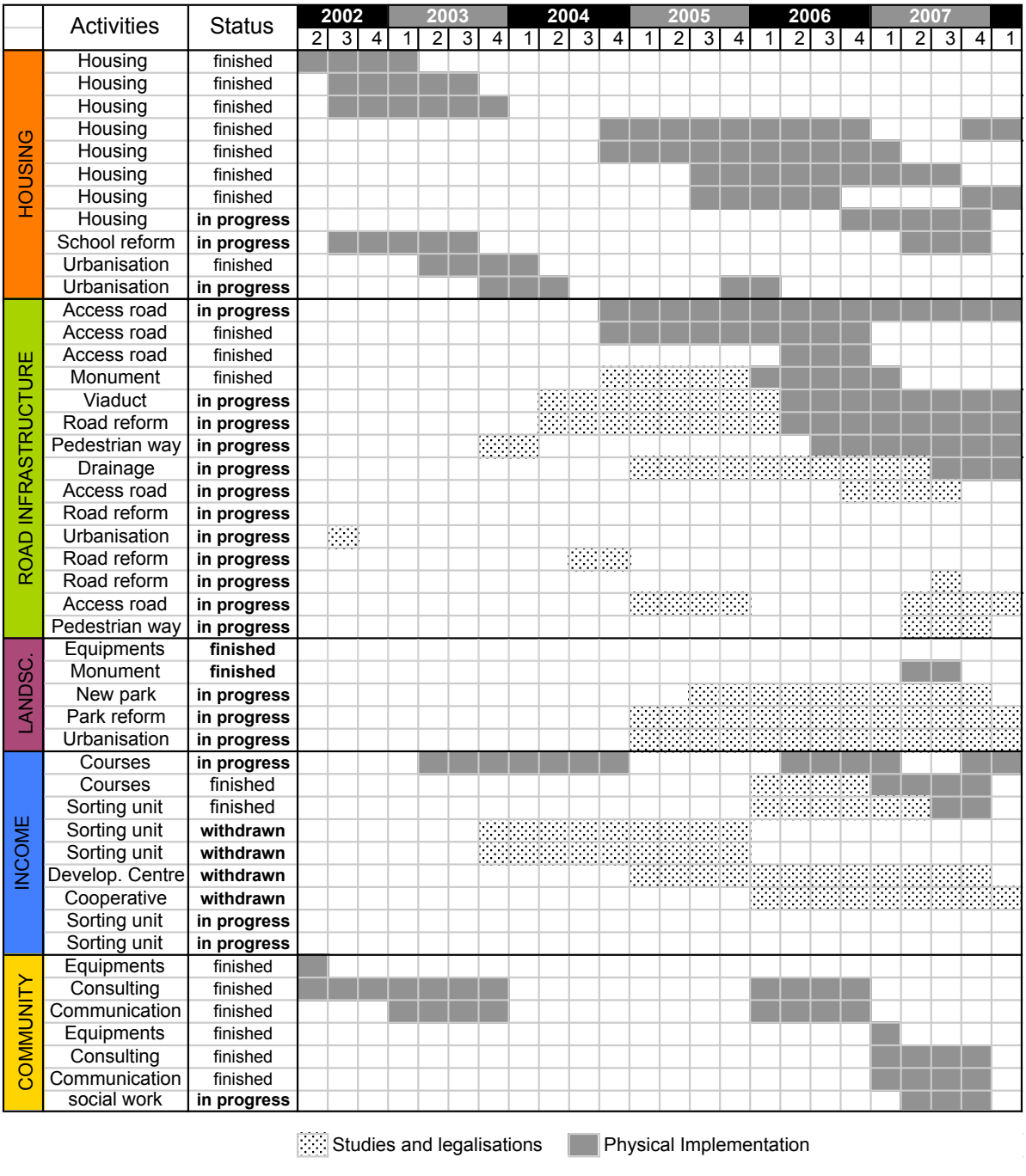

Figure 51: Status of activities by project

It can be observed that a large amount of time was spent with preparatory activities and all projects were behind schedule. Also, not all activities shown in the diagram matches the activities planned in the LFA. The reason for that was the need to re-evaluate the scope of intervention. Many activities had to be withdrawn and replaced by others. Figure 52 shows an estimate of the activities status for that period. The numbers based on progress reports and complimented with data gathered on the interviews and on the online tool. It is important to mention that this is an estimative, because it was very difficult to

compare the current programme status with a baseline, since the scope of intervention changed and there was not a comprehensive list of updated planned activities. However, this table is useful to demonstrate the difficulty of finishing activities on time and keeping the scope of projects as planned. The figure also shows the number of activities withdrawn from plan due to difficulties that could not be overcome, as well as activities added.

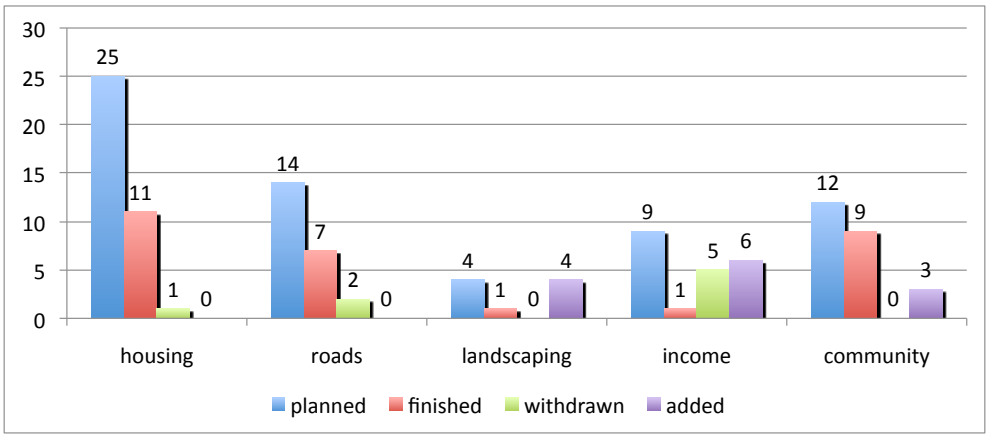

Figure 52: Status of activities in june 2008

Figure 53 shows an estimate of programme expenditure. The chart was built based on data from the progress reports and the online managerial tool. According to these sources of data, the programme spent half of the available resources by the first semester of 2008. Due to obstacles for implementation some projects spent less or more money than the expected. The non-uniformity on the expenditures among projects is also an evidence of the lack of a synchronised implementation.

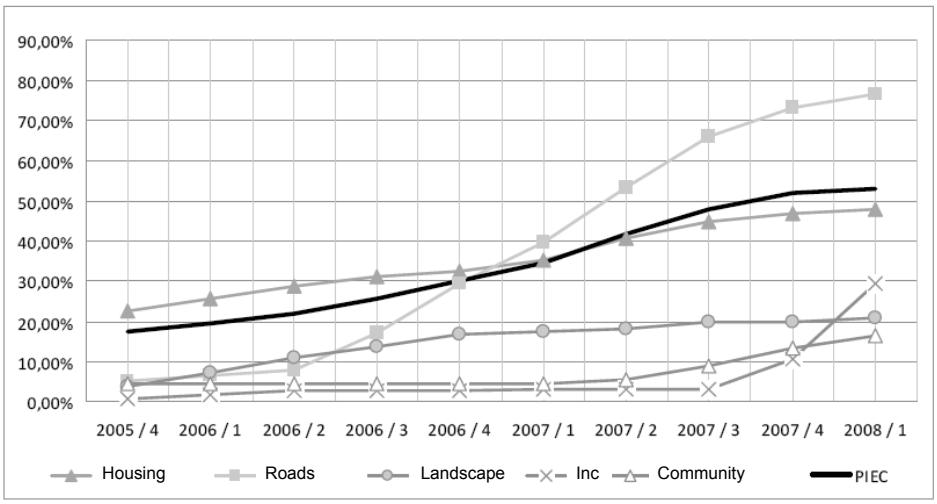

Figure 53: Estimated programme expenditures in june 2008

5.1.4 Programme's Delivery Method

Figure 54 is based on data gathered in July and August 2008 and reflects the changes made by the programme team after the elections in 2004. The project follows a traditional bidding process. By Federal Law, public construction projects in Brazil have to follow a bidding process in which the lower offered price must be selected. Each project had a separate delivery process, and different challenges for their implementation.

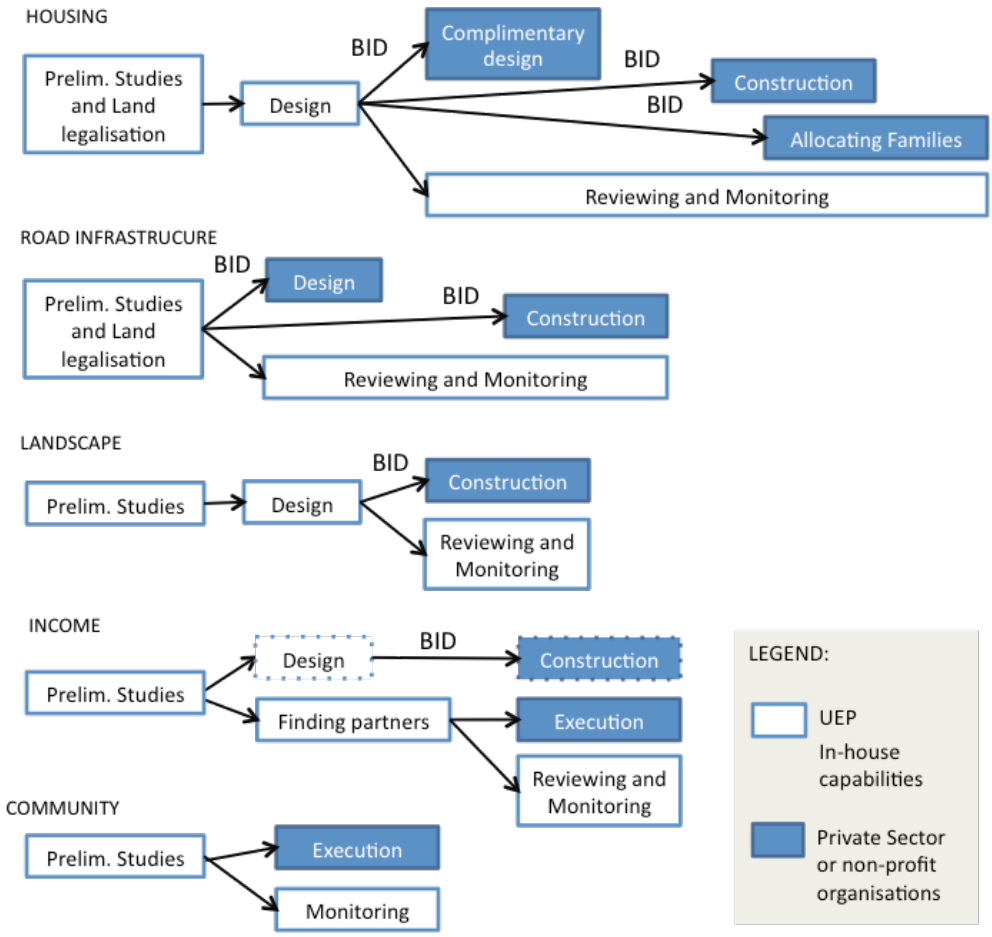

Figure 54: Schematic representation of project processes

In projects involving the construction of physical facilities (housing, roads infrastructure and income generation), the intervention generally started with the negotiation and legal possession of areas that are not owned by the city government. However, only 31% of land designated for the Programme's implementation was already City's property and available for implementation. The other 69% had to be negotiated with private owners (17%) and the federal government (50%). Sometimes, even when land was owned by the city, it could not be used, as there were irregular occupation and the need to remove irregular occupants and legalise the land.

The existence of irregular occupants on selected areas caused a lengthy process for the city to get the legal possession of lands. Also, the release in the news that one of the housing schemes was ready to start construction caused a group of families that were not included in the PIEC to occupy the site. Those families were protesting and wanted also to be included in the programme. As a result of the disagreements with that community, that specific housing scheme had to be withdrawn from plan.

The major differences are the outsourcing of design activities and social work in the housing project, and the search for new partners to execute the income generation project. Outsourcing these activities was a result of a change in mentality and also a response to new demands from alternative sources of funding. One of these sources was the BNDES funding agency. The agency required submission of all detailed designs for the housing project prior to giving building permit. Thus, outsourcing design would reduce timescales. Another example was the income generation project. The later team had a different understanding of this initiative and set a greater emphasis on waste sorting activities. As a result, the city's urban cleaning department was engaged in the project.

The bidding processes for outsourced projects were also lengthy. The main reason for that is because companies would not meet the necessary requirements; proposals were either over budgeted or incomplete. The work that was outsourced also frequently presented quality problems. Drawings delivered from private companies had to be redone, as they were not detailed enough to support execution or contained errors.

During an interview, the project manager for the road infrastructure project explained how external stakeholders influence on approving design proposals slowed down the implementation of some activities. The manager described the delay of the viaduct execution. After the design of the viaduct was delivered by the private sector, the national airport planning agency (INFRAERO) alert that the planned viaduct was too high to be executed near the airport. The design had to be reviewed by a technical team that was not considered in the initial plan. Also, additional technical support was required during the execution of the viaduct.

5.1.5 Programme Design and the Adoption of the Logical Framework Approach

From 1999 to 2008 there were several changes on the programme's scope. In 2008, when the Programme was evaluated, the LFA was taken as a starting point to devise an evaluation tool. Consequently, the matrices were revised and the researchers created Figure 55 to illustrate the Programme's logic.

	Programme overall goal: Improve the quality of life of a target community living in three neighbourhoods				
	Housing	Road infrastrcuture	Landscaping	Income generation	Community development
	Projects overall objectives: Provide urban infrastructure and environmental recovery				
Objectives	Improve living conditions	Provide adequate urban infrastructure	Provide aesthetic value/ leisure places	Opportunities to generate income	Support community development
Components	1. Provide area to build housing and places for income generation	1. Analyse needs for road connectivity	1. Reform and improve existing leisure areas	1. Build waste sorting units	1. Community organisation
	2. Build housing schemes and places for public health/education services	2. Provide area to build new roads		2. Build the centre for economic development CDR	
	3. Allocate families in new housing schemes	3. Build new roads	2. Build new leisure areas	3. Establish the cooperative CONSTRUSOL	2. Social political actions
		4. Build drainage system			
Summary of Activities	1. Acquisition/Legalisation of 8 sites	1. Studies and drawigs for road infrastructure execution	1. Reform existing open areas and park, acquire equipment to maintain those areas	1. Build 3 waste sorting units, acquire equipment and recruit managerial staff	1. Reform existing space and acquire new furnishing and equipment, sign contract with consultants and partners
	2. Built 19 new housing schemes, urban infrastructure for 2 neighborhoods, refurbish public school and build 213 temporary homes	2. Acquisition and Removal of existing iregular occupancy		2. Build physical space, acquire furnishing and recruit teaching staff for courses	
		3. Build 1 avenue, 1 elevated roadway, 5 new connecting streets, 1 intersection and the expansion of 2 main avenues	2. Build open space along new avenue and on new housing schemes	3. Bulid physical space for CONSTRUSOL, acquire equipment and recruit supporting staff	2. Reform existing buildling (SESI), acquire equipment, sign contract with consultants and outsource educational material
	3. Allocate families in new housing schemes	4. Reform exiting drainage system and replacement drainage equipment			

Figure 55: Programme's logic based on LFA

However, the first Programme LFA found was published in 2002 by the City Council. It was produced as part of the negotiation process with FONPLATA. The first version was found to be very incomplete, with several assumptions and monitoring indicators left in blank or poorly defined. Part of the LFA, which is fully presented in PMPA (2002), is described below.

Seven matrices compose the Programme's LFA: one general and one matrix for each of the six projects. The first LFA matrix consists on an overall plan for the Programme, which is presented on Figure 56. The programme major aim is to improve the quality of life for the target community, and, in order to achieve that, six projects were planned. The figure shows exactly how the matrix is originally presented.

Logical Framework - PIEC

Summary	Indicators	Verification	Assumptions
Result			
Improve the quality of life	-	-	-
Purpose			
Provide urban infrastructure and environmental regeneration for the north zone of Porto Alegre	-	-	-
Projects			
1. Social housing	-	-	-
2. Urban infrastructure	-	-	-
3. Landscaping	-	-	-
4. Income generation	-	-	-
5. Community development and environmental education	-	-	-
6. Programme management	-	-	-
Activities / projects			

Figure 56: Plan for Programme implementation (PMPA, 2002)

For each specific project, a similar matrix was built. Data from the matrices are summarised as follows:

- *Social Housing Project*
    - Aim: to provide better housing conditions and adequate urban infrastructure (e.g. education and health centres)
    - Performance indicators: area of land acquired / time, number of houses, schools and nurseries built / time, number of families moved / time.
    - Means of verification: progress reports
    - Assumptions: adequate areas for implementation, no legal problems in land acquisition, available resources and successful bidding processes
    - Activities: 27 activities were listed and grouped into 3 components: acquiring land; building housing, health and education facilities; and moving families to new housing schemes.
- *Urban Infrastructure Project*:
    - Aim: introduce new roads and improving the area's drainage system
    - Performance indicators: number studies / month, area of land acquired/ month, linear meters of road implemented / month, drainage bombs reformed and installed / month
    - Means of verification: progress reports
    - Assumptions: no legal problems in land acquisition, available resources and successful bidding processes

- Activities: 21 activities were listed and grouped into 4 components: preliminary studies, acquiring land; building roads; and reforming the drainage system.

- *Landscaping Project:*
  - Aim: improve area's appearance and provide adequate places for leisure
  - Performance indicators: square meters / time, number of parks recovered / month
  - Means of verification: progress reports
  - Assumptions: available resources and successful bidding processes
  - Activities: 4 activities were listed and grouped into 2 components: reforming existing parks and building new ones.
- *Income Generation Project:*
  - Aim: provide job opportunities and professional qualification
  - Performance indicators: job posts / month, building facilities in operation / month
  - Means of verification: progress reports
  - Assumptions: community engagement for occupying job posts created, community organised in groups to work in waste sorting units as formal employees, available resources and successful bidding processes
  - Activities: 9 activities were listed and grouped into 3 components: build 2 sorting waste unit facilities, build a regional development centre facility and organise a cooperative with 90 job posts.
- *Community Development Project:*
  - Aim: provide support to community development and more access to the city social policies
  - Performance indicators: implemented actions / month
  - Means of verification: progress reports
  - Assumptions: community engagement, available resources and successful bidding processes
  - Activities: 12 activities were listed and grouped into 2 components: engaging and organising the community; and developing social policy activities

The bar-chart bellow (Figure 57) presents the original plan for the programme implementation, considering the main components of each project.

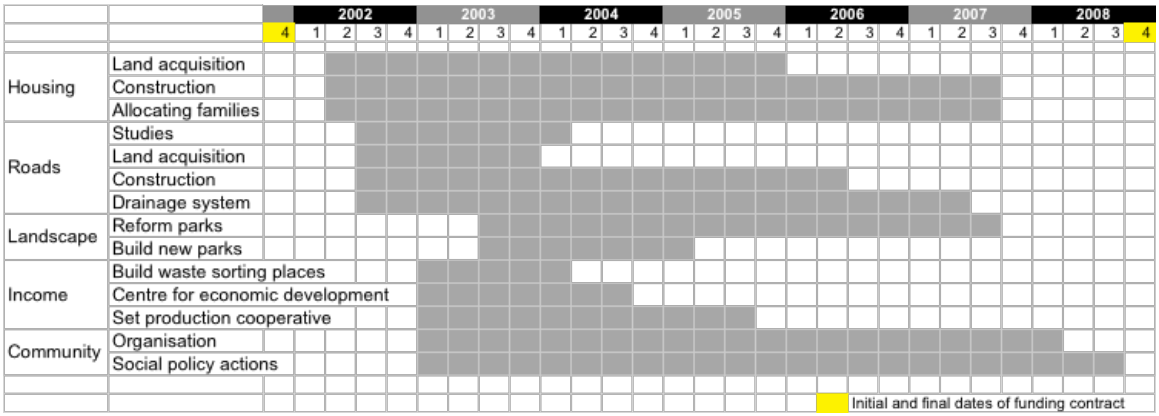

Figure 57: Plan for Programme implementation (PMPA, 2002)

The UEP was responsible for monitoring the implementation and keeping the funding agency (FONPLATA) informed through periodic progress reports. It was observed that the LFA was not used for monitoring purposes. Instead, an online tool was being developed and implemented to support programme monitoring.

The expected benefit of such tool was to provide a better support for the integrated management of the programmes. With such tool, which was introduced with the support of a consultancy firm, each department could input data from their specific projects, informing progress and providing performance indicators. All the relevant information about the different projects would be kept in this online tool, available for restricted access online to fulfil accountability and scrutiny purposes.

The UEP reviewed the programme monitoring indicators to be included in the online tool. However, similarly to the ones stated in the LFA, those indicators emphasised the physical advance of the housing, roads infrastructure and landscaping projects, being expressed in linear meters of roads, square meters of parks, or dwellings built per month, respectively. As justified by one interviewee, the rationale for that is because demonstrating the physical advance of the programme is better for accountability purposes, “physical advance can be seen by the society”.

The programme manager provided access for the researchers to this online tool from April to November 2008, enabling the researchers to follow the programme process in real time. A snapshot of the tool is shown in Figure 58. The tool contained information such as: (a) Programme tasks by project and their status, including how problems were being solved; (b) Key performance indicators, including the

responsible for collecting data and means of verification; (c) Charts showing project status, the deadlines for meeting objectives and what has been already completed; and (e) Programme expenditures (detailing the share of expenses between the city government and funding agency) and the remaining financial resources available. However, it was observed that each project team was responsible for inputting information about their project in a separate manner. The online tool was being used with the emphasis of giving accountability of individual projects rather than supporting their implementation on an integrated manner.

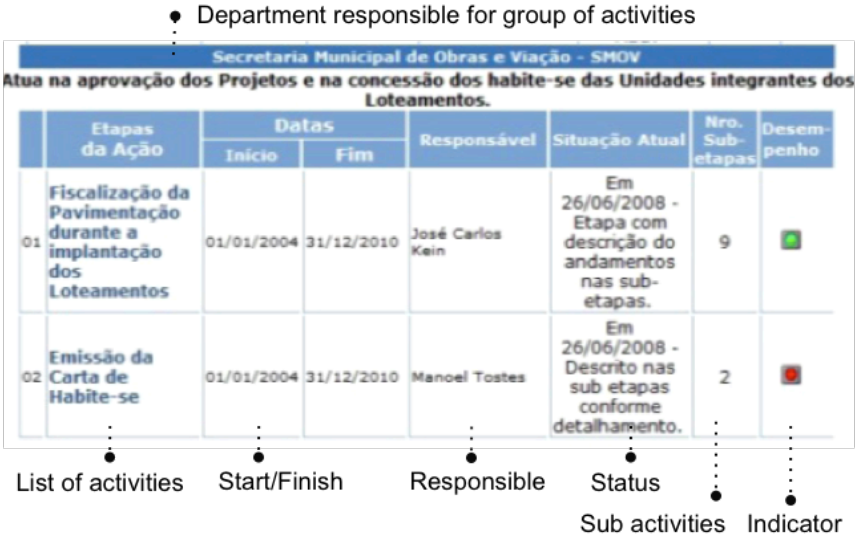

Figure 58: Snapshot of online managerial tool

In the last two months of observation, it was observed an increase in the amount of information being input by the UEP. It was explained by interviewees, the city government established a programme for rewarding the managers with outstanding performances in the various on-going construction programmes. In the UEP meetings, which were held every month, the programme manager would incentivise teams to use the online tool as a way to improve the programme's overall performance. The programme's performance was reviewed every month through the indicators displayed on the online tool and compared to other on-going programmes implemented by the City Council. The programme manager, incentivised by such governmental programme, would steer the team to seek performance improvement.

5.1.6 Team's opinion about the challenges to generate expected outcomes

During the period when the interviews were carried out, the programme team was undertaking many efforts to overcome the observed obstacles. The alternatives generated by the team were documented in the progress reports and displayed on the online tool. The programme manager played an important

role in supporting and incentivising the team to find alternative solutions for the problems observed The team was capable of finding alternative sources of funding, overcoming barriers for the implementation of projects while keeping a transparent relationship with the community. The Programme's evaluation was an initiative of the programme manager to contribute for keeping accountability for the impacts to the community and also to improve the team's performance, learning from the results.

The interviews were however focused on understanding the difficulties to implement the different projects on a synchronised fashion. The main identified difficulties are described below.

In the housing project, the most important difficulties were:

- Existence of irregular occupants on selected areas and consequently long process for the legal possession of lands;
- Difficulty to get funding from alternative sources (the funding agency required that the design of housing schemes should be presented to get funding, this issue was solved by anticipating design before the legal possession of lands and contracting an external firm to do complementary designs;
- Need to adapt project scope due to an unpredicted lack of resources; and
- Financial difficulties of private sector organisations bided to execute services.

Also, one of the schemes had to be withdrawn from plan. The anticipated communication to the community that the construction would soon start in a specific area, lead to an invasion of additional families in the area. The invasion happened because those extra families also wanted to be included in the scheme. However, including them on the budget to build the scheme turned that project economically unviable, and it had to be withdrawn. This early advertisement had to be avoided in the next projects. According to the programme manager, which has been accompanying the project since its early implementation, the first housing schemes were having structural problems due to issues on the foundation design, which have to be solved through almost one year of studying a more adequate construction technology.

In the road infrastructure project, the most important difficulties were:

- Existence of irregular occupants on selected areas and consequently long process for the legal possession of lands;

- Need to adapt project scope as some activities from other projects were prioritised and resources re-allocated;
- Need to review designs delivered from the private partner and introduce changes in order to enable the execution phase (along the implementation process, the department hired and external team to give support in the monitoring and solving emerging problems in the execution phase)
- Need to review design (delivered by the private partner) to meet external stakeholder requirements (e.g. maximum height due to airport proximity) and long process to get approval and to make the necessary changes in order to meet those requirements.
- Long process for getting authorisation and requiring the cooperation of external partners or other departments to solve emergent problems

With the resource shortage, there was a need to readapt the programme scope of intervention and to set priorities. According to the interviewees, some planned activities for the road infrastructure project were withdrawn and the resources passed on to other projects with higher priority.

In the landscaping project, the most important difficulties were:

- Existence of irregular occupants on selected areas and consequently long process for the legal possession of lands;
- Long bidding processes due to private sector companies not meeting the public sector requirements, or over budgeting proposals, or even due to having no candidates for a bidding process;
- Need to review designs delivered from the private partner and introduce changes in order to enable the execution phase;
- Need to review design to meet external stakeholder requirements (e.g. provision of concrete barrier close in areas to the highway) and long process to get approval and to make the necessary changes in order to meet those requirements; and
- Difficulty to deal with routine work and demands from the programme.

The landscaping team was also responsible for several activities that were emerging along the programme implementation. The team was mainly intervening where infrastructure could not be delivered, e.g. enlargement of roads or the construction of facilities. In such cases, the team would provide an alternative solution for the area, with green areas and leisure activities.

In the Income Generation Project, the scope had to change substantially. For this project, the main components were to build a facility for the regional development centre, where the professional courses would take part; and organise a cooperative with 90 job posts to fabricate the bricks and build the houses for the housing project. However, it was neither possible to establish the cooperative nor to build the building facility for the regional development centre. The professional courses were provided even though, and one more sorting unit was built. The change in the programme structure in 2004, also led to a division of responsibilities between the Production, Industry and Commerce Department and the Urban Cleaning Department. Whereas the focus of the former was on professional qualification, the later was on waste sorting activities. The main difficulties faced in this project were:

- Need to re-adapt project scope due to the re-allocation of resources;
- Long processes to get funding from other agencies;
- Difficulty of persuading the community to participate on the professional qualification courses without offering financial reward (people outside the programme area started to apply and occupy the vacancies that were not occupied by the programme's community); and
- Difficulty of persuading the community to work on sorting waste units as a formal organisation (which includes having the rights and the duties of a formal employee).

Regarding the main difficulties faced on the community development project, the interviewed partner responsible for such project mentioned that the late payment for services delivered was the major aspect causing delayed on project implementation. In the specific case of the social policy development activities, these are depending on the refurbishment of an existing building called SESI. The refurbishment project was over budget and is being re-evaluated to cope with available resources.

The lack of collaboration among teams was an issue pointed out by different project managers. The success of some activities developed within the community development project was depending on the intervention of the housing project team and the income development team. To get those teams to collaborate, social workers had to require the intervention of the programme manager. Similarly, the non-facilitation of project approvals between departments was another recurrent issue mentioned by project managers. According to the programme manager, the PIEC started with a different organisational structure, in which each department focused on its own activities and responsibilities. The idea to work as a group and in an interconnected way was new and it required an organisational culture that takes time to be built.

During the programme implementation, aspects of learning should be emphasised. In the housing project, for instance, the first implemented schemes presented structural problems. Solving this problem took the team almost one year of studies to come up with a more appropriate technical solution for the housing structure, which was implemented in the following projects. It is important to observe that the housing project was the first to begin implementation. Also, the way of spending resources was improved throughout the years. Firstly, the government would allocate all available resources from the funding agency in the beginning of each year and the city government would then cover the remaining expenditures. However, by the second semester of each year the city government already spent most of its resources gained from tax payment at the beginning of each year. Now, expenditures are shared between the city government and the funding agency in different proportions for each project (e.g. 40% and 60% for the housing project). This was a solution to avoid late payments, a complaint made by the company in charge of implementing the social work.

5.1.7 Discussion

The PIEC meets all the characteristics of a complex infrastructure project described by Miller and Hobbs (2005). The programme was motivated by the need to solve a social problem in Porto Alegre: to provide a solution for thousands of families living in very poor conditions in the city entrance. The decision to tackle a social problem in a more systemic way than before, led the city council to face challenges to manage a programme with high complexity. The envisioned solution required a complex system of actions to be put in place in order to achieve the expected outcomes. For the city council, PIEC was a novel way to tackle a social problem, which also required an integrated team effort that was new to the programme team. Furthermore, the influence of myriad external stakeholders also contributed for the challenges to implement the projects in a synchronised way. Each project had a different route to follow and different obstacles to overcome.

Several changes happened to the programme objectives and means for achieving those objectives over time. The programme evaluation, which was carried out nine years after it has started, indicated that scope was still being re-evaluated and adapted. Rather than having clear and established objectives and means to attain those objectives from the outset, the programme was shaped according to a series of opportunities and events, i.e. influence of external consultancy to integrate housing project and social work and the changes in scope when the funding contract was signed with FONPLATA. The contracts with funding agencies also meant complying with prescribed procedures, i.e. creation of a managerial unit (UEP) and the adoption of LFA. PIEC also had a very participatory environment, engaging the community from its inception phase in different decisions.

As observed by Winter *et al.* (2006) in other similar projects, PIEC was highly susceptible to social, political and economic changes in the external environment. Indeed, as suggested by Miller and Hobbs (2005), complex projects are highly embedded in their context and cannot be analysed in isolation. As argued by the same authors, susceptibility to external changes is higher to the lengthy periods of implementation. Two major events impacted the programme: the instability of the dollar currency exchange rate and the governmental change in 2004.

The support of the LFA to deal with such complexity was evaluated (see session 5.1.5). Also included on the evaluation was the programme's delivery method (see session 5.1.4.) Other managerial mechanisms were observed to contribute for improving value generation. These issues are discussed as follows, under the three themes identified in the current vs. desired state table, presented in Chapter 2 (see session 2.5).

1) Support for understanding value as purpose fulfilment

As observed in other studies (SAVAYA; WAYSMAN, 2005), the main contribution of the LFA was to support the understanding of the programme's underlying logic. The LFA provided a template in which the relationships between project activities, outputs and outcomes could be easily visualised. Such template was used to communicate with the funding agency about the programme's expected goals and intended ways to achieve them. Thus, the LFA main contribution was to support the process of goal specificity.

The also LFA provided a baseline, upon which the team could relate in the progress reports to the funding agencies and report the status of implementation. The LFA was also expected to provide means for measuring the effected change, after programme's completion. However, the monitoring indicators established in the framework did not fulfil their purposes of tracking the realisation of outcomes as they emphasised the measurement of physical advance. It was observed that the team had difficulties in filling out the LFA Matrix, particularly regarding the establishment of indicators for assessing the achievement of expected outcomes.

When the programme was evaluated in 2008, the online managerial tool was being used as an attempt to improve managerial support. However, regarding its contribution to monitoring purposes, it did not provide a better support than the LFA as the revised indicators also emphasised physical progress as opposed to measuring the programme's impact.

Independent from the use of the LFA, in this project, whole life-cycle issues were considered. The possibility to adapt the houses in the future was one strategy used to support purpose fulfilment throughout the use of the space. Moreover, maintaining the city's ownership over houses was also a strategy that contributes for fulfilling the programme purpose during its life cycle. In fact, the difference of the PIEC from the other housing programmes promoted by the city council was the focus on the provision of housing only as a capability to support the community improving their quality of lives, along with job opportunities, access to education and social inclusion. Those elements were seen as means and not as ends to value generation.

2) Considering a means-ends chain to achieve goals

The LFA provided a template for clarifying the logic, or the means-ends chain necessary to achieve the expected outcomes. However, a difficulty was observed to fill out the assumptions of implementation and the establishment of monitoring indicators (beyond measurement of physical advance). Despite the fact that the LFA provided a clear visualisation of the programme's logic, there was a breakdown of major programme goals into sub-goals that were assigned to different projects, and within each project these sub-goals were broken down into activities. The interdependency of activities belonging to different projects was not considered. Thus, a transformation perspective was emphasised, not properly considering the flow and interdependencies to generate the desired results that would lead to value generation, as suggested by Koskela (2000). A substance view of metaphysics was adopted as oppose to a process view (KOSKELA; KAGOIGLOU, 2005)

After planning was concluded each department took their own individual route for the execution and monitoring of their planned activities. The interdependency and possible changes to projects were not properly considered and projects were implemented in a separate and counterproductive manner. If a production-based approach to project management was considered, the interconnectivity among project activities and the sequencing of implementation would be better analysed. In such approach, expected results (value) are the starting point to pull the right sequence of interdependent activities necessary for its generation (KOSKELA, 2000).

3) Support for creating a unit of purpose and common set of commitments

According to Simon (1997), the specificity of goals can support the creation of a unit of purpose within an institutional environment. Simon (1997) advocates that institutional environments have an important role on supporting people to make collective decisions to achieve an agreed goal. However, although the LFA contributed for the specificity of goals, this was not sufficient to fully support purposeful action.

The way the work was distributed in the programme did not contribute for creating a collaborative environment. The team also created a formal structure to support a unit of purpose and common set of commitments (as suggested by Simon, 1997). However, it was observed lack of collaboration among the different projects to solve problems. Reasons for that were: (a) bureaucratic process to ask for collaboration to solve problems and (b) a teamwork culture that was not created as departments are used to work individually.

Furthermore, the bidding processes inhibited the collaboration between the UEP and private sector companies. The customer-supplier relationship ended when drawings were delivered and the UEP did not receive support if there was a need for making changes when unexpected events occur.

Another aspect related to the creation of a common purpose, is the consideration of different stakeholder perspectives. The city council was defending the interests of the target community in this programme. In order to include the community on the programme development, different participatory mechanisms were put in place. Thus, the programme was subject to intense scrutiny and social acceptability, from its inception throughout its implementation process.

4) Recognising that value proposition and means are subject to refinement

The main limitation of the LFA, as applied in this programme, was the provision of a snapshot of the programme's logic. Such snapshot represented the programme's logic in 2001, when the LFA was developed. Thus, when the city council suggested the research group to use the LFA as a guide for the programme's evaluation, it was difficult to do so. The framework did not reflect the changes that happened in the programme scope throughout the years. The same problem has been observed in other examples of LFA adoption (e.g. CRAWFORD; BRYCE, 2003; SAVAYA; WAYSMAN, 2005).

Moreover, the delivery method (bidding processes) used in this programme also assume a stable environment, in which plans can be followed with no need for further judgement and adaptation. During the programme evaluation it was observed however, that the team was capable to overcome several obstacles and searching for alternatives to maintain the intent of the programme. One identified aspect contributing for such process was the support of the programme's leadership. The role of strong leadership to support the team dealing with the characteristics of a complex project, i.e. changes in the environment and need for adaptation was also observed by Miller and Hobbs (2005).

5.2 CASE 2: 3Ts REDEVELOPMENT PROGRAMME

5.2.1 Programme's value proposition

Figure 59 shows an aerial 3d view of the proposed new campus for BSUH, to be implemented through the 3Ts programme.

Figure 59: Proposed facility for the 3Ts programme

According to the Outline Business Case developed by the BSUH in 2009, the Programme's investment objectives and their justification are as follows:

- Replace the wards and other clinical accommodation currently in the Barry and Jubilee buildings with adequate accommodation that meets standards of NHS health policies (i.e. improve patient privacy and dignity), in line with existing and emerging national priorities. The Barry and Jubilee buildings are over 180 and 130 years old respectively and currently contain 200 beds for general and elderly medicine, cancer, HIV and Infectious Diseases. They are amongst the oldest buildings in the NHS still providing acute inpatient care;
- Transfer the Regional Centre for Neurosciences and expand its capacity (following public consultation carried out in 2004 and the Sussex-wide Tertiary Services Commissioning Strategy

and other commissioning intentions). This will allow patients from Sussex who currently have to travel to other centres (mainly in London) to be treated closer to where they live;

- Develop and expand non-surgical cancer services, in line with the Sussex Cancer Network's Service Delivery Plan and the Sussex Tertiary Services Commissioning Strategy. This will allow patients across Sussex to receive radiotherapy and chemotherapy treatment closer to where they live and will enable the Network to continue to meet national waiting times standards;
- Develop the Royal Sussex County Hospital as the Level 1 Major Trauma Centre for Sussex and the South East, as set out in the NHS South East Coast strategy Healthier People, Excellent Care (2008) and in line with Lord Darzi's report, High Quality Care for All (2008); and
- Develop teaching, training and research activities within the Trust, in partnership with the Brighton & Sussex Medical School; Kent, Surrey & Sussex Deanery; and the Universities of Brighton and Sussex – again in line with Lord Darzi's vision of high quality teaching and research supporting high quality care. This will magnify the radiated benefits for the whole of the NHS across the South East for the next 20 years and beyond, in terms of the benefits to patient care of the research undertaken and the quality of clinical staff trained locally.

The expected benefits of the 3T Programme are also detailed in the Strategic Outline Case developed by the BSUH in 2008:

- Strategic Aims Met: the extent to which the investment supports the delivery of local commissioning plans and clinical network strategies (within the frameworks set by national policy), and the Trust's strategic vision;
- Improved Clinical Outcomes: the extent to which the investment is likely to capitalise on clinical co-location, the use of emerging technologies and research evidence to improve clinical outcomes for patients;
- Modern Healthcare Facilities: the extent to which the investment replaces ageing building stock with accommodation that is fit for purpose: comfortable, therapeutic and efficient;
- Improved Access to Health: the extent to which the investment will improve patient access to services: timeliness – expanding capacity and improving care pathways, and (ii) physical access – access to the RSCH campus, patient and visitor movement around the campus and patient flows between services / facilities;
- Focus on Teaching, Training and Research: the extent to which the investment is likely to strengthen links with academic partners, propagate research activities, further develop RSCH

as a University Teaching Hospital campus and attract the highest calibre of pre- and post-registration students; and

- Effective Use of Resources: the extent to which the investment will optimise use of resources and generate value on a whole-life costing basis, i.e.:
    - Buildings designed to the highest possible standards of environmental sustainability;
    - Co-location of specialties to make best use of resources and the development of new services;
    - Efficiencies in ward staffing by replacing small wards with standard ward sizing; and
    - Building for future adaptability, i.e.: potential to adapt or expanded facilities in the future.

The only potential negative impact identified by the team was the temporary disruption to services inevitably arising from a major redevelopment. This was however addressed through a decant plan and highlighted as a risk in the financial projections.

5.2.2 Programme Timeline and Definition Process

The starting point for the development of BSUH's healthcare strategic plan was in 2002, when Brighton Healthcare NHS Trust and the acute services of Mid Sussex NHS Trust were merged to form the BSUH trust. The BSUH's vision was to: become one of leading UK's teaching hospital in the UK; enjoy a reputation for excellence in critical care, and provider of specialised and tertiary care services; and contribute to provide excellent secondary care for the region. In 2007 the BSUH team started to develop a strategic plan for the hospital campus, reviewing governmental policies that were being published around that period. The programme strategic aims were defined after a review of main policies that were ruling the context in which the programme sets upon, such as national and governmental policies, regional as well as local policies. Such policies and how the programme is expected to respond to these needs are summarised in Figure 60:

Need	Response	Source of Need
Need for facilities to ensure teaching and training support high quality care	Provide opportunities to develop enhanced facilities for research, teaching and training	National policy
Need for facilities to meet medical school and the Trust's goals	Provide opportunities to develop enhanced facilities for research, teaching and training	Local/Sussex-wide/Regional policy
Need to provide care for patients with multiple trauma (currently unavailable in the region)	Develop a Level 1 major trauma centre	Regional policy
Fragmented services for clinical infection	Provide accommodation that is fit for purpose in the Barry and Jubilee buildings	Sussex-wide policy
Increase capacity and better locate neurosciences	Provide accommodation that is fit for purpose and transfer neuroscience to another site	Sussex-wide policy
Cancer beds suffer from same issues as other facilities in the Barry building (lack of dignity and privacy, poor capacity, etc)	Provide accommodation that is fit for purpose in the Barry and Jubilee buildings	Sussex-wide policy
Maintain waiting time standards and provide facilities for patients who are currently treated elsewhere	Increase capacity for inpatients radiotherapy and chemotherapy	Sussex-wide policy
Imaging and nuclear medicine are in poor accommodation and low capacity	Provide accommodation that is fit for purpose in the Barry and Jubilee buildings	Local policy
Need to provide more integrated services for patient who have suffered a stroke	Provide accommodation that is fit for purpose in the Barry and Jubilee buildings and Integrate services with the Regional Neuroscience Centre	Local policy
Provide more efficient patient care, potentially by increasing number of beds	Provide accommodation that is fit for purpose in the Barry and Jubilee buildings	Local policy
Provide facilities that will support better infection management and control	Provide accommodation that is fit for purpose in the Barry and Jubilee buildings	Local policy
Poor levels of privacy and dignity in the Barry and Jubilee buildings	Provide accommodation that is fit for purpose in the Barry and Jubilee buildings	Local policy

Figure 60: Policies underlying strategic planning for 3Ts programme

The project's scope is defined in terms of activities modelling and building capacity. The service model sets out how services will work together to provide more integrated care. The model also identifies changes in service provision that are planned in the redevelopment. The service model is developed based on discussion with experts and on policies. Predictions of changes in services and population profile are also considered. The services models all have to pass through public consultation and approval. This process was carried out and documented in the OBC.

An extract from the service model description, available in the OBC is presented in Figure 61 below:

- *Increase of single rooms in the new building;*
- *Better integration of infectious diseases and HIV services into a single clinical facility under the auspices of Clinical Infection Service, which will also include the provision of treatment for patients with TB, currently managed on general medical wards. Also, greater link with the Medical School is expected;*
- *Acute brain injury centre: refinement of stroke pathway to improve early intervention. Neuroradiology services should be involved to provide some of the required services. Also, greater link with the Medical School is expected;*
- *Imaging and nuclear medicine: an integrated imaging, neuro-imaging, nuclear medicine and interventional radiology service will be created. Additional capacity will also be created.*
- *Four additional CTs will be created for the treatment of patients with trauma: one in the emergency department, one within the neurosciences centre and two for use in the radiotherapy treatments;*
- *Three additional MRs will be created and two spaces will be reserved in case others MRs are needed in the future;*
- *The prediction for x-ray is to be replaced with digital x-ray, and a possible increased demand for fluoroscopy will be offset by the transfer of other procedures to alternative modalities;*
- *Three interventional facilities will be created and equipped as theatres to enable IR procedures (currently the facilities are remote from ICU, emergency and theatres and the patient has to be moved between buildings);*
- *An additional ultrasound room will be built as its playing an important role in the management of patients with trauma in the U.S.*

Figure 61: Service model description (source: OBC)

The Programme Definition was also influenced by the Trust's documents regarding estates and capital projects strategy. Trust's estates strategies include issues such as sustainability, achieving low maintenance costs and designing for future proof. The project leader had an important role in making sure those strategic intents were pursued. One of the leader's initiatives was to develop a plan with requirements to drive design for flexibility, identifying the critical and non-critical areas where flexibility would be required.

The trust also developed with clinical and non-clinical staff a design brief to facilitate the design process, describing each criterion. The main themes were:

- Space: legibility, openness, interaction, gradation from public to private, privacy and staff observation, "in-between" places;
- Place: sense of Brighton, Sussex landscape, views, campus, inside/outside transition, art; front entrance;
- Form: civic presence, image, health promoting
- Environment: Light, temperature, ventilation, orientation, health encouraged and sustainability.

The project also passed through BREEAM (Building Research Establishment Environmental Assessment Method) in its early stages, which will be undertaken again in the future. BREEAM is a

worldwide used methodology to assess building's environmental performance. It can be undertaken during design, construction or operations. The project leader established a team effort with Conclude Consultancy and the general contractor to implement a strategy called “in-use energy management”. The intent of such strategy is to achieve high-energy performance during the operational stage of the facility.

The 3Ts programme was also subjected to an ‘Achieving Excellence in Design Evaluation Toolkit’ (AEDET) Evolution review, which was carried out on May 2009 led by the architectural company assigned for this project. AEDET Evolution is part of a benchmarking tool to assist Trusts in measuring and managing the design quality of their healthcare facilities. It considers aspects such as: (a) innovation; (b) form and materials; (c) urban and social integration; (d) performance; (e) engineering; (f) construction; (g) use; (h) access; and (j) space.

The 3Ts project leader also established a partnership with Salford University for implementing the BeReal model and for assisting in using computer modelling during design. One of the intents to use computer modelling was to contribute for the BREEAM assessment and also to provide a better visualisation for clinical staff during the planning stage. Mock-ups were built for all the standard rooms (rooms that appear more than 5 times in the design, such as wards, offices, facilities management spaces, individual rooms, etc.). According to the capital project leader, this has contributed to improve the understanding of facilities managers and hospital policy makers, which had to be trained in order to understand the 2D drawings. Computer modelling was also being used to improve constructability. The 3T project was the largest BIM (Building Information Modelling) endeavour taken by the General Contractor.

It was the also programme’s director initiative to adopt a formalised benefits realisation approach in the 3Ts programme. The 3Ts director joined the programme in 2008, he has an academic background and has been involved in the HaCIRIC research project since an earlier period. By the time the 3Ts director got involved, the strategy for the 3Ts in terms of service provision was already defined and documented in the SOC. This is the reason why a formalised benefits realisation approach was not implemented since the beginning of the 3T programme. Thus, the benefits realisation efforts were joined to the patient public involvement efforts and both had a strong emphasis on accountability and scrutiny.

The City council senior planning officer was also a member of the Programme board and helped the team to identify the key statutory planning issues, which can be summarised as follows:

- Massing, height and external appearance;

- Sustainability, including transport and parking;
- Delisting and demolition of a protected historical chapel at the rear of Barry building; and
- Helipad impact.

Several studies had to be carry out to inform the statutory planning process, including: (a) massing and height configuration study; (b) traffic impact assessment; (c) environmental impact assessment; and (d) habitat survey. Also, to minimise the disruption on hospital operation during the construction period, a detailed decant plan was developed with the help of the general contractor assigned for this project.

The Programme also included a series of scrutiny mechanisms. Patient representatives and members of the public have been continuously engaged in the development of the service vision and design described in the OBC, initially through the *Fit for the Future* consultation and subsequently through a series of workshops and events for the SOC and OBC. A Design Panel was also established to discuss issues directly with patients and patient representatives.

The Hospital Liaison Group was also established to take the perspective of the overall public. Public perspective is being considered through public expositions of the designs and questionnaire application. The Programme also has a website, where the general public can access all relevant information about the redevelopment and provide feedback through a web based questionnaire. Also, the Programme team established a webpage on *Facebook*, upgrading the programme's status regularly.

The Trust's clinical staff has been involved in the discussions relating to the development of the 3Ts programme since the SOC stage. The 3T team developed a training pack and a series of workshops to inform and train staff in the process of reviewing 1:500 and 1:200 drawings and to understand that how the discussions they would have with the scheme designers translate into practice. The 1:500 process then took the preferred option design and worked with the user groups to ensure that the right clinical adjacencies could be fully achieved. Once this was agreed, the individual User Groups (of which there were 29) examined the details of the 1:200s to ensure that the intra-departmental relationships also worked. All of the key 3Ts documentation and plans are available on the Trust's public website so that staff who are not directly involved can stay abreast of progress.

As an organisation subject to NHS standards and regulations, BSUH had to follow a series of governmental procedures and an established investment route. The Office of Government Commerce (OGC) determines those standards. The Office of Government Commerce (OGC) is an independent office of HM Treasury, established to help the UK's Government deliver best value from its spending (OGC, 2011). The OGC provides policy standards and guidance on best practice in procurement,

projects and estate management, and monitors and challenges governmental departments' performance against these standards. One of its initiatives is the Achieving Excellence in Construction (AEC), introduced in March 1999 by the Chief Secretary to the Treasury to improve the performance of Government as a client of the construction industry. The key aspects of the AEC include:

- Partnering;
- The development of long-term relationships;
- Reduction of financial and decision-making approval chains;
- Improved skills development and empowerment;
- The adoption of performance measurement indicators; and
- The use of tools for value and risk management and whole life costing.

The OGC also prescribe guidelines for the investment process. The process presents some major milestones such as the submission of a Strategic Outline Case (SOC), an Outline Business Case (OBC) and a Full Business Case (FBC).

The project also has to pass through the OGC Gateway reviews (Figure 62). The reviews use a series of interviews and documentation analysis to provide an external assessment to the robustness of project's plans and processes. There are six stages: (a) Gate 0 is strategic assessment; (b) Gate 1 is assessment of business justification based on the SOC; (c) Gate 2 is assessment of the delivery strategy based on the OBC; (d) Gate 3 is the assessment of FBC and governance structures prior to the investment decision; and (e) Gate 4 assesses readiness for services; and (f) Gate 5 reviews if the expected benefits of investment were achieved, this review is carried out periodically during the lifetime of the new service/facility.

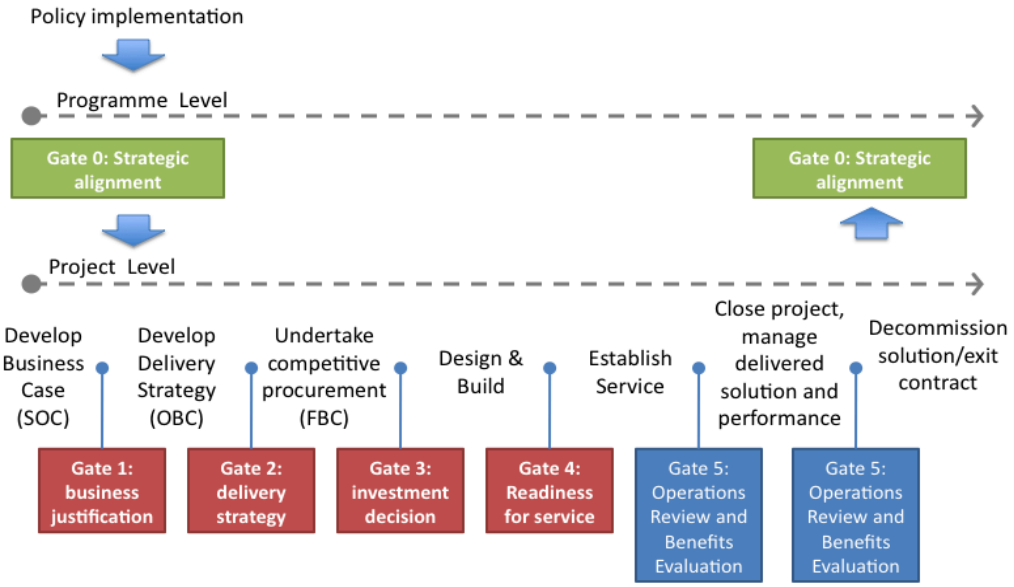

Figure 62: The OGC Gateway process (adapted from OGC 2011)

The analysed processes in this case comprise the revision of activities for the development of the Strategic Outline Case (SOC) and the Outline Business Case (OBC). When data for this research was gathered, in 2011, the team was in the OBC stage and entering the FBC stage. The SOC is composed by the following key sections: (a) strategic context, (b) health service need, (c) formulation of options, (d) affordability, and (e) timetable and deliverability.

The process for developing the SOC begins with agreeing about the deliverables and setting a plan for developing the SOC that is owned by all key stakeholders. Then, the current situation has to be analysed and defined. In the 3Ts case, this involved analysing the financial, service and estate performance from extant databases, identifying cost drivers, the Trust's and PCT's finance and service profiles, the Trust's estates profile and the current PCT/SHA disposition of service locations. Stakeholders should also agree the defined current position. The future scope and scale of services should compose the case for change. This includes analysing the service assumptions, future configurations and design, and the financial profile. A clear statement of the need for change and the nature and type of change required should be developed. The next step of the process is appointing a design team by drawing up terms of reference of proposed commission using the guidance from the Department of Health estates, interviewing prospective candidates and appointing the most economically advantageous. Both an architect for the design and a quantity surveyor for capital costing should be selected. The design brief should then be prepared, outlining policies and schedules for project functions, and identifying potential constraints. The design options should be generated with the architects, making sure they strategic goals are achievable. The options should be appraised regarding

their non-financial benefits (by selecting benefit criteria, and undertaking weighting and scoring exercise), financial appraisal, financial and economic analysis, and value for money and sensitivity analysis. The preferred option should be affordable (costs 10% of organisation turnover), meet health service need, and fit with overall health strategy. After a preferred design option is selected, the next step is assessing a likely PFI tariff through financial projections for assets retained and trust operating costs, the guidance from DH private finance unit on likely PFI tariff based on observational evidence and by analysing the attractiveness of project to private sector. The SOC document is then developed with the outputs from these steps and submitted to the SHA for comment and input.

The Outline Business case has five Key sections: (a) Strategic Case – how the proposals contained in this OBC fit strategically and tactically with national, regional and local priorities for the development of healthcare services; (b) Financial Case – how the proposals contained in the OBC demonstrate that the programme is affordable and sustainable within the local health economy in terms of both revenue and proposed capital cash flow; (c) Economic Case – how the proposed preferred option set out in the OBC demonstrably represents the most economically advantageous solution; (d) Commercial Case – how the proposed way forward (public funding) demonstrably has a sound commercial base and that there are appropriate ways of managing risk in the delivery of the programme; and (e) Project Management Case – how the proposals contained in the OBC are demonstrably realistic, deliverable and achievable.

The first task in developing the OBC is defining a service baseline, which includes: (a) activity levels, (b) utilisation of facilities, (c) interspeciality links, and (d) planned service developments; a financial baseline that includes: (a) revenue costs, and (b) capital commitments; and an estate baseline including: (a) space utilization, (b) functional suitability, and (c) backlog.

The service plans are then reviewed and updated. This review includes considering changes in the management of patients, developing interspecialty links, focusing care on patients, balance between acute, community and primary care, and future for elderly care. Commissioner specifications should also be reviewed (and challenged): balance between acute, community and primary care, future location of services/specialties, review of other providers' plans, and future for elderly care. The strategic direction should be produced, setting out: (a) planned service developments, (b) potential use of the estate/assets, and (c) financial environment.

From the strategic direction, some options should be established. Such options should include a do-nothing option and a low capital option. Potential development options should be identified and potential partnerships with private sector established. Design solutions are then produced around each option: (a)

use of existing buildings, (b) new build requirements, and (c) identification of land/buildings surplus to requirements. The capital costs of identified options should be calculates (e.g. building, equipment), as well as revenue costs for each option.

For evaluating options, criteria should be established and agreed: (b) timing, (c) flexibility, (d) cost constraints, and (e) commissioner support. The best option should then be identified against defined criteria: (a) set out service benefits, (b) timing of developments, and (c) overall cost profile. A control plan should be developed for the chosen option, including the design of chosen option for each site, timetable for the developments, capital costs, project plan for design and construction and outline planning consent. Finally, the OBC can then be produced, sent for the submitted to the SHA for comment and input, and later to be approved by the Department of Health.

The OGC also recommends that benefits realisation management should be planned, including the statement of expected benefits in the SOC and the inclusion of benefit criteria and appraisal of design options based on those benefits for the OBC. During the OBC, the following steps should be considered:

- Description of benefit or dis-benefit;
- Dependencies (on projects, risks, other, benefits and programmes, etc);
- When the benefit is expected to occur and over what period of time realisation will take place;
- Measure for the realisation of the benefit and how it will be carried out; the 'before-state' measurement;
- Key performance indicators in the Trust operations that will be affected by the benefit, immediately after realisation and for the future, and current or performance targets;
- Details of changes to operations/staffing;
- Costs associated with realisation and measurement;
- Dependencies on risks or other programmes or projects; and
- Which Trust division/clinical area is responsible for the benefit and its realisation.

In the 3T programme, the design options were generated concurrently to the elicitation of benefits. The non-financial benefit criteria were generated through workshops with different stakeholder groups (clinical and non-clinical staff) and used to undertake a weighting and scoring exercise to identify the design option that is preferred option using non-financial means.

All options were also assessed for affordability (using the Trust's medium and long term financial model which will be embedded in the future financial projections across Sussex) and tested for their overall economic impact (using technical measures such as Net Present Values and Equivalent Annual Costs) in line with the published methodology for undertaking appraisal of options in the public sector and the NHS.

The non-financial and financial analyses are then combined to produce a cost/benefit analysis, which identifies the overall cost associated with producing the benefits identified. The option which produces the highest relative benefits for the lowest relative cost thereby provides best value for money and will be the actual preferred option taken forward for further development. This does not mean that the appraisal will produce the lowest cost option: the absolute lowest cost option may provide the lowest level of benefits and thereby will rank quite low against other options. The preferred option may have a high cost, but may also produce the highest level of benefits – thereby being preferred.

5.2.3 Programme's Delivery Method

The SOC was approved in July 2008. In August 2008 the Trust appointed the Laing O'Rourke ProCure 21 (P21) consortium to assist in developing the OBC. The contractor was chosen based on their expected contribution to the project, including but not limited to: experience with similar projects (size, confined site within a fully functioning hospital, new building and refurbishment, construction phasing, decant and capital cost), confirmation of available capacity to meet programme's needs, and examples of innovation and sustainability.

P21 provides access to a complete supply chain that has passed through a rigorous national betting process, which is endorsed by the government. When this research was carried out, there were 8 pre-selected companies. Those companies are assessed periodically and have to maintain their performance standards in order to remain on the pre-selected list. This type of procurement is also an incentive to maintain performance standards during the project, as the contract for pre-construction services and construction services are separate and in each phase there is a new selection process.

Under P21, the contractor appoints and manages external advisors required through its approved supply chain. The chosen architectural firm was the Building Design Partnership (BDP), who was also the designer of the multiple award-winning Royal Alexandra Children's Hospital adjacent to the 3T redevelopment site and has developed a good relationship with the Trust over the last seven years.

In the 3T programme, the contract used was “Engineering and Construction Contract, 2nd edition (Option C: target contract with activity schedule)”, under the ProCure21 framework. This allows a Guaranteed Maximum Price (GMP) and a contract bounded to Laing O’Rourke and its supply chain to deliver the new facilities to time, cost and quality. All prices negotiated with, or secured by tendering from, sub-contractors are shared with the Trust on a transparent open-book basis. At the end of the construction period, the Trust shares any savings on an agreed basis. Option C is a target cost contract with an activity schedule where the out-turn financial risks are shared between the client and the contractor in an agreed proportion. This document contains all the core and secondary option clauses, the schedules of cost components, and contract data relevant to an option C contact. The Contractor is not paid according to the Activity Schedule or the Bill of quantities but is reimbursed his Actual Costs plus a Fee, for his overheads and profit, in the same way as in a cost reimbursable contract. However, any total cost over run or under run, when compared to the Target Cost, is shared between the Contractor and Employer in a pre-agreed way. This arrangement motivates the parties to the contract to decrease costs.

5.2.4 Programme Design and the Adoption of the BeReal model

During the design process, the programme was organised by work streams. The reason for that was because of programme complexity, involving a number of other organisations to complete different groups of activities. In order to facilitate intra-organisational working, different work streams were set up. In each work stream, people are engaged according to the capabilities that are required to complete that specific group of tasks. Some important work streams observed during programme design were:

- The benefits realisation work stream through the specific workshops for defining the expected benefits of the programme. These workshops involved clinical and non-clinical staff;
- The hospital liaison group includes listening residents within a half-mile radius from the hospital, it is mainly about the external appearance of the building.
- The patient public involvement through different ways of public consultation, such as workshops held in 2008 with patients’ representatives to discuss how to make the design better. Those workshops were later formalised into the patient and public design panel. Patient groups were defined to act as a reference group for the programme team, participating mainly on design discussions;

- The users group design process, which is attended by users representatives and change managers, as well as the architects and the contractor's project leader. The proposals are evaluated by the key leaders and users, which give a grade for the designs; and
- The service modernisation work stream, which counts with a series of change consultants that are responsible to modernising the services (avoiding that old bad practices are transferred to the new building) and working in the interface between the services and the building design.

The nature and type of these work streams change according to the stage of development of the programme, meaning that for the SOC development there were a group of work streams different then those for the development of the OBC and different from those for the FBC.

Thus, Figure 63 shows a simplified map of the programme design phase. Not all work streams or stakeholders are listed in the picture as well as not all activities are mapped. The figure shows only the activities and stakeholders that were recognised as important to explain how was the design process in the 3T programme, which is described bellow.

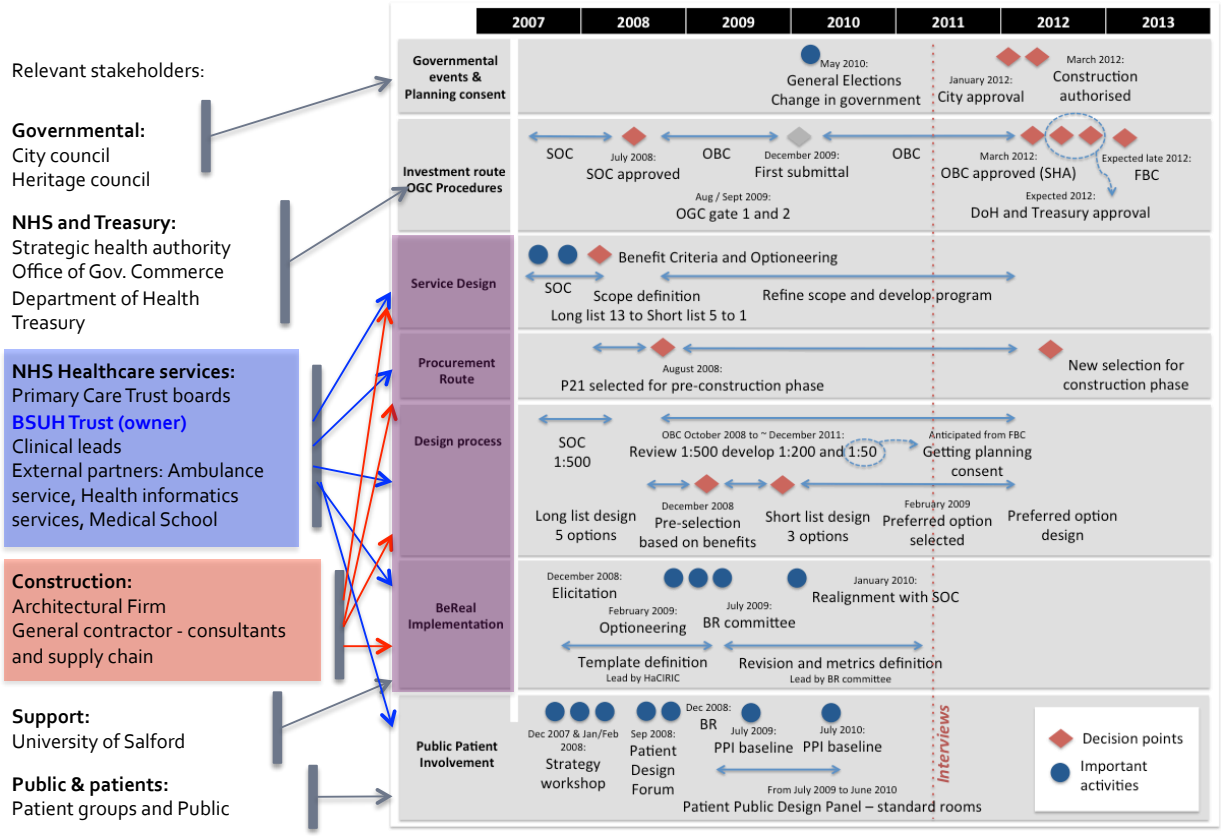

Figure 63: Schematic representation of 3Ts planning process

The SOC sets the strategic context and defines the expected benefits of the investment, the analysis of local healthcare demand, the proposition of different options for programme scope, then the assessment and selection of one of this options based on the established benefit criteria. In the SOC, 13 scope options for the building were designed. From this long list, 5 preferred options were selected based on the expected benefits (stated in the SOC). The SOC was approved in July 2008, and in August 2008 the Trust appointed the Laing O'Rourke ProCure 21 (P21) consortium to assist in developing the OBC.

After the SOC, the programme team had to reach a deeper level of detail for the OBC, identifying the Trust and local commissioner's preferred design option for the new development in terms of what the facility will look like and how it will be organised. Thus, during the OBC, these 5 options were shortlisted into 3, and then a preferred option selected. Design proposals at this stage are developed in a scale of 1:500 and more than 50 Trust staff was involved in the workshops for shortlisting the design options.

The process for identifying the preferred option during the OBC began with agreeing on a set of objectives and criteria (non-financial in the first instance) that can be used to compare options against the other and thereby determining the one which best suits the needs of the vision for clinical service delivery in the future. The outcome of this activity is known as the non-financial benefits appraisal, which needs to be included in the OBC document along with a financial appraisal that includes transaction costs, lifecycle costs and revenue predictions.

In order to agree on the set of criteria to compare the different design options, a benefit criteria workshop was carried out in September of 2008. This workshop brought together clinical and non-clinical staff to discuss and further detail the expected benefits stated in the Strategic Outline Case. From this process, the criteria for assessing the different options would be defined. This is called a non-financial analysis, which combined latter with a financial analysis would produce a cost/benefit analysis, identifying the overall costs of providing the expected range of benefits to feed the OBC.

The focus of this workshop was then on the elicitation of sub-benefits, derived from the key benefits. The main output of this workshop was a list of sub-benefits and design or services related comments divided in different categories: neuroscience, service access, general, teaching and research, medicine, infectious disease/HIV and staff. Part of the output of this workshop is shown in Figure 64:

Key Benefit	Sub-Benefit	Design/Other Comment
Category: Neurosciences		
Relocate Neurosciences to RSCH	*No disruption to service*	
	Provide for future sustainability of service – if move does not happen, referrals will drift away	
	Potential to provide neuromedicine ITU (as at Queen's Square) as a future aspiration	*10-20 patients per year: look after more in the longer term*
	Potential to provide paediatric neurosciences (future aspiration)	
	Co-location with spinal surgery (transfer work from SOTC at PRH) to provide Spinal Injury Recovery Unit	*Neurorehabilitation continues to be provided at PRH*
Modern, purpose-built facility		*New facility should not be called Hurstwood Park – suggestion of Sussex Neurosciences Centre*
	Provide seminar rooms for teaching	
	Provide small, private patients facility	*Private work in area of brain tumours currently at HWP – small market*
		Private work for backs and chronic pain
Improve infrastructure	*Improve control of infection*	*Wash hand basins by each bed in ITU*
	Improve privacy and dignity	*HWP built in 1948 – poor layout now.*

Figure 64: Part of output from the Benefits criteria workshop

In December 2008, a Benefits Criteria Workshop was also facilitated by the University of Salford research team, with the BSUH team and members of clinical and non-clinical staff to further detail the benefits. The participants included different stakeholders groups:

- Group A: Imaging, Cancer, HIV/Clinical Infection Service, Outpatients;
- Group B: Medicine/Elderly Care, Trauma/Critical Care, Neurosciences;
- Group C: Programme Board
- Group D: Patient Representatives, Patient Experience Panel.

The output of this workshop was a list of 682 requirements for the project. Part of this output is shown in Figure 65:

Small gardens for each area
Roof gardens to look at and good insulation
Rooms with colour and artwork, bedside tables, homely, chest of drawers, touch lamps
Access to a garden to smoke in – able to shelter form the wind, with plants and kept borders
Cordless phones to use
Adequate management of bedding especially pillows
Enough pillows
Ensure help with eating provided where required
High Quality food essential
Closer attention by staff to patients' eating requirements
Nurses to see that patients are eating as part of their job and keep records
Protected meal times everywhere and that means doctor-free as well
Visitors who can help relatives with feeding should be allowed onto the wards at meal times and made welcome
Appropriate meals matching the need with the individual
More than one vegetarian option
Staff should ask patients about food so that they have an opportunity to say if they are not eating the food and what the reasons are for this
Onsite kitchens – local organic, varied menu, fresh food not processed
Offer refreshments after surgery
Better publicity for the availability for fruit and snacks on wards
Quiet rooms for patients
Allocate space for staff to discuss patients other than the nurses station where they could be overheard
Area for staff to get away from patients – positive effect and more relaxed when treating patients
Less hiding behind job demarcation to avoid certain jobs
Single room for all dying patients but adequately staffed to provide care

Figure 65: Part of output from the Elicitation workshops

After the elicitation workshops, an internal workshop was carried out to refine and better structure the elicited benefits. The result was a list of 8 strategic benefits and 37 sub benefits (Figure 66):

1.	Strategic Fit (and Contextual)
1.01	Stakeholders alignment
1.02	Synergy of services
1.03	Context development
1.04	Co-location / distribution
1.05	Image, reputation, objectives
1.06	Appropriate location (and access)
2.	Clinical Outcomes
2.01	Reduce referrals
2.02	Improved quality of care
2.03	Improve care outcomes
3.	Appropriate Facilities (and Facilities Management)
3.01	Fit-for purpose building & infrastructure
3.02	Facilities flexibility and proofing
3.03	Physical distribution of service locations (layout)
3.04	Improved support services
3.05	Increased patient/user safety
3.06	Greater privacy (by better design)
3.07	Removal of backlog maintenance
3.08	Better working environment
4.	Access to Services
4.01	Service diversity/capacity fit
4.02	Increased physical access
4.03	Increased availability of services
5.	Training, Teaching & Research
5.01	Improved research capability
5.02	Improved teaching
5.03	Knowledge transfer
6.	Use of Resources
6.01	Better equipment/recourses (technology)
6.02	Better personnel
6.03	Improved efficiency
6.04	Cost savings
7.	Operations Management
7.01	Improved service coordination
7.02	Preventive health services
7.03	Improved user experience
8.	Development and Implementation
8.01	Investment / change management effort
8.02	Construction negative impact
8.03	Planning ability
8.04	Sustainability
8.05	Development feasibility
8.06	Reduce service interruption
8.07	Faster delivery (up to operation)

Figure 66: Refining the elicited benefits

Then in December 2008, a Design and Decant workshop was realised. In this workshop, 5 design options were presented, plus a “do minimum”. The output of this exercise was for each attendee to pick up (intuitively) their preferred option. Then, each attendee scored the options according to the 07 benefits and sub-benefits identified in previous meetings. The template used is shown in Figure 67.

Your name: _____ Score: 1 (low) to 5 (high)

	Criteria	Description	1	2A	2B	3	5	Do Min.
1.	Strategic Fit							
1.1	Stakeholder alignment	How consistent is the option with the priorities and targets of our PCTs, SHA and Department of Health?						
1.2	Context	How consistent is the option with the Trust's strategic priorities?						
1.3	Research alignment	How well does the option further the joint research priorities of BSUH/Brighton & Sussex Medical School?						
1.4	Synergy	How consistent is the option with the strategies of our clinical networks and neighbouring NHS Trusts?						
1.5	Image & reputation	To what extent is the option likely to improve the Trust's reputation/image with our patients and local residents?						
2.	Clinical Outcomes							
2.1	Co-location	How well does the option co-locate services on the RSCH campus to improve patient care?						
2.2	Reduce unnecessary patient attendances	Outdated accommodation leads to inefficient processes and repeat patient visits. To what extent will the option improve this and reduce unnecessary attendances?						
2.3	Improved quality of care	How well will the option improve the patient's experience of the care they receive?						
2.4	Improved care outcomes	To what extent will the option improve clinical outcomes, eg. Healthcare Acquired Infection, mortality.						
3.	Appropriate Facilities (and Facilities Management)							
3.1	Fit-for-purpose building & infrastructure	To what extent will accommodation be 'fit for purpose' in the option?						
3.2	Flexibility and future development of facilities	To what extent does the option lend itself to flexible use of facilities and possible expansion in the future?						

Figure 67: Template for choosing a preferred option

The output of this workshop was a list of preferred options with the respective justification for it (Figure 68). Three design options were selected to move forward.

Preferred Option	Why
2A	Provides requirements and financially sensible
3	Like footprint, like idea of entrance, seems more affordable but cant remember if this optimises the hot flows adequately
2A	This option delivers almost everything for the 2nd best cost
5 (second choice 3)	Future proofing, ensures best integration of "hot" with existing theatres and A&E, must have car park at Barry site
5	Future Proof, compact, flexible, minimal decant
1 (second choice 3)	Best space utilisation (Barry demolished), ensures future capacity, appropriate car parking
3	Healthcare split achieved, lower maximum height of new build (preserves RACH/TK aspects), Best potential for site entrance, good opportunity for links to TK tower, re-provides cancer and catering, offers future expansion potential, balance of mass across site looks preferable

Figure 68: Template for choosing a preferred option

In February 2009, the Optioneering workshop was facilitated by the research team to select a preferred option from the 3 remaining ones. Several stakeholder groups including clinical staff and patient groups attended to this workshop. The architect started the presentation by describing that the main concept used for developing the design was the "campus like" type of building which integrates the existing facilities to the new ones also improving the orientation and flow of people across the new development, therefore improving patient experience without service disruption. A comparison of the three options was presented, including the building organisational aspects and stages for implementation (Figure 69) and timeline required for each option (Figure 70).

Figure 69: Organisational proposal and implementaion stages

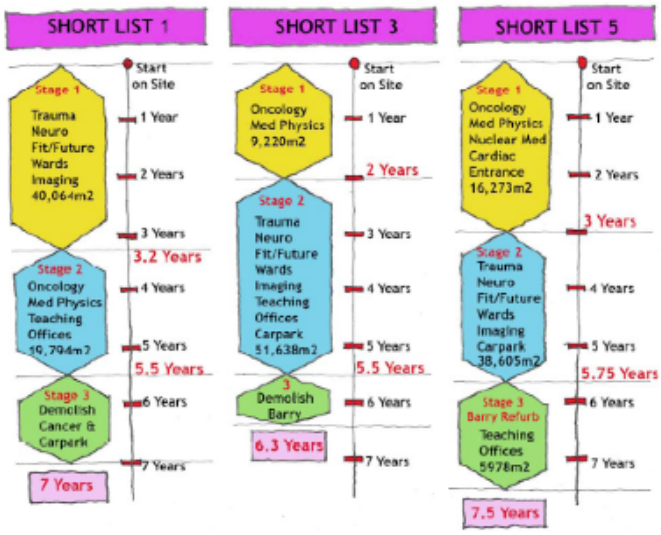

Figure 70: Timeline required for implementing each option

Once the scoring exercise was finished, the weighting exercise was carried out. This exercise started with ranking the 8 strategic benefits in order of importance and then attributing a percentage to this benefits related to it relative relevance. The 8 strategic benefits should add together a total of 100%. The ranking and the relevance was gathered through consensus of the group (brainstorm).

The final results of this exercise were:

- Clinical Outcomes (2) and Appropriate Facilities (3) as the most relevant of the benefits in equal level of importance;
- Strategic fit (1) and Operational Management (7) as the second most relevant of the benefits and in equal level of importance;

- Access to Services (4) and Teaching, Training & Research (5) as the third most relevant of the benefits and in equal level of importance;
- Use of Resources (6) as the fourth most relevant and important; and
- Development & Implementation as the least relevant and important.

There was some discussion regarding whether the weighting method was the right one. The main point was related to the fact that some benefits had more sub-benefits than others. Also to the fact that words such as improve and increase (used in the description of the sub-benefits) were not associated to the extent of improvement or increase. Attendees were then asked to attribute a percentage for each of the sub-benefits, according to the amount given in the previous ranking exercise. However, it was highlighted that those values could be changed if adjustments were necessary. The results of this exercise is presented in Figure 71:

	Benefits Criteria	Weight	No. of People Scored	Options/Scores					Weighted Options/Scores				
				1	3	5	Do Min A	Do Min B	1	2	3	Do Min A	Do Min B
1	**Strategic Fit**	**13.4**											
1.1	Stakeholder Engagement	2.7	33	8.76	6.73	6.15	0.70	1.88	23.46	18.02	16.48	1.87	5.03
1.2	Context	2.7	35	8.71	7.03	5.94	3.29	1.63	23.34	18.83	15.92	8.80	4.36
1.3	Research Alignment	2.7	31	7.94	6.84	5.58	0.74	1.26	21.26	18.32	14.95	1.99	3.37
1.4	Synergy	3.6	33	8.42	6.67	6.15	1.27	2.03	30.09	23.81	21.97	4.55	7.25
1.5	Image & Reputation	1.8	35	8.80	6.74	5.91	1.03	1.69	15.71	12.04	10.56	1.84	3.01
2	**Clinical Outcomes**	**17.9**											
2.1	Co-location	5.4	34	8.53	6.26	6.15	0.74	1.50	45.69	33.56	32.93	3.94	8.04
2.2	Reduce unnecessary patient attendances	1.8	28	8.36	6.89	5.43	1.14	1.96	14.92	12.31	9.69	2.04	3.51
2.3	Improved quality of care	5.4	33	8.39	7.24	6.61	0.97	1.79	44.97	38.80	35.39	5.19	9.58
2.4	Improved care outcomes	5.4	32	8.00	7.09	6.50	1.13	1.81	42.86	38.00	34.82	6.03	9.71
3	**Appropriate Facilities (and Facilities Management)**	**25.0**											
3.1	Fit-for-purpose building and infrastructure	3.6	35	8.34	6.57	5.97	0.94	1.60	29.80	23.47	21.33	3.37	5.71
3.2	Flexibility and future development of facilities	2.7	33	8.12	6.18	5.55	2.12	2.48	21.75	16.56	14.85	5.68	6.66
3.3	Physical distribution of service locations (layout)	3.6	37	8.11	6.46	6.43	0.95	1.57	28.96	23.07	22.97	3.38	5.60
3.4	Improved support services	1.8	19	8.00	7.11	6.74	1.21	2.05	14.29	12.69	12.03	2.16	3.67
3.5	Increased patient safety	5.4	27	8.19	7.19	6.59	1.19	2.07	43.85	38.49	35.32	6.35	11.11
3.6	Greater privacy (by better design)	3.6	31	8.71	7.81	7.16	1.29	1.90	31.11	27.88	25.58	4.61	6.80
3.7	Backlog maintenance	0.9	22	8.45	7.64	4.77	0.86	1.77	7.55	6.82	4.26	0.77	1.58
3.8	Better working environment	3.6	32	8.78	7.72	6.72	1.19	1.97	31.36	27.57	24.00	4.24	7.03
4	**Access to Services**	**10.7**											

Figure 71: Optioneering and weighting exercise

The stakeholders were asked to rank the 8 identified expected benefits in order of priority and a weigh was attributed to their relative relevance. The researchers then asked the group to first choose an

alternative intuitively and then use weighted benefits to assess which option fulfilled each benefit criteria better. As a result, the higher scores given would identify the preferred option. Option 1 was selected to move forward.

The OBC was delivered in December 2009, approved by the SHA and submitted to the Department of Health (DoH). However, in May 2010 there was a governmental General Elections in the UK and changes in the government happened. Due to a busy moment in the government, the OBC was not reviewed, and after the Elections, the BSUH team was contacted and required to submit a revised and updated proposal.

The planning application was supposed to be submitted to Brighton & Hove City Council in late 2010, however there was a delay on this process, for two reasons: the delayed approval process in the DoH and the difficulty to get planning consent with the City Council. The City Council was requiring the Trust to deliver all design details in order to get the planning consent. The team had to go further into detailing design, anticipating a level of detail that was only required for the Full Business Case stage. The City Council request for further detail was due to the high complexity of the site, which is located in a conservation area. The BSUH campus is a confined site surrounded by a conservation area protected by the English Heritage. The site contains existing buildings that should be maintained and surrounding historical buildings that shouldn't be visually affected by the new building. Since negotiation started, 27 changes have been made to the building geometry. Thus, by the time data was gathered for this study (April 2011), the team was undertaking an effort not only to review the OBC proposal, but also to develop the full set of design documents for the FBC.

The team's decision was to develop the full design set in the scales 1:200 and 1:50 and anticipate the FBC submittal. Thus, the design process in that period included the participation of 18 departmental user groups, including representatives from clinical departments, facilities management, whole hospital policies and other services. This user group design process was established in September 2010 to fix the building geometry and agree on adjacencies and connectivity among activities and departments. The proposals were developed observing NHS policies, and signed-off by the user groups. This process is summarised in Figure 72.

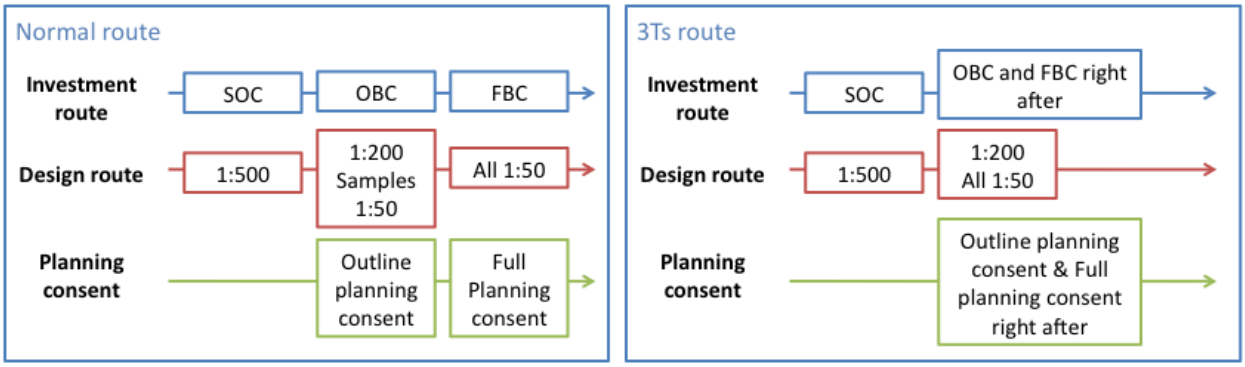

Figure 72: Overall view of 3Ts design process and approval

The programme's design process is very participative. The team has a group of healthcare services change consultants from the Trust that focuses on service modernisation issues. The group has been working on the 1:500s, and now on the FBC phase are working on the 1:200s and on the 1:50s, giving their input for the design process. After the design is fixed, that group would move the focus to service modernisation again. Representatives from the medical school are also involved in the detailed design process, as well as the facilities manager and people responsible for hospital and operational policies (Whole hospital policy). The medical school also has a sit in the programme board, thus participating of main decisions regarding the redevelopment programme.

Usually there are 10 to 12 people discussing a particular design. As the design goes into further detail, there are rising issues that cannot be solved in these particular meetings, such as increasing the amount of space. These issues are brought to the *design process review group* that is chaired by the Programme Director in a weekly basis. The required changes (usually made by the users) are discussed and approved by the Programme Director. There is also a record of all the required changes.

Generally when something is changed in the design, it is not a radical change, as the functional content of the building has not changed in 18 months. The changes are exceptions: *"we review by exception, if something changes in the world".*

Also, there are other design groups, composed by people responsible for facilities management and whole hospital policy issues. The facility managers are internal of the Trust and in this project they were involved since the beginning of the development. According to the capital project leader, these teams had to take some training to better understand the flat drawings. The Trust team has been working with Salford to generate 3D models as a way to facilitate communication, but they only have built the mock ups of the standard rooms so far (rooms that appear more than 5 times in the design, such as wards,

offices, facilities management spaces, individual rooms, etc.). The project leader adds that it makes a big difference in their understanding.

Figure 73 illustrates the arranged groups for the Full Business Case (FBC) phase. These teams are working on the 1:200s and 1:50s detailed designs. It's is a total of 18 different teams, which are grouped together in three different colours:

Category	Groups
Blue Groups	(a) Acute floor; (b) ICU; (c) Imaging; (d) Fracture clinic; (e) Neuroscience
Yellow Groups	(a) Wards; (b) Sussex Cancer Centre; (c) Nuclear medicine; (d) ENT Audiology Maxfax; (e) Therapies; (f) Rheumatology; (g) Cardiac testing
Red Groups	(a) Whole hosp. stage 1 & FM Dept.; (b) Whole hospital stage 2 & EBME; (c) Multi faith, PALS, staffside and temp. staff; (d) Trust HQ; (e) Doctors Mess; (f) BSMS, CIRU; (g) Meeting, teaching and Simulation

Figure 73: Groups in the participative design process

The Trust provides the designers with all the activities required and specifications (such as whole hospital policies and operational policies). The designers add their experience to the project and develop design proposals about the layout and department formats. All the designs are brought back to be reviewed and approved by the Trust. Things like adjacencies and connectivity among activities and departments are checked. This process is not as iterative as in the development of the OBC, its more focused on approving and signing-off. The Trust has established a *users group design process,* since September 2010, which is coordinated by a project manager and attended by users representatives and change managers, as well as the architects and the contractor's project leader. The proposals are evaluated by the key leaders and users, which give a grade for the designs (more than 30 departments are being designed). Grade "A" means that they are happy with it. It is a big challenge for this process to get the users (service's key representatives) involved, as they have to find time in their schedules to contribute for the project.

In order to achieve more transparency and give accountability to patients and the public in general, the Trust has established a Patient and Public Involvement (PPI) work stream (see Figure 1). In the early stages of the development, the perspective of patients and patients' representatives was also taken into consideration through a number of workshops:

- 3T Strategy Workshop held in 21st December 2007, in which patients and patients' representatives participated;

- 3T Strategy Workshop held in 15th January 2008, in which patients and patients' representatives participated;
- 3T Strategy Workshop held in 8th February 2008, in which patients and patients' representatives participated;
- Design Principles workshop in 8th September 2008
- Benefits criteria workshop in 9th December 2008

The intent of such workshops was to allow the participants to contribute with thoughts and recommendations for the design. Small group sessions focused on individual elements of the patient's journey from outpatient communications, transport, visiting, inpatient stay and going home. Every person had the opportunity to offer suggestions in every category and these were all recorded.

The Design principle workshop for instance, included the participation of 18 representatives from a wide variety of patient associations and groups. Patients representatives gave their opinion regarding different topics: inpatient experience, going out and follow up, medicines, outpatients, communication and information prior to coming to hospital, visiting the hospital, transport and parking.

In July 2009, the Programme Board established the Patient Public Design Panel. The panel was set up to include the patient and public perspective in the building design, discussing the design of standard rooms. The Panel also attempts to provide advice as required on issues that relate to the provision of better patient care such as disability access, patient transport, information requirements and other systems issues that may arise. About 30 workshops were carried out from September 2009 to June 2010. The group that participates on the design panels includes representatives from the death and blind association, elders, cancer, and also through an open appeal they recruited people to sit on the design panel.

In July 2009, a Benefits Realisation (BR) committee was created in the project (see Figure 1). After the process of supporting decision making in design based on identified benefits, the BR committee was established to develop a measurement system based on expected benefits and define the responsibilities for gathering data for the evaluation. The BR leader became also responsible to link the efforts of the PPI work stream with the BR work stream. A large amount of information was gathered through the PPI work stream. Such information was being compiled by the BR leader to create a baseline for assessing the project in a future state.

In April 2011, the next steps being planned to take the BeReal model forward was the revision of identified benefits in the project and establishment of a measuring system to track the realisation of

benefits. The statements of benefits had evolved thorough the different workshops and the participation of different people generating different versions of the benefits criteria (Figure 74). The effort the team was undertaking was to review such data and update the framework based on the knowledge gained so far.

July 2007 - SOC (3T team)	12/2008 – HaCIRIC (3T team, clinican and non-clinical staff)	07/2009 – 3Ts Workshop (BR leader)	01/2010 – 3Ts core team
Strategic Fit support the delivery of local commissioning plans, clinical network strategies and the Trust's strategic vision.	**Strategic fit** Stakeholders alignment, Synergy of services, Context development, Co-location / distribution, Image, reputation, objectives Appropriate location (and access)	**Strategic benefits**	**Integrated stroke and neurosciences centre, Development of non surgical cancer services through expansion of Sussex Cancer Centre, Level 1 trauma service**
Clinical Outcomes capitalise on clinical synergies/co-location, the use of emerging technologies and research evidence to improve clinical outcomes for patients.	**Clinical outcomes** Reduce referrals Improved quality of care, Improve care outcomes **Operational management** Improved service coordination, Preventive health services, Improved user experience	**Clinical benefits**	
Modern Healthcare Facilities replace ageing building stock with accommodation that is fit for purpose: comfortable, therapeutic and efficient	**Appropriate facilities (and FM)** Fit-for purpose building & infrastructure, flexibility and future proofing, Physical distribution of services, Improved support services, Increased patient/user safety, Greater privacy, Removal of backlog maintenance, Better working environment	**Estates benefits**	**Improved ward environment**
Improved Access improve patient access to services: (i) timeliness – expanding capacity and improving care pathways, and (ii) physical access – access to the RSCH campus, patient and visitor movement around the campus and patient flows between services / facilities.	**Access to services** Service diversity/capacity fit, Increased physical access, Increased availability of services	**Environmental benefits**	
Teaching, Training & Research strengthen links with academic partners, propagate research activities, further develop RSCH as a University Teaching Hospital campus and attract the highest calibre of pre- and post-registration students.	**Teaching, training and research** Improved research capability, Improved teaching, Knowledge transfer	**Educational**	**Teaching, training and research opportunities**
Effective Use of Resources optimise use of resources and achieve value-for-money on a whole-life costing basis	**Use of resources** Better equipment/recourses (technology), Better personnel, Improved efficiency, Cost savings		
	Development and implementation Investment / change management effort, Construction negative impact, Planning ability, Sustainability, Development feasibility, Reduce service interruption, Faster delivery (up to operation)		
		Consumer benefits, Staff benefits	

Figure 74: Evolution of stated benefit criteria

5.2.5 Team's opinion about the challenges and enablers to generate value

The challenges and enablers to focus on value generation were discussed with the team. Next section summarises the main findings from data collected through interviews and the participation on the workshops. The challenges for generating value in the programme are mainly related with the complex characteristics of the 3T programme. Main challenges are discussed bellow, as well as the contributions of BeReal to focusing on value generation.

Managing the interests of different stakeholders

The 3T redevelopment site is a very complex project. There are several conservation areas nearby and a series of elements that have to be conserved inside the site. Thus, the English Heritage and the City Council are key stakeholders that have to be satisfied (among others, like the Commission for

Architecture and the Built Environment - CAPE). Satisfying them is a requisite for getting the planning consent.

The need of reconciling competing interests is the major challenge for achieving the intended benefits in such complex project. The team has to consider the different interests of different stakeholders groups e.g. national heritage bodies, local conservation heritage groups, city council, changes in the secretary of the state, changes in national government, local residents, local politics, the clinicians, etc. It is a challenge to achieve a design that reflects best practice nationally and internationally, supported clinical services, reflect the strategic objectives of the Trust, and be modern and efficient, and yet deal with so many external influences: “Everybody has an interest in whether there is a building, on how the building looks like from the outside, as well as how it works clinically from the inside. Reconciling all those competing interests and still driving the process forward is a big challenge”.

Changing policies, changing strategies and need to adapt project objectives

One major challenge faced by the team was the need to deal with ever changing policies triggered by a better understanding of how to deliver healthcare. A project with an approximately 15 years implementation period is subject to not only a better understanding of healthcare provision but also to many technological improvements, as illustrated by the director of service modernisation: “In the design of our major trauma care we worked based on the view of our orthopaedic surgeons that suggested a link between orthopaedic and major trauma. But as time moves on and the national debate on major trauma moves on we appointed a chief a trauma that has a slightly different perspective and understand that things should be separated, and we took months researching how it should be designed”.

The lack of clarity about how the models of care will be in the future, the role of technology and even changes in population profile results in a difficulty to predict spatial requirements: “the detailed designs that we developed represent our best guess on how services will be, we had to anticipate modernisation, reflect on how we currently do things and how things will be done differently”. As emphasised by the director of service modernisation the uncertainty about how things will progress makes it difficult to make good decisions: “Hard wire nurse call systems, start track VoIP technology… do we design with a backup to the old technology or we assume and change the design for what the world is going?”

Nonetheless, changes in NHS policies regarding how major trauma care should be delivered triggered the opportunity of developing a major trauma centre within the 3T programme. Thus, in January 2011 the team was developing a business case for the centre. In this sense, as argued by the director of

service modernisation, the objectives change along the implementation of a complex project like the 3T as there is a need to adapt to changes in the external environment and seize emerging opportunities.

Trying to develop the best solutions in a 'projectised' environment

One of the main challenges to generate value according to the interviewees was the need for meeting the deadlines and still making sure the plan reflects the organisation's strategic aims. "We have a capital programme that's very structured and is moving ahead at pace, in a highly 'projectised' environment that the health services are not used to. There are absolutely specific deadline and drop-dead dates, meaning that when we agree on a date to deliver a particular brief to the architects we have to meet the date […]. But then, at the same time you have all that nebulous process of service modernisation. Some of these processes are our responsibility, some are happening individually, and some being managed throughout the rest of the organisation to meet other objectives, such as the financial savings targets for instance, and we need to think of how this modernisation process reflects into the design".

The general contractor made the same observation, stating that the challenge for working collaborative from early stages is dealing with the tight deadlines of a design process and the client's decision-making process. The client cannot simply hire extra resources to meet a tight deadline, as a design firm could do. It is a challenge for them to engage the right people and feed the design process with the required information, while still meeting the tight deadlines. Many assumptions have to be made about the operational phase of the hospital and about how the strategic vision will impact such operations. However, the experienced people that can provide the most accurate assumptions are the ones most busy trying to keep the hospital operating and the services running operationally.

Another challenge that was pointed out, which is specifically related to the early involvement of designers, is that while there is no guarantee that this early involvement will necessarily lead to a better building, there are high costs associated to engaging the team in a earlier stage.

Dealing with increased complexity in the design process

As mentioned earlier, the team decided to develop the full set of drawings in order to get full planning consent. Prior to that decision, the building geometry had already changed 27 times. However, one issue brought up in the interviews is the perceived increased complexity due to the involvement of a large number of people in the design and the fact that decisions are being made simultaneously (or not following a sequential order) in the different phases of design: "we have been working in the 1:200s and

1:50s and non of them has been approved yet, there is not a linear progression from bigger to smaller things, it is a complex process involving a lot of people".

According to the interviewee's perception, there are many opinions involved and the different groups do not always agree on each other's suggested changes. Hearing different opinions creates a compromise, which sometimes cannot be met, "the annoying thing is to be listen to but nothing you said made any difference". Similarly, all the information gathered through the PPI work stream was not used to feed the design process, but to create a baseline for evaluation. Using such data to feed the design process requires a lot of analysis, clean up and processing information to really understand its content.

Despite the observed challenges, aspects that supported the team focusing on value generation were also observed. These aspects are described bellow:

Bringing experienced people upfront to make the best assumptions on how services, the facility and the production system should be designed to achieve strategic intent.

The early involvement of the supply chain was beneficial for both parties in many aspects. Firstly because the designers became aware of the strategic vision and could better contribute to shape the project and advise the Trust in a very collaborative manner on how to achieve those set objectives. Also, as the contractor is responsible for hiring specialised personnel to assist in specific issues of the development, problems could be solved upfront with the help of such professionals. For instance, in the earlier stages of design, architects specialised in historical buildings were involved to deal with the issues of English heritage, as the site had many complications regarding such aspect. Similarly, healthcare planners were brought on board to assist setting up the brief, detailing the type of rooms and the activities that would be performed in those rooms.

Another benefit for the clients is that the contractor was chosen based on performance and its selection for the next phase was dependent on keeping a good performance. Thus, from the contractor's perspective, being involved in an early stage enables to gain knowledge about the site and to build a close relationship with the client. The contractor feels better prepared to deal with the construction and the chances of being selected for the next phase are increased. As the contractor's pre-construction leader stated: "We have one year and a half of knowledge and relationship with the Trust ahead of other contractors".

Choosing a contractor by performance also allowed the client to select a company with experience in this type of projects, increasing the predictability of cost expenditure. The chosen contractor is also

experienced with off site manufacturing, being able to build in a quick and less operational intrusive manner. This was important to the Trust, as part of the hospital campus will still be operating during the construction period. With designers and the construction team working together under P21, the design process was also driven to meet the manufacturing requirements and constructability is improved. The expectations of involving a high standard architectural firm were also high, as the selected architects have a worldwide experience and can bring what is considered best practice to the project.

The facilities management leader was also brought to contribute to the design process. This was possible because the Trust has an in-house team (carpenters, painters, electricians) of 25 people that provide maintenance and repair services for the hospital. Other types of services are outsourced, such as cleaning, pottering, waste management, security and medical devices maintenance. Thus, having an in-house facilities manager enabled his involvement since the early stages of development for a better consideration of how design can facilitate maintainability in the operational phase. During the interview, the facility manager illustrated many past cases in which the easiness of maintaining a building was compromised by design decisions that poorly considered building's operational phase. However, the interviewee also mentioned the difficulty to predict the evolution of services in the future: "We've been discussing about a regeneration trolley (an oven on wheels), I had to say we use that current one, but I don't know how these things will be in 10 years from now".

Improving learning opportunities (complementary to investing in team's experience) to better understand how to achieve the desired results

During the interviews with the service modernisation director, the facilities manager, the hospital director and the benefits realisation leader, it was possible to identify a large effort to bring learning opportunities to the project.

The clinical services were designed individually and also their adjacencies analysed to improve the synergy. Strategic decisions on how to best deliver services were supported by looking at best practices and examples of other hospitals that have taken a similar route: "Both clinicians and managers contribute for improving services. It's all about dialog. We are taking them to other cancer centres, and see how you physically design our cancer centre. We are going to other hospitals to see how they are doing".

The facilities managers participating on the design process is also an incentive to think of what they have been currently doing (in terms of policies) and what they want to do. There are contributions to review the policies, but they won't change them now.

Deal with uncertainty by planning for flexibility that can accommodate the need for future changes.

The programme director has developed a flexibility policy for the building, pointing out some critical places where flexibility should be considered. The longevity of the building is an issue that has to be considered as the team is following BREEAM. In the design, the team is working closely with the architects to provide some flexibility without being redundant. It's an iterative process of finding the most adequate solution. "For instance, training spaces were located close to the beds space, if the need for beds increase we can knock off the wall and use part of that space". Building Information Modelling (BIM) was also utilised to store relevant information that will help in case things change in the future and the hospital needs to be adapted.

Having strong leadership to deploy organisation's strategic aims

The use of BIM, the BREEAM assessments and the adoption of a Benefits Realisation approach were incentivised by the programme leader. According to the interviewees, the main enablers to adopt the BeReal approach were the strong leadership supporting and incentivising such approach. Also, the programme leader insisted the supply chain to adopt BIM and established connections with academic partners to support the introduction of such approaches and techniques. Another aspect that incentivised the leader to pursued those means were the strategic goals set by the NHS for facilities development, which included for instance, the need to achieve high energy efficiency standards and improved building operability thorough its lifecycle.

Building ownership over designed solutions by engaging and considering the perspective of different stakeholder groups

The design process in the 3T programme was very participative. More than 50 Trust staff participated in the process of selecting a preferred design option. Moreover, several user groups were established to participate in the design process, including a group responsible for the hospital operational policies and the facilities manager. The public and patients engagement initiatives were also expected to add to the design. However, the team think it is complicated to combine the input from patient workshops on the current developing stage, in which the efforts are to fix first the functional aspects of the building. Later, this information can be used to design aspects that will make a difference to the user, such as interior design. The team feels it is complicated to translate more abstract issues to the design, for instance the feeling of comfort, as there are many interpretations to that. Thus, the information gathered in the patients and public workshops are being mainly used for assessment and accountability purposes.

5.2.6 Team's opinion about the contributions of the BeReal model

The team was also asked to give their opinion about the contributions of the BeReal model and the challenges for its implementation. Main findings are discussed bellow:

Contributions of the BeReal model

The major contribution of the BeReal model was that it provided transparency and accountability to a very participative and inclusive decision making process. Adopting the model enabled to take forward the stated expected benefits defined in the early project stages and use them as a guideline to support the decision making process in the planning phase. Design options were evaluated based on the established benefit criteria, and such criteria were previously agreed by the relevant stakeholders.

Every project starts with the intent to generate a set of benefits. OGC standards contributed to make those expected benefits explicit and the BeReal provides a methodology for further defining them, using the criteria to support selecting a best design option and then evaluating the benefits and providing accountability for its realisation. The BeReal model provided a rational decision making process to evaluate the different design options based on their ability to fulfil the expected benefits. Such process met OGC requirements for business case development.

In many projects there is an attempt to comply with OGC rules and have a plan in which benefits are stated as well as means for accountability. However, for different interviewees, their experience is that in most projects the expected benefits are rarely evaluated. The team gets dispersed after the project is delivered and no one checks if the intent of investment was achieved. It is expected that this project will be different, as the project team are planning the way they will measure it and assigning responsibilities through the benefits realisation work stream.

Increased awareness of the need to understand and track how project's outputs will lead to project outcomes was pursued by the establishment of a benefits realisation work stream and the definition of a leader that is responsible to find the appropriate ways of measuring these current and desired states, as well as engaging other people and defining responsibility for tracking those benefits over time. It was however observed that the benefits realisation work stream was segregated from other project activities. Other project team members were not involved on these activities and didn't have much awareness about what were the expected programme benefits.

Challenges for adopting BeReal

One big challenge to implement the model was a perceived large amount of information produced with a lack of clear framework that would structure such information and clearly display the evaluation criteria that's is being used. The team endeavoured a large effort to reach such framework, however, each time it was revisited the expected benefits changed due to different interpretation of different stakeholders participating in this process and a full concise framework was never created. A related challenge was selecting the right people to participate on the formulation of the benefit criteria. Many people involved in the workshops had no previous knowledge about the Trust's strategic aims and it was difficult for them to think in terms of strategy and understand the terminology used.

Moreover, in spite of the fact that the BeReal enabled a transparent process for decision-making, the validity of a rational system was questioned to the ability of choosing the best option. As participants were asked to intuitively choose an option before hand, the question here is if decisions were really made based on the scoring of individual attributes and then reaching a preferred option, or if the preferred option was chosen intuitively and then justified by giving it the higher ranks.

It was also extremely difficult to balance rigor and relevance in the measuring system. Difficulty was found to find the adequate metrics to measure some of the expected benefits, particularly for the intangible ones. The difficulty to set metrics for some expected benefits, i.e. less disruptive construction process, led the team to focus on benefits related to user and staff satisfaction, which data could be gathered through questionnaires and interviews.

5.2.7 Discussion

The value proposition for this programme, as stated in the strategic development phase, was very broad and systemic, considering not only how the built facility would contribute for generating better health outcomes but also how the construction process could be efficient and less disruptive to on-going hospital services. Environmental and urban impacts were also important issues that were considered during programme design, as the programme was subject to intense scrutiny by different external stakeholders. The main challenges related to the programme complexity were: the need to manage multiple stakeholder interests, to deal with changing strategic policies, having to consider myriad activities and work streams required to achieve the expected outcomes, and managing a very inclusive design process.

The support of BeReal to deal with such complexity was analysed (see session 5.2.6). Also included on the evaluation was the programme's delivery method (see session 5.2.3). In this project, the OGC also played an important role in establishing managerial procedures that supported dealing with such

complexity, i.e. adoption of set-based design principles, organisation of project activities by work streams. These issues are discussed as follows, under the four themes identified in the current vs. desired state table, presented in Chapter 2 (see session 2.5.)

1) Support for understanding value as purpose fulfilment

The project definition process started in 2007 and was rooted on myriad policies (local, regional, national) for health delivery in the UK. Also, NHS's policies for estate facilities were considered. Those policies include the consideration of purpose fulfilment through the facility's whole life cycle, emphasising the need to consider flexibility to allow for future adaptation and change.

As part of developing the SOC, the OGC recommends listing the expected investment benefits. Such statement of benefits was used to justify the need for building the facility. After programme completion, evidence should be provided to illustrate how the expected improvements were achieved. The main contribution of the BeReal model for this process was establishing a method for specifying these expected benefits. Such method included workshops to agree on the expected benefits, templates to support their documentation (including indicators and ways for measuring benefits after programme's completion, beneficiaries and responsibilities), and criteria to support the evaluation of proposals during the design process.

However, it was observed that despite the fact that the programme had a very broad value proposition, such vision was not fully captured in the goal formalisation process, as previously shown in Figure 74 (see session 5.2.4), confirming Bradley's (2006) observation that it is often difficult to convert policy vision or business strategy into detailed and measurable statements of expected benefits. Sustainability and construction efficiency related benefits, for instance, were specified in the SOC, specified in the benefits template and considered in the process for choosing design proposals. However, they were not included in the system to assess the benefits after programme completion. The reason for that was the difficulty to establish metrics for measuring those targets. Such difficulty led to an emphasis on the evaluation of benefits from users and patient's perspective, as the means of assessment were already established.

2) Considering a means-ends chain to achieve goals

The main focus of BeReal on this programme was to provide support for defining the expected benefits and then finding the appropriate ways for evaluating design options and assessing the realisation of expected benefits after programme's completion. However, it was not observed a contribution of the

BeReal in this case for defining the means for achieving the benefits, i.e. the cause-effect relationship between action and generation of results. It became difficult to track if the means were in place to generate the desired outputs that would lead to desired outcomes. Also, identifying the cause-effect relationship enables the identification of external elements necessary to cause the change. This route, from activities to outcomes was not clearly specified in this case study.

Different mechanisms were adopted to achieve strategic aims. One of the intents of procure 21 was to support an efficient construction process, in which the product and production process are defined together. The adoption of BIM was also requested by the programme leader as a mean to improve constructability. The decant plan was also developed to make sure the construction process would be less disruptive to on-going hospital services. The consideration of sustainability issues was supported by the adoption of BREEAM, and design quality by the adoption of AEDET. Those were means planned by the programme team for achieving strategic intent, indicating an implicit cause-effect relationship that was not specified in the BeReal. The specification of such cause-effect chain was a contribution expected from a BRA (THORP, 1998) not observed in this project.

Other aspects played an important role in defining those means to achieve the desired ends. The programme's leadership had an important role in selecting and adopting techniques and methods that would support the achievement of strategic intent. Upfront engagement of team members also helped the definition of design assumptions regarding how the expected results would be achieved. The owner organisation brought together service planners, a modernisation team, clinical staff and facility managers to work jointly with architects for designing services and the physical space together. Similarly, the early engagement of the supply chain enabled the technical team to be more aware of the strategic concerns and develop the design options accordingly. Such team was also able to get better prepared for the construction phase by considering constructability issues in the design.

3) Support for creating a unit of purpose and common set of commitments

Thinking about the benefits from the outset sets a direction for the team and a constant awareness of why the project is being developed. According to Simon (1997) the specification of goals contributes for establishing the organisational framework required for teams to focus on pursuing value generation. In the sense of specifying goals, the BeReal model supported a very inclusive process, in which users stakeholders were engaged to discuss and agree the programme's value premises and select design options based on established benefit criteria (decisions were made by consensus).

Other aspects were found to contribute for creating a unit or purpose and common set of commitments. Procure21, a relational type of procurement, enabled the alignment of the diverging interests between owners and suppliers. Instead of choosing who bears the risks, in Procure21 risks and rewards are shared, incentivising suppliers to collaborate with owners to improve project solutions. Another mechanism that was found to contribute for such collaboration was the fact that the suppliers chosen for the design phase would not necessarily remain for the construction phase. Their performance would be assessed before making the decision to continue with the same suppliers. The uncertainty about remaining for the next phase was also an incentive for suppliers to demonstrate a good performance during the design process.

The way the work was distributed and organised within the programme also contributed to support collaboration. OGC sets key milestones to be met during project development. The organisation of work is then arranged in different work streams to achieve those milestones. The arrangement by multi-disciplinary packages of work facilitated teamwork and better consideration of the interdependencies among tasks, as opposed to an organisation of projects by discipline, as observed in the first case.

The need for having an established process to support effective collaboration was also observed. The need to anticipate design phases that are traditionally carried out sequentially, led participants to perceive an increased complexity in the design process. One of the major challenges in this programme was managing the interests of relevant external stakeholders. Having an established process for involving these external stakeholders, i.e. English Heritage, in the decision making process upfront could have avoided latter approval problems. Nonetheless, the same benefits could be generated for patient and community involved, with better procedures for considering the feedback process and reducing managerial complexity.

4) Recognising that value proposition and means are subject to refinement

The evaluation established by the adoption of BeReal in this programme focused on supporting the selection of design options by and establishing the means for reviewing achieved benefits after programme completion. However, the established measurement system did not support an evaluation if the means to achieve desired outcomes were adequate. The established metrics, which focused on the confirmation of benefits generated after the programme's completion did not provide much support for learning and adjusting the means for achieving expected benefits, as suggested in the literature (i.e. FARBEY, et al., 1999).

Sources for learning and adjusting the means to achieve expected benefits were established by other means. Acquiring knowledge were recognised and incentivised during the programme development mainly through visits to other hospitals to observe how other teams were generating similar expected results. Also newly released policies for health by NHS were reviewed and discussed among leaders to analyse how they could consider these emerging resolutions in the programme. These learning sources did not only help the development of the first design assumptions during early stages but also their revision throughout programme planning.

One aspect that contributed for this revision of design assumptions was the process prescribed by the OGC. The OGC requires the developing several design options and narrowing those options gradually throughout project development in a set-based design approach. Such approach provided more time for the team to be informed about newly released policies, and better evaluate previously made design assumptions.

In summary, the main contribution of BeReal for the programme was the support for specifying and the project's goals. This enabled the establishment of a decision making process by consensus, which was driven by the agreed benefit criteria, and the establishment of methods for assessing benefit generation. The adoption of BeReal was however shaped by the circumstances of this project, in which the primarily role of adopting BeReal was for accountability purposes and less on supporting the refinement of means for achieving benefits. In this study, a series of other mechanisms to support value generation were also identified i.e. strong leadership, upfront engagement of key stakeholders and incentives for learning based on other examples, adoption of set-based design principles, organisation of project activities by work streams and use of relational type of procurement establishing a regime for sharing risks and rewards.

5.3 CASE 3: SAN CARLOS PROJECT

5.3.1 Timeline and Influences on Project Definition

San Carlos project was initiated in 2006 with the first IFOA signed. However, the project definition process starts earlier on in a pre-project stage. The project feasibility study, which contains the first conceptual drawings, was the first document found about this project. Such study was the beginning of the negotiation with the city for approving the project in early 2003. The project passed through the suspension period and in June 2012, when this empirical case was being concluded, the project was again passing through a re-evaluation of scope. Along its implementation, changes occurred in the

scope, in costs, in the expected time for delivery, in personnel and in the IFOA. These changes are described over a timeline, as summarised in Figure 75.

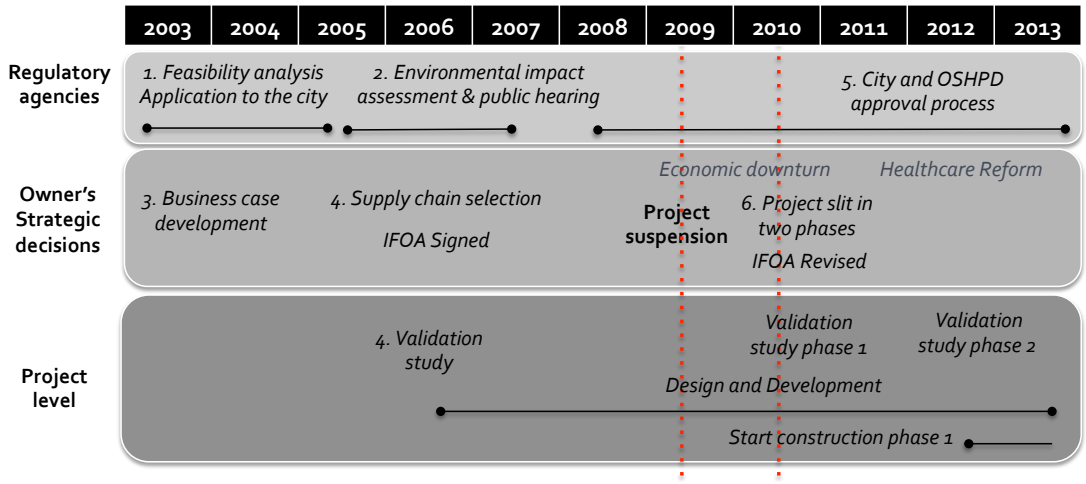

Figure 75: Schematic representation of project's timeline

In 2003, PAMF submitted the Preliminary Application to the City of San Carlos for the development of the PAMF San Carlos Centre, a medical campus at 301 Industrial Road that would include medical offices, ancillary services and a hospital. The process for getting initial approval in the City Council took five years. Such process included the negotiation of land use in the City's general plan, the commitment to decontaminate a site that was previously used for industrial purposes, assessment of benefits to the community and city, etc.

Another component of the approval process is the Environmental Impact Report, required under the California Environmental Quality Act (CEQA). The EIR is designed to provide the San Carlos Planning Commission and City Council, as well as the general public, with information and analysis of the environmental impacts that could result from PAMF's San Carlos Centre. Several stakeholders were consulted for the development of the EIR, including the California Department of Transportation (Caltrans), Division of Aeronautics, and the Federal Aviation Administration (FAA). When submitted in 2006, the Draft EIR was distributed for public review. The document was reviewed by various state, regional, and local agencies, as well as by interested organisations and individuals. Sixty-two comment letters were received from eight public agencies, six organizations, and 49 individuals. The concerns manifested by these stakeholders had to be remediated or justified by PAMF and Sutter as part of the approval process. In October 2007, the San Carlos City Council voted unanimously to approve the PAMF San Carlos Centre.

In October 2006, the IFOA was signed to build the hospital. The architect and the general contractor were chosen based on owner's perception about their capability to have a good performance in delivering the project. From 2006 to 2007, the design was revised until a final proposal was achieved. One reason for changes in design were emerging business opportunities for PAMF and the anticipation of collaborative projects for 2008-2012. As a consequence, some changes were made to the project scope. Figure 76 shows the evolution of building design throughout the years.

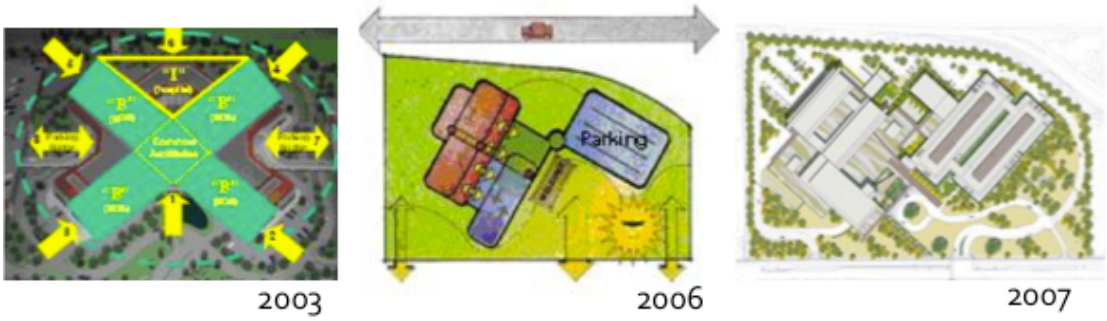

Figure 76: Design evolution

Business opportunities for PAMF were among the reasons for changes in design. Another reason was the involvement of One reason for changes in project scope was The impact that those decisions had on the project was the addition of a cardiovascular sector to the project scope in 2007. PAMF was envisioning creating capacity in San Carlos for a world-class cardiovascular programme.

The project's design and pre-construction phase proceeded until mid-2009, when the project was partially suspended due to capital funding constraints. Funding constraints were due to an economic downturn in the U.S. and Sutter Health had to re-evaluate its capital expenditures. PAMF SCC was placed on hold temporarily and the costs deferred until capital funding is again available. Authorisation to re-start was given in mid-2010. During the summer of 2010, the IPD team was challenged to deliver the clinic component of the project within the owner's funding constraints. The team prepared a validation study to confirm project feasibility within the given constraints. The validation study was prepared in 4 months, addressing the programming, scheduling and expected costs for a reduced scope of the project, consisting of only the medical clinic, commons/welcome centre, garage and site work (Phase 1). Capital funding for the anticipated hospital building and associated site work (including a possible central utility plant) was deferred to a future date (Phase 2).

In parallel to that, changes were happening in the National sphere that might impact the project. 2012 is an election year and there is a proposal for reforming the healthcare sector. Thus, there is a high

uncertainty for PAMF about the impacts of such changes in their business model and thus if it will really be a good choice to build the hospital after those changes. As a consequence, Sutter health advised the team to keep the project open as long as possible and with the least amount of expenditure. At that time, Sutter was also building another hospital in San Francisco, demanding a large amount of cash flow, and that was also one reason why efforts in the SCC project had to slow down. In mid-2012, to support their decision, Sutter required the team to develop another Validation Study. The aim however was only to confirm if the amount of money the team predicted in early stages would still be adequate to build the hospital.

5.3.2 Programme's Delivery Method

Along with the prescription of an organisational structure and the adoption of LPDS, the IFOA determines risks to be shared among members of the integrated them. The general intent of the Risk Pool Plan is for the team members to put 100% of their fixed profit at risk for those costs for which the integrated team is responsible under the IFOA, with the right of sharing in the savings generated by the integrated team in driving down the cost of the work during the preconstruction phase and the additional right to share in any savings generated by the integrated team during the construction phase.

The profit pool is distributed piecemeal at the project milestones listed below. 20% of the initial profit pool is held back until final payment, with the remaining 80% available for distribution at designated project milestones if the project stays within cost parameters. 50% of the design incentive is held until final payment.

The actual cost of the project at final completion determines the band into which the Risk Pool integrated team members fall. This will determine the risk/reward outcome at final completion. Small profits are made along the milestones, but if at the end, the actual cost is more than the EMP (Estimated Maximum Price) then the team has to return the money (Figure 77).

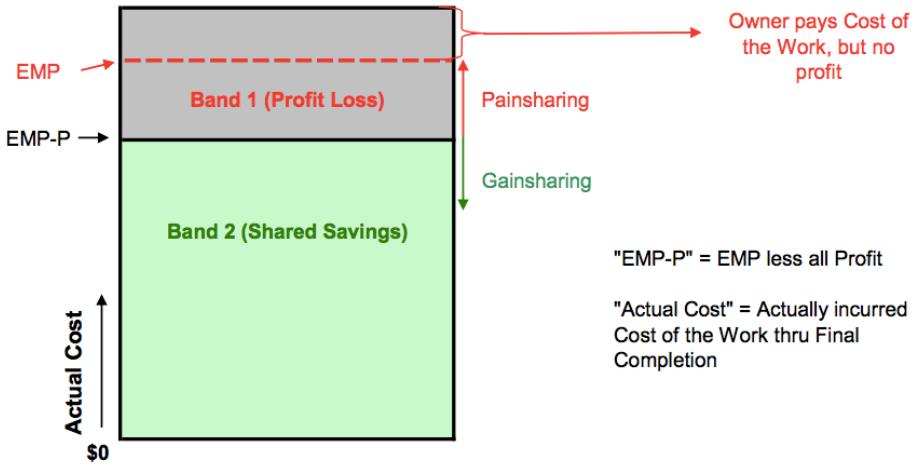

Figure 77: Risk pool pain sharing x gain sharing system

Band 1 (Actual Cost at or above EMP-P):

- Profit Pool = Fixed Profit + Design Incentive - (Actual Cost - EMP-P) - Owner costs charged to Profit Pool pursuant to Agreement, but the Profit Pool may not be less than zero.
- If the Profit Pool equals Zero, then Owner pays the Cost of the Work incurred by IPD Team in accordance with the Agreement, but no amount of Profit.

Band 2 (Actual Cost is less than EMP-P):

- Shared Savings = 35% of (EMP-P - Actual Cost - remaining balance of Escalation Contingency), but if a negative number, will equal zero.
- Profit Pool = Fixed Profit + Design Incentive + Shared Savings - Owner costs charged to Profit Pool pursuant to Agreement, but the Profit Pool may not be less than zero.
- If the Profit Pool equals Zero, then Owner pays the Cost of the Work incurred by IPD Team in accordance with the Agreement, but no amount of Profit.

The EMPs are established when the Core Group determines that the construction documents for a certain scope of the project are sufficiently complete, parties should establish an EMP for that scope and if agreed, execute an amendment that establishes the EMP for each scope. Scopes are divided in three packages: C1/C4, C3, C5, C8 and parking garage, C6 and C7, Ambulatory Surgery Centre (ASC). There is only one EMP, which is progressively amended until all project scopes are included. The EMP includes costs for unloading and handling at the site, labour, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts.

The intent of the design incentive is to reward Risk Pool IPD team members for the success of their efforts during the preconstruction phase in driving down the cost of the work. If the cost of the work established in the EMP is less than the adjusted savings threshold, then the design Incentive is 35% of the difference between the savings threshold and the cost of the work established in the EMP.

5.3.3 Project design and the adoption of LPDS

Level of LPDS adoption

As required by Sutter, the project team had to follow managerial principles of the LPDS. For that, many methods and tools were prescribed in the IFOA. For the pre-construction phase this included the use of last planner system to coordinate the activities, the use of language of reliable promises, Target Value Design and Set Based Design to improve design options, the use of A3 reports and CBA for selecting design alternatives.

As this was the first time that this team was working together, the managerial processes, tools and methods that the team needed to use collaboratively had to be developed or agreed based on a method suggested by one of the parties. There was a continuous process of agreement and development of methods to perform activities. This was evidenced in the core group meeting analysis. By analysing the meeting contents from March to May, it was possible to identify that every meeting the core group discussed how the team should proceed to perform some activity they knew it was necessary but did not know the best way to perform it. A total of 34% of meetings time was used to discuss *how* to best perform necessary actions (Figure 78).

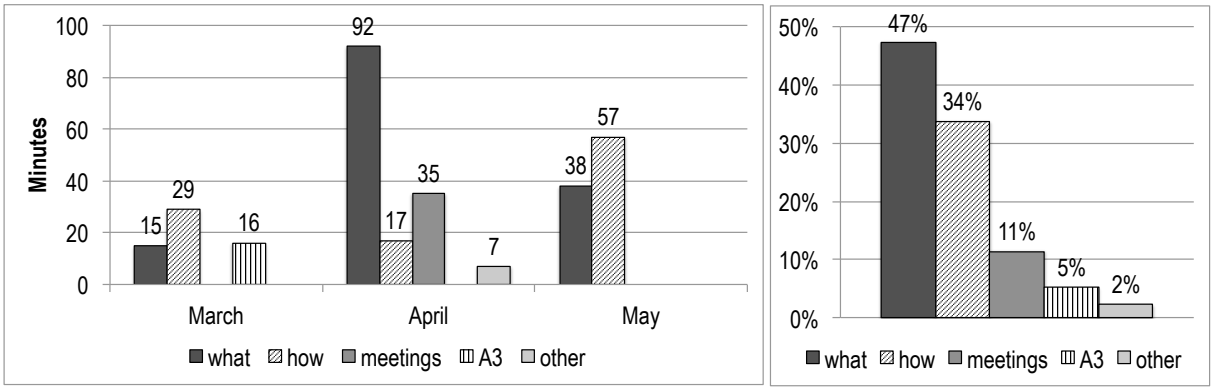

Figure 78: Content analysis core group – how to best perform activities

Among the discussed issues were: (a) how to do the transition into EMPs; (b) amendments to the risk pool; (c) how to improve the documentation of design changes during design development and the

adoption of Target Value Design; and (d) how to improve management of cost updates and design changes. On the last IPD meeting attended (June/2012) the team was discussing (general contractor and trade partners) a common method for managing the risk pool. Skanska developed and suggested a method and also explained to the trades the importance of using the last planner system.

Another positive aspect that contributed for the team to learn and adopt lean principles on their processes was the lean trainings offered to all project participants. Once a week there was a lean training provided by Skanska for the integrated team (Figure 79). It was during lunchtime and everybody was invited to participate. The researcher participated in the lean trainings during the case study period. In the beginning, only a few trade partners would participate in the trainings. Later, core group members started joining the training, since it was subsequent to the core group meetings. The popularity of the lean training sessions increased as time passed, trade partners started to engage in the training by bringing examples to discuss and trying to implement some of the learning on their processes. Participation was incentivised as presence in the training started to be tracked and requested by the owner organisation.

Figure 79: Lean training - lesson about visual management

The participation on the core group meetings also enabled the observation that the team had some strategies for learning how to better adopt LPDS. Sutter was capable of transferring good practices across projects, through the collaboration among its project managers from different projects. Examples of templates and procedures from other projects were used to solve managerial challenges in the SCC.

In order to incentivise collaboration among team members, the project team was co-located in an open office space, called the “Big Room”. The Bid Room consisted of a large conference room, surrounded by open offices (no doors), a kitchen and a room for office supply. The lean facilitator encouraged people to apply 5S to the Big Room and would teach trade partners’ representatives by applying simple

rules to manage supplies in the kitchen and the supply room. Figure 80 shows the space occupied by trade partners and the 5S applied to the supply room.

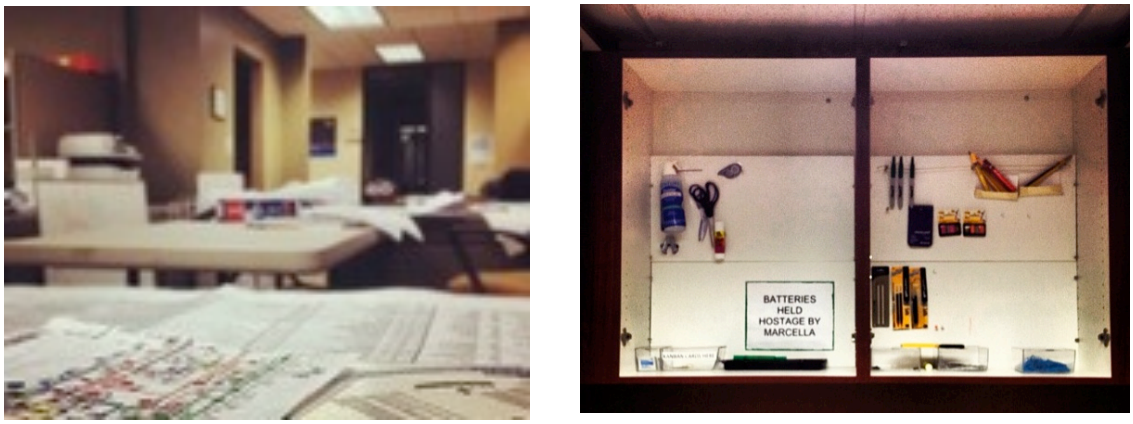

Figure 80: Trade partner's desks in the Big Room and 5S applied to a cabinet in the supply room.

Another initiative to improve the implementation of LPDS in the project was a partnership with Stanford and the development of a monitoring system to measure the team's performance. Figure 81 shows the dashboard that was sent to the core group and displayed in the Big Room. The monitoring system was fed with a survey realised weekly and facilitated by a researcher. The survey included questions about customer satisfaction, constraints resolution by clusters, level and contribution of computer modelling and other technologies, effectiveness of target value design, effectiveness of leadership and conformance to LPDS. The results were analysed periodically and sent to the core group. In the core group meetings, the owner would remind the team about the results and ask different partners to help improving the issues that were not positive.

Figure 81: Team's performance dashboard

All the meetings, with exception of the SMT and meetings to discuss design alternative with PAMF user groups, were carried out in the Big Room. The architects, who are based in Seattle, would join the meetings mainly through conference calls. Invitations to meetings would be sent by email with a link to the WebEx, allowing everybody that was not in the Big Room to participate. Some meetings were also carried out in Seattle, as both Skanska and NBBJ have offices there.

Overview of the design process and roles of actors

Figure 82: presents a diagram that shows the main group of actors involved in the design and decision-making processes. Also, the figure distinguishes two different parallel design process observed: (a) refinement of design solutions that did not have the required level of detail (generally developed in the validation study); and (b) improvement of solutions through Target Value Design (TVD) and Value Engineering (VE).

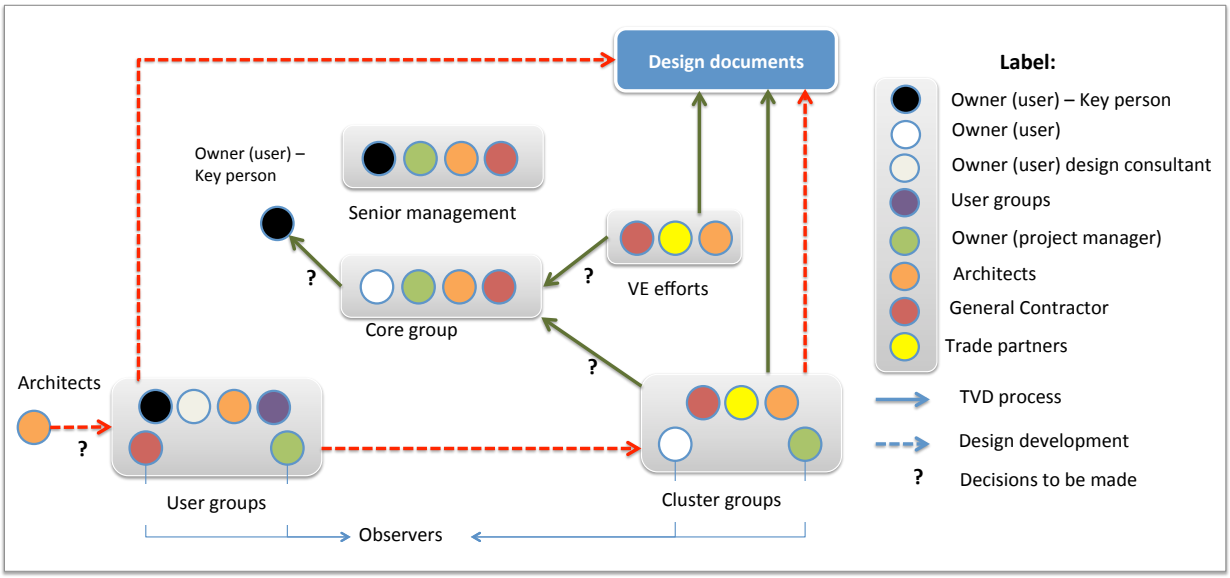

Figure 82: Actors involved in the design process and the decision making flow

As Figure 82 shows, there were four groups of actors involved in the design process:

- The cluster groups involved in developing and refining the design options;
- The core group, which main responsibility in this process is to approve design alternatives;
- The user groups, which is a group established by the project team to discuss design alternatives with PAMF's staff (experienced clinicians and nurses);

- The Value Engineering (VE) efforts, which are specific meetings of a multidisciplinary team members set to analyse and improve design solutions; and
- A key person in the design decision-making process, which is a PAMF leader that is responsible for making many decisions regarding the design of the facility.

The diagram also shows two different design flows, which were distinguished between design development and the TVD process. A distinction was made between those flows because the former was focused on further developing a solution that was in a conceptual level and the later was part of TVD efforts to find better solutions than the ones previously established in the validation study. The starting point for developing design solutions was the validation study developed in 2010, which provided a baseline for the further development and refinement of design options. The need to develop a design solution had different reasons:

- The identification of a problem that needs to be solved: e.g. change in standards from agencies influencing the project, city requirement that needs to be fulfilled, etc;
- An opportunity to save money while keeping the same or achieving improved performance;
- An opportunity to improve the design solution to better fulfil client's needs;
- Need to further develop a solution that was drawn conceptually in the validation study;

The design development process generally started with a dialogue between PAMF users and the architects. The user groups were set after the suspension period to support the design process. Prior to suspension, PAMF leadership made most of design decisions. However, with the lost of a key PAMF leader, the decisions had to be made by only one PAMF leader, a key person, who set up a series of users group meetings, including internal design consultants, nurses and clinical users to help in making design decisions. On these user group meetings, representatives from Sutter Health and from the general contractor would always be present to make sure they are aware of the decisions that are being made. PAMF leaders for facilities development would also be present; to make sure the design would be aligned with some of their strategic intents. The process of developing design solutions with the user groups was very iterative and frequently user requests are directly included in the drawings. When the user's requests are associated with a specific trade partner, the architects involve the trade partners in the estimating and detailing process and then include user's requests in the project drawings.

The design development process can also start in the cluster level, with the identification of a need to further detail design, or the identification of alternative solutions or a problem that needs to be solved. Sometimes, the solution is primarily technical, does not represent a significant impact on costs or it is

easy for the cluster groups to find the best alternative. In such cases, the options are not taken to the core group approval and are directly memorialised in the drawings. However, when a problem is recognised in the core group level and the clusters are required to come up with a solution, generally the core group wants to be informed on how the team is pursuing the alternatives.

The existence of these concurrent processes led to a lack of a clear process for design decision making; and lack of clarity on the role of who should be involved in making design decisions and for which type of decision their involvement is appropriate, as observed in some interviews.

"Sometimes the requests come directly from some outside consultant, and it appear in the drawings, but it was supposedly to be added through the proper channels, top down".

"Users sometimes require things that there is a lot of cost associated with it and no one questions them if that is really needed. Somehow the items are included in the scope without prior approval of the core group. The team tries to meet those requests as they want to deliver best practice, but now we have a resource issue and every opportunity to save money should be analysed".

Figure 83 summarises the different opinions regarding the need to approve design options, based on the source that triggered their development.

Type	Source	Need core group / owner (user) approval?
Design development	Coming from user groups	Not always (architect), Yes (trade partner, estimator)
	Coming from clusters	Yes (lean consultant), Not always (project engineer, architect)
Value engineering	Coming from clusters	Yes

Figure 83: Different opinions about which type of design change needs approval

Refinement of design solutions

During the development of design alternatives, the team would also get together to reach consensus about the best alternative to solve an identified problem. One example of such meetings was for discussing and agreeing on the most adequate solution for vapour barrier specifications. The meetings involved designers, engineers from the general contractor and detailers from the trade partners' side. Different parties brought different solutions to present, discuss and reach agreement as a team on which solution would be more adequate.

Another example was one type of sink that was specified in the architectural drawings. The trade partners identified that the specified sink had constructability problems. The integrated team undertook an effort to analyse other alternatives that would facilitate assembly during construction but yet kept the design intent. In the Figure 84 below, the integrated team analyses a mock-up of an alternative sink brought to the Big Room by the supplier.

Figure 84: Collective problem-solving

Computer modelling was also used in this project for assessing the constructability of design proposals. Every week the architects uploaded their model on SharePoint, the project's shared database, and those models were brought to a local server from which the detailers and trade partners could access them. As the detailers and trade partners were co-located in the Big Room, they carried regular coordination meetings to evaluate constructability of proposals and evaluate alternative options.

The team modelled eight different room types to discuss with users. Such process enabled the users to identify design problems that would impact the use of space in the future. Those issues have not been previously identified on the review of 2D drawings. Also, 3D modelling enabled different trades to better plan for pre-fabrication and construction. Alternatives were discussed regarding better ways to assemble the different systems on site and design options that could facilitate access to future maintenance.

Adoption of TVD and VE

The other identified route is the TVD process. Due to the circumstances of this project, TVD efforts were taken in different moments. According to some members of the project team, during the validation study significant TVD efforts were carried out in order to address the economic feasibility of the project. The team had to work with a reduced project scope but also with a reduced budget. The focus of the Value

Engineering efforts in this project was mainly focused on reducing costs, as the team was challenged to deliver a project with a restricted budget.

The opportunity to improve a design solution was generally initiated at the cluster level, with the identification of different alternatives to solve a design issue. The VE workshops also generated ideas on how to solve a design problem with more efficiency. These alternatives were developed by teamwork efforts involving designers, detailers, estimators and engineers and need to be approved by the core group.

During the development of this research, the project was in the detailed design phase and getting ready to submit permit drawings to the city council. The circumstances of this project made it difficult to set a target cost in the validation study bellow the expected cost. The reason for that is the low budget available to build the facility, which already represented a challenge to the team. A target cost was anyway set by clusters, which were challenged to reduce the costs of their packages by 5%. The team would track its performance to achieve the target cost through periodic cost updates and the baseline for the cost updates was established in August 2011. In November, the team realised the project was almost $3 million over the expected cost. Further analysis revealed that the interiors cluster was mainly responsible for that overrun. Thus, the team engaged in an effort to reduce that amount of money through a series of value engineering workshops (Figure 85). This VE meeting involved designers, engineers and estimators from the general contractor's firm; and estimators, consultants and a foreman from the trade partner's side. Its focus was on finding alternative solutions that could reduce the overall costs of the interior's package.

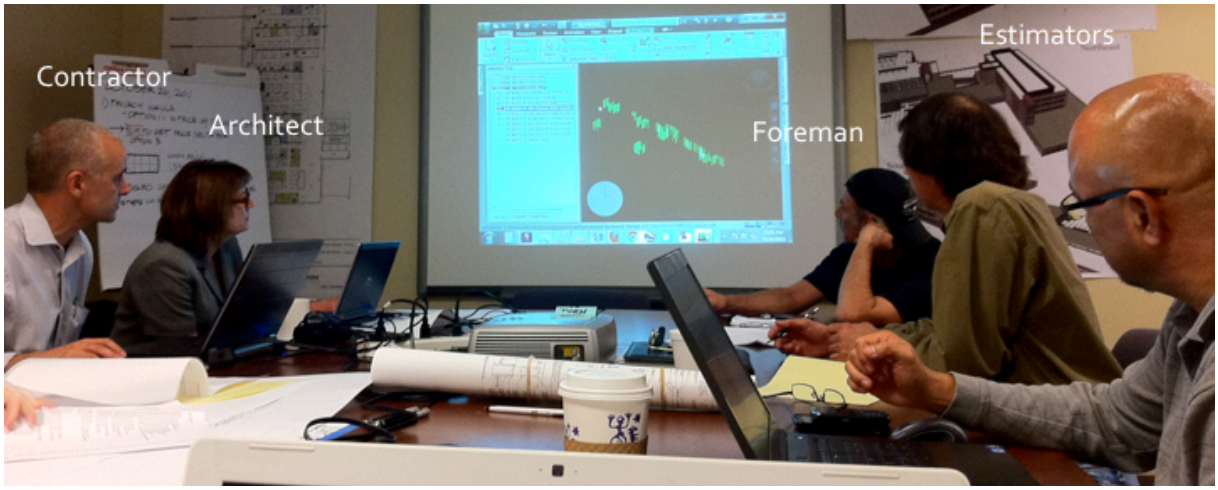

Figure 85: Value Engineering meetings

The chart below shows the progression of cost estimates for the overall project. In November, the VE efforts for the interiors package started. By December the project team was able to reduce the project's overall costs by over 1 million (Figure 86).

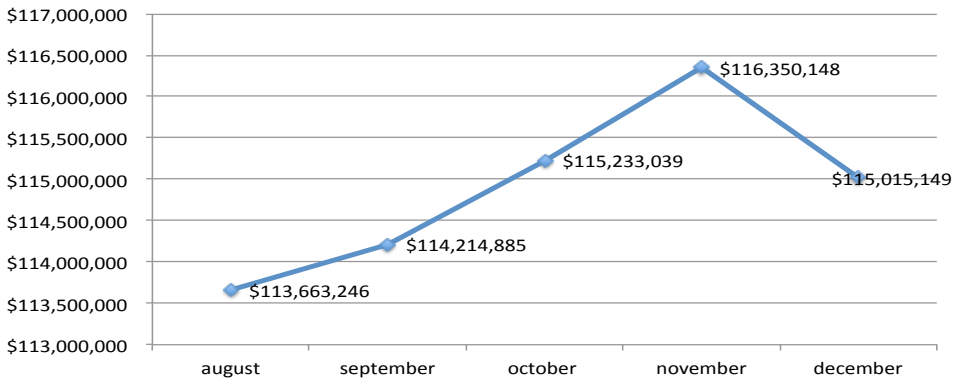

Figure 86: Cost updates from August to December

Decision-making process for design solutions

The development of design options starts with the identification of an opportunity to improve a design solution and documentation on the TVD/DDCS log. TVD means Target Value Design and DDCS means Design Development Cost Study. The identified options can either imply savings (TVD) or added cost (DDCS). The options are kept in the log until it is time to make a decision and they have to be reviewed by the Core team.

Two main techniques were used to present the design options to the core group: A3 reports and Choosing by Advantages reports. These reports provide an easy visualisation of issues, but most importantly they support a collaborative process for problem solving. A3s and CBAs have an "owner", a person responsible for summarising all the information gathered and displaying on the A3 report. The solution for a problem generally requires the contribution of different team and information gathering about several possible solutions. Those techniques support the memorialisation of these contributions and a decision that was made by consensus.

According to one of the project engineers, the CBA was only used once in the project. During the development of the options, once the team sat down together to discuss the alternatives, they realised that the solution was obvious and there was no need for more complex evaluations. The engineer concludes that the most valuable aspect of such techniques was the process of developing the alternatives, which triggered collaboration and brought a new understanding of the problem.

By analysing the recorded conversations in the core group meetings it was observed that a high percentage of time in the meetings was used to discuss the design options without an approval in the end. As indicated in Figure 87: 67%, 63% and 33% consecutively of the meeting's time were used to discuss design alternatives only with consequent identification that more information was needed to select the best alternative. Figure 87: also shows the negative effect of the difficulty to make decisions, as the number of A3s being analysed (showed in the grey boxes) was increasing each week.

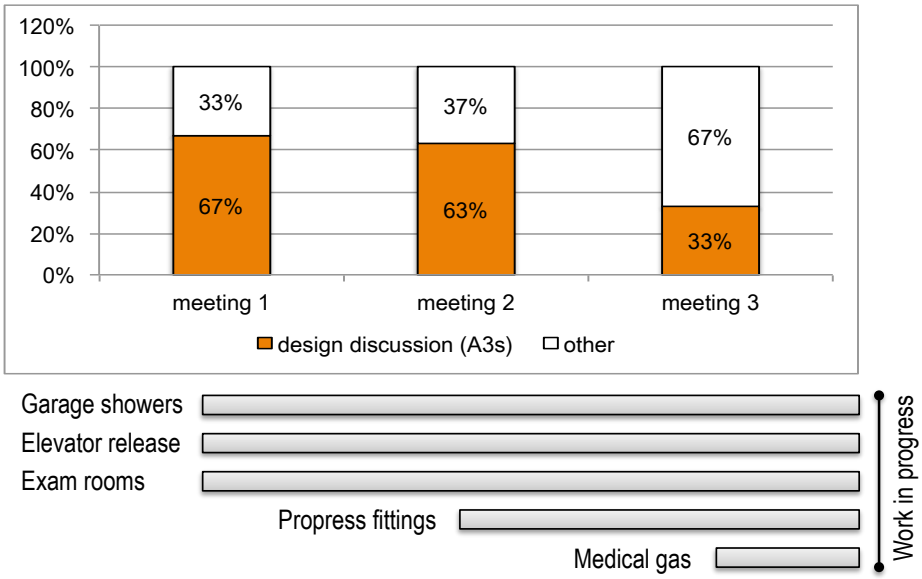

Figure 87: Discussion of A3s in a 3-week period

Prior to the SMT meeting, the Core team decided to make an effort and go through the TVD log and the on-going A3s to get some approvals and present them at the SMT meeting. The Core team was able to approve a series of items on the TVD log and all the on-going A3s, even though they were not fully finished. There were two issues identified in the TVD log: (a) difficulty for the team to prioritise which items to analyse first and make a decision; and (b) difficulty to see in the log how much was being saved. It was also observed that the decision making process is based on choosing the most satisfactory option among the existing ones. This could be done even if information about options was incomplete.

Some members from for core group explained that it is not clear on the IFOA or Sutter's Lean Manifesto how the suggested techniques and tools should be used to support decision-making. The IFOA describes the role of the core group in the decision making process and exercising leadership but it doesn't describe how this should be done. In a similar way, techniques such as the Target Value

Design, Pull Scheduling and Commitment based planning or tools such as the A3 reports and CBA are suggested but not much detail is given on how to properly use them.

Further analysis was then carried out to identify opportunities for improving the decision making process. It was observed that the approval of design options is based on the conditions of satisfaction, as explained in the literature, on the impact on costs and on where the resources would come from. However, the conditions of satisfaction were not formalised. As a consequence, design options would be presented to the core group with incomplete information. Observing the discussions during the selection and approval of a design option, it was possible to identify what were the conditions of satisfaction. Figure 88 shows an extract from a conversation in the core group meeting about a specific design alternative.

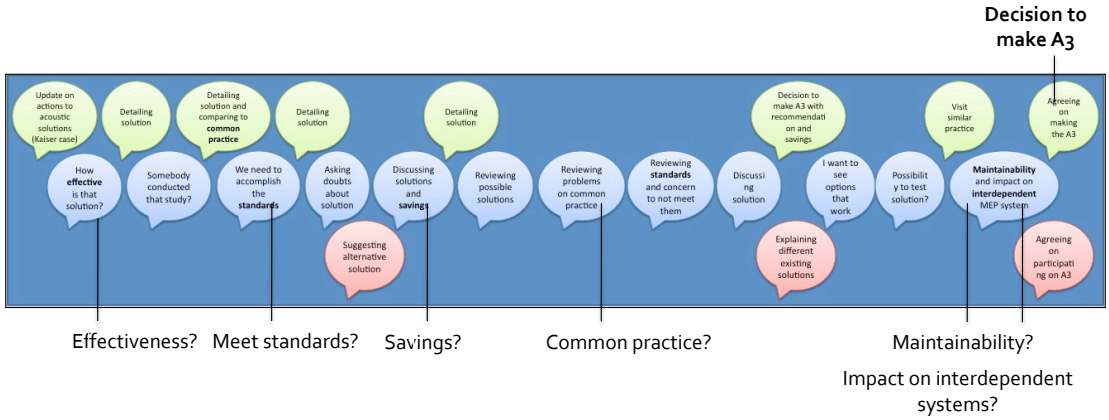

Figure 88: Dialog between owner, designer and contractor about a design option

By analysing the dialogues during the decision making process, some recurrent criteria for evaluating the options were observed, namely:

- The effectiveness or performance of the solution to solve the design problem
- If the suggested alternative complied with new regulations and standards
- How much money would be saved by choosing the alternative
- It the suggested alternative had been used before in previous or similar projects
- The performance of the proposed solution regarding maintainability issues
- The performance of the proposed solution regarding constructability issues
- The potential impacts of choosing that alternative on interdependent systems

Such criteria could be used as part of a standardised process for the TVD process, not only for the evaluation of design options but also for the consideration of such criteria upfront in the development and presentation of design alternatives.

Managing and monitoring the design process

In June, 2010 Skanska initiated an effort to engage ADEPT Management's services in managing the design process. According to the design manager from Skanska, the motivation for using Adept was to facilitate the interface between the design team and PAMF leadership and users. As users were involved in design, there was a need to increase the efficiency of those meetings by informing them of what type of decision was necessary and by when. However, PAMF personnel were never fully engaged in the pull session and the schedule development.

The evidence that there could be a better engagement between PAMF decision makers in the design process was observed during the QA/QC week. There was a misalignment of expectations regarding that week. PAMF decision makers were expecting to only approve drawings that were ready to be submitted to the city, while the team was expecting PAMF to still make decisions about different options in the drawings. There were different expectations regarding level of detail in the drawings for that stage.

Despite that, ADEPT enabled the IPD team to coordinate their activities and the status of activities and constraints for completion were regularly discussed in the cross cluster meetings. The analysis of data from the ADEPT dashboard in a period of 3 months (August to October, 2011) indicated that the three main reasons for the team failing to complete the work planned were: awaiting for design information (102); resource not available (94), which means that there were not enough people to complete the activity on time; and program priorities changed or were incorrect (56) (Figure 89).

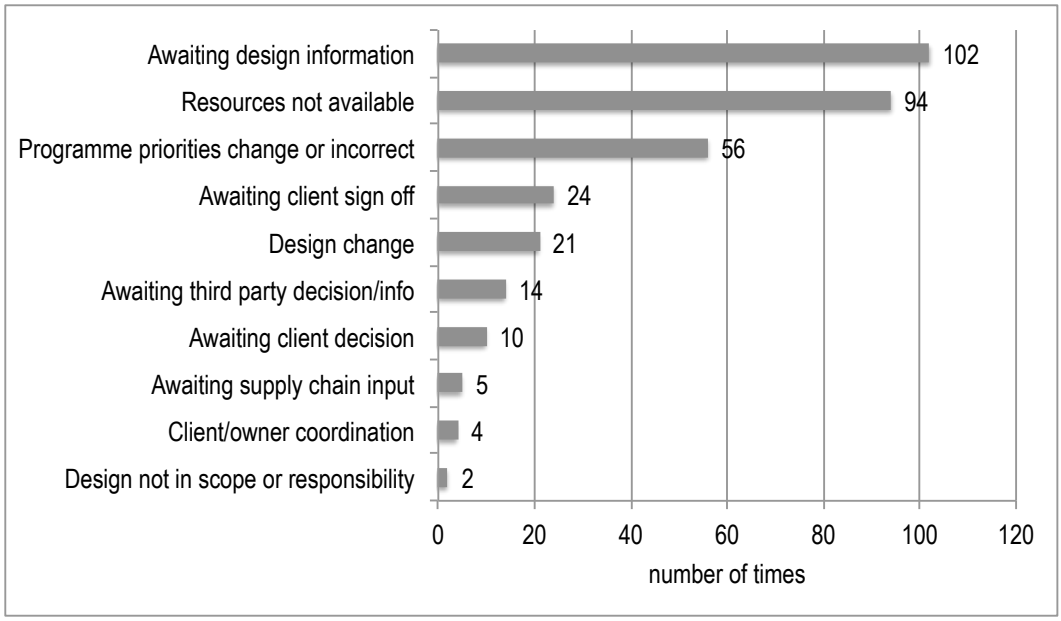

Figure 89: Reasons for failing to complete the % of work planned

These reasons for not completing the work planned might be associated with the number of changes that happened in design, taking the validation study as a baseline. As mentioned earlier, some team members said that they did not expect so many changes in design.

Another issue that can be observed and that was also mentioned earlier is the time it takes to solve a specific design issue by email. This can also be associated with the high number of issues that couldn't be completed because the team was waiting for design information. One issue that was mentioned in different interviews is the time that it takes to get an estimate from some trade partners. While some trade partners provide prompt responses to requests, others are not so quick in their responses, delaying the design process.

Also, by observing the cluster meetings during the design phase it was possible to identify that meetings that had a standard procedure (e.g. discussing the Adept results) were more efficient than the meetings in which a non-routine topic was being discussed (e.g. planning for QA/QC week):

Example 1 (Adept): the cluster meeting had an agenda and the facilitator would go through each item, stating the status of each activity and asking each participant responsible for the item in the agenda about the status of the activity and if they needed anything from other members to finish their activities. Review of reliable promises was also realised. However, the facilitator does most of the talking, including completing the review of the meeting at the end. Plus and deltas were also asked. The Lean facilitator was in the meeting and instructed people to be more ready for the meeting by reading the agenda and preparing what they will say (it was a very quiet meeting).

Example 2 (Adept): another meeting recorded was the cross cluster meeting. The facilitator announced what was going to happen and passed the baton to people that had something to say. He would explain the topic that each person would talk about. He was pulling the conversation with a focus. The design manager read the results of metrics from Adept and invited people to discuss, trying to make sense of data and asking what others think. Then the architect presented the schedule for upcoming activities in the project and so forth.

Example 3 (QAQC): the cluster meeting focused on preparation for the QA/QC week. Along with the meeting agenda, the proposed schedule for the QA/QC week was sent to all participants in advance. The QA/QC topic was discussed for 22 minutes (this cluster meeting had a total of 30 minutes). During that period 10 questions were asked regarding the QA/QC process, such as: Who is going to be there? How will the drawings be presented? Where are the meetings going to be? In the answers, the expression “I think” appeared 6 times, “maybe” 3 times, also appearing at least once in the dialog: “I believe”, “should be”, “could be”, “I haven’t thought about that”. At the end there was a request to revise the schedule as it didn’t include other activities that would occur in parallel and the team wanted to know when and where.

5.3.4 Team’s opinion about the challenges and enablers to generate value

External influences and changes on project scope

PAMF’s vice president for business strategy and planning explained that every healthcare project is a challenge in terms getting the right assumptions about how things will be in the use phase of the facility. Having that in mind, PAMF tries to consider flexibility as much as possible in the design of their facilities. One example given by PAMF’s project manager was the use of modular furniture to accommodate future changes. Technology also changes dramatically during the development of a project and extra capacity needs to be considered in the IT (Information Technology) room for future expansion.

PAMF leaders are the responsible for making clinical and operational decisions in the project. They need to make sure they are always up to date with the changes happening in the healthcare environment, and for that they regularly attend to conferences, and participate on industry events. Since the conception of this project, PAMF leaders decided to shift the model of care into a more integrated, team based approach. Furthermore, in June 2011 Sutter and PAMF started a shift into lean health care delivery. This means that all healthcare services are now delivered based on lean principles. In order to support the organisation to achieve the necessary changes in their processes, PAMF has architectural firms working as consultants to support such transformation. In order to align the design of the new

facility with strategic intent, PAMF leaders also participate in the user group meetings during the design and development phase, making sure that design decisions not only consider user's perspective but also reflects PAMF's strategic intents.

An analysis of core group meetings from March to May also demonstrates the impact of the negotiation with external stakeholders and the external influences on the decision making process (Figure 90). The type of discussions observed in the core group meetings were classified into: (a) how things should be done – when the team knows what to do but has to decide on the best means to do it; (b) what should be done – when the team has to decide what to do as a response to an emerging issue; (c) discussion to plan next meetings; (d) discussion of other issues, non project related; (e) discussion and approval of design alternatives (A3 reports). The analysis showed that a total of 47% of meetings time was used to discuss emerging issues that the project team had to deal with, and agree on *what* should be done.

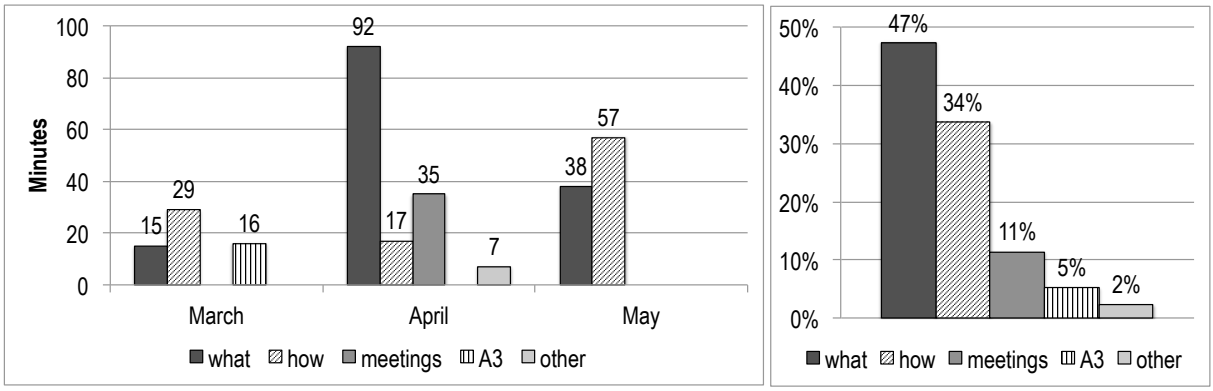

Figure 90: Types of discussions in core group meetings

A recurrent topic of discussion in the core group meetings was the negotiations with the city council to get approval for initiating construction. Different issues had to be taken care of in order to acquire the permission to build: survey of endangered species in the site; site remediation program, transfer of property title; public appeal process; the fact that the neighbours were very sensitive to construction beginning before 8am; etc. The negotiation with the city and the water board were the major causes for delaying construction. Planned to start in January, site mobilisation could only be initiated in June.

Another unforeseen issue was the changing standards of regulatory agencies as well as changes in PAMF's design requirements. In the San Carlos project, there were new design specifications released by PAMF that implicated in a revision of the finishing materials that were already specified in the project. Also, ADA (Americans with Disability Act) regulations6 for clinic design were revised and implied in

[6] Information and technical assistance available at www.ada.gov accessed in 06/05/2012.

changes to be considered; as well as the new OSHPD requirements, which required a revision in the use of sliding doors.

The third mostly discussed emerging issue was the fact that the owners were not sure if Phase 2 of the project should move forward due to changes in the external environment that could affect their business models. If those changes happened, the investment on Phase 2 would be too risky. In this sense it was difficult to determine into what extent investments should be made to prepare to prepare the building to adapt in the near future, when Phase 2 is build. The project manager from Sutter is the main decision maker for these issues and always decided to built-in capability to adapt as changes in the future would be a lot more expensive. One example is a tube that should be installed in Phase 1 in order to support the functioning of the future hospital. However, the team did not know the size of the tube and design efforts were required to determine the size. Another example is the showers. The showers were originally 5 and located in the hospital building. For the clinic, only 3 showers were required and the team had to decide whether to invest or not in larger pipes to increase capacity in Phase 2. Uncertainty regarding Phase 2 also generated doubts in how much effort should be done to design the next phase, as previously explained. Instead of developing a full validation study again the team decided to confirm the allowable costs based on the existing drawings and keep design in a very high level.

The unforeseen events and changes that occurred during the project implementation were the cause of major managerial challenges in the San Carlos Project, according to members in the core group team. A discussion with the core group about the project's managerial challenges enabled the development of the diagram bellow (Figure 91).

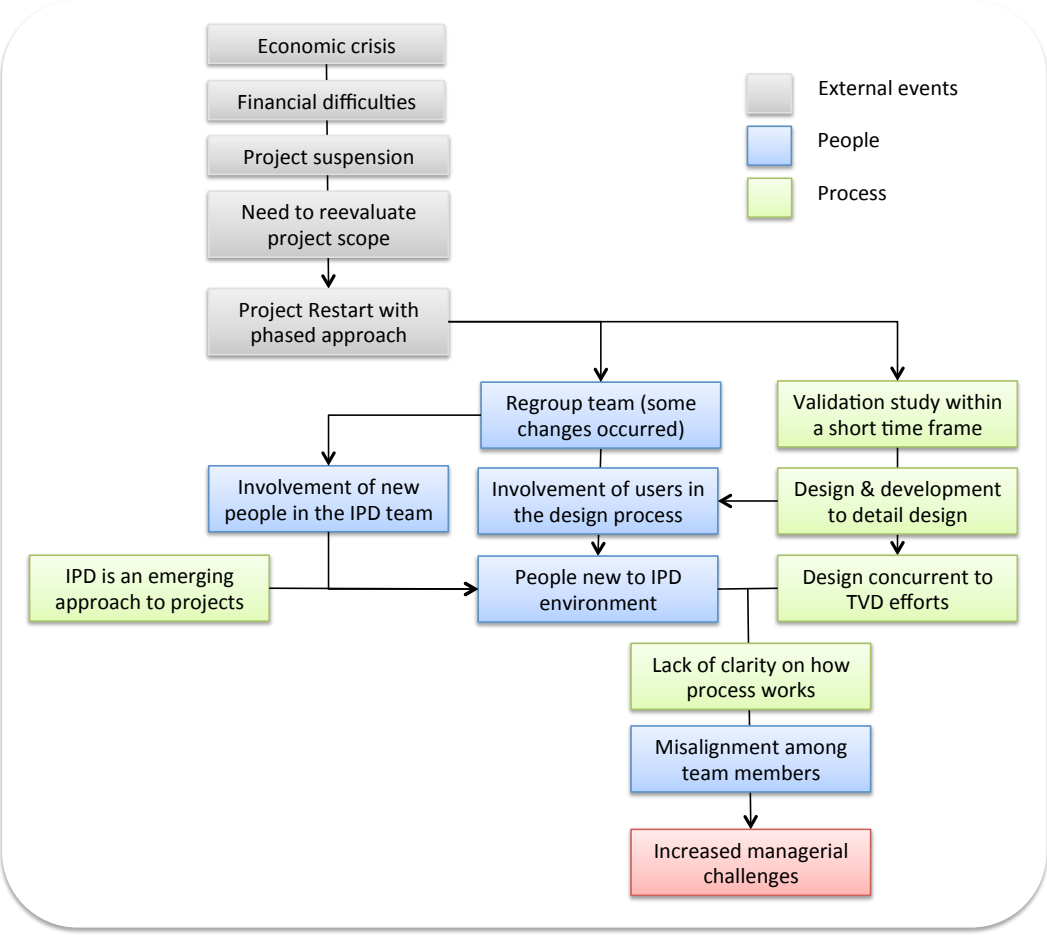

Figure 91: Causes for increased managerial challenges

One of the causes of perceived managerial challenges was the project suspension due to the economic downturn in 2008. This event triggered the need to readapt the project scope to make it economically viable within the given budget. According to some core group members, this resulted a very short period to carry out the validation study and consequently many decisions were left for later, at the detailed design stage. The detailed design phase was then inflated with myriad design decisions that should have been taken on a prior stage, and such process had to be managed concurrently to the TVD efforts. That, in addition to a first experience in an IPD project led to increased difficulty to manage the design process.

However, opinions were divergent. One client representative argued that during the validation study the design team was aware that the scope was changing from the construction of a hospital to the construction of a clinic. All the design changes to make sure that the clinic could be operated without the supporting services of the hospital should have been predicted at the validation stage.

It was also observed in this project an inflation of fees by the design team due to many changes that happened in the building design. The root cause of such problem is still not clear for the team: if it was a responsibility of designers to predict that such changes would happen since the scope has drastically changed from a hospital to a clinic; or if the involvement of users in the decision making process caused more changes than what was previously expected.

The suspension period also affected the project in other aspects. After that period, many changes happened in the project team. The majority of the team members that were interviewed joined the project after 2008. The changes in personnel also reflected on changes about how things were being done. One example is the decision making during the design process. Before, PAMF leadership was the main decision making body, while after the suspension period different user groups were involved in the decision making process, changing dramatically the demand for design coordination. Conversely, PAMF representatives argue that companies changed their personnel after suspension and all the resources spent on documenting the decisions made prior to suspension did not serve its intent. Another opinion that adds to the causes presented above is that one of the challenges to manage design was the unsuccessful attempt to use the ADEPT schedule in the interface with the client. Despite the team efforts to implement it, PAMF leadership was never fully engaged and aware of the demands for their decisions in the design process.

Similarly, some IPD team members argued that the changes in personnel that happened after the suspension period were also a cause for the lack of understanding of how things should be done. The established agreements prior to suspension on how the process should be were lost and the team had to establish such processes from the beginning after suspension.

Such issue was understood by a client representative as one major cause for the difficulties in implementing lean in the San Carlos project. The client has seen lean being successfully implemented in many projects in which the scope was well defined upfront, but in the San Carlos project the difficulty to implement lean is greater due to the problems such as the influence of external stakeholders, delays, and the fact that the team is not communicating so well since a process has not been established yet (consequence of suspension).

Another issue that was brought up in the interviews is the fact that the client is still not certain about the project objectives. While designers and trade partners generally want to move forward with design and detailing, the client cannot move forward due to uncertainty about what is going to happen. Strategic issues faced by the client have reflected on decisions to hold back design and keep it on a high level.

The decision for holding back design are passed on to the IPD team and it is not always explained why such decision was taken. The need to follow decisions without understanding the reasons behind them were found to have a negative effect on some team members, as they start questioning and disagreeing with such decisions since the reason is not shared with them.

Different organisations in the project coalition, different priorities and need for negotiation

During the design phase, decisions are negotiated between PAMF and Sutter Health. First PAMF approves than Sutter Health approves. However, priorities tend to be different between the two stakeholders: PAMF tends to prioritise the durability of systems while Sutter prioritizes first costs. As mentioned by one interviewee, this is a common situation that he has observed in many other projects: the project manager organisation is generally concerned about the first costs while the users organizations are more concerned with durability and maintainability.

Two examples were given to illustrate such differences in priorities. In other PAMF's project, there was a negotiation between the two owners regarding the installation of a large sculpture that was donated for the hospital. The costs of installation were 700,000 dollars and PAMF had to negotiate with Sutter to approve the expenditure. One concern with the installation of the sculpture was the image of a luxurious facility, which PAMF and Sutter Health, as non-profit organizations shouldn't pursue. Moreover, the cost for installing the sculpture was not in the project budget. Similarly, in the San Carlos project, the initial idea was to use natural stone as a finishing material, to maintain a similar image as PAMF's other facilities. However, Sutter Health did not approve the material due to increased costs. Despite the clients mentioning in the interview that this is not an issue, having two owners in this project means having different priorities. PAMF leadership, as the main users, was observed to be willing to spend more money for higher quality, while Sutter, as the project manager, would constantly monitor expenditures and defend the project's budget and the shared profit.

A similar situation was observed in the development of design options. The architects tend to prioritise what they think will generate more value for the client, while the general contractor and trade partners have a concern on the costs of those options. A negotiation process starts and the final result is a design option that everybody agrees is the most advantageous one.

As one owner representative described it, *"in IPD projects everything has to be negotiated. Decisions are not mandated*". The IPD team provides the owners with adequate information to make sound decisions. Those decisions are negotiated with the team, based on what is best for the project as a whole. It is difficult to engage everybody in an efficient collaborative process, as not all the trade

partners are in the IFOA or the Big Room, and a lot of buy in is necessary for them to provide the necessary information on time.

Early involvement, Co-location and effective collaboration

The Big Room enabled the creation of a welcoming and friendly environment. People extended the conversation beyond technical problems and shared things about their lives, travels, problems, life projects, vacations, etc. There were different activities extra work that also demonstrated the team's engagement.

According to the interviewees, the IPD environment was very positive for different reasons. Firstly it enables better communication and a close relationship between owners and the supply chain. It also incentivises open discussion about things that are going well and things that are not going well in the project, enabling the team to adapt and improve their performance. The increased collaboration among different technical teams also enables the development of better design options as people with different backgrounds are contributing to generate those options. Maintainability issues for instance are being successfully considered in this project as the owners engaged some of their team involved in facilities management to be part of the core group.

While the positive aspects of early involvement and co-location on building good relationships was captured during the interviews, the relationship with team members that were not co-located was found to be different. Two main problems were identified related to the non-collocation: the perception of 'broken communication' and the absence of stronger relationships with members of the team that were not collocated.

"Can you guess how many emails I exchanged with this person until the problem was solved? … 27 times. There are 27 emails on my mail box to discuss this specific item with that one person" – Design Detailer, IPD team.

"These people [IPD co-located team] are like my work family, I care about them, and I don't want to let them down. The feeling is not the same for those who come here only once a month" – Design Detailer, IPD team.

Sharing risks and rewards

The interviewees listed the positive aspects of IPD understood as a combination of: financial incentives, sharing risks and rewards, involving the teams upfront and co-location. The only thing that was

mentioned specifically about the risk pool was the difference in the way general contractors work and architectural firms work. According to interviewees, the risk pool and shared profit seem to affect those companies differently. While it is a big incentive for general contractors to work in such terms, it is not very clear if architectural firms perceive that same incentive as their profit margin is much lower and as architectural firms traditionally have their profit based on the amount of work they do. Some interviewees believe that it is a different business model and the risk pool seems to have a different meaning for these companies.

In this project, the actual fee paid to the architects was much higher than estimated. Moreover, according to one owner representative, a large amount of extra money was spent auditing the project's documents to review consultants' fees.

Establishing project means by learning and collaboration

It is the first time on an IPD and lean project for most of the team members. According to some interviewees, being for the first time on an IPD project and joining the team at a later stage (due to the suspension period) affects the team's understanding of how things work. Firstly because on IPD projects there are a set of implicit rules that people need to follow to enable an effective collaborative environment. Not being in the project since the beginning makes it difficult to grasp those rules. New team members that joined after the suspension period learn to behave on IPD and lean project as they go:

"It was never explained to us as a group how the process [selecting and approving design options] should work. Where does it start and then it goes to who and then it comes to me and what should I do with it. We are kind of learning as we go along" – Design Detailer, IPD team.

When asked about lean implementation in San Carlos, one client representative answers that the project had lots of problems so there are more challenges for the adoption of lean construction if compared to other projects. All the interviewees, IPD team and core group members recognise the difficulties of introducing lean construction for the first time and in a project that is being implemented in a highly uncertain environment. However, the efforts for implementing lean have also been recognized, including the engagement on the lean training and the core group commitment to continuous improvement.

It was also mentioned during the interviews the need to better engage key people from the owner's side (users), as they have a key role in the decision making process and were not as engaged as the IPD

team on the lean trainings. An interviewee from PAMF stated that they are aware of the benefits of using lean in construction but their lean training is focused on healthcare deliver:

"We, as clients, focus on the healthcare delivery side of lean. It is different from lean applied to construction and we don't have training in lean construction. But we've seen very successful adoptions of lean in our projects, that saved us a lot of money during the construction phase".

The opinion of some members of the core group team about the difficulty to establish standardised and lean processes that the IFOA and related documents generally prescribe methods, techniques and tools to be used, but those prescriptions are not sufficient for a team implementing such methods for the first time to know the steps they need to follow in order to achieve a successful implementation.

Understanding of prescribed processes and the different roles in the design phase

Discussion with members of the core group to try to understand the causes of the problems observed in the design process led to the recognition that the design process and the role of individuals on design process are still not very clear in a IFOA project for the team. The team is new to an IPD environment and the supporting documents such as IFOA or Sutter's Lean Manifesto do not provide details on how the suggested techniques and tools should be used neither detail how the proposed organisational structures should be engaged on pursuing the managerial principles suggested by these guides. In addition, the suspension period, the changes that happened in the team members contributed for this lack of clear process and clear roles.

5.3.5 Lessons Learned Workshops

The intent of the lessons learned workshops was not only to review what could be done better in the following phases of the project or in future projects, but also to improve collaboration among the different partners, by enabling them to openly discuss several issues that were latent in the project and had been observed through individual interviews with team members. In order to increase collective understanding about the issues concerning each different partner, they were asked to report what has worked well so far and what has not worked so well with changed roles (the owner-user being the owner-project manager, the architects being the owner-user, the contractor being the architects and the owner-project manager being the contractor). The workshops that followed were focused on discussing why certain things worked well and why others did not work so well, analysing how things could be done differently and how each partner could help to do things differently. Two lessons were extracted from this process: (a) team members became more aware of how others expected them to contribute to the

project, and if they were meeting such expectations or not; and (b) a collective understanding was built regarding the reasons behind the difficulties the team was having how each team member could contribute to overcome them.

Prior to the first workshop the Core Group was asked to list what was working well and what was not working so well so far in the project. This question was sent individually by email and a summary of the answers by each different partner is shown below (Figure 92). The top matrix shows what was working well in the teams' opinion while bottom matrix shows what was not working so well. The numbers represent a sum of the assigned importance given by each item (the team was asked to list 5 issues in order of importance). The architects' opinion is not shown in the matrix, as they did not send their feedback for this question.

	SUTTER	GC	PAMF
Collaboration, big room space, teamwork	10	1	6
Soft issues (honesty, transparency, trust)	2	0	2
Early involvement, knowledge exchange	0	12	0
Regular cost updates	3	5	0
Efforts to implement lean / trainning	5	1	7

Reliable promissing/scheduling	5	0	0
Difficulty of collaboration, co-location and open communication	8	8	0
Lack of clarity on how to effectively do TVD - cost updates and design changes	12	17	5
Lack of a clear design x decision making process	3	5	5
Lean thinking not imbibed yet fully and throughout all levels of the organization	2	0	5

Figure 92: Summary of individual answers – what is working well and what is not working well

As shown in the picture, Sutter's opinion about what is working well in the project is similar to PAMF's opinion. Both organisations think that what is working well is related to being in the big room with the project team and being able to see the team working together to identify and solve issues collectively and in collaboration with them, the owners. With that, increased transparency and trust was also observed as positive points. Another positive point observed by the owners was the team's efforts to standardise their processes and follow lean principles. For the general contractor, the positive aspects are related to exchanging knowledge with trade partners from an early stage and increased transparency on cost control with the frequent cost updates pulled together by the team.

Regarding the aspects that are not working so well, the three different stakeholders pointed out the difficulties being faced to follow a target value design approach. One issue was the misalignment

between cost updates and changes in design. Cost updates were not following the pace of design changes. As a consequence changes would happen without the adequate support of cost information. Another issue was the lack of a shared understanding between owners and suppliers about what type of decisions needed to be made and by when. It was also pointed out the need for improving collaboration and communication among team members and the need to make a greater effort to improve the level of LPDS adoption. Sutter also mentioned the problem of non-reliable promises, as the team was finding it difficult to get information about costs on time from the different trade partners, especially from the ones that were not part of the integrated agreement.

The same question was then asked in the workshop, this time with the roles changed. The discussion was recorded and later the time spent on each item was measured. The rationale for doing this was to try to prioritise the items for further discussion with the group, as more time was spent on issues that were hard to solve or upon which there was no consensus about its causes. Figure 93 and Figure 94 show the responses to the questions grouped by topic (each colour represents a different topic). Among the major problems discussed were the decision making process, which was the process bottleneck and the difficulties to manage design and costs together, i.e. difficulty to get costs updates from all the trade partners, constant changes in design from what was established in the validation study and the fact that design involves considering the requirements of multiple stakeholders.

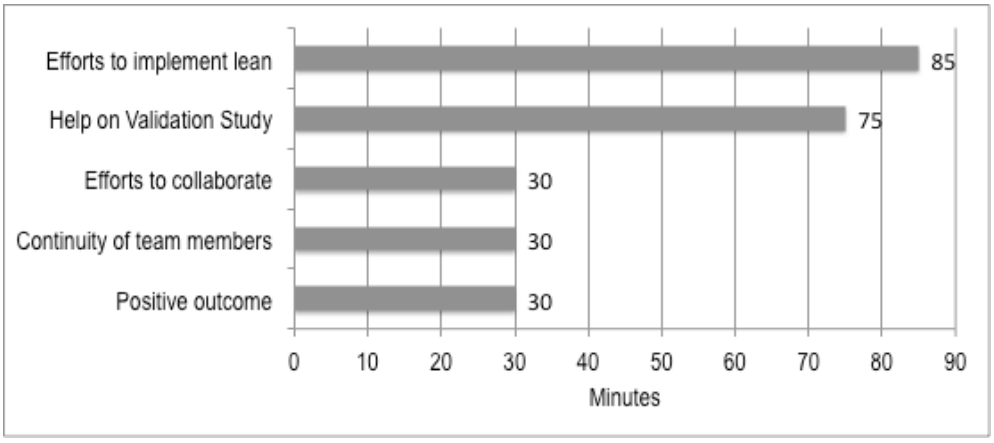

Figure 93: Time spent in discussion– what was working well

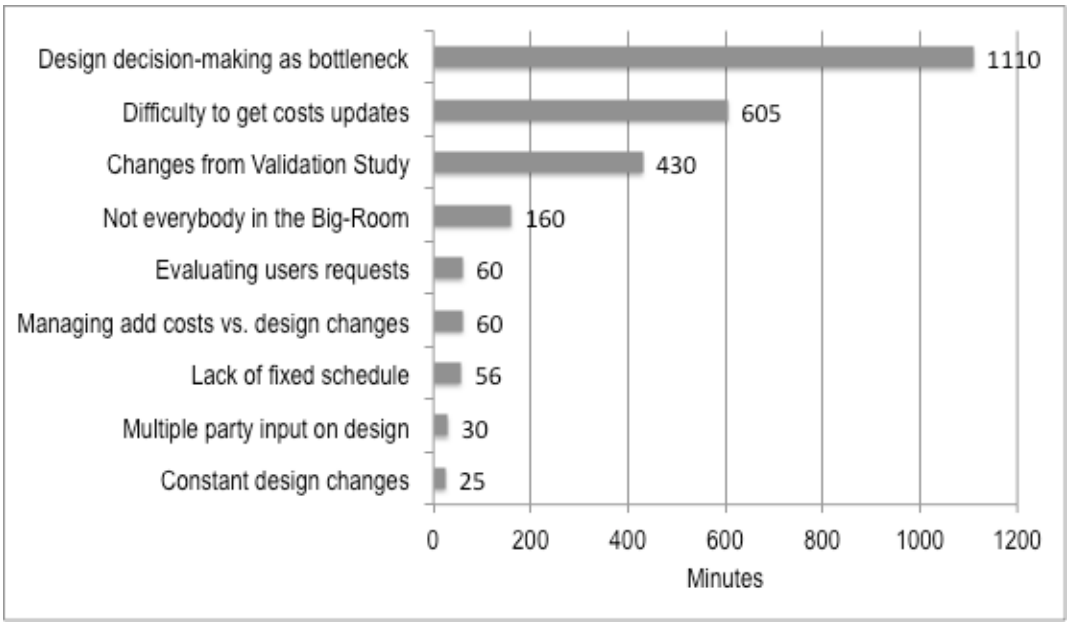

Figure 94:Time spent in discussion – what was NOT working well

Concurrently to the lessons learned review, the researchers have asked the Core Group to build their value proposition for the project. In order to do that, an open question was sent by email individually: Please, tell us how would you like this project to be seen from an outsider's view when it's completed? In other words, what does success look like to you? List five characteristics ranking them by importance. By aggregating similar answers and categorising them, it was possible to build the matrix shown in Figure 95.

		Architects	Owner user	Owner PM	Contractor	
Product	Client satisfied with building	5	5			10
	Users satisfied with building	5				5
	Benchmark for clinic facilities	4	5			9
	Sustainable design	2				2
	Landmark for the city	1				1
	Meeting targeted demand for care		5			5
	On time and budget	5	5	5		15
	Finantial return for IPD team (fairness)	1		1	2	4
Process	Successful IPD teamwork	3	4	4	5	16
	Big room collaboration				4	4
	Satisfied team willing to work together	2	2			4
	Honesty			5		5
	Competent/experienced			4	5	9
	Trustworthy/Commited			3	4	7
	Resolved/knowledgeable			2	3	5
	Seamless		4			4
	Innovative in process (Lean/BIM/cont.imp)			3	4	7

Figure 95: Project vision defined by Core Group members

This matrix brings some insights about what the team understands as achieving success and value. Reading the matrix horizontally, it is possible to observe that success for the team is understood as both

a result of a good product (end) and a result of a good process (means). This team perceives the means to achieve the expected product as an important component of achieving success, contradicting the traditional perception that project success should be measured only in relation to time, cost and quality at the delivery point.

Reading the matrix vertically, it is observed that the perception of success from the different partners tends to be different. The architects and the owner-users are more inclined towards the project's end result, while the general contractor and the owner-project managers stress the importance of the process to achieve the ends. Different team members have different perceptions and their priorities may vary. This is a major reason why integrated delivery methods are expected to be more successful than traditional delivery methods. Team diversity and the adequate alignment of interests are expected to enable teams to pursue a more complete value proposition for the project. Bringing different perspectives to the table and talking about them is a way to make the most out of the benefits expected from such integrated projects. Focusing only in one aspect or the other would result in suboptimal results.

Thus, five different success criteria were identified to steer the project team towards achieving success and generating value for themselves (Figure 96): (a) achieving Client/user satisfaction and high product quality; (b) delivering the project on time and achieving a shared profit; (c) having successful teamwork; (d) building trust and competency among team members; and (e) being innovative and successful in developing processes and using technology.

Figure 96: Value proposition built by the core group for the SCC project

5.3.6 Discussion

The project definition process was identified as a long process of negotiation among different stakeholders with different priorities. The negotiation with external stakeholders for project approval, i.e. City Council and OSHPD, was of constant concern during project development. The project was also susceptible to external events. The economic downturn in 2008 resulted a need to review project's feasibility and construction had to be separated in two phases. Another external event was the prediction of a healthcare reform, which will impact the owner's business model and might implicate in a need to re-evaluate project's goals.

Since the project team started the application to the city in 2003, many changes happened in project scope. The separation in two phases had positive and negative aspects to the project: the positive aspect is that delaying the construction of the hospital to a later stage enabled the team to perceive the impacts of the healthcare reform and further judge the benefits of building the full hospital. The negative aspect is related to the fact that the team was not predicting a suspension period. Thus, changes in personnel occurred and this was very negative to the project. Main difficulties for a successful teamwork were associated with the fact that the suspension period represented a break in the learning process and a need to start all over again with new participants and new processes to be established. Despite some difficulties faced during the implementation of some LPDS techniques, the role of such approach in supporting the team to overcome the challenges in this project are reviewed below:

1) *Support for understanding value as purpose fulfilment*

One major concern in this project was its economic feasibility. This was the main target specified in the project. Target value design and value engineering were then used to support the team in reaching the agreed target cost. There were satisfaction criteria for the selection of alternatives, but they were implicit and discussed during the decision making process according to the nature of the problem in hand. Thus, goal specificity was not an emphasis in this project.

It was observed that the leaders from PAMF and Sutter, involved in the design phase as part of the project team, were responsible for making sure the project was developed according to their strategic objectives. PAMF leadership developed a set of design principles, specifying the link between strategic intent and building design. However, Sutter, which was concerned mainly with production efficiency, did not specified this goal, but rather used the IFOA and the prescription of LPDS concepts as a means to achieving this strategic aim.

Also, strategic decisions were aligned with decisions in the project level through the engagement of key players in the planning process. Strategic aims discussed in the SMT were implemented in the project

through the core group. This was possible because the core group members were part of the SMT and also part of the cluster groups. Therefore, they were in charge to observe that decisions on the project level were aligned with strategic concerns. PAMF leadership would also participate in the user group meetings (meetings between users, i.e. doctors and nurses, with architects to define design options). Such participation had the intent to observe if design was aligned with strategic concerns.

2) Considering a means-ends chain to achieve goals

One way the adoption of a production-based approach to project management support the understanding of means-ends chain by designing the product and the production process together (BALLARD; HOWELL, 2003). By doing so, the behaviour of the system that needs to be put together during the construction phase in order to generate the desired asset is analysed. Although this process is focused on the construction of the physical asset rather than the generation of outcomes, it contributed to understanding the means of achieving production efficiency, one major strategic concern.

Also, the engagement of experienced professionals upfront supported this process, as they contributed for defining the means to achieving the strategic intents, i.e. increased production efficiency, generating the capabilities to deliver PAMF's strategic aims. Another aspect that contributed for defining the means to achieve the expected goal of a target cost was the multidisciplinary VE meetings and the analysis of how costs were reduced in other similar projects.

Regarding the analysis of production efficiency, computer modelling provided an additional support to understand the system's behaviour during the construction phase. It enabled the technical team to simulate the construction, analysing interdependencies among the different systems and also defining the desired sequence of activities in the construction site (as suggested by Eastman *et al*., 2008). They were able to identify problems beforehand and find better ways to assemble pre-fabricated parts on site.

3) Support for creating a unit of purpose and common set of commitments

According to Koskela and Howell (2002), the role of management should be in structuring the environment to support purposeful action. A set of different mechanisms were introduced in this project to create an environment that supports collaboration, i.e. contract, share of risks and rewards, collocation of teams, a common and agreed process and the use of computer modelling. Those mechanisms were found to be interdependent, as both the clarity of roles within the project and a defined process to follow defined the rules for an effective collaboration. TVD, as a standard process, provided the basis for a multidisciplinary team to collaborate by establishing rules that were known by all

participants. Conversely, the lack of clear roles in the decision making about design options led to a misaligned of expectations regarding who should make the decisions, and what decisions should be made by when.

The need to create common and agreed processes to realise the activities resulted in an aligned team effort to define them. The adoption of those standard processes and the concern about understanding the rules was supported by the lean trainings. It was observed that the main problem of LPDS implementation was the non-understanding about the specificity of certain techniques and tools. The fact that the IFOA prescribe them but does not describe how they should be used forces the team to determine rules that are unclear and reach agreement upon them.

It was also observed that the establishment of a shared risk pool was an incentive for teams to collaborate. However, co-located team members were found to be more wiling to collaborate with team members inside the Big-room than those that were not everyday in the Big-room.

The governance structure created in the IFOA also enabled a closer relationship between owners and suppliers. In the core group meetings, problems and solutions were discussed and agreed by a multidisciplinary decision making body, involving the clients and different suppliers. Although the clients had supremacy in the decisions, the suppliers were engaged and committed to face the difficulties, contributing not only to find solutions but also to framing the problems.

Managing the benefits and impact to external stakeholders was a role performed by the city council and other regulatory agencies. Such process was carried out through a long and phased evaluation process, as described in session 5.3.1. The owner representatives managed such negotiations and in the core group these negotiations were discussed and necessary documentation or solution to problems were a shared responsibility of the core team.

4) Recognising that value proposition and means are subject to refinement

Integrated governance played an important role in helping the project team dealing with the changes caused by uncertainties and external stakeholders. Such structured increased the supplier responsibilities for project success and its commitment to cooperate with owners. When the owners decided to first build the clinic, postponing the hospital for a second phase, the technical team gave support by designing the facility in a way to facilitate hospital construction in the future. Also, when the owners engaged users in the decision making process, the technical team also provided a technique for

improving the coordination of the design process. Another example was the suggestion to delay the development of the EMPs based on the permit set of drawings, improving its accuracy.

Due to uncertainty, the San Carlos team also kept the design for Phase 2 at a low level of detail. It was observed that as part of the strategy to deal with uncertainty, only the standard rooms were modelled in 3D to discuss with the clients in further detailed. This process enabled the identification of problems that have not been identified before.

The fact that the team was collocated supported not only the development of solutions, but also, and mainly the identification and communication of problems. The engagement of an experienced and multidisciplinary team upfront was the main enabler for the refinement of solutions aligned also with the commitment to meet the agreed target cost.

One aspect that also contributed for improving design solutions was also the search for knowledge outside the project. Learning from other examples was observed to support not only the refinement of design solutions but also the improvement of team's performance, based on examples of successfully adoption of LPDS techniques. Also, the use of metrics to monitor the team performance provided the appropriate information for the team to identify opportunities for improvement.

Thus, in this case it was observed mainly the contributions of focusing on establishing the means to realise work and establishing clearly defined roles, as suggested in a management by means rather than management by results approach (JOHNSON, 2002). While LPDS defined a common process for the different stakeholders to collaborate, the organisational framework defined in the IFOA, prescribing the participation of key stakeholders in the SMT and cluster groups enabled project development and implementation to be aligned with strategic aims. However, it was also observed that those created by the IFOA organisational framework need to be supported by established and clear processes that dictate the rules for collaboration. Making the project's value proposition explicit supported the different partners to discuss their different opinions and how they could better work together to meet the different concerns.

6. THE CONCEPTUAL FRAMEWORK

Three empirical studies were carried out in construction projects with similar characteristics: (a) the involvement of myriad stakeholder groups, (b) high susceptibility to their external environment; (c) large amount of interconnected elements necessary to generate the desired outcomes; and (d) goals or means subject to refinement.

The required changes in project management to improve value generation in complex projects were analysed. These changes were presented in a current vs. desired scenario in Chapter 2 (see session 2.5). Recommendations for change were categorised in four different dimensions: understanding value as purpose fulfilment (vision); devising a means-ends chain to achieve goals, considering not only *what* is necessary but *how* they are interconnected and might change through time (means-ends chain); the establishment of a unit of purpose and a common set of commitments, engaging different stakeholders in contributing to generate value (building and sustaining commitments); and recognising that both value proposition and means for achieving it are subject to further refinement (refinement).

These dimensions suggest that generating value depend not only on building a value proposition for the project, but also it requires identifying the means for its generation, or understanding the path from the initial actions, their interdependency with other necessary elements and how this system will evolve to generate the desired outcomes. This means a focus on monitoring the system evolution rather than automatically measuring end results. Nonetheless, defining and generating value is a social process, in which stakeholders need to agree on a value proposition and collaborate for its generation. The pyramid below (Figure 97) shows three main components underlying the value generation concept: (a) at the bottom of the pyramid are the stakeholders, which negotiate, define and organise themselves in a collaborative effort to realise the purpose of investments; (b) at the centre is the managerial process (concepts, methods, techniques) that supports these stakeholders to negotiate, define and collaborate to achieve the agreed goals; and (c) at the top is the value proposition which represents the purpose to be fulfilled by projects and that is constructed and revised considering the different perspectives of stakeholders.

Figure 97: Three dimensions of value generation

The managerial approaches analysed in this research offered different contributions to improve the generation of value in complex construction projects. Based on the pyramid described above, the BeReal and LFA emphasise the negotiation and specification of goals as means to achieving a project purpose. Conversely, the LPDS emphasise the need to structure the environment to support purposeful action (Figure 98).

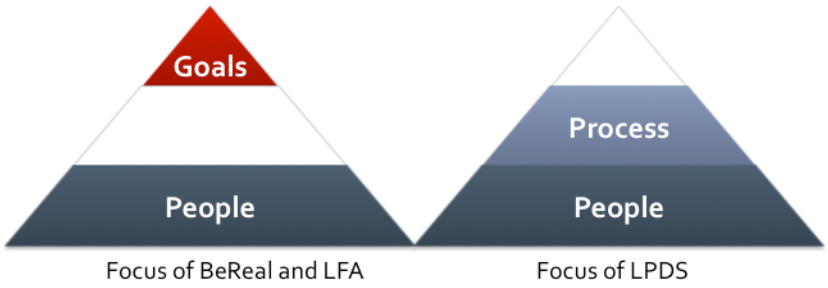

Figure 98: Contributions of the analysed approaches to support value generation

The results of each evaluation enabled the development of a conceptual framework based on an attempt to abstract from observed practice (Figure 99). The framework reveals the underlying concepts of the managerial approaches (LFA, BeReal and LPDS) and other practices that were observed empirically and that contribute towards improving value generation. The framework is presented in a table format with three columns. In the first column are the dimensions revealed in Chapter 2, based on an analysis of a current vs. desired scenario. In the third column are the practices observed in each case study. Finally, in the second column, are the constructs developed in this research, which represent the underlying concepts revealed in the empirical observation. The empirical observations were grouped together based on their contributions for the four dimensions. Then, constructs were devised to highlight the relationship between observed practices and the dimensions, making their contributions to improve value generation more explicit.

Dimensions (Chapter 2)	Contributions (why)	Practices observed empirically (how)
VISION *Understanding value as purpose fulfillment*	***Goal specificity***	Discuss strategic intent, consider potential externalities and agree on a value proposition (BeReal & LFA) Identify the assumptions for realisation of expected outcomes (LFA) Define targets and metrics to assess outcomes realisation (BeReal) Review the constraints – time, costs (LPDS)
MEANS-ENDS CHAIN *Considering a means-ends chain to achieve goals (what and how)*	***Understanding system behaviour***	Simulation techniques to understand system behaviour (LPDS) Consider how activities are interconnected and change in time (LPDS) Formulating well-informed assumptions (early engagement of experienced professionals (LPDS); incentivise learning from similar projects; evidence from empirical research, supplier chosen based on past experience) Understand and document the cause-effect chain (LFA) Leadership to search for means to achieve strategic aims Allow future adaptability
BUILDING & SUSTAINING COMMITMENTS *Creating a unit of purpose and common set of commitments*	***Scrutiny & Accountability***	Clear decision-making process and criteria (BeReal) Transparency regarding programme logic (LFA) Participatory mechanisms Environmental and social acceptability evaluations (i.e. impact assessments and public consultations)
	Integrated Governance	Sharing risks and rewards (LPDS) Decision making by consensus (LPDS) Performance based contract
	Effective Teamwork	Create organisational framework that incentivises collaboration (LPDS) Co-location (LPDS) Create a common language with standardised processes and well defined roles (LPDS) Computer modelling to support collaboration
REFINEMENT *Recognising that value proposition and means are subject to refinement*	***Robustness***	Adopt set-based design approach (LPDS) Modularise and built-in extra capacity to leave options open
	Continuous improvement	Set targets and incentivise team to achieve them (LPDS) Monitoring performance to support learning and improvement (LPDS) Incentives to pursue continuous improvement (LPDS) Observe opportunities and threats

Figure 99: Conceptual framework summarising observed practices and their contributions to value generation

1) Understanding value as purpose fulfillment

Contribution: Goal specificity (focus of LFA and BeReal)

Generally construction projects consider the delivery of a physical product as the final goal of projects. Recent literature suggests that the role of projects should be understood as the fulfilment of a purpose, contributing to change and generating benefits to different stakeholder groups (e.g. ZWIKAEL; SMYRK, 2009). In order to understand how the physical asset will contribute for generating outcomes, one of the aspects suggested in the literature is the creation of a means-result chain (SIMON, 1996; KOSKELA;

KAGIOGLOU, 2007), in which final results should be understood as the achievement of a desired change. In order to create a means-result chain, the project purpose should be defined. One approach is through the elicitation of goals. The elicitation and agreement of goals helps creating a unit of purpose among the different stakeholders (SIMON, 1997) and establishing criteria to support decision-making, so they can work together towards the achievement of a common goal.

It was observed in the empirical cases that making the goals of a project explicit can be a very difficult task. In the first and second cases there was an emphasis on the elicitation of goals. However, in both projects the final templates with specified goals did not fully reflect the project's strategic aims. Project objectives in terms of end and means were influenced by a multitude of perspectives from different stakeholders; they changed according to emerging opportunities in the external environment; while some goals (e.g. revenue generation, growth opportunities) may have been omitted due to political reasons.

However, even though the stated goals did not reflect the complete project team's intention, making the project goals explicit helped creating an understanding of different perspectives and the agreement about a common purpose. In the first case it enabled a shared understanding among different organisational departments and the external funding agency about the programme goals and how the team indented to achieve them. In the second case, goals specificity helped establishing agreed criteria to evaluate design options in a decision-making process by consensus. Design options were evaluated based on their contribution to expected benefits, incentivising the team to think about how the link between project outputs and outcomes. Also not included on the benefit criteria but part of the decision process was the costs and time for delivering the different solutions, which was also analysed.

In the third case, the only explicit target was a target cost, agreed in the validation study. However, the workshops carried out to elicit project's value proposition enabled the team to discuss each partners' different perspectives. It enabled the team to also identify that successful teamwork was a component of their value proposition for that project. Successful teamwork was related to a strategic intent of being better prepared for integrated projects such as the one in case, and for building long lasting partnerships in that industry. The team was able to reflect upon their performance and discuss how they could better work towards that goal.

In the first case, the LFA approach supported the process of goal specificity by providing a template in which the logic behind activities, results and outcomes is easy to visualise. Such framework also shows the external changes that need to happen for the realisation of outcomes. In the second case, the

BeReal supported the specificity process through a series of workshops that included different stakeholders to discuss and agree on project goals and define a measurement system to assess their realisation.

The need to establish measurable indicators for benefits realisation was found very important in the second case because those indicators contain the logic implicit about how the team intent to realise them. Although the LFA also recommends the establishment of a metrics system based on the programme's logic, difficulties were observed to determine the indicators beyond physical aspects. In the third case, some assumptions about means and ends were made, i.e. increased collaboration to achieve successful teamwork. In that case, the metrics were set to verify the means, increased collaboration, rather than the ends, successful teamwork. The assessment was realised through surveys and supported the team to review their performance toward that target.

The main contribution for the value generation concept and for the project management discipline is that purpose fulfilment can be viewed from different perspectives. The subjective perspectives of purpose fulfilment has also been discussed elsewhere, i.e. Saxon (2005) and Winch *et al.* (2003), which argue that the value of construction projects are subject to multiple perspectives: value generated by the construction process and value generated by the physical asset. Both second and third cases show that the value proposition can go beyond the customer and user perspective, to include: better partnerships, faster delivery, efficient use of resources, successful teamwork and non-disruptive construction project. These perspectives have to be understood and agreed. In this sense, goal specificity enables the different stakeholders to build a vision to be pursuit throughout project implementation (SIMON, 1997).

2) Considering a means-ends chain to achieve goals

Contribution: Understanding the system behaviour (focus of LPDS)

Along with creating a shared understanding of goals, defining and agreeing the means to achieve those goals is fundamental to establish the set of commitments that the team will have to follow as part of pursuing the unit of purpose (SIMON, 1997). Understanding the system's behaviour here reflects the focus on establishing the means to achieve specified goals, defining the means to achieve the vision and not only its formulation. In order to support the understanding of cause-effect chains, assumptions about the behaviour of systems have to be made. Techniques that support the simulation of such behaviour can help teams to define the means to achieve desired results. Koskela and Kagioglou (2007) explain that this is a back and forth process of analysis and synthesis: backwards for solution (analysis, resolution) and forwards for proof (synthesis, composition).

Moreover, Koskela and Kagioglou (2005) criticise approaches that emphasise a decomposition of things to understand how they work, in a substance view of metaphysics. The same authors explain that such view does not properly consider how things are interconnected and change through time, aspects considered in the process view of metaphysics. In this sense, understanding the logic behind activities, results and the generation of outcomes also requires understanding how these elements are interconnected and behave through time in generate the desired outcomes.

In the first case, the LFA supported the team to define the sequence of activities required to achieve the desired outcomes (analysis); whereas by establishing indicators and assumptions supports the team to predict the system behaviour, understanding if the elements will lead to desired solution (synthesis). However, the benefits of doing such exercise were not fully perceived due to an assumption of stable environment. The clarification of means focused on the breakdown of activities, adopting a substance view of metaphysics.

In the second case the main role of BeReal was to define expected benefits and establishing evaluation criteria. The focus was not on understanding the cause-effect chain, or the means for achieving strategic aims and policies in the project. Instead, the programme leader played an important role in defining the means to achieve the programme's vision; engaging different partners and initiatives to make sure those aims were achieved. Other aspects were observed to support the team on understanding the means to achieve desired goals. To predict the "behaviour of the system" the team relied on the experienced guesses of technical team, e.g. healthcare service change managers, facilities managers, and the early engagement of the supply chain. The early engagement of the supply chain was possible due to Procure 21, a type of relational procurement used in that project. Suppliers were also chosen based on their past experience (similarly to what was observed in case 3).

Also, to support the team to make the best possible assumptions, learning from other projects was incentivised. The teams would visit similar projects and identify new ways to achieve desired goals. The team also tried to use Evidence Based Design as a way to understand the means for achieving the desired results. However, the pursuit was not taken forward as the team could not find robust studies that provided strong evidence of cause and effect relationships. Evaluating tools such as BREEAM, AEDET also offered some contributions, as they bring implicit assumptions about the links between project's outputs and outcomes. Finally computer modelling allowed the team to simulate hospital operation and visualise how it would visually impact the urban environment. Built-in flexibility to enable future adaptation and support purpose fulfilment throughout the entire building lifecycle was also observed in this case and also on the other analysed cases.

Some of these mechanisms observed in the second case are prescribed in the LPDS, i.e. early involvement of experienced suppliers, use of computer modelling, and simulation techniques. One simulation technique prescribed in the LPDS is pull planning. Pull planning brings together different interdependent actors to simulate the group of activities that they need to perform, enabling them to visualise interdependencies the flow of activities. Other mechanisms observed in the second case but not prescribed in the LPDS were also observed, i.e. learning from other projects, role of leadership.

The main contribution for the value generation concept and project management discipline is that purpose fulfilment requires not only the consideration of what needs to be done in order to achieve the expected results but also how it needs to be done. The traditional transformation does not properly consider flow and interdependency. Fulfilling a purpose requires a shift from the transformation model to also considering flow and the customer perspective (focus by the specificity of goals) (KOSKELA, 2000). Another contribution was the identification of elements that can support the method of analysis and synthesis, i.e. the use of computer modelling, the process of developing metrics, which requires understanding the meaning of targets; and the early engagement of a technical team to define the assumptions about a system's behaviour. The search for similar problems in other projects was also found to be an important source of knowledge for making such assumptions. Understanding the behaviour of a system, including interdependencies and how such system may change through time, is a starting point for defining a means-ends chain to achieve agreed goals. As suggested by Simon (1997) such understanding will set the ends towards which activity is directed.

3) Creating a unit of purpose and common set of commitments

Contribution: Scrutiny and Accountability (focus of LFA and BeReal)

As explained by Pearce (2003), construction projects can generate externalities, which can represent negative impacts to society, such as carbon emissions, increased traffic, environmental implications, etc. The perspectives of external stakeholders were considered in the three analysed cases, by different means.

The first case was a public projects and highly subject to scrutiny, including evaluations by those providing funding and social acceptability evaluations through diverse mechanisms of public consultations. The targeted community was engaged in the decision making process through different participatory mechanisms. The LFA was used to support the specification of the programme's logic to be evaluated by the external funding agency. In fact, this was a major contribution of the LFA to that project.

The second case was also a public project and highly subject to scrutiny. The programme business case had to be endorsed by relevant external stakeholders, the building volume was a concern of the English Heritage and the programme had also to gain social acceptability though diverse mechanisms of public consultation (i.e. public displays, website, surveys) and participatory mechanisms (i.e. patient forums, user groups). Managing the different perspectives of myriad external stakeholders was a major challenge in this project. The main contribution of the BRA for this project was providing a method for including different stakeholders in the decision making process.

Despite the fact that the third case was not a public project, it was also highly subject to scrutiny, including environmental and social acceptability evaluations as part of the approval process with the city council and other regulatory agencies. The city provided the means for community to vote in favour or against the project and to communicate their concerns. Also, surveys to analyse potential environmental and urban impacts were carried out. Mechanisms for public consultation included periodic public hearings throughout the project approval process. The participatory mechanisms in this project were the user groups, involving nurses and clinicians from the owner's organisation. The management of external stakeholders perspectives is not included in the scope of LPDS prescriptions.

The main contribution of observed practices is that managerial approaches should consider value generation from multiple perspectives. The non-consideration of external stakeholder interests can jeopardise the success of projects. Thus, projects should be transparent and subject to intensive scrutiny, taken into consideration possible externalities and how they impact different stakeholder groups. Subjecting the project to scrutiny since the early stages avoids dealing with problems later on when the solutions are more refined and the cost for changes is higher. Thus, accountability and scrutiny are important as means of considering the perspective of external stakeholders.

Contribution: Integrated Governance (focus of LPDS)

Winch (2006) observes that perspectives of value may be contradictory among the different actors within and outside a project coalition. Within a project coalition, members of distinct organisations need to solve particular problems of common concern as well as define the means to achieve agreed purposes (DTF, 2006). Integrated governance establishes an organisational framework in which the ends towards which activity is directed is negotiated and agreed among the different partners (SIMON, 1997). The structures of governance also clarify the role of each party and their responsibilities for achieving agreed goals (ZWIKAEL; SMYRK, 2011). In addition, the alignment of commercial interests

creates an incentive for different organisations to align their efforts towards these common objectives (THOMSEN *et al*., 2009).

In the first case, the intent of the UEP was to create an integrated governance structure within the city council to integrate the different departments. However, such structure did not include the alignment of commercial terms with suppliers. As a consequence, the UEP did not receive support when unpredicted changes happened, having to bear that risk.

In the second case, an integrated governance structure was established through Procure 21. The early involvement of the supply chain enabled suppliers to participate in the decision-making process and help the team to define the most adequate means for achieving their strategic aims. The suppliers were incentivised to collaborate, as risks and rewards were shared between clients and suppliers. It was also observed that uncertainty about the supplier's continuity in the project was also an incentive for them to collaborate (their performance was going to be evaluated prior to extending the contract for the building phase). Despite the fact that the BRA literature argues that project governance is important in realising benefits (e.g. ZWIKAEL; SMYRK, 2011), the BRA, as adopted in the project, did not have any influence on project organisation.

The LPDS prescribes the use of relational contracts. In the third case integrated governance was established by aligning the commercial interests of key stakeholders. An organisational framework was prescribed by contract, in which decision-making should be made by consensus. It was observed that the alignment of commercial interests created a shared responsibility for the project success among the different partners. As previously discussed, decisions were made by consensus by leaders from the different organisations represented by the core group. Such leaders were committed to face difficulties together, identifying and solving problems based on their complementary capabilities. As observed by Ballard and Koskela (2006) in the early stages of projects the supply chain can play an important role in helping clients defining what they want, suggesting solutions not previously considered and explaining the consequences of their requests. It was observed that through an integrated governance structure, such contributions were extended from the definition phase. Throughout project development owners had the input of an experienced technical team to make better decisions and the suppliers had owners challenging their assumptions and incentivising them to continuously improve proposed solutions.

The main contribution observed was that managerial approaches should consider the customer-supplier relationship as reciprocal. Integrated governance and the alignment of commercial interests increase collaboration and commitment towards an agreed set of goals. The additional effort suppliers make for

improving solutions is rewarded, while risks are also shared. The responsibility about project success is shared among the different partners and suppliers. Establishing an organisational framework also defines the roles and responsibilities of each different partner on the collaborative effort to pursuit project goals. By doing so, the different priorities are discussed, trade-offs evaluated and a common direction agreed.

Effective Teamwork (focus of LPDS)

Teamwork contributes to mitigate the cognitive limitations of one individual and supports a better decision-making process, which is limited by human cognition and available information at a given time (SIMON, 1981). When planning the means to achieve desired results, assumptions about a system's behaviour have to be made. Those assumptions are better formulated when there is a collaborative effort based on the knowledge of different team members, with different backgrounds and experience. By working in multidisciplinary groups, interdependencies among tasks can be better considered. Similarly, problems are better identified and solved when teams are working collaboratively.

In order to work effectively, project participants need to spend some time interacting and thereby gain knowledge of other participants' expertise, so that roles and responsibilities for problem solving can be established (EMMITT; GORSE, 2007). Over time, groups develop norms and agreed rules, which to a large extent can structure behaviour and seem vital for effective group work (EMMITT; GORSE, 2007).

In the first analysed case, the organisational structure of the project hampered collaboration among the different teams. The work was organised in projects, by disciplines, not properly considering the interdependency among them. Such structure, aligned with a bureaucratic process to engage members from other projects in problem solving, did not contribute for the team to collaborate. Conversely, in the second case, collaboration and teamwork was incentivised by the way the work was organised: in multidisciplinary work packages. This structured considered the interdependency among tasks and facilitated teamwork.

In the third case, collaboration was also incentivised by the organisational framework. The technical team was distributed by multidisciplinary clusters, according to the different building systems. Such structure supported cross-disciplinary work towards a common objective. Co-location was also another strategy to support collaboration among the different teams. The close contact and face-to-face interaction was found to strengthen the relationship among project owners and among different suppliers. Project participants were able to identify other participants' expertise and learn how they could help to solve problems. Co-location also affected the team's relationship and improved their

willingness to collaborate with each other. Computer modelling, used in the project mainly for coordinating the different building systems, providing support for the different trade partners to work together.

The adoption of LPDS techniques, i.e. TVD, VE, last planner, pull scheduling, A3 reports and CBA supported the creation of standard processes that were common to all different project participants, thus supporting an effective teamwork. The organisational framework also provided a clear definition of roles, also facilitating the team to work together efficiently.

The main contribution for the value generation concept and project management discipline is that the different means for generating value are better revealed in a collaborative effort. Collaboration also supports the identification and solution of problems, as such processes are generally realised the limits of human cognition and available information at a given time (SIMON, 1981). However, such teamwork should be effective. Co-location, the distribution of work considering the interdependency among project participants, and clearly defined rules for working as a team, were found to contribute for effective teamwork. Effectiveness here is related to the fact that the results of teamwork efforts can be better achieved if teams understand their roles and how they should act as a group. Such effectiveness contributes for creating a unit of purpose and common set of commitments.

4) Recognising that value proposition and means are subject to refinement

Robustness

In the process for developing a solution, new knowledge about the problem can be revealed, changing the problem perspective and again the solution scope (SIMON, 1981). Thus, March and Simon (1958) argue that the definition of goals and means can serve only as a starting point that will be further refined.

Delaying decisions and exploring multiple alternatives supported the teams in two of the analysed cases to choose the most satisfactory option among all the possible ones identified in a certain period of time. Such strategy enabled the team to further explore the future consequences of their solutions and to make better assumptions as further knowledge about the situation is gained (SCHON, 1991).

Decisions can also be prioritised to support their delay. By doing so, the team works only in solving the problems that most need attention, based on downstream activities in the design process (BALLARD *et al*., 2009). Phasing decision-making also creates the opportunity for the establishment of learning

cycles, as suggested in the literature (FARBEY, LAND; TARGET, 1999) and it has been observed to be an approach that contributes design practice (MACOMBER; HOWELL; BARBERIO, 2008).

In the first analysed case, the LFA did not offer much support to deal with further knowledge about the situation and the need for change. The way the delivery methods were set up also did not provide support for further judgement and negotiation with the supply chain. Also, the way the execution was planned did not give much support for revisions and learning. The implementation of each individual project was set up as a unique effort of execution. If the implementation had considered a phased approach, location based, i.e. execution of housing, road infrastructure and income generating on one section of the whole area, the intermediate results could have been more positive as such expected results depended on the capabilities created by these three interdependent projects.

In the second case, 13 design options for the hospital were developed. Throughout more than one year, the team passed through a long process of refining and shortlisting such options, until the most satisfactory one was selected. Such time enabled the design team to gain further knowledge about the situation and to better understand the consequences of their proposed solutions. The BRA had no influence over the design process and such phased process was an OGC requirement. Another strategy observed was modularisation. The team fixed all the standard rooms first, leaving the other sectors to be defined later.

In the third case, set based design was observed in the detailing phase. Multiple options would be developed and presented to the core group. Robustness was considered to deal with uncertainties about project scope, whether it would stay as a clinic or be transformed into a hospital. In order to achieve that, the team anticipated some parts that would facilitate future adaptation. Design considered the need to leave options open.

The main contribution of such observations is that the vehicles to generate value are subject to further judgement and refinement. Generating value means visualising a desired situation and finding the means to achieve that situation. However, both the desired situation and the means to achieve it are subjective to further judgement as knew knowledge about the situation in hand is acquired. Delaying decisions and adopting strategies that can leave multiple options open for longer are ways to pursuit the best possible means for fulfilling a project's purpose and thus generate greater value from projects. This is what the construct `robustness` represents, the possibility to delay final decisions and make changes in a later stage.

Continuous improvement

As argued by Simon (1997) while project ends can be validated by consensus, project means can be validated empirically. Pursuing continuous improvement can be achieved by periodically reviewing the project's value proposition based on judgement and consensus; and by monitoring the adequacy of means to achieve them with empirical observation.

Farbey, Land and Targett (1999) suggest the cyclic evaluations of means to support learning and continuous improvement. In the first case study improvement was seized through periodic meetings involving project leadership to discuss progress and difficulties. The established metrics however did not support learning, as they focused on measuring physical advance. It was the evaluation carried out in 2008 that gave the support for the team to review how the means for delivering the project could be improved.

In the second case, metrics were established for accountability purposes and did not support learning and adaptation. However, in this project a target cost was set and as design was developed, the costs were monitored to identify deviations from target. The same approach was used in the third case. This process allows team to monitor the cost of their design options and make sure they meet the agreed target. In case three, metrics for measuring the team's performance were also established. A dashboard would provide information about team's performance each month, so opportunities for improvement could be identified.

In the three analysed cases, an important element for allowing such re-evaluation of goals and pursue continuous improvement was that the teams were constantly scanning the external environment for opportunities and threats. The role of the project leaders in incentivising such exercise was also fundamental in the three analysed cases.

In the first case, the opportunity to transform a housing project into a wider and complete programme led the team to review project goals and value proposition based on the opportunities given. The occurrence of unpredicted events also led the team to re-evaluate the entire scope of the project and agree to adapt accordingly, as an attempt to find better means to fulfil the project purpose. One mechanism that allowed the team to recognise threats regarding the realisation or not of expected results was the presence of social agents in close contact with the community, making it possible to gather information about aspects that were not working as expected during the implementation period. This was possible to observe because the programme was gradually implemented throughout the years.

In the second case, the opportunity to receive governmental funding for the creation of a major Trauma centre, led the project team to agree to take that opportunity and adjust the programme scope. Similarly,

in the third case, the opportunity of a partnership with another local healthcare service provider also resulted in changes in the project scope in the early planning phases. Later on, the emergence of unpredicted events that would influence the fulfilling of the project's strategic aims resulted in extensive re-evaluation of scope and agreeing to adapt project's goals accordingly.

In the second and third cases, an important aspect that enabled the project teams to re-evaluate project goals and review the adequacy of the means to achieve such goals was the engagement of the supply from the early stages of project development chain through a relational type of contract, incentivising them to pursue continuous improvement.

The contributions of such observations are that complex circumstances with emerging properties do not only offer threats to project management, but also opportunities to achieve better results. Sensing the circumstances and then acting upon them can allow project teams to take opportunities in the environment to both improve the project goals and the means (KURTZ; SNOWDEN, 2003).

7. CONCLUSIONS AND OPPORTUNITIES FOR FUTURE RESEARCH

This research was motivated by a practical problem with potential theoretical contributions. The problem in hand was the difficulty to generate value in complex construction projects. In order to find a solution for such problem, the first step was to understand the challenges that generating value from complex projects poses to project management. Then, find managerial practices that could contribute for improving project management and finally, revealing the underlying concepts of observed practices. Those concepts could then be used to develop new or improve existing managerial approaches to provide a better support for generating value from complex construction projects.

In order to understand the problem, empirical observation was carried out where it was identified. Such observation had the intent to understand why the team was facing difficulties to achieve the expected value of a programme that was designed focus on the generation of outcomes. Such study enabled the identification of a lack of proper support given by managerial approaches adopted in that case. Although such approaches might be suitable for some projects, they did not provide the appropriate support to deal with the myriad elements that should be arranged in the right sequence in order to generate the expected outcomes. A gap between programme design and programme implementation was observed. Design should have given a better support to the execution of actions taking into account their interdependency and how they should flow to generate expected results. The evaluation of the LFA, used in this programme and the programme´s delivery method enabled the observation that those practices did not provide the adequate support to deal with project complexity, the challenges of a dynamic environment and the need to refine project´s goals and means for obtaining these goals.

Alternative managerial approaches were identified as having potential contributions to better deal with the observed problems and improve managerial practices: the BeReal model (based on the BRA) and the LPDS. These approaches were found to provide different contributions to support value generation in complex projects. By analysing their adoption with empirical studies, it was also identified several practices that were used together and also provided contributions to value generation. It was possible to identify the particular role that the BeReal model and LPDS assumed in practice, which was shaped by contextual characteristics. As the BeReal model was adopted in a public infrastructure project, its main purpose was to provide accountability and support a participatory and transparent decision-making

process. Conversely, LPDS was adopted in a private initiative project and accountability is part of an approval process that happens outside the project context and its means established by external regulatory agencies. LPDS in that project assumed a role of establishing a clear process upon which the integrated team, with members from different backgrounds could relate and be effective. In this sense, the three analysed cases presented different contributions to improve project management towards improving value generated from projects. Nonetheless, it was observed that the underlying concepts identified in this research are rooted in different theoretical underpinnings, i.e. organisation studies and production science. Project management is a multidisciplinary field and whereas studies tend to advocate the adoption of one theoretical underpinning over the other, in this research, a combination of concepts from different disciplines was suggested. One observation was the interdependency among a well-defined managerial process (from production science) aligned with well-defined roles in a project coalition (from organisation studies), as a means for effective collaboration towards value generation.

Regarding the scope of design, it was expected to find a better integration of building design and services design, as these approaches were being introduced in healthcare facility projects. However, this was found to be still a limitation of current managerial practices adopted in construction, which emphasise the need to define the physical space and improve constructability over the need to better consider the interdependency between space and services to achieve expected outcomes.

The intent of this research was to devise a framework with instrumental knowledge for the development of managerial approaches. The concern was not with the actual application of scientific knowledge to solve a managerial problem, but with the development of scientific knowledge, at an abstract level, that can be used in the process of designing solutions to problems in the field in question. The constructs developed in this research should be utilised in the development of managerial approaches taken into consideration the particular characteristics of projects and contextual environment.

This research was however, limited to observing contributions to project management based on assumptions in the literature about how managerial practices can contribute for improving value generation. It was not in the scope of this research to measure the generation of value after project completion in order to evaluate if those practices result in increased value indeed. Along the development of this research, the observation of managerial practices revealed different constructs that can contribute towards developing approaches focused on value generation. Thus, the further analysis of these constructs is an opportunity for future research. This research identified a trend towards more collaborative projects and increased cooperation among stakeholders as means to improve value

generation. The impact of increased cooperation on value should be further investigated, as well as the desired conditions to create such environment.

It was also not in the scope of this research to generalise the findings beyond the context of the empirical studies. Thus, opportunities for future research include the development of formal theory, beyond the context that was considered in this research.

REFERENCES

AMERICAN INSTITUTE OF ARCHITECTS (AIA); UNIVERSITY OF MINNESOTA (UMN). **IPD Case Studies**. AIA Minesota, School of Architecture, UMN, 2012.

AMERICAN INSTITUTE of ARCHITECTS (AIA). **Integrated project delivery**: a guide. AIA California Council, 2007.

AKINCI B.; TANTISEVI K.; ERGEN E. Assessment of the capabilities of a commercial 4D CAD system to visualize equipment space requirements on construction sites. **Proceedings** of Construction Research Congresss, Honolulu, HI, 989-995, 2003.

ANSARI, S., J. BELL, J.CAM-I; TARGET COST CORE GROUP. **Target Costing**: The Next Frontier in Strategic Cost Management. Irwin, Chicago, 1997.

ASHURST, C., DOHERTY, N. F. Towards the formulation of 'a best practice' framework for benefits realisation in IT projects. **Electronic Journal of Information Systems Evaluation**, v.6**,** pp. 1-10, 2003.

ATKINSON R.; CRAWFORD L.; WARD, S. Fundamental uncertainties in projects and the scope of project management, **International Journal of Project Management**, v. 24, pp. 687–698, 2006.

AUSTRALIAN GOVERNMENT OVERSEAS AID PROGRAMME - AUSAID. **Ausguidelines:** The Logical Framework Approach. Canberra: Ausaid; 2000.

BACCARINI, D. The concept of project complexity—a review. **International Journal of Project Management**, v.14, pp. 201–204, 1996.

BALLARD, G. The Target Value Design: Current benchmark. **Lean Construction Journal**, pp.79-84, 2011.

BALLARD, G. The Lean Project Delivery System: An Update. **Lean Construction Journal**, pp.1-19, 2008. Retrieved from: www.leanconstruction.org in 28/07/2010.

BALLARD, G.; HAMMOND, J.; NICKERSON, R. Production control principles. **Proceedings** of the 17th annual conference of the International Group for Lean Construction, Taipei, Taiwan, July, 2009. Pp 489-500.

BALLARD, G.; HOWELL, G. Lean Project Management. **Building Research & Information**, 31(2), 119–133, 2003.

BALLARD, G.; HOWELL, G. Shielding Production: Essential Step in Production Control. **Journal of Construction Management & Engineering**, ASCE, New York, NY, 124 (1) 11-17. 1998.

BALLARD, G; HOWELL, G. Relational Contracting and Lean Construction. **Lean Construction Journal**, pp.1-19, 2005. Retrieved from: www.leanconstruction.org in 11/03/2012.

BALLARD, G; HOWELL, G. Competing construction management paradigms. **Lean Construction Journal**, vol 1 (1), October 2004. Retrieved from: www.leanconstruction.org in 20/11/2012.

BALLARD, G,; REISER, P. The St. Olaf College Fieldhouse Project: A Case Study in Designing to Target Cost. **Proceedings** of the 12th annual conference of the International Group for Lean Construction, Elsinore, Denmark, August, 2004.

BARTHOLOMEW, D. **Process is back**, Cleveland: Industry Week, 1999.

BARTLETT, J. **Managing programmes of business change** (4th ed.). Project Manager Today: Hampshire, UK. 2006.

BENEFITS REALISATION IN HEALTHCARE (BEREAL). The Benefits Realisation Model. Retrieved from: http://www.bereal.salford.ac.uk/N/model-process.htm in 05/10/2010.

BOLAND, R.; COLLOPY F. (Eds.) **Managing as Designing**. Stanford University Press, 2004.

BRADLEY, G. **Benefit Realisation Management** – A Practical guide to achieving benefits through change, Hampshire, UK, Gower, 2006.

BRADY T.; DAVIES A.; GANN D. M. Creating value by delivering integrated solutions. **International Journal of Project Management**, v. 23, pp. 360-365, 2005.

COLLEDGE, B. Relational contracting – creating value beyond the project. **Lean Construction Journal**, v.2, n.1, pp. 30-45, 2005.

COMMUNITY DEVELOPMENT RESOURCE ASSOCIATION. **Measuring Development**: Holding Infinity. Annual report, 2000/2001. Retrieved on 12/11/08 from: http://www.cdra.org.za/

CRAWFORD, L.; POLLACK, J. Hard and soft projects: a framework for analysis. **International Journal of Project Management**, v. 22, n. 8, 2004.

CRAWFORD, P.; BRYCE, P. Project monitoring and evaluation: a method for enhancing the efficiency and effectiveness of aid project implementation. **International Journal of Project Management** 21, 363–373, 2003.

CYERT, R. M.; MARCH, J. G. **A behavioural theory of the firm.** Upper Saddle River, NJ: Prentice Hall, 1963.

DEPARTMENT OF TREASURY AND FINANCE (DTF). **The Practitioners Guide to Aliance Contracting**. DTF: State of Victoria, 2010.

DUPUIT, J. *De la measure de l'utilite des travaux publiques. Annales des ponts et Chaussees, 2nd series, 8.* Reprinted in translation. On the measurement of the unitility of public works, in: **International economic papers**, 2: 83-110, 1952.

DURLAUF, N.S.; BLUME, L. E. (Eds) **The New Palgrave Dictionary of Economics**, Second Edition, 2008 Palgrave Macmillan, 2008. Retrieved from http://www.dictionaryofeconomics.com/article?id=pde2008_E000200. Accessed in 06/06/12.

EASTMAN, C. M.; TEICHOLZ, P.; SACKS, R.; LISTON, K. **BIM handbook**: A guide to building information modeling for owners, managers, architects, engineers, contractors, and fabricators, Wiley, Hoboken, N.J., 2008.

EMMITT, S.; GORSE, C. Communication in construction teams. Spon research, Taylor & Francis, Abingdon, Oxon, UK, 2007.

EMMITT, S.; CHRISTOFFERSEN, A. K. **Collaboration and Communication in the Design Chain**: a value-based approach. In: O'BRIEN W. J.; FORMOSO C. T., VRIJHOEF R.; LONDON K. A. (Eds). Construction Supply Chain Management Handbook; 2009. 508 p.

EUROPEAN COMMISSION. **Project Cycle Management Handbook,** version 2.0. March 2002.

FARBEY, B., LAND, F. & TARGETT, D. The moving staircase – problems of appraisal and evaluation in a turbulent environment. **Information Technology and People Journal***,* 12**,** 238-252, 1999.

FORGUES D.; KOSKELA, L. The influence of a collaborative procurement approach using integrated design in construction on project team performance. **International Journal of Managing Projects in Business**, Vol. 2 (3), pp. 370-385, 2009.

FORGUES, D. Using Boundary Objects to Generate Better Value in the Construction Industry. **PhD dissertation**. School of the Built Environment, University of Salford, Salford, 2008.

FOX, S. Evaluating potential investments in new technologies: Balancing assessments of potential benefits with assessments of potential disbenefits, reliability and utilization. **Critical Perspective on Accounting,** 2008.

GANAH A.A.; BOUCHLAGHEM N. M.; ANUMBA C. J. VISCON: Computer visualization support for constructability. Journal of information technology in construction: special issue: from 3D to nD modeling. Vol 10, 69-83, 2005.

GANN, D.M., SALTER, A.J.; WHYTE, J.K. The Design Quality Indicator as a tool for thinking, **Building Research and Information**, v. 31, n. 5, pp. 318-333, 2003.

GLASER, B. G.; STRAUSS, A. L. **The discovery of grounded theory**: Strategies for qualitative research. Hawthorne, NY: Aldine de Gruyter. 1967.

GLYNNE, P. Benefits management-changing the focus of delivery. **Association for Progress Management Yearbook** 2006/07, pp.45-49, 2006.

GRANT, H. H. **Logical Framework (Logframe) Methodology**: a practical approach. The Project Development Institute, 2007. Retrived on 05/01/10 from: http://www.izmirab.gov.tr/WEB/documents/kutuphane/LOGFRAME.pdf

HANEMANN, W.H. the economic conception of water, In: **water crisis: myth or reality?** Eds. P.p. rogers, m.r. llamas, l. Martinez-cortina, taylor & francis plc., london, 2006.

HOLMSTROM, J.; KETOKIVI, M.; HAMERI, A.-P. Bridging Practice and Theory: A Design Science Approach. **Decision Sciences,** v. 40, n. 1, p. 65-87, 2009.

IRANI, Z.; SHARIF, A.M.; LOVE, P.E.D. Transforming failure into success through organisational learning: an analysis of a manufacturing information system. European Journal of Information Systems, v. 10, pp. 55-66, 2001.

JACKSON B. **Designing Projects And Project Evaluations Using The Logical Framework Approach**. Iucn; 2001.

JONES, R. E.; DECKRO, R. F. The social psychology of project management conflict. **European Journal of Operational Research**, v.64, pp. 216–228, 1993.

JOHNSON T. H. A former management accountant reflects on his journey through the world of cost management. **Accounting History** Vol 7, No 1, 2002.

KATO, Y. Target costing support systems: lessons from leading Japanese companies, management accounting research, 4, pp. 33-47, 1993.

KIPPENBERGER, T. Managing the business benefits. **The Antidote from CSBS**, issue 27, pp. 28-29, 2000.

FORGUES D.; KOSKELA, L. Can procurement affect design performance? **Journal of Construction Procurement**, Vol. 14 (2), pp. 130-141, 2008.

FORGUES D.; KOSKELA, L. The influence of a collaborative procurement approach using integrated design in construction on project team performance. **International Journal of Managing Projects in Business**, Vol. 2 (3), pp. 370-385, 2009.

KOSKELA, L. J. Which Kind of Science is Construction Management?, **Proceedings** of the 16th Annual Conference of the International Group for Lean Construction, Manchester, UK, 16-18 July 2008. TZORTZOPOULOS-FAZENDA, P.; KAGIOGLOU, M. (Ed.), University of Salford, Manchester, UK, pp.51-60, 2008.

KOSKELA, L. J.; HOWELL, G. The underlying theory of project management is obsolete. **Proceedings** of the Project Management Institute Research Conference, Seatle, 2002.

KOSKELA, L. J. **An exploration towards a production theory and its application to construction.** Espoo, VTT Building Technology. 296 p. VTT Publications; 408, 2000. Retrieved from: http://www.inf.vtt.fi/pdf/publications/2000/P408.pdf

KOSKELA, L. J.; BALLARD, G. Should project management be based on theories of economic or production? **Building Research & Information**, v. 32, n. 2, pp. 154-163, 2006.

KOSKELA, L. J.; HOWELL, G. Reforming project management: The role of planning, execution and controlling. **Proceedings** of the 9th International Group for Lean Construction Conference. Kent Ridge Crescent, Singapore, 6 - 8 August 2001. CHUA, D.; BALLARD, G. (eds.). National University of Singapore, pp. 185-198, 2001.

KOSKELA, L. J.; KAGIOGLOU, M. On the Metaphysics of Production. **Proceedings** of the13th International Group for Lean Construction Conference (IGLC 13), Sydney, 2005.

KOSKELA, L. J.; KAGIOGLOU, M. The Proto-theory of Design: the Method of Analysis of the Ancient Geometers. **Strojarstvo,** v.49, n.1, pp.45—52, 2007.

KOSKELA, L., HOWELL, G.; LICHTIG, W. Contracts and production, In: **Symposium on Sustainability and Value through Construction Procurement**, CIBW92 Procurement Systems, CIBW, Salford, 2006.

KOSKELA L.; TOMMELEIN, I. The economic theory of production conceals opportunities for sustainability improvement. **Proceedings** for the 17th Annual Conference of the International Group for Lean Construction, 2009.

KOSKINEN, K.; MAKINEN, S. Role of boundary objects in negotiations of project contracts, **International Journal of Project Management**, Vol. 27, pp. 31-8, 2009.

KRUTILLA, J.V. Conservation reconsidered. American economic review, 57: 787-796, 1967.

KURTZ, C.F.; SNOWDEN, D.J., 2003, The new dynamics of strategy: sense-making in a complex and complicated world, in **IBM Systems Journal**, 42(3), 462–483, 2003.

LAHDENPERA P. Making sense of the multi-party contractual arrangements of project partnering, project alliancing and integrated project delivery. **Construction Management and Economics** 30, pp.57-79, 2012.

LEVITT, T. Marketing Myopia, **Harvard Business Review**, July-August, pp. 45-56, 1960.

LEYTON, R. Investment appraisal: the key for IT? IN FARBEY, B., LAND, F., F. & TARGET, D. (Eds.) **Hard Money, Soft Outcomes**. Henley on Thames, Alfred Waller Ltd, in association with Unicom, 1995.

LICHTIG, W.A. Sutter health: developing a contracting model to support lean project delivery. **Lean construction journal**, 2 (1) 105-112, 2005.

LICHTIG, W. The Integrated Agreement for Lean Project Delivery. **Construction Lawyer**, v.26, n.3, pp. 1-8, American Bar Association, summer 2006.

LIN, C.; PERVAN, G. A review of IS/IT investment evaluation and benefits management issues, problems and processes, pp. 2-24. In: GREMBERGEN, W., V. **Information technology evaluation methods & management.** London: Idea Group Publishing**,** 2001.

MACOMBER, H.; HOWELL, G.; BARBERIO, J. **Target-Value Design**: nine foundational practices for delivering surprising client value. The American Institute of Architects (AIA), 2007. Retrieved on 26/08/2010 from: http://www.aia.org/nwsltr_print.cfm?pagename=pm_a_112007_targetvaluedesign

MARCH, J. G.; SIMON, H. A. **Organisations.** Oxford: Basil Blackwell, 1958.

MARCH, S. T.; SMITH, G. F. Design and natural science research on information technology. **Decision support systems**, v. 15, p. 251-266, 1995.

MARSHALL, A. **The pure theory of (domestic) values**. London School of Economics, UK, 1879.

MATTHEWS, O. **Integrated project delivery**: a collaborative process. Westbrook management coorporation (internal document), 2001.

MATTHEWS, O.; HOWELL, G. A. Integrated project delivery – an example of relational contracting. **Lean Construction Journal**, v.2, n.1, pp. 46-61, 2005.

MAYLOR H.; BRADY, T. B.; COOKE-DAVIES, T. C.; HODGSON, D. From projectification to programmification. **International Journal of Project Management,** v.24, pp. 663–674, 2006.

MILLER R.; HOBBS, B. Governance regimes for large complex projects. **Project Management Journal**, September, 2005. Project Management Institute: vol. 36, no. 3, 42-50, 2005.

MIRON, L.I.G. Gerenciamento dos requisitos dos clientes de empreendimentos habitacionais de interesse social: proposta para o programa integrado entrada da cidade em Porto Alegre/RS. 2008. **Tese** (Doutorado em Engenharia) – Escola de Engenharia, Programa de Pós-Graduação em Engenharia Civil, UFRGS, Porto Alegre.

MONROE, Kent B. **Pricing:** making profitable decisions. New York: McGraw-Hill, 1990. 502 p.

MORGAN, J. M., AND LIKER, J. K.. **The Toyota Product Development System**: Integrating People, Process, and Technology, Productivity Press, New York, NY, 377 pp., pp. 274, 2006.

NATIONAL HEALTH SERVICE - NHS (2005), **Delivering Quality and Value**: The ISIP Guide to Strategy and Benefits. Retrieved on 10/08/09 from: http://www.isip.nhs.uk/library/archive/strategyandbenefits/ISIP_strategy_and_benefits_overview.pdf

NICOLINI, D.; TOMPKINS, C.; HOLTI, R.; OLDMAN, A.; SMALLEY, M. Can Target Costing and Whole Life Costing be Applied in the Construction Industry?": Evidence from Two Case Studies. **British Journal of Management***,* Vol. 11. 2000.

NOGESTE, K. Developement of a method to improve the definition and alignment of intangible project outcomes with tangible project outputs. **School of Business**. RMIT, 2006.

OFFICE of GOVERNMENT COMMERCE. **Managing Successful Programmes (MSP)**. London: The Stationery Office, 2007.

PARISH, K. D. Applying a set-based design approach to reinforcing steel design. **PhD Dissertation**. Civil and Environmental Engineering, University of California, Berkeley, 2009.

PAWSON, R.; TILLEY, N. **Realistic Evaluation.** London: Sage, 1997.

PAYNE, M. **Benefits Management** – Releasing project value into the business. Project Manager Today, Hampshire, UK , 2007.

PEARCE, D. **The Social and Economic Value of Construction**: The Construction Industry's Contribution to Sustainable Development, London: nCRISP, 2003.

PEARCE, D. Is the construction sector sustainable? Definitions and reflections. **Building Research and Information**, 34(3), 201-207, 2006.

PELLEGRINELLI, S., *et al*. The importance of context in programme management: An empirical review of programme practices **International Journal of Project Management***,* 41-55, 2007.

PREFEITURA MUNICIPAL DE PORTO ALEGRE (PMPA). **Plano diretor de desenvolvimento urbano e ambiental.** Porto Alegre: PMPA/SPM, 1999.

PREFEITURA MUNICIPAL DE PORTO ALEGRE (PMPA). **Programa Integrado Entrada da Cidade.** Caderno 1 Marco de Referência e descrição do Programa. Fundo financeiro para o desenvolvimento da bacia do plata. Porto Alegre: PMPA, 2002.

REISS, G., ANTHONY, M., CHAPMAN, J., LEIGH, G., PYNE, A., RAYNER, P. **Gower Handbook of programme management,** Gower Publishing: Hampshire, UK, 2006. 712p.

REMENYI, D.; SHERWOOD-SMITH, M. Business benefits from information systems through an active benefits realisation programme. **International Journal of Project Management**, v.16, pp. 81-98, 1998.

ROOKE J. A.; SAPOUNTZIS, S.; KOSKELA, L. J.; CODINHOTO, R.; KAGIOGLOU, M. Lean Project Management and the Problem of Value. **Proceedings** of the 18th International Group for Lean Construction Conference. Haifa, Israel, 14 - 16 July 2010. WALSH, K.; ALVES, T. (Eds.). Technion Israel Institute of Technology, pp. 581-590, 2010.

ROSSI-HANSBERG, E.; SARTE, P.; OWENS II, R. Housing externalities. National bureau of economic research (NBER), **working paper series**. NBER, 2008.

SAPOUNTZIS, S.; HARRIS, K.; KAGIOGLOU, M. **Benefits Management and Benefits Realisation, a Literature Report.** HaCIRIC, april 2008, 73p.

SAPOUNTZIS, S.; YATES, K.; LIMA J. B.; KAGIOGLOU, M. Benefits Realisation: Planning and Evaluating Healthcare Infrastructures and Services. In: TZORTZOPOULOS, P.; KAGIOGLOU, M. (Eds.) **Improving Healthcare through Built Environment Infrastructure.** Oxford UK: Blackwell Publishing, 2010.

SAVAYA, R.; WAYSMAN, M. The Logic Model: a tool for incorporating theory in development and evaluation of programs. **Administration in Social Work**, 29:2, 85-103, 2005.

SAXON, R. **Be Valuable**: A Guide to Value in the Built Environment. Constructing Excellence, London, 2005.

SCHÖN, D. A. **The Reflective Practitioner**: How Professionals Think in Action, Arena, Aldershot, 1991.

SCOTT, R. W.; DAVIES, G. F. **Organisations and Organising**: rational, natural and open system perspectives. Pearson education, New Jersey, 2007.

SEDERA, D.; ROSEMANN, M.; GABLE, M. **Using performance measurement models for benefit realisation with enterprise systems** - the Queensland government approach (case study), 2001.

SHEWHART, W.A. Economic Control of Quality of Manufactured Product. Van Nostrand, New York. 501 p., 1931.

SHOOK, J. **Managing to Learn**: using the A3 management process to solve problems, Gain Agreement, Mentor & Lead, Lean Enterprise Institute, Cambridge, MA, 2008.

SIMON, H. A. **Administrative behavior**: a study of decision-making processes in administrative organizations (4th ed.). NY: Free press, 1997.

SIMON, H. A. **The sciences of the artificial** (2nd ed.). The Massachussets Institute of Technology, 1981.

SNOWDEN, D. J.; BOONE, M. E. A Leader's Framework for Decision Making. **Harvard Business Review**, November, 2007.

SOBEK II, D. K., WARD, A.; LIKER, J. K. Toyota's principles of set-based concurrrent engineering. **Sloan management review**, 40(2), 67-83, 1999.

SUHR, J. **The choosing by advantages decision-making system**, Quorum, Westport, CT, 1999.

THIRY, M. Combining value and project management into an effective programme management model. **International Journal of Project Management**, v.20, n.3, pp.221-228, 2002.

THOMPSON, J. D. **Organisations in Action**. New York: McGraw-Hill, 1967.

THOMSEN, C.; DARRINGTON, J.; DUNNE, D.; LICHTIG, W. **Managing Integrated Project Delivery**. CMAA, US, 2009.

THOMSON, D. S.; AUSTIN, S. A. ROOT, D. S.; THORPE, A.; HAMMOND, J. W. A problem-solving approach to value-adding decision making in construction design. **Engineering construction and architectural management**, 13(1), 43-61, 2006.

THORP, J.. **The Information Paradox.** E-book version, 2007. Retrieved on 01/07/2009 from: http://www.fujitsu.com/ca/en/news/publications/books/ip.html.

THORP, J. **The Information Paradox**: realising the business benefits of information technology, Toronto, Canada, McGraw-Hill, 1998.

TURNER, J.R.; COCHRANE, R.A. Goals-and-methods matrix: coping with projects with ill-defined goals and/or methods of achieving them. **International Journal of Project Management** v.11, pp. 93–102, 1993.

VAN AKEN, J.E. Management research based on the paradigm of the design sciences: the quest for field-tested and grounded technological rules. **Journal of Management Studies**, v.41, n.2, pp.219–46, 2004.

VOORDIJK,H. Construction management and economics: the epistemology of a multidisciplinary design science. **Construction Management and Economics**, v.27, pp.713–720, august 2009.

WARD, A., LIKER, J. K., CRISTIANO, J. J.; SOBEK II, D. K. The Second Toyota Paradox: How Delaying Decisions Can Make Better Cars Faster. **Sloan Management Review**, 36(3), 43 – 61, 1995.

WARD, J., TAYLOR, P., BOND, P. Evaluation and realization of IS/IT benefits: an empirical study of current practice. **European Journal of Information Systems**, v. 4**,** pp. 214–225, 1996.

WARD, J.; DANIEL, E. **Benefits Management** – Delivering Value from IS & IT Investments, Wiley: West Sussex UK, 2006.

WEGGE, T. C.; HANEMANN, W. M.; LOOMIS, J. Comparing benefits and costs of water resource allocation policies for California's Mono Basin. **Economic institutions and increasing water**,1996.

WEISBROD, B.A. Collective consumption services of individual-consumption goods. **Quarterly journal of economics,** 78(3): 471-477, 1964.

WHELTON, M. G. The Development of Purpose in the Project Definition Phase of Construction Projects - Implications for Project Management. **Thesis**, Civil and Environmental Engineering Department, University of California, Berkeley, 2004, 336 p.

WILLIAMS, T. **Modelling Complex Projects.** Chichester: John Wiley & Sons, 2002.

WINCH, G. Towards a theory of construction as production by projects. **Building Research & Information**, 34(2), 164–174, 2006.

WINCH, G., COURTNEY, R. AND ALLEN, S. Re-valuing construction. **Building Research & Information**, 31(2), 82–84, 2003.

WINTER M.; SZCZEPANEK,T. **Images of Projects.** Surrey, UK: Gower publishing, 2010.

WINTER M.; SZCZEPANEK,T. Projects and programmes as value creation processes: a new perspective and some practical implications. **International Journal of Project Management,** v. 26, pp. 95–103, 2008.

WINTER, M.; SMITH, C.; MORRIS, P.; CICMIL, S. Directions for Future Research in Project Management: The Main Findings of UK government-funded research network. **International Journal of Project Management**, v. 24, n.8, pp. 638-649, 2006.

WOMACK, J. P. D.; JONES, D.T **Lean Thinking.** New York: Simon & Schuster, 1996.

WOODRUFF, R. B. Customer Value: the next source of competitive advantage. **Academy of Marketing Science Journal**. Spring 1997; 25, 2; ABI/INROFM Global. p 139-153, 1997.

THE WORLD BANK. **What is governance?** Arriving at a common understanding of “governance”. Retrieved from: http://go.worldbank.org/g2chlxx0q0, Accessed in: 11/23/2012.

ZWIKAEL, O., SMYRK, J. R. **Project management for the creation of organisational value**. London: Springer, 2011.

ZWIKAEL, O.; SMYRK J. R. Towards an Outcome Based Project Management. Theory. **In:** proceedings of the 2009 IEEE IEEM, 633-637, 2009.

APPENDICES - Interview protocols

APENDIX A – Interview Protocol for CASE 1

NORIE	**Interview protocol** **CITY ENTRANCE INTEGRATED PROGRAMME – PIEC** Porto Alegre City Council	2008

1. What are the main difficulties that you face during project's implementation/execution?
2. Does your department have any characteristic that could represent a difficulty for executing the planned activities?
3. What are the problems/contingencies that you are facing the project's implementation? How were they being solved?
4. What have been the bottle-necks in the project's implementation process?
5. How the organisational structure of your department and existing capabilities facilitate for the project implementation?
6. What are the benefits being gained from participating on this programme? Does the participation affects your department's internal procedures and routines?
7. How are you dealing with the need to work together with other departments/agents to deliver the expected project result?

APENDIX B – Interview Protocol for CASE 2

HaCIRIC	**Interview protocol** **TERTIARY, TRAUMA and TEACHING (3Ts) PROGRAMME** Brighton and Sussex University Hospital (BSUH) – NHS	2011
General contextualisation		
1. How is the project organised?		
2. What is your role in the programme?		
3. Since when are you involved in the programme?		
4. What activities are you involved in?		
5. What is the current state of the development?		
Perception regarding stakeholder engagement, collaboration, learning and improvement		
6. How are the interests of key stakeholders taken through the project?		
7. Are there discussions to challenge and improve how things are done (and to achieve better results)?		
8. How do stakeholders (services providers, architects, the contractor) contribute for improving the results?		
9. What are the advantages and disadvantages of having an earlier involvement of the suppliers?		
Perception regarding benefits realisation		
10. What is your understanding of a benefits realisation process?		
11. What is your expectations regarding its outcomes?		
12. What have been the contributions of the BeReal for the 3T programme?		
13. What do you think are the main challenges and facilitators for adopting a BR approach?		
14. How do you think it could be improved for the next project?		
Perception regarding the challenges to generate value in general		
15. What are the main challenges for generating the expected value in a complex programme like the 3T?		

APENDIX C – Interview Protocol for CASE 3

	Interview protocol **SAN CARLOS CENTRE - SCC** Palo Alto Medical Foundation (PAMF) and Sutter Health	2012

General contextualisation
1. What is your role in the project?
2. Since when are you involved in the project?
3. What activities are you involved in?
Perception regarding stakeholder engagement, collaboration, learning and improvement
4. How are the interests of key stakeholders taken through the project?
5. How do stakeholders (trade partners, architects, the contractor) contribute for improving the results?
6. What are the advantages and disadvantages of having an earlier involvement of the suppliers?
Perception regarding benefits realisation
7. What is your understanding of LPDS?
8. What is your expectations regarding its outcomes?
9. What have been the contributions of LPDS to the project?
10. What have been the difficulties for implementing LPDS?
11. How do you think it could be improved?
Perception regarding the challenges to generate value in general
12. What are the main challenges for generating the expected value in the SCC?
13. What are the strategies adopted to make sure design follows strategic intent?