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Application of Theory of Constraints concepts and Lean tools as an innovative approach to the Timor-Leste public procurement process

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ABSTRACT

At a time when public resources are very limited and while demand for better services is continuously increasing, the public procurement function can have clear benefits from 'doing more with less'. This thesis has sought to explore the mechanisms and practices that inhibit the ability of the Timor-Leste procurement (TLS-P) services to make better use of available resources. It also sought to investigate the viability of usage of the Theory of Constraints concepts and Lean tools (TOC-L) towards ongoing improvement processes within such a system.

The Theory of Constraints (TOC) concepts and Lean tools have been developed and intensively used within profit organisations: especially in production and distribution systems, in addition to service industries, such as health care services. Although applications of the Theory of Constraints concepts and Lean have been successful within the service sector, the literature is predominantly reporting cases where the concepts were applied separately, rather than as an integrated concept and the researcher has not identified any literature that discusses the application of both concepts within a public procurement process.

This study demonstrates that TOC-L can provide TLS-P services with a systematic framework for identifying problems that limit their ability to maximise budget execution effectiveness. The TOC analysis shows several policies and practices exist within the TLS-P which, whilst seeming to be intuitively logical and efficient for each agency, actually tend to focus these agencies on sub-optimal local performance. This approach means that the system's agencies do not have a clear agreement to coordinate and synchronise their activities, measurements and schedules —and therefore, budget execution effectiveness suffers in this situation. The results of the analysis suggest that all agencies must realign their local performance focus to one of a system-wide performance, in order to achieve desired benefits.

In order to facilitate this realignment, the researcher proposes a modification of the drum-buffer-rope methods for goods and services into a hybrid model, which can work for the TLS-P dynamic environment. This 'Dynamic-DBR'

(DBR_D) model provides the system with the ability to adjust capacity resources to meet service levels and due dates. The aim of this DBR_D is to fill the gap in the literature of reported adaptations of drum-buffer-rope methods, in order to suit the synchronisation of scheduling within public procurement processes.

The study also develops recommendations for the improvement of this approach, which is intended to facilitate future research.

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Mr. Wright taught me how to use the TOC and Lean for supply chain optimisation and for ongoing improvement of processes within production and distribution systems. He stimulated my thinking and interest on how both concepts could be applied to the public sector — and especially to improve the TLS-P process. His ability to provide scientific freedom and encouragement to find my own way, together with his offered guidance and feedback has added considerable value to the quality of this writing. Dr. Norman Marr deserves special recognition for his role in showing me how to use research methods in supply chain management, in addition to providing valuable feedback on both the structure and quality of the writing in this thesis and their valued contribution has raised the level of this thesis.

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LIST OF ABBREVIATIONS

ADN	Agencia Decevolvimento Nacional (National Development Agency)
BoQ	Bill of Quantity
C/O	Change Over
CAFI	Conselho Administrasaun das Fundus da Infratructure (Council of Administration for Infrastructure Funds)
CCR	Capacity Constraint Resources
CM	Capacity Management
CNE	Commisariado Nasional das Elecoens (National Election Commission)
CoM	Council of Ministry
CPV	Cashier Payment Voucher
CRD	Conflict Resolution Diagram
EC	Evaporating Cloud
CRT	Current Reality Tree
CS-VSM	Current State Value Stream Map
DBR	Drum-Buffer-Rope
DBR_S	Drum-Buffer-Rope for services
DEs	Desirable Effects
EC	Evaporating Cloud
FCFS	First Come First Serve
FRT	Future Reality Tree
FS-VSM	Future State Value Stream Map
GoTL	Government of Timor-Leste
I_a	Active Inventory
IO	Intermediate Objective
I_p	Passive Inventory
L/T	Lead Time
LMs	Line Ministries
MDGs Suco	Millennium Development Goals Sucos
MoF	Ministry of Finance
MPS	Major Project Secretariat
NPC	National Procurement Commission
NVA	Non-Value Added
OE	Operation Expenses
P/T	Processing Time
PDD	Pakote Desenvolvimento Decentralizado (Decentralization Development Package)
PO	Purchase Order
PPP	Public-Private-Partnership
PR	Purchase Requisition
PRT	Prerequisite Tree
SBD	Standard Bidding Document

SLA_Q	Service Level Agreements quality
SLAs	Service Level Agreements
SLA_T	Service Level Agreements cycle time
SLA_U	Service Level Agreements utilization
SPP	Strategic Procurement Plan
STA	Secretariado Tekniko do Approvisionamento (Procurement Technical Secretariat)
T	Throughput
TLS-P	Timor-Leste Procurement
TLS-P EC	Timor-Leste-Procurement Evaporating Cloud
TLS-P CRT	Timor-Leste-Procurement Current Reality Tree
TLS-P FRT	Timor-Leste-Procurement Future Reality Tree
TLS-P PRT	Timor-Leste-Procurement Prerequisite Tree
TOC	Theory of Constraints
TOC-FS	Theory of Constraints – Five Steps Focus
TOC-L	Theory of Constraints and Lean
TOC-TP	Theory of Constraints – Thinking Process
TP	Thinking Process
TSDP	Timor-Leste Strategic Development Plan
TT	Transition Tree
UDEs	Undesirable Effects
VSM	Value Stream Map
WIP	Work-In-Progress

CHAPTER 1 – INTRODUCTION

1.1. Introduction

This research report discusses a case study application of the Theory of Constraints and Lean approaches to the analysis and improvement of the Government of Timor-Leste's public procurement processes. This first chapter introduces the background to the case and the reasons for conducting this research. It includes definitions of the research questions; the scope and research limitations; the theoretical framework related to the topic; the significance of the contribution of this research; and the thesis layout.

1.2. Background of the Case Study

"Every improvement is a change, but every change is not an improvement" (Scheinkopf, 1999, p. 4).

According to a review of the Timor-Leste Procurement Process (TLS-P) by Blunt (2010), from 2009 to 2010, the TLS-P activities represent 70% of the annual Government budget. The basic procurement law (Timor-Leste, 2005a), which prescribes how individual elements of the procurement process should be conducted, have gone through several amendments. These changes have included the establishment of the Procurement Commission and the Procurement Technical Secretariat (STA) (Timor-Leste, 2010a), which was later abolished and replaced by the National Procurement Commission (NPC) (Timor-Leste, 2011b) and the National Development Agencies (ADN) (Timor-Leste, 2011a).

A further complicating factor, however, is that existing procurement institutions, under the Ministry of Finance (Timor-Leste, 2005a), also have some involvement in the development of procurement policy. The Ministry provides advice on a range of public procurement issues and this situation causes confusion, since the Government's approach appears to lack consistency. As a result, policy development and its implementation are

weak and they have created unnecessary duplication of procurement activities.

There are also conflict of interest issues throughout the stages of the procurement process (Deloitte, 2008). The link between the budget and procurement planning is weak. An effective plan should inform the resources required for the effective and efficient delivery of procurement activities. The absence of a detailed procurement plan may, therefore, have contributed to delays in project execution and led to poor Government budget execution (Blunt, 2010).

1.3. Research Objective

The objective of this research is to apply the Theory of Constraints and Lean (TOC-L) concepts to the TLS-P process, in order to leverage benefits and develop continuous system improvement. In order to achieve this objective, the researcher seeks to investigate the current procurement system in order to understand the following:

- How does the system work?
- What are the constraints in the system that limit the throughput value and why?

Answers to the above questions will provide in-depth information about the flow of the process at each stage of the TLS-P procurement cycle, thus enabling the researcher to identify answers to the following research questions:

- How can the system be improved?
- Can TOC-L help towards system improvement?

1.4. Scope and Limitation of Research

Due to time and budget constraints, the scope of this research focuses on the process flow at each stage of the TLS-P process and it is limited to procurement activity within the National Procurement Commission (Timor-Leste, 2011b) and the National Development Agency (Timor-Leste, 2011a).

1.5. Significance of the Research

Although the implementation of TOC and Lean concepts has been successfully applied to 'for-profit' organisations and well-documented, there is scarce information about the application of these concepts within services. According to Ricketts (2008), this is because services are highly intangible, reusable and dynamic. Although Reid (2007) and Schiele and McCue (2010) have discussed successful applications of TOC and Lean concepts in the services sector, both concepts have been applied individually, rather than as an integrated concept and no literature has been found that discusses the application of TOC-L within the public procurement process.

Therefore, this research seeks to overcome this shortcoming and it will provide a significant contribution to current knowledge on the integration of TOC and Lean principles within the public sector. Applying TOC-L as an innovative approach to the TLS-P, within the government sector, can provide significant improvement for the Government of Timor-Leste's procurement process, thus producing a high quality of services with the lowest possible cost, which will then deliver higher value to its customers.

1.6. Theoretical Framework

The primary objective of public sector procurement is the best value for money: "the total life cycle costing and quality based on customer requirement" (Loader, 2008). This means providing the best quality of goods or services at the lowest possible cost during their lifetime. This is in line with

TOC and Lean philosophy, which emphasizes high customer satisfaction (value) through waste elimination and continuous improvement.

Figure 2.1 shows that the Timor-Leste public procurement system is comprised of sequential processes, which are interdependent. This is an interesting issue because it is aligned with the TOC principle, which sees a system as chains of dependent links. TOC also claims that every system always has a constraint that limits the system performing at its maximum efficiency. Therefore, continuous improvement should be focused on this constraint.

Although Lean tools and TOC concepts are highly regarded in business organisations, attempts to generate comparable gains for the government sector are seldom documented in published literature. Loader (2008) suggests that the Lean approach is well suited to systems with high volume and repetitive tasks in sequential flows, with a minimised structure of management that allows empowerment and engagement of the workers. It is suggested that combining the Lean approach with TOC could provide significant improvements in effectiveness, in a wider variety of system types. Therefore, this research mainly focuses on TOC concepts and Lean tools as the theoretical framework for data collection, analysis and discussion, in order to answer the research questions.

1.7. Thesis Outline

The structure of this thesis consists of five chapters in the following order:

Chapter One – Introduction: This chapter introduces the background of the case study and the reasons for conducting the research. This includes the research questions; the scope and limitations; the theoretical framework related to the topic; the significance of the contribution of the research; and the thesis layout.

Chapter Two - Literature Review: This chapter discusses the most relevant literature from the existing body of knowledge that relates to the topic, which

will help to clarify and refine the focus, in addition to the research questions to be addressed. The discussion focuses on Lean principles and the Theory of Constraints' concepts, as being the theoretical frameworks to answer the research questions.

Chapter Three - Research Methodology and Design: This third chapter provides details about the chosen research methodology and the methods used to address each question, in addition to arguments behind the selected methodology and methods.

Chapter Four – This chapter analyses the data collected, in relation to the research questions. The discussion includes the significant findings and interpretations, based on the results of data analysis. The chapter is comprised of the following:

- Section 4.2: This section discusses how the TLS-P process works and what the problems (UDEs) are which prevent the system from improving information flow between agencies, at each stage of the procurement processes. This section answers the first research question.

- Section 4.3: The purpose of this section is to identify the constraints/core problem/s in the TLS-P system, by using a Current Reality Tree (CRT) to find the answer to the question “What to change?” and the use of a Evaporating Cloud (EC) to identify why such a constraints/core problem/s exists in the system. This section answers the second research question.

- Section 4.4: This section discusses details on how to apply the EC, FRT and PRT towards system improvement. Firstly, the EC is used to find the best possible injection (win-win solution), in order to break the conflict cloud that causes a dilemma within TLS-P systems. Later, this injection is used in the FRT to change UDEs to DEs, in order to answer the third and fourth research questions: “How the system can be improved?” and “Can TOC-L help towards system improvement?”

Chapter Five – Conclusion: Limitations and recommendations for further research. This chapter sums up advances in knowledge that have emerged from the study, with reflections on the research undertaken and its limitations, in addition to an outlook towards future research. This includes a comparison between the outcomes and objectives that the researcher set out to accomplish. This chapter closes with recommendations for further research.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

This chapter discusses the findings of a literature review that relates to the topic. The aim to help clarify and refine the focus: and the research questions to be addressed. This research focuses on how the Theory of Constraints and Lean methodology can be used to identify the core problem and thus find a solution to improve the Timor-Leste public procurement improvement process. Therefore, this literature review covers the following sections:

- Section 2.2 discusses public procurement and focuses on the Timor-Leste procurement process.
- Section 2.3 discusses existing literature on the application of TOC and Lean methodologies within the service sector.
- Section 2.4 discusses the Theory of Constraints (TOC) concepts and measurement system, which is used as a conceptual framework to analyse and find a solution to improve the procurement process.
- Section 2.5 discuses appropriate Lean tools which can help the TOC in regards to the process of continuous improvement.
- Section 2.6 discuses the compatibility of the TOC and Lean approach to the process of ongoing improvement.
- Section 2.7 discusses potential contradictions between the TOC and Lean.
- Section 2.8 is the conclusion of the literature review.

2.1.1. Public Procurement

In both the public and private sectors, the procurement job/responsibility is to acquire the best possible goods, services or works, on time, at acceptable quality and at the lowest possible cost. However, despite their similarities, public procurement is quite different to procurement within the private sector. According to the World Bank (2008), public procurement is the process of acquiring goods, services or works on time and at acceptable quality and

cost, in order to support government strategy and policy for public well-being. This process must be conducted with the following:

- Transparency: the ability of all interested participants to know and understand the actual means and processes by which contracts are awarded and managed. This implies equal opportunities for all bidders and a clear process.
- Integrity: to do what it is promised to do and to avoid improper, wasteful, corruption and fraudulent practices.
- Accountability: when procuring for public entities, their officers must be accountable for their decisions and actions.

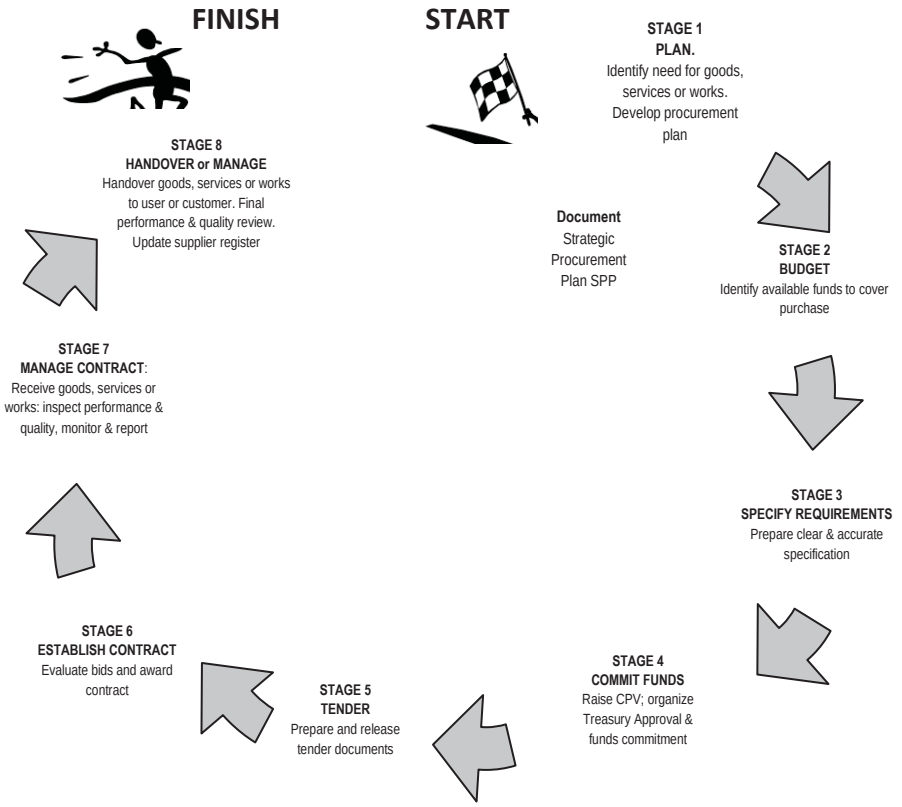
The purpose of public procurement is to protect companies from unfair competition and to avoid corruption and bribery (Ohashi, 2009). The result is often that the formal requirements become quite an extensive and lengthy process. These requirements of government have transformed the role and complexity of public administration, and the regulation of procurement (Schapper & Malta, 2011).

Public procurement processes are different between countries in the way they are organised and operated: and also in terms of their stage of development. This research focuses on the Timor-Leste public procurement (TLS-P) process. The aim is to investigate how applicable improvement methodology from the private sector can be transferred to procurement processes within the public sector. This question is not possible to answer without first understanding more about public procurement in practice, especially the Timor-Leste public procurement process.

2.2. Timor-Leste Procurement Process

As shown in Figure 2.1, The TLS-P cycle starts with identifying the need for goods, services or works. These are developed into a procurement plan by each Line Ministry (LM) in the form of a ‘Strategic Procurement Plan’ (SPP). This SPP is then submitted to the Ministry of Finance (MoF) for the

identification of available funds to cover the purchase, prior to the preparation of clear and accurate specifications and costs. Consequently, The MoF raises a Cashier Payment Voucher (CPV) and organises treasury approval and fund commitment. The LMs then send project documents, together with the CPV for the tendering process and evaluation, followed by the selection of bids and the award of a contract to the strongest suitable company. The contract is then handed over to the contract management process, in which the project owner and ADN conduct inspections on performance, quality, monitoring and reporting. This process aims to ensure that the project is delivered according to the contract agreement. This procurement cycle ends with the handover of goods, services or works from the contractor to the LM, which conducts a final performance and quality review and also updates the supplier register.



Source: (Ministry of Finance, 2011)
Figure 2.1 Cycle of procurement

Timor-Leste public procurement expenditure represents 67% (USD800 million) of the Government's total 2012 annual budget (MoF, 2012b). It is thus worthwhile to reflect on what amount might be saved and reinvested in public services provision, if the spending bill could be reduced by just 10%, for a small country such as Timor-Leste.

The Timor-Leste public procurement is undergoing a reform process, based on a procurement process assessment report provided by the World Bank (2004) and Deloitte (2008). These reports propose the need to streamline, standardise and simplify legislation and regulations. The aim is to achieve value for money, in addition to greater accountability, transparency and integrity, in order to reduce corruption. A fundamental proposed reform is the segregation of certain key duties along the procurement cycle, in order to improve internal control.

This segregation means separate processing being undertaken by different government agencies at various stages of the procurement cycle, in addition to an independent review of the work performed. The main purpose for this segregation is to reduce the possibility of corruption and to emphasise the accountability of all key players in the procurement process (UNDP, 2006), together with effectiveness of internal control (Aziz, Nor, & Ahmad, 2010).

These changes have included the establishment of the Procurement Commission and the Procurement Technical Secretariat (STA) (Timor-Leste, 2010a), which were later abolished and replaced by the National Procurement Commission (NPC) (Timor-Leste, 2011b) and the National Development Agencies (ADN) (Timor-Leste, 2011a).

A further complicating factor, however, is that existing procurement institutions, under the Ministry of Finance (Timor-Leste, 2005a), also have some involvement in the development of procurement policy, since the Ministry provides advice on a range of public procurement issues. This causes confusion, as the Government's approach appears to lack consistency. As a result, policy development and its implementation are

weak and this situation has created unnecessary duplication of procurement activities.

There are also conflict of interest issues throughout the stages of the procurement process (Deloitte, 2008). The link between the budget and procurement planning is weak. An effective plan should inform the resources required for the effective and efficient delivery of procurement activities. The absence of a detailed procurement plan may, therefore, have contributed to delays in project execution and thus led to poor government budget execution (Blunt, 2010). This is because public procurement is complex, due to accumulating layers of authorisation at different levels, which often have additional strategic or policy objectives (CEMR, 2011).

Although there has been some progress (the researcher has witnessed the Timor-Leste Government striving to address some of these problems with new policies and costly organisational changes), these changes do not take place quickly — nor are they satisfactorily completed. Furthermore, procurement procedures have become more complex with many added administrative processes. According to UNOPS (2012) and Zaheer, Mushtaq and Ishaq (2008), this can contribute to delays in the procurement of requisite goods and services, due to protracted administrative lead times and procedural complexities.

It can be clearly seen that the above procurement reform is only focused on parts of the problem (internal control) and not on a holistic approach. This is because there is the assumption that the only way to solve a complicated system is to use a complex solution. In addition, the reforms do not take into consideration the complicated human relationships and technical and organisational interdependencies that will be affected by the intended transformation.

According to Goldratt and Ashlag (2008), when people are trying to solve complex systems, they easily fall into the trap of looking for complicated solutions. People assume that, in order to solve complicated problems, the solution must also be complex. The problem is that such solutions do not

work and they may, indeed, create many new problems. Therefore, both author suggest the finding of simple solutions, as a result of their claim that any complex system always has an inherent simplicity that only needs to be uncovered.

Goldratt also states that the more complex a system is to describe, the simpler it is to manage. This idea is that the more inter-connected the pieces of a system are, the fewer areas that are needed to manage an impact on the whole system (i.e. the interconnections mean that the system has fewer “degrees of freedom”). This is in line with the Theory of Constraints, which sees every organisation as having at least one constraint, relative to its process, that limits the organisation’s performance towards reaching all its goals. Significant improvement can thus be achieved by finding the core of the problem and then developing a solution for it, which solves the intermediate problems — and does not create any additional problems along the way.

Figure 2.1 shows that the Timor-Leste public procurement systems is comprised of sequential processes, which are interconnected and exhibit interdependency. This is an interesting issue, because it is aligned with the TOC principle that sees a system as a chain of dependent links.

In addition, Loader (2008) suggests that the Lean approach is well suited to systems with high volume and repetitive tasks in sequential flow. Indeed, both concepts, along with six-sigma, have been applied together at six plants and successfully produced vast improvements (Pirasteh & Farah, 2006). More details about the concepts in the Theory of Constraints and Lean tools are discussed in the following section, in order to facilitate the reader’s understanding of how they are going to be used in Chapter 4: Analysis and Discussion.

2.3. Application of TOC and Lean in the Public Sector

The TOC and Lean concepts were originally designed to be used for production/manufacture processes: and their common use is 'for profit' organisations. They are useful where the product and services are processes within sequences of interconnected activities. However, TOC and Lean can also be uses in not-for-profit organisations (Watson, Blackstone, & Gardiner, 2007). For example, a study conducted by Kate et al. (2004) was aimed at reducing patient waiting time in hospitals and another study on the TOC thinking process was applied to the Water Utility Management Systems (WUMS) at Albuquerque Public Works Department (Shoemaker & Reid, 2005). Cox III and Schleier (2010), in their edited book, "*Theory of Constraints Handbook*", which is a compilation of chapters an all major areas of TOC concepts and practice, do not include any discussion on the applicability of TOC within the public procurement setting. Meanwhile, (Schiele & McCue, 2010; Schiele & McCue, 2011) discuss how Lean thinking can be applied within a public procurement setting — however, they still doubt whether their ideas can be put into practice.

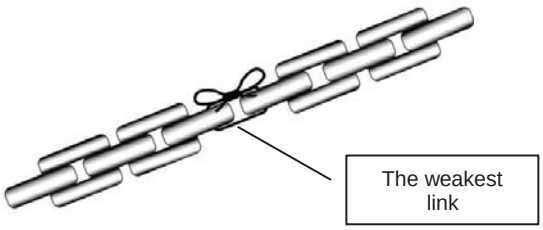
Although the above discussion demonstrates that TOC and Lean concepts can be successful applications within the services sector, the researcher, however, has found both concepts were applied as individual concepts, rather than as an integrated concept — and there is not any literature available that discusses the application of TOC-L within the public procurement process.

2.4. Theory of Constraints (TOC)

The TOC is based on the existence of constraints that limit organisations from successfully achieving their goals. It is these constraints (physical or policy) that dictate how much an organisation can produce. TOC considers that every business process is comprised of dependent events that are linked together and which act like a chain. The strength of the entire chain is

dependent on the weakest link (the constraints) and therefore, if the weakest link breaks down, the whole system is affected (Watson et al., 2007).

Furthermore, management should identify and focus on the weakest link, since the whole chain depends on this link. Strengthening other than this weakest link is considered a waste in most instances. According to the TOC, this weakest link is known as a 'constraint'.



Source: (Dettmer, 2007, p. 8)
Figure 2.2 A System as a 'Chain' Concept

By focusing on making the constraint operation (weakest link) more efficient and aligning it with other resources, in order to support it, an organisation will operate at a higher level. When constraints are removed, it will increase the organisation's performance toward its goal: but any new constraint must then be identified, since TOC claims that all organisations have at least one constraint in play at all times (J. F. I. Cox & J. G. Schleier, 2010).

TOC introduces five simple steps to manage constraints: identify, exploit, subordinate, elevate, and repeat if constraint is broken.

2.4.1. TOC Five Steps (TOC-FS)

The TOC-FS is based on the idea that an organisation is a network comprised of a series of interconnected chain links of activities. The TOC-FS provides a theoretical framework and also the tools to continuously identify constraints — and to use the five steps as a process for ongoing improvement (Golratt, 1984; McMullen, 1998), as described below:

- **Identify the constraints**

Since a system is a chain of dependent events, therefore, in order to improve the system in terms of its goal/s, organisations should identify the weakest link (the constraint) in the system, which is limiting the organisation's ability to successfully achieve its goal/s. It is the weakest link that determines how far an organisation can go to achieve its goal/s. Systems will not become stronger until there is improvement in the weakest link. It is important to note that this step implies that a clear understanding of the fundamental goal of the organisation exists, and that measures of that goal have been defined.

Constraints can be a physical or a policy. Physical constraints can be identified easily within an organisation, for example, there is usually a large amount of work in process (WIP) at the front of a resource constraint waiting to be processed. It can be noted that resource constraints are only one of the types of physical constraints that can exist. Policy constraints are more difficult to find, because they are not physical entities that can be easily observed: and eliminating policy constraints can be more difficult, since they may be strongly supported by people within the organisation. Changing policy constraints often requires a considerable buy-in process before there is agreement to a change of policy that may have been in use for long time. Since policy dictates how the system should perform or behave, Bell (2006) claims that policy constraints must be identified first, followed by physical constraints: and it should be in this order. This is a viewpoint that might be subject to debate, in this author's view, as the key location where policy constraints manifest as negative is usually at the physical constraint — and thus, the latter can be a useful starting point for the discovery of negative policy. Bell also claims that eliminating policy constraints can result in a larger degree of system improvement than eliminating physical constraints — but this viewpoint could also be debated.

TOC identifies constraints within the non-manufacturing system as being a core conflict, which explains the primary reason that the system does not perform well. It is the root cause of one or more undesirable effects within the system. According to Dettmer (2007), policy constraints are very difficult and

complex to identify and break, because they require: (1) motivation to improve the system; (2) knowledge about the subject; and (3) the change agent must have some degree of authority or influence, in order to initiate the change and s/he must understand how to apply TOC-TP and TOC-FS.

Bell's (2006) suggestions (above) seem problematic and difficult without including these three criteria, as suggested by Dettmer. It may be appropriate to identify physical constraints first. Once the physical constraint is identified then one can trace back to see if there is a policy or rule that has caused such a constraint to exist. If so, then the TP can be used to identify, analyse and eliminate the core problem, in order that a proposed plan can be introduced for implementation improvement. This may provide evidence of what is 'going on' at the bottom level and it will also help to gain support from top-level management.

- **Decide how to exploit the constraints**

This step helps the decision on how to obtain as much of the constraint/s capability, without needing potential investments. 'Exploit' means maximising the constraints' ability to produce goal units, so that it is more effective than before. (i.e. squeeze as much of the potential from the existing constraint as possible)

- **Subordinate everything else to above decisions**

Once an exploitation has been made to increase capacity, sub-ordinate everything else to the above decision. This step is taken to synchronise non-constraint resource activities with constraint resource activities, so that the constraint can work at its optimal capacity. All non-constraints in the system should be used to help maximise the output of constraints..

However, this synchronisation could also be problematic, because sub-ordination means non-constraints must be 'relegated' to supporting the role of the constraint. This may be difficult, since most people working with non-

constraints may resist undertaking the necessary actions to subordinate the rest of the system to the constraint. Therefore, management must require most people at every level to accept a behaviour change — and to accept that they are part of a whole system.

The management may redefine the objectives of every process in the system, through the establishment of the necessary conditions needed to support the constraint and thus achieve the organisation's ultimate goals, since the whole system depends on constraints to produce output.

- **Elevate the constraints**

If the constraint still cannot produce output to meet demand, the alternative way is to elevate the constraint. This is a step where major changes take place in order to eliminate the constraint, if practically and economically justified. The aim is to increase the current capacity of the constraint. This may require additional resources, such as people and/or machinery. Sometimes, there may be a requirement to also change policy, for example, allowing overtime or eight hours rotation.

However, before thinking of elevating the current constraints, the management should consider the question: "Where will the next constraint be?" It may be possible that the next constraint might be difficult to manage, compared to the existing constraint: and this might reduce the margin for control over the system. The ability to always have control over the constraint will help the organisation to achieve a better performance after elevation.

- **Repeat Step One – but don't allow inertia to become a system constraint**

Since this is a continuous improvement process, if the four steps are executed successfully, then the constraint/s will likely (or eventually) move to somewhere else. Check if the current physical constraint has moved, or policy may become an obstacle and no longer be of benefit to the entire

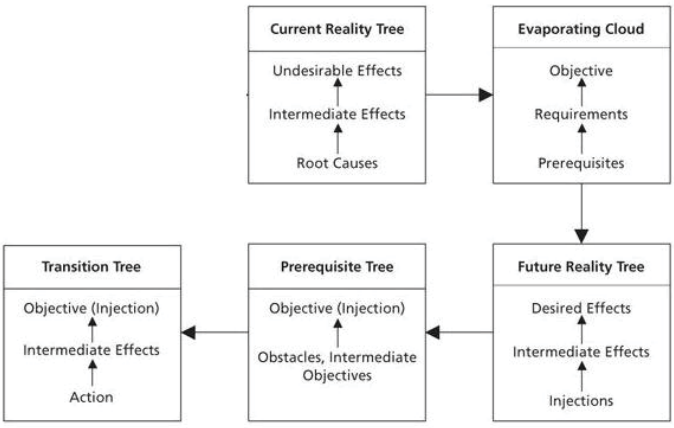
system. Therefore, the system must be re-evaluated, in order to identify the location of the new constraint, by repeating Step One, in order to find that constraint/s. This continuous iteration process takes place as part of a process of ongoing improvement.

2.4.2. TOC Thinking Process (TOC-TP)

The TOC-FS is very effective in dealing with physical constraints. However, it will be difficult to find it, if the real constraint is a policy. In order to overcome this problem, Goldratt introduced another concept known as the Thinking Processes (TP) (Berry & Smith, 2005; Choe & Herman, 2004; Goldratt, 1994). The TP provides a problem solving mechanism for complex systems by simply answering three questions:

- What to change? (Identify the core problem)
- What to change to? (Identify the breakthrough solution to eliminate the core problem)
- How to cause the change? (Identify actions that are needed to create the desired environment and how can they best implemented)

The TP are essentially tools used by people who have an intuition about the subject matter being analysed. The TOC-TP helps to answer the above three questions by using five logical thinking processes for problem identification, solution development (detailed strategy) and implementation to achieve desired outcomes (Berry & Smith, 2005; Goldratt, 1994).



Source: (Dettmer, 2007, p. 30)

Figure 2.3 Relationship between TP tools

This section will discuss the basic concepts of the five TOC-TP tools based on Dettmer (1997) book *Goldratt's Theory of Constraints: A Systems Approach to Continuous Improvement* provides a more detailed explanation on the TOC-TP approach to solving complex problems, which this researcher is going to use as part of the data analysis. In fact, Shoemaker and Reid (2005) applied TOC-TP in their case study to solve water management system at Albuquerque Public Works Department.

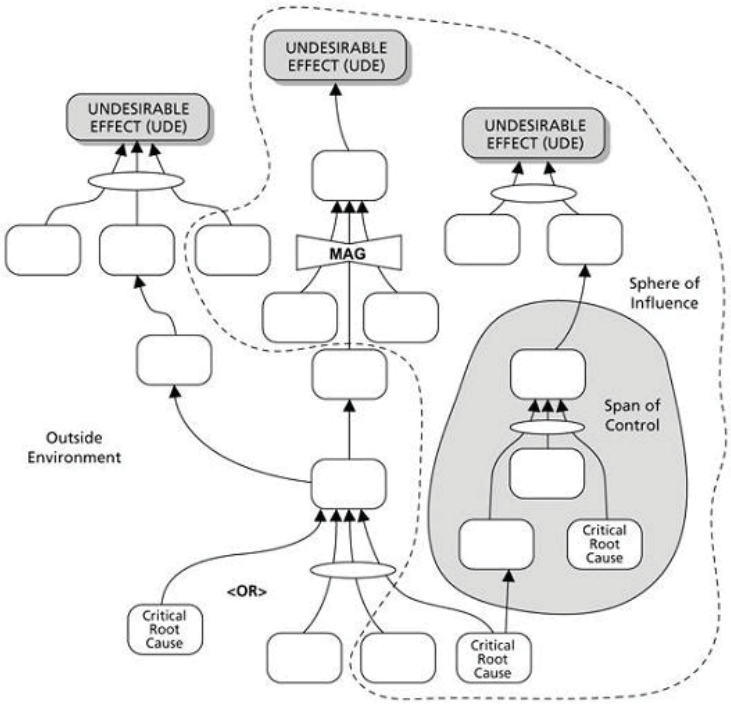
- **What to change?: The Current Reality Tree (CRT)**

All systems are subject to logical cause-and-effects that are related to the consequences from any action, decision or event that has occurred. This relationship can be visually mapped and analysed to solve complex problems, by using the CRT. The CRT is used to evaluate the network of cause-effect relationships between undesirable effects (UDEs) and to help to identify the root cause of the UDEs.

The CRT process begins by identifying the degree of control and level of influence necessary to cause the change. It then lists all potential UDEs in the current situation and looks for clarity in each problem (UDEs) statement using the present tense. The contributing factors that are associated with these UDEs are listed accordingly: creating a cause and effect loop

downwards; looking at single UDEs; and using intuition as a guide to see if there is more than one UDE participating in the cause.

These causes are then viewed as effects and the process continues until there are no more loops coming in. The UDE which is no more loops coming in (once found) is the single cause (i.e. the "core problem") responsible for all UDEs. For example, the top UDE is caused by the second UDE down and then another UDE is the cause of the second one. The tree is read from the bottom to the top using "if …and/or then…." and logic follows the arrowheads.



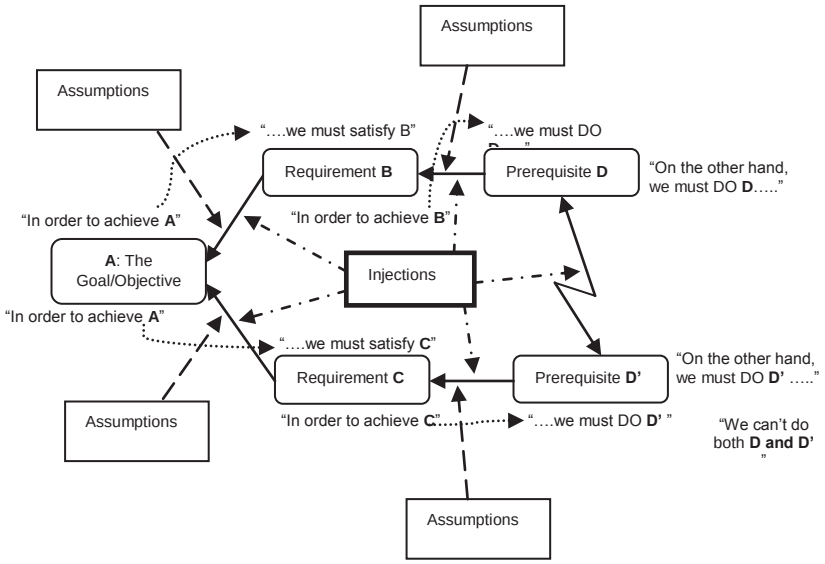
Source: (Dettmer, 2007, p. 97)
Figure 2.4 Example of CRT

This method continues until the CRT is completed. When all UDEs are linked (and if no more loops are coming into the UDE at the bottom level) those UDEs are the core problem, which should represent at least 70% of UDEs in the organisation (Dettmer, 1997). Select the core problem that lies inside the authority of the change agent to attack because, if the core problem is located beyond the control and influence of this person, then it is difficult to change.

- **What to change to?: Evaporating Cloud (CRD)**

Once the core problem is identified, significant improvement can be achieved by eliminating the core problem. However, the existence of a core problem is usually sustained by two opposite forces that result in conflict (a tug-of-war) (Schragenheim, 1999). In such a situation, the Evaporating Cloud (EC), is the correct tool that can be used to find a solution that is underlying the conflict (Choe & Herman, 2004; Goldratt, 1994).

The EC simply poses the conflict between two requirements and prerequisites for reaching a common goal. The requirements give us insight into the path that leads to the sources of conflict. In order to fulfill a requirement, there are prerequisite activities, which cause a conflict to exist. There are assumptions that drive the establishment of requirements and prerequisites. When the hidden assumptions inherent on the conflict diagram are exposed, a breakthrough solution becomes possible, which enables all parties to arrive at win-win solutions, rather than compromises or win-lose situations. Figure 2.5 shows the basic EC structure.



Source: (Dettmer, 2007, p. 25)
Figure 2.5 Evaporating Cloud

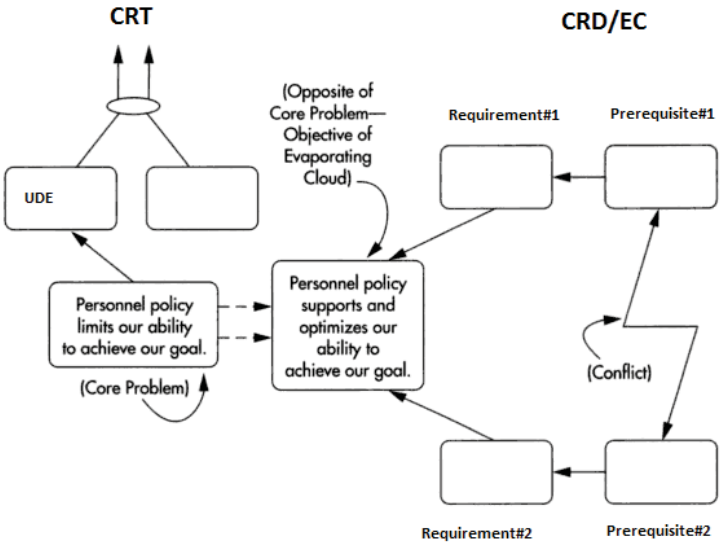
The dotted arrow shows how to read entities in EC:

In order to achieve [THE GOAL/OBJECTIVE], we must satisfy [REQUIREMENT B], in order to satisfy [REQUIREMENT B], we must do [PREREQUISITE D]. In order to achieve [THE GOAL/OBJECTIVE], we must satisfy [REQUIREMENT C]. In order to satisfy [REQUIREMENT C], we must do [PREREQUISITE D']. However, we cannot do [PREEQUISITE D] and [PRERQUISITE D'] to satisfy all.

The goal of using the ECs is to try to identify all the pertinent requirements that impact on the desired objective, in order to arrive at a win-win solution as the most preferred result (compared to win-lose or a poor compromise). The EC utilises an analytical approach in order to get the parties to arrive at a mutual consensus. In order to achieve the desired objective, typically, one or more necessary condition 'requirements' must be satisfied. There is also a necessary condition to a prerequisite, in order to accomplish requirements which give an insight into the path that can lead to the source of conflict between two opposite forces.

The establishment of requirements needed to achieve the desired objective and what prerequisites are necessary to accomplish these requirements, come from some assumptions about them. Therefore, it is important to record these assumptions for use in the analysis. If these assumptions are uncovered, they can often be broken and they would no longer present a barrier. Once these assumptions become clear, then the designated action/injection can be identified. Injections are conditions or actions that will be needed towards overcoming any underlying assumptions that would prevent the achievement of the objective.

This breakthrough solution is a condition or action that will exist/occur in the future and it is geared towards overcoming any underlying assumptions that would prevent the achievement of the objective. For example, an assumption may have been correct in the environment that existed in the past, but it is not correct in a new/changed environment. A solution that invalidates any of the assumptions is called an 'injection'.

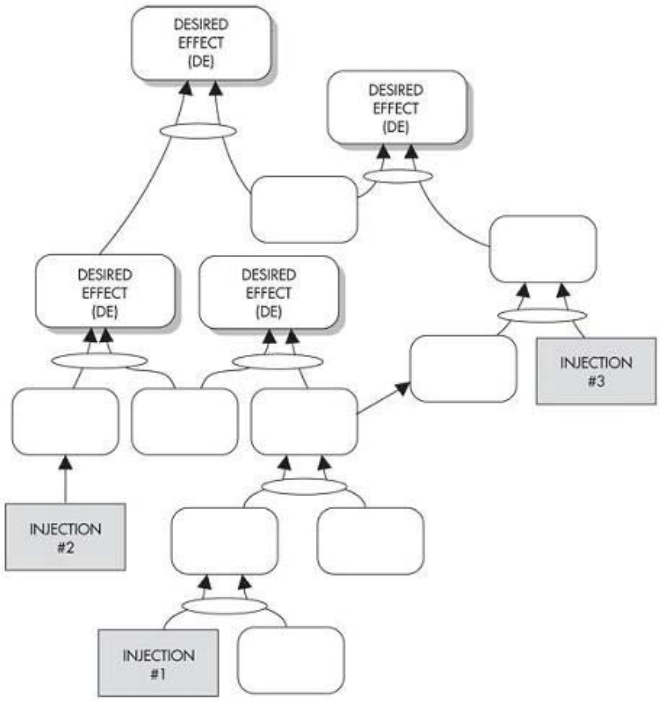


Source: (Dettmer, 1997, p. 105)
Figure 2.6 The relationship between CRT and EC

The CRD not only helps create a breakthrough solution to resolve the core problem (the constraint), through a brainstorming session to produce desirable effects (DEs), the CRD can also be used to uncover the conflict related to the core problem identified in the CRT. This can be undertaken by turning the core problem statement in the CRT to an opposite, where it becomes the objective for EC (Choe & Herman, 2004), as shown in Figure 2.5.

- **What to change to?: Future Reality Tree (FRT)**

The CRT is used to identify the root cause of the problem and then the EC is used to identify the objective needed to counter the effect of the root cause and develop an injection to attack the root cause: and thus achieve the desired objective. The work of CRT and EC provide a path to the FRT.



Source: (Dettmer, 2007, p. 26)

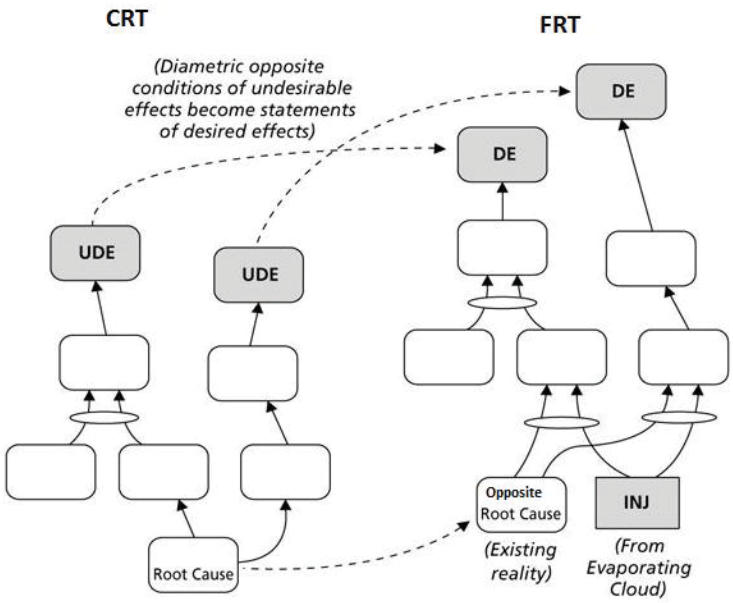
Figure 2.7 Future Reality Tree

The injection can come from the EC, or it can also be converted directly by turning UDEs (from CRT UDEs) to DEs (for the FRT), if the solution to the core problem is known and if it does not require a totally new approach to solve the problem. This helps to find the way from ‘current state’ to ‘future state’. If the stated injections are applied to the CRT, the result and effect of the injections is to bring the system to the desired objective. If all UDEs do not disappear, then additional injections are needed — until the stage is reached where UDEs are replaced by DEs.

The FRT can guide management to achieve any desired set of objectives or solve a problem in answer to the question, “What to change to?” by using the same cause-and-effects of the CRT to test the validity of the solution. This can provide logical verification that a proposed solution will actually deliver the desired results.

The FRT focuses on overcoming the problem that was identified in the CRT, by injecting DEs to specific UDEs that are most likely overcome the problem. This tool can help to simulate what might happen in practice, when certain

actions are initiated towards achieving desire outcomes. The FRT starts with action that might resolve the core problem and it produces desirable effects (DEs).



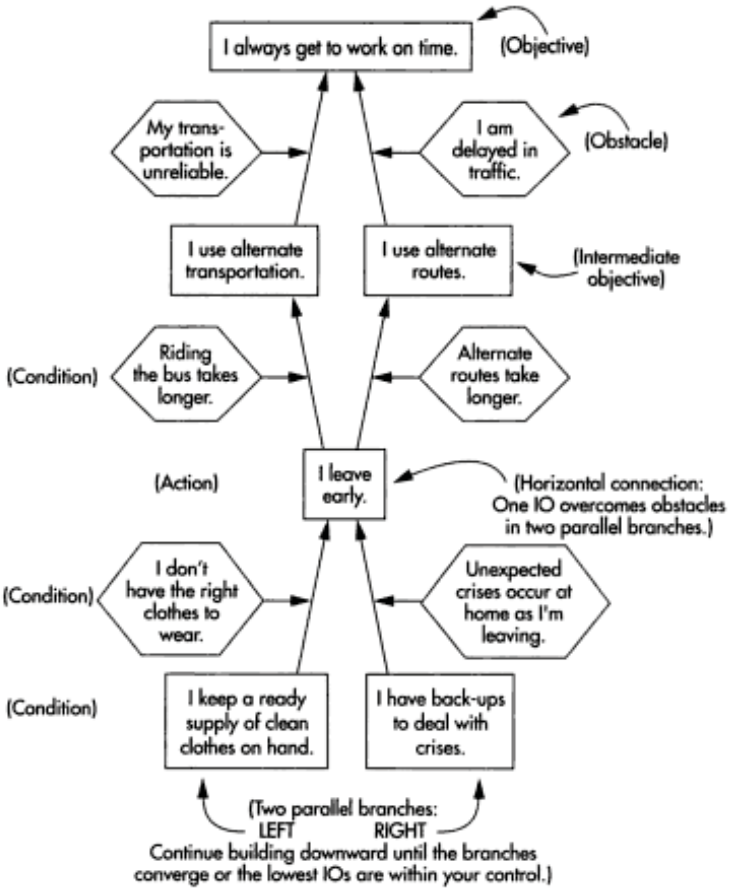
Source: (Dettmer, 2007, p. 220)
Figure 2.8 The FRT injection from EC and CRT

The injection applied on the CRT may cause some negative outcomes called Negative Branch Reservations (NBR) which must be taken into consideration.. Each negative branch requires more decisions or injections, in order to prevent the new UDEs it contains. This iteration process is continued until the new reality is closer to the final expected outcome — and no old, or new, UDEs remain.

- **How to cause the change?: Prerequisite Tree (PRT)**

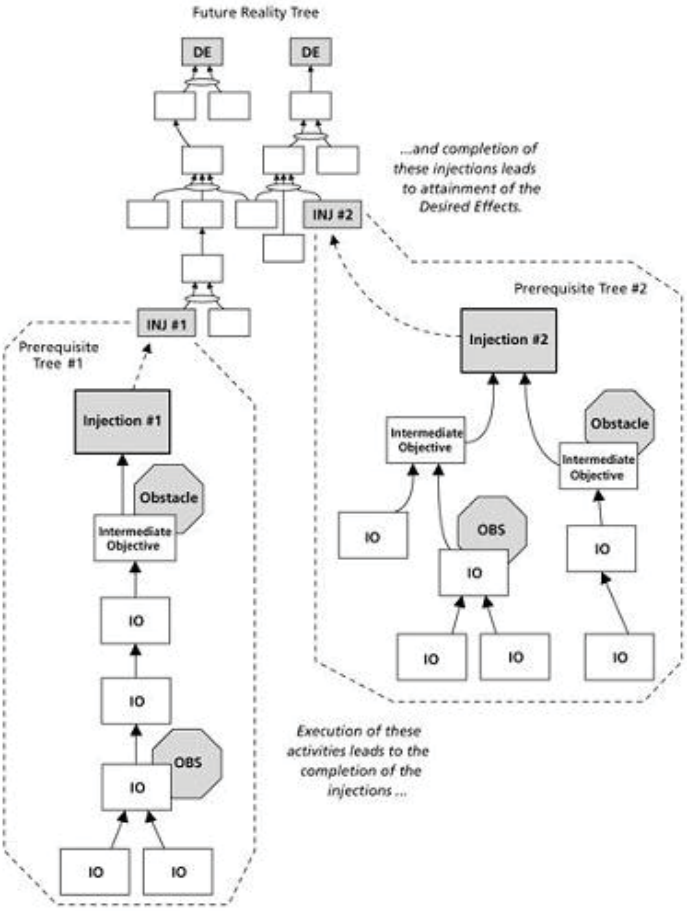
This tool is the transitional step needed to attain the solution, by identifying obstacles that exist between the current state and the desired objective. It provides a way to determine the appropriate approach to eliminating those obstacles. This answers the question: “How to cause the change?” The PRT is comprised of a chronological list of actions that essentially produce the desired state. The PRT defines the obstacles needing to be overcome, in

order to implement the injection that will replace UDEs with DEs (Dettmer, 2007): and the intermediate objectives which will undertake the said 'overcoming'.



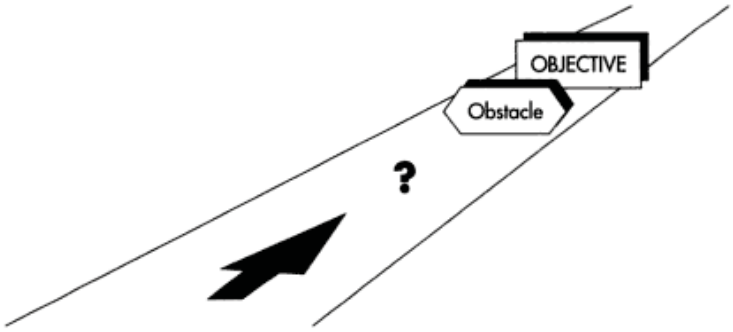
Source: (Dettmer, 1997, p. 269)
Figure 2.9 Example of PRT

If some of the proposed injections are conditions for which there is uncertainty as to how they can be achieved; then these injections became objectives for the PRT. Consequently, the PRT can help to identify the obstacles and ways to overcome them.



Source: (Dettmer, 2007, p. 224)
Figure 2.10 Transitions from FRT to PRT

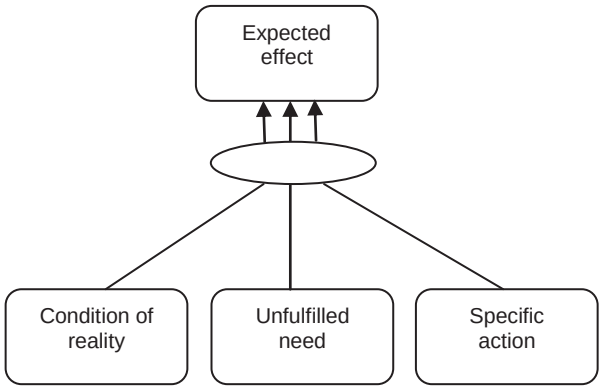
Overcoming the obstacles requires the establishment of intermediate objectives (IO) that are focused on specific obstacles. The PRT is a compilation of these IOs and their associated obstacles. If the CRT and FRT are sufficient to show that all entities are adequate to produce the next entities, the PRT will show the transition conditions that must be achieved before one can go to the next step. So *in order to achieve* [the objective], the organisation *must first have* [something] *to overcome* [the obstacle]. In another words, the organisation wants to have [UPPER IO], but they are prevented by [OBSTACLES] and therefore, organisations must have the [LOWER IO] (Dettmer, 1997).



Source : (Dettmer, 1997, p. 241)
Figure 2.11 Simple Illustration of PRT

- How to cause the change?: Transition tree (TT).

The TT is the last step of the TP tools, which is used for final strategic planning and implementation of how to change from now, to the future.

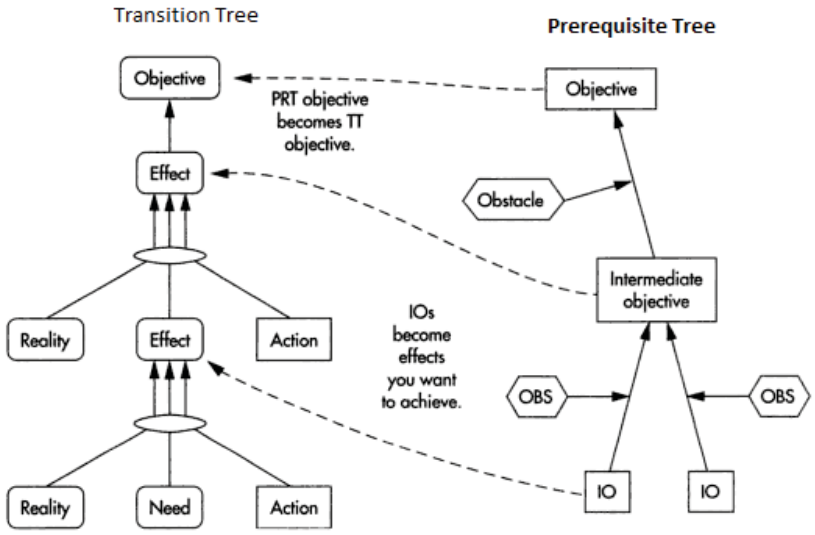


Source: (Dettmer, 1997, p. 295)
Figure 2.12 The four element of TT

There are five elements needed to construct a structure for the TT:

- Condition of existing reality
- Unfulfilled need
- A specific action to be taken
- Expected effect of the preceding tree
- Rationale needed for next level

The TT lays out the steps to overcome the uncovered obstacles in the PRT and it helps to explain the rationale for the proposed action to be taken by those responsible for implementing them. This is more or less similar to the cause-and-effect relationship analysis in CRT, but the TT uses upward analysis like the FRT, rather than downwards as in CRT.



Source: (Dettmer, 1997, p. 289)
Figure 2.13 Transformations from PRT to TT

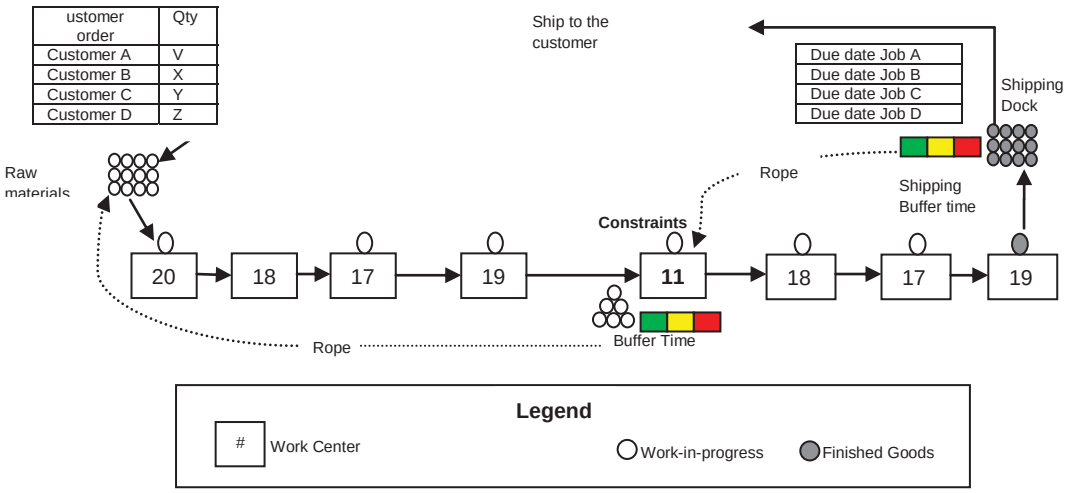
2.4.3. TOC Drum-Buffer-Rope (TOC-DBR)

The TOC drum-buffer-rope (DBR) is a manufacturing model which recognises that constraints will determine the overall performance of a manufacturing system (Mahoney, 1997). Therefore, DBR always focuses on the constraints that slow the flow of product through the system/s.

- **Drum-Buffer-Rope for goods (DBR_G)**

The DBR_G is designed to regulate the flow of materials through a system according to its capacity constraints resources (CCR) (Nicholas, 2011) .

DBR_G is illustrated in Figure 2.14.



Source : (Schragenheim, Dettmer, & Patterson, 2009, p. 14).
Figure 2.14 Drum-buffer-rope

The DBR_G system works by ensuring that the WIP materials are always available for the constraints to keep running, in order to meet the schedule. If the upstream supply of work-in-progress is disrupted, the constraint remains running, due to a buffer at the input stage of the constraints. The pace of the system and the need for materials is therefore determined by the 'drum' or bottleneck of the system. The rate the constraint processes units (drumbeat) contained in the buffer is synchronised with the replenishment rate (Mahoney, 1997).

The inventory buffer represents the amount of time needed in advance for work-in-progress that is scheduled on constraints (based on the customer order due date). These buffers will absorb any upstream process time; set-up time; time lost in breakdowns; quality problems; and common cause variation, thus protecting constraints and throughput. It is important to understand that inventories at the constraints, assembly and shipping points, represent the amount of time needed to produce the product, in order to meet schedule and delivery time, without starving these constraints, assembly and shipping points (Sproull, 2009). If the scheduled maintenance or breakdown occurs at the non-constraints, the buffer time at the front of the constraints will absorb it (Wright, 2011).

In order to ensure materials are arriving according to schedule, the buffer contents at the constraint (or other buffered point) must be monitored and compared to the schedule of planned activity by the constraint. This control action is known as 'Buffer Management' (BM). It usually consists of a visual system which uses three colours (green, yellow and red) to give an early-warning signal of any problems (Noreen, Smith, & Mackey, 1995). If parts do not arrive into the buffer at a suitable time before being scheduled for the constraint, then it is said that the absent parts (called a 'hole in the buffer') are 'penetrating the buffer'.

The green zone means everything has arrived as per schedule (actually ahead of the constraint schedule by a small time margin), so there is no problem. The yellow zone indicates that parts are not arriving at the desired arrival time, so the controllers must start to create a plan to speed up the flow of missing parts. The red zone means the parts will not be arriving into the buffer in time to meet the constraint schedule, unless something expedient is done. It is, therefore, at this time, that action must be taken to speed up the flow by using the plan made when the yellow zone was penetrated. If there are only green zone penetrations over a period of time, then this is an indication to reduce the buffer size. If many red zone penetrations occur, then this signals the need to increase the buffer size.

In order to facilitate communication between down and upstream, the 'rope' (see Figure 2.14) is a signal to release jobs into the system from upstream. The size of this rope (a time interval) is based on the actual run time to the constraint, plus a safety time, in order to ensure that WIP arrives at the CCR well before it is scheduled to be processed. The rope and the buffer time are really one and the same concept. This early, but controlled, release ensures that no excess work is in process within the system: and also that there is no shortage of materials for the constraint to work on. In other words, the rope is to protect the capacity constraint's resources (CCR) from being swamped with work in progress (WIP), or starved of productive work to do (J. F. Cox & J. G. J. Schleier, 2010). The aim is to ensure that all work centres are stretched to perform (on average) at the speed of the drum or constraints,

but with the provision that they work as fast as they are capable (with good quality being essential) when work is available — but not worry about idleness when it is not.

If the rope releases the job into the system too late, then the drum will be starved and it will produce less than its maximum amount. On the other hand, if the job is released too early, this will result in large WIP in front of the constraint and this may cause confusion regarding which jobs must be processed first.

- **DBR for services (DBR_S)**

Although the TOC-DBR concept was initially used for manufacturing purposes and it was designed to manage inventory, it can also be applied in static and repeatable services, if they consume physical inventory (something which is flowing through the system), at the time of delivery. For example, DBR_S has been used for largely static, repeatable services, for example, in health care for scheduling patients who were willing to wait (Kate et al., 2004).

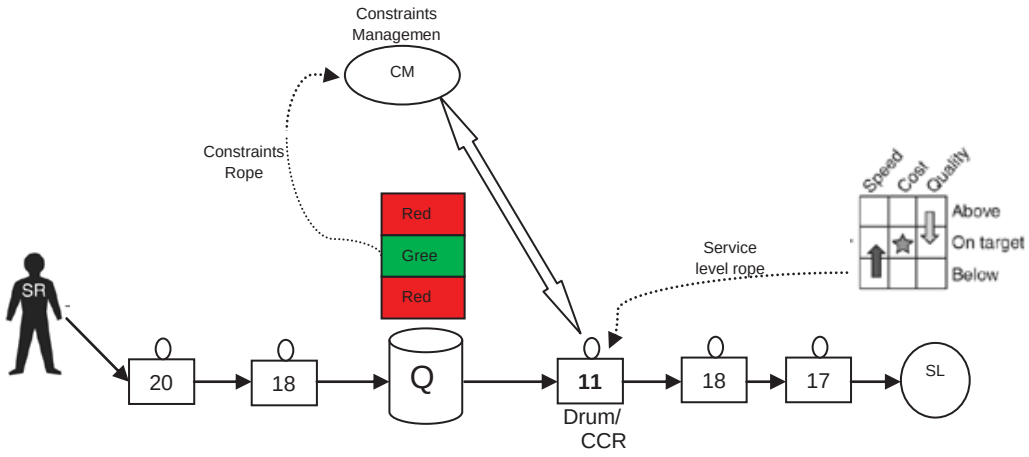
DBR_S releases the work into the system, based on the availability of constraint resources: and the shipping rope governs work after the constraint, in order to meet job order due date, or first come, first served (FCFS). This is therefore suited very well to instances where the customers' tolerance of waiting time is sufficiently high to allow the system to process the requirement from scratch, or where the physical output of the system can be stored, awaiting customer demand. This will be problematic, however, when customers expect services on demand (and no opportunity to store the service exists). In this instance, the competitive edge is often based on speed, cost and quality (Demirkan, Sphorer, & Khrisna, 2011).

Recently, Schragenheim et al. (2009) have suggested a system of "make to availability", to which the DBR system can also be connected. They suggest that organisations should accept the need to maintain sufficient "protective capacity" (even at capacity constraining resources), if they need to cope with

fluctuating demand and/or on-demand customer services. This protective capacity is closely monitored so that, when planned load exceeds 80% of safety level, there is still sufficient time to add capacity. This will provide the ability to respond quickly to customer demand.

Although service providers may have had experience of demand patterns, they often have no control over the amount of jobs entering the process at any given time. It is also difficult to determine the schedule in advance for each job, if the amount of work is huge or not known. Since they cannot control both input and output of the process, the only way is to manage the flow through the constraints (Ricketts, 2008).

$DBR_{S,}$ as show in Figure 2.15, solves this problem by replacing buffer management with capacity management (CM).



Source: (Ricketts, 2008, p. 133)
Figure 2.15 DBR for Services

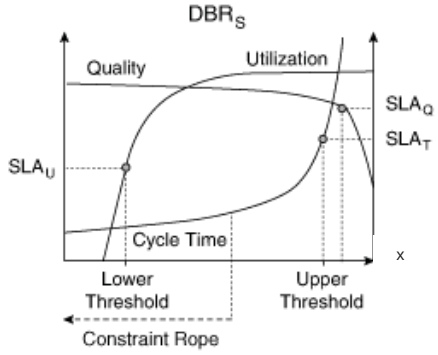
The CM is linked with a constraint rope, which functions as a control mechanism to increase or decrease capacity at the constraint, in order to meet service level agreements (SLAs). The buffer is often measured in items per period flow (flow rate) and it contains the total amount of work which is in front of the constraint. This buffer can be monitored by counting incoming jobs and items in the queue, plus WIP in constraint.

This buffer is comprised of three zones (upper red zone, green zone and lower red zone. Upper and lower red-zones trigger a change in capacity.

When the buffer reaches the upper buffer level (upper red) zone it signals that there is an unusually high amount of work en-route to the constraint. This triggers an increase in capacity, which eventually will stabilise the buffer to the normal level (green). If the buffer shrinks to the lower level (lower red), this signals the need for a decrease in capacity and thus, it will eventually stabilize the buffer at the normal level. The service level rope governs the work of constraints and the capacity applied to the constraint resource: and is measured according to the SLA. This means the work priority (and due date) is dependent on SLA — not simply on first arrivals. In order to achieve service levels, the capacity has to be flexible, so the in-flow rate must be translated into the resource level requirements during capacity management. An example of a strategy to achieve this might be excess resources from the non-constraints that can be called in during peak times and then returned during the off peak season. Therefore, all worker performance evaluations should be tied up to meeting the SLA, so they can adjust their productivity effectively during peak or emergency situations (Ricketts, 2008)

- **Buffer Sizing and Zones**

In order to manage the constraints well, the buffer size should be monitored and adjusted effectively. Ricketts (2008) provides a guideline for buffer sizing in DBR for services, as shown in Figure 2.15.



Source: (Ricketts, 2008, p. 141)
Figure2.16. Buffer Sizing

The length of the constraint buffer level is used by the CM to determine an appropriate flow rate at the constraints. At the lower buffer level, the cycle time service time and resources utilisation are at their minimum level, while quality is high because there is sufficient time for resources to work carefully. As the buffer level starts to rise, due to an increase in arriving jobs in the queue, the cycle time and resources utilisation also increases. Once incoming jobs increase proximity to the maximum flow rate (x = maximum capacity) that the constraints can handle, the cycle time and resource utilisation rise rapidly. As a result, quality drops sharply, because there is no longer time for resources to work carefully.

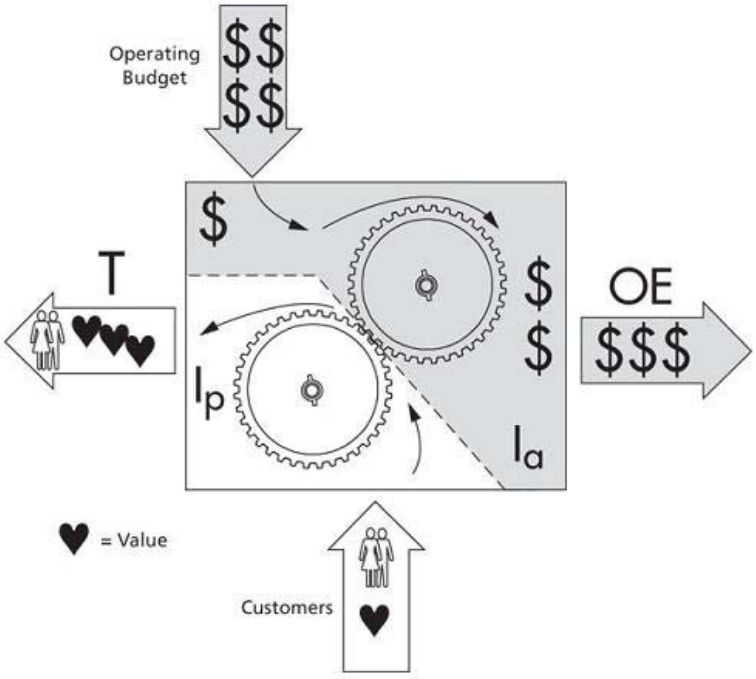
The middle range of the cross section, between cycle time and utilisation curves and represents dynamic equilibrium, where incoming and out-coming jobs are stable, due to protection by capacity management. If the buffer level is below dynamic equilibrium, the resource is starved for work: and if the buffer level exceeds this zone, it means resources are swamped with work. Therefore, dynamic equilibrium is the appropriate place for buffer thresholds.

The upper threshold on the buffer is determined by SLA cycle time (SLA_T) or SLA quality (SLA_Q), depending on their dominance. If cycle time is more dominant, the upper threshold will be determined where (SLA_T) meets the cycle time. The same mechanism is also applied to determine the lower threshold level, where the SLA utilisation (SLA_U) meets the utilisation curve. If cycle time rises above $SLA_{T,}$ or resource utilisation rises above the (SLA_U) threshold, this means the services provider is unable meet the SLA.

DBR for services therefore uses two red zones (the lower and upper zone) to trigger a decrease or increase in capacity that is needed to meet the SLAs. Using the buffer level threshold, as buffer zones for buffer management, is not effective, because there is no time for constraints management to act when it reaches those thresholds. Therefore, the buffer zone should be set at a sufficient time for a capacity change, before the buffer level passes either threshold. This can be done by setting the red zones boundaries just below the threshold, as quantified by the net change in buffer level that is expected during the time to change capacity.

2.4.4. TOC Performance Measurement

In order for TOC (in fact, any system) to work effectively, there should be a measurement of success. For profit organisations, the TOC suggests operational measures which include throughput, inventory and operating expenses. These can be shown to relate directly to the company's profit. In the case of not-for-profit organisations, which have a fundamental goal that is not about making money, throughput, as originally defined by Goldratt, is not a valid measurement. Goldratt (Dettmer, 2007) suggests a different approach for not-for-profit organisations seeking improvement towards their goal/s: that is, by using non-monetary value measurements to measure a different type of throughput, as illustrated in Figure 2.16.



Source: (Dettmer, 2007, p. 20)
Figure 2.17 The TOC measurements for not-for-profit organisations

Money is still used to measure operating expenses (OE), while inventory is only a portion of it. Goldratt divides inventory into either passive or active. Passive inventory (I_p) is non-monetary inputs, for example, patients in hospitals, who are going through the system, in order to be created into healthy people (I_p is something which flows in the system and to which value is added, but not in monetary terms). The active inventory (I_a) is an investment that can be measured in terms of money, for example, machines

or equipment that turns I_p into throughput value. The order of importance is still the same: increase the throughput, limit the investment and thus reduce operating expenses; and management should focus on how to manage throughput and the passive inventory. Goldratt (Dettmer, 1997) suggests that an operating budget is a vital and necessary condition and critical success factor, in order to achieve a goal, but it is not the fundamental goal. Reduction in the active inventory and operating expense will have a positive impact on the annual budget. Therefore, management should direct their efforts, in due consideration to T,$I_{p,}$ I_a, and OE, as described.

2.5. Lean Tools

Lean tools were originally designed for manufacturing approaches (Dhandapani, Potter, & Naim, 2004). However, this literature review has found that these tools can also be used for office and administrative processes within service industries. For example, (Bonaccorsi, Carmignani, & Zammori, 2011) suggested streamlining the information flow, by focusing on reducing the total cycle time, by applying service value stream management, at the centre of enrolments in Italia University.

There are many well-written Lean successes in production applications. However, service organisations and administration processes within the government sector often struggle to apply this concept, because they are ‘rule and policy’ driven, which can then limit the way in which how Lean can be applied, especially how Lean can be applied within a public procurement setting (Schiele & McCue, 2010).

Essential Lean tools for office and administrative processes improvement are as follows:

- Five S
- Value Stream Mapping
- Just-in-Time - Pull production
- Continuous Flow Processing

- Prevention of Quality Defects and Equipment Breakdowns
- Continuous Improvement
- Worker Involvement (Team work)
- Standardised Work

More detail of each of these tools is provided in the following sections:

2.5.1. The Five-S (Sort, Straighten, Shine, Standardize, Sustain)

A Five-S programme focuses on organisation, cleanness and standardisation, in order to improve efficiency and productivity; simplify the office work environment; and health and safety issues It does this by reducing wasted time, inefficient office setups and downtime. The elements of Five-S are described as follows:

Sort - means having the right things and removing unnecessary items to get more free time and space to help streamline the flow of a process along a value stream. This is to decrease waste time due to searching for work items.

Straighten - means simplify access and efficiency. Make sure that the tools are easy to locate and available when needed. This will help with reduction of setup time and movement of the employee, which can increase efficiency.

Shine - means clean the workplace by removing excess and relocating remainder. Observe, inspect and correct as well as remove damaged items or scrap paper from desk or office space so that it looks clean. This can help improve employee morale, as well as health and safety.

Standardize - means systemise the organization by adopting the best practice and providing guidelines that everyone understands and knows where, how and when they should be used. Employees are allowed to give input into the standard procedure, thus, can increase the ownership of the workplace.

Sustain - means to maintain all procedures and tools in accordance with to the first 4-S (Pries, 2006, pp. 267-268).

2.5.2. Value Stream Map (VSM)

Value stream mapping is a tool used to create materials or an information flow map of a production or service system. A 'value stream' is a series of activities or processes, which directly affect the flow of material and information within an organisation, in order to produce output. These activities include 'value added' (VA) and 'non-value added' (NVA). VA is all the activities in the process that add value to the product/services, from the customer's perspective. Anything other than VA is considered as being non-value added activities (NVA) or 'waste' and therefore, they should be eliminated *(D. Jacob, Bergland, &* Cox*, 2009a; Revelle, 2002)*. Otherwise, they will add unnecessary cost to the product/services. This elimination of NVA can reduce cost and production lead times, to provide a good quality of product/services with the lower possible cost.

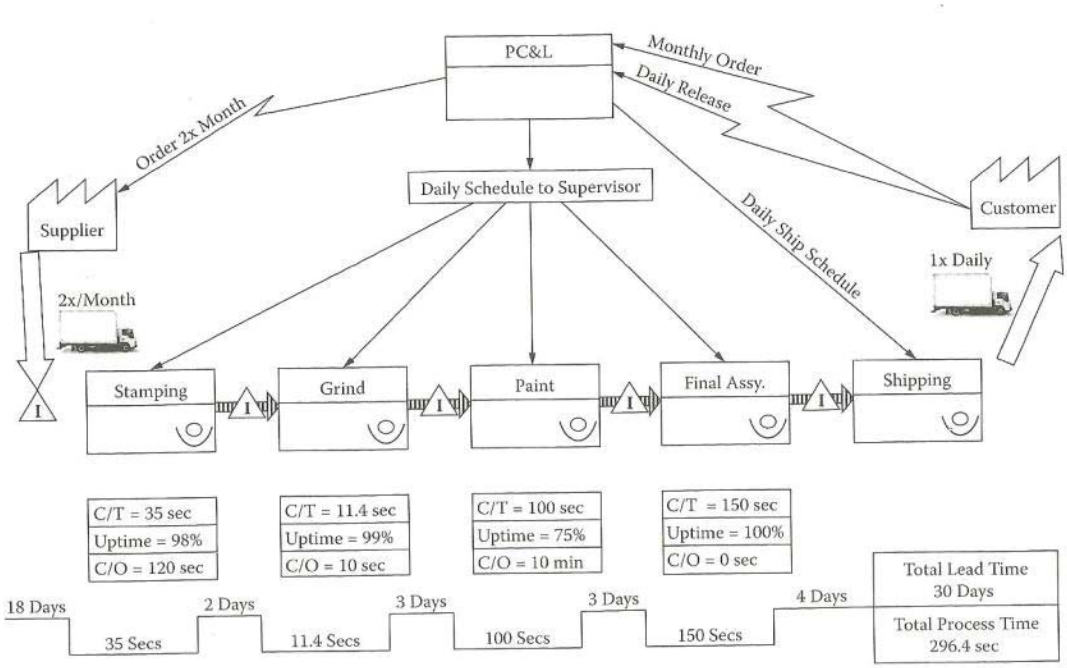
Organisations can use the VSM tool for an office, in the same way as it is used in manufacturing processes. VSM enables an organisation to visualise the process and locate the problem and direction for improvement. In service organisations, the VSM starts by selecting a particular service 'family', which contains offerings that share similar processing steps, but they do not have to be identical to each other (Lewis, 2008). Classification of services to fit into a family may be based on, for example, order, cost and design, since these depend on the customer's perspective of the value stream (Keyte & Locher, 2004). The value stream encompasses all the actions required to move materials through processes until delivery of the final product/services to the ultimate customer (Kerber & Dreckshage, 2011; Lewis, 2008; Nicholas, 2011).

The VSM shows the sequential process steps and data pertinent to each step, in addition to the overall metric related to the whole process. The map also shows how information flows, which can help to identify potential

bottlenecks and opportunities for improvement. The following are important components for implementing a value stream:

- **Current State VSM (CS-VSM)**

Similar to the CRT used in TP, Lean uses the CS-VSM to evaluate the network of interconnected activities and to identify waste. The CS-VSM is drawn up with information gathered quickly through the process and it pin points the problem in the stream (Keyte & Locher, 2004). It is later used as a base to construct a future state value stream map (FS-VSM), in order to eliminate the NVA activities (Harris, Harris, & Streeter, 2011). In other words, the current state value stream map shows the current situation, while the future state value stream map shows what the future of the system will be.



Source: (Harris et al., 2011, p. 149)
Figure 2.18 Example of current value stream map

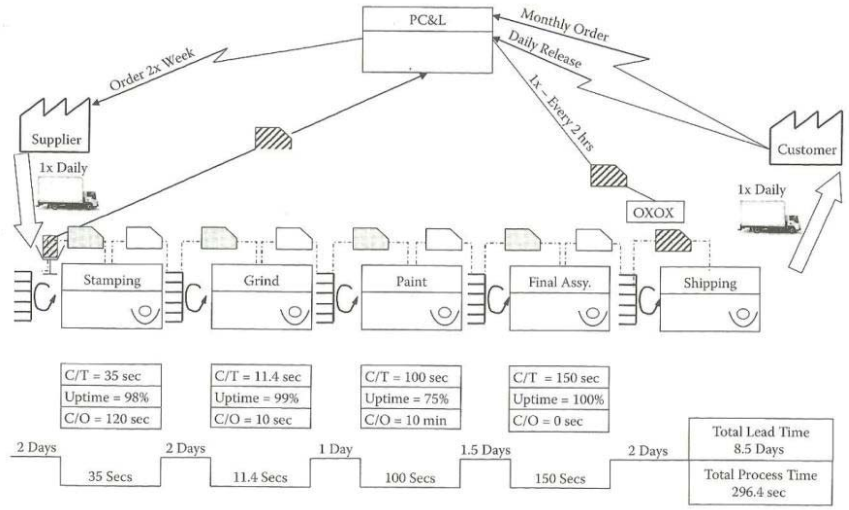
As the current value stream map is created and analysed, the bottlenecks which prevent the flow of services become much easier to locate. Figure 2.18 shows that it takes 30 days for the raw material to move first from stamping to the final assembly before it goes to the shipping department.

However, it only takes less than five minutes of processing time (sometimes called ‘touch time”) to produce a unit of a product.

The difference between total lead time and processing time means that there is a vast improvement opportunity in this value stream. This discrepancy is actually caused by a large inventory throughout the process, which prevents the value stream from performing at full efficiency. As a result, production lead time is longer, in comparison to actual service processing time, because all inventory levels must pass through the entire process, which takes 30 days.

- **Future State VSM (FS-VSM)**

In order to improve the CS-VSM, the FS-VSM must be drawn, so that everyone involved can understand what the value stream may look like in the future (as shown in Figure 2.19). This map focuses on the direction of a new design for CS-VSM and its intended performance at a point in a Lean transformation. The FS-VSM is used to analyse and describe how the value stream should operate in an efficient and effective way over timelines.

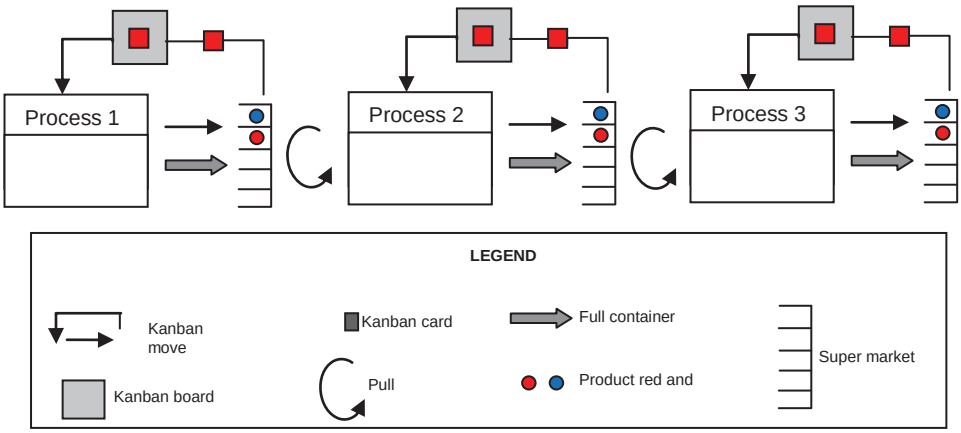


Source: (Harris et al., 2011, p. 151)
Figure 2.19 Example of future state value stream map

2.5.3. Just in Time: Pull Production

A fundamental feature of Lean manufacturing is the 'pull' mechanism. which is the principle of only producing what is consumed (customer demand) (Kerber & Dreckshage, 2011; O'Grady, 1988). Under this condition, inventories arrive in small quantities, just in time to go into production when the downstream workstation or the customer needs them. This pull system is integral to Lean manufacturing, because no upstream activity or production occurs unless there is demand from downstream. This concept relays information or signals from downstream levels (such as work centres or customers) to upstream operations about what parts or services are required (Alavala, 2008).

The 'Kanban Card' is used as a signal to exchange information between downstream and upstream operations (Black, 2008; F. R. Jacob & Chase, 2008): that is, where work centres signal (with a card) to upstream operation that materials are needed. The Kanban system plays an important role in levelling production or shortening production lead-time, by maintaining a sequential flow of timely information to all processes (Carreira, 2005; Kerber & Dreckshage, 2011; Nicholas, 2011). This provides the system with the capability to respond to small variations in demand and it facilitates work-in-progress inventory control.



Source : (Kerber & Dreckshage, 2011, p. 80)
Figure 2.20 A simple Kanban system

Figure 2.20 illustrates the basic concept of how Kanban cards work. As a container is pulled from the supermarket inventory, a Kanban card is sent to

the supplying process requesting a replacement quantity. Typically, the card will hang on a board next to the supply operation. If the red product is used, then a Kanban card indicating to replenish red is sent back. If the blue product is used, then a blue Kanban card will be sent. The quantity of Kanban cards will be adjusted based on changes in set-up time and travel time between work centres (process).

This method ensures that production does not exceed immediate needs, thereby reducing the work-in-progress inventory level and cutting manufacturing lead times (O'Grady, 1988, p. 45). However, the major problem with this mechanism is that any disruptions at any work centre can cause the entire line to halt, if the inventory buffer at one of the work centres is exhausted.

- **Takt time**

Takt time is the amount of time required to produce a product to meet demand/customer orders (Black, 2008; Nicholas, 2011). The current Lean equation of Takt time is the available working time divided by demand rate (after deduction from available time of such things as breaks, lunch, start-up and planned maintenance) (Carreira, 2005; Lewis, 2008). Takt time is also used to determine how many resources (labour and machines) are required in the value stream (Kerber & Dreckshage, 2011). In other words, Takt time will set the pace of the whole production line to meet customer demand. If several products are being produced in the assembly process, then Takt time must be calculated and it must be scheduled for each type of product.

The cycle time (C/T) is the time required to process a unit of product from start to finish (Sproull, 2009). This cycle time determines if the process can produce the quantity required based on the Takt time. The amount of Takt time is set to equal (or be just above) cycle time, in order to meet customer delivery orders (Revelle, 2002). All resources (including people and equipment) should be balanced to just under Takt time: and anything beyond

the Takt time line is not efficient and considered waste and therefore, it should be eliminated.

This balanced line philosophy can become problematic, for example: What would happen if market demand required the system to work beyond Takt time? This means that Takt time is efficient but sometimes not effective, especially if there is a high variation and uncertainty in the market. In such cases, Takt time must be adjusted and this may require the same resources which had previously been eliminated.

2.5.4. Continuous Flow Processing

The smaller the batch size which flows through the value stream, the shorter lead time — because it reduces WIP. Achieving one-piece flow of materials, based on customer orders, is one of the primary objectives of the value stream, because it reduces waste and no inventory is needed (Kerber & Dreckshage, 2011), which helps to eliminate the congestion of parts within a process (or between processes) and to achieve continuous flow processing. One-piece flow must keep pace with the Takt time, in order to avoid overproduction or late delivery and at the same time to facilitate continuity (Lewis, 2008).

In order to facilitate continuous flow, Lean manufacturing attempts to arrange the plant layout, to ensure materials can quickly flow from one process to the next. By grouping parts into a product family based on similar processes (also known as group technology) (F. R. Jacob & Chase, 2008; Nicholas, 2011), it is therefore possible to line up equipment and workstations in the sequence in which parts will be processed. Often the layout is in a U shape which is also called a Cellular Layout (Kerber & Dreckshage, 2011). This cell is composed of people (generally multi-skilled), equipment and work centres arranged in a logical sequence for a smooth and steady flow process: which can result in a reduction in the cycle time (C/T).

2.5.5. Prevention of Quality Defects and Equipment Breakdown

There is a tendency to react by accumulating stock based on an estimate of quality defects, equipment breakdown and employee absenteeism. In order to avoid such a problem, the Lean manufacturing method has adopted 'Jidoka' which aims to "solve the quality at source" as soon as a problem appears, rather than being reviewed later (Black, 2008; Nicholas, 2011).

Jidoka means a machine safely stops when the normal process is not completed, or it detects and stops any defective product from being produced. Only a product that satisfies the quality standard will be transferred to the next process in the production line (F. R. Jacob & Chase, 2008). Since the workers are in the best position to discover a defect, they can easily identify the cause of the problem and prevent its recurrence (Nicholas, 2011). Using the mistake-proofing, single-minute exchange of die (SMED) for quick changeover and five-S will help to bring a focus on making the part correctly the first time (Kerber & Dreckshage, 2011).

2.5.6. Continuous Improvement

Lean manufacturing emphasises continuous improvement (Kaizen), by identifying and removing non value-added activities, in order to improve the production process (Revelle, 2002). This improvement process involves the Kaizen management focusing on the overall value stream; whereas the Kaizen work team focuses on individual processes (Kerber & Dreckshage, 2011, p. 11) for identification of better ways to do things. These improvements can be used to redefine previous set standardised work, which is a very important step towards efficiency.

2.5.7. Worker Involvement (Team Work)

Lean manufacturing is a team-based process (Lewis, 2008) that requires a cross-functional team to facilitate the changeover (O'Grady, 1988). Lean Manufacturers empower their workers to act as soon as non-value added is

detected. Lean manufacturing also supports and encourages people to continuously improve the processes that they work on (Kerber & Dreckshage, 2011). This is done by forming a team and giving training and responsibility to do multitasking and allowing the team to meet, in order to discuss a problem and find ways to improve the process. It has a paradigm of rewarding staff for their suggestions, in order to motivate them and to show respect to their workers.

This is important to Lean Manufacturing because they believe that teams create synergy and flows, in addition to maximising resources to deliver customer-perceived value.

2.5.8. Standardised Work

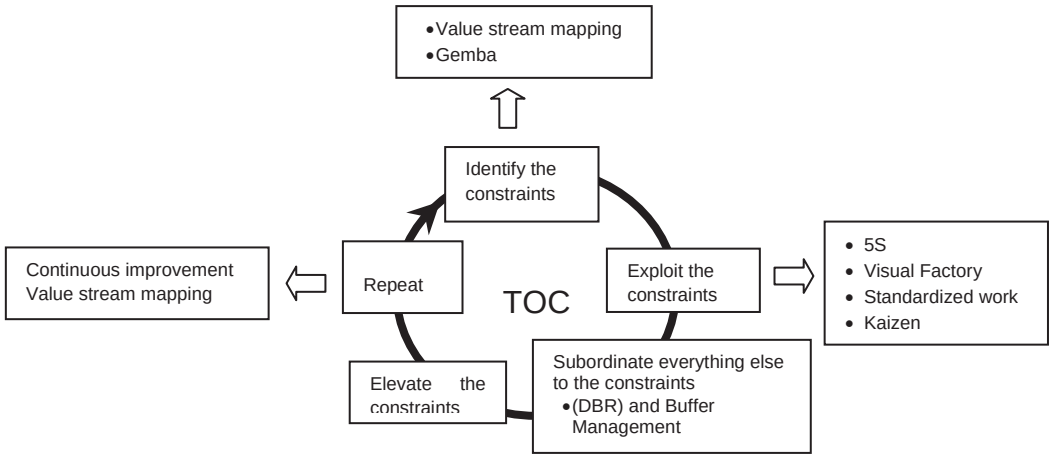
Standardised work is not only about documentation, but it is also an improvement process, which includes work methods that emphasises human motion. It involves training people to develop efficient workflow, resource utilisation and safety and quality, until the workers and their team leader can generate their own standard work procedures. This standard work is necessary to sustain the gains made and (combined with the discipline of improvement) this work can help to minimise or eliminate waste.

2.6. Compatibility between Lean and TOC-DBR Approach

The ability to implement DBR without needing to balance the capacity of production processes raises an interesting issue. The TOC-DBR does not discuss very fully how to improve the non-constraints, but rather it advocates that a degree of “protective capacity” is needed at non-constraints. Buffer management indicates when this protective capacity is at levels that are insufficient to aid flow through the system, but the reduction of said extra capacity, when the level is too high, is not dealt with, except to indicate that it is wasteful to have too much “protective capacity”. Improvement of non-constraints is something that has to be done with the Lean approach. It is

true that removing variation out of processes does not necessarily lead to increased throughput. Nevertheless, careful implementation of Lean techniques may reveal opportunities for real savings, which might be hidden within a DBR implementation.

Therefore, Lean can be used in conjunction with the TOC (DBR) approach, to leverage more benefits from the production process. Unlike TOC-DBR, which primarily focuses on the constraints (bottleneck) for a quick response to low inventory (despite variability levels), Lean focuses on reducing all seven types of waste at all levels and once variability has been reduced, it achieves a rapid response and low inventory (lecturer's note). However, both approaches have some similarities that can be worked together and integrated, for example, using the TOC five steps with some of the compatible Lean tools, as shown in Figure 2.21 below.



Source: (Com, 2010).

Figure 2.21 Using lean Alongside TOC-DBR

The major reason for harmonisation is to gain the best possible outcome and therefore a focus on throughput (T), as the primary measurement for continuous growth, is the best choice. This is because the TOC-DBR concept sees a system as a chain which is comprised of dependent links and hence, improving the weakest (constraint) link will have a greater impact than improving everywhere in the chain. The integration and harmonisation of

Lean features into the five steps of TOC for manufacturing approaches are as follows (D. Jacob et al., 2009a; Sproull, 2009):

2.6.1. Step One: Identify the Constraints

Once the goal has been established and the system defined, the system process is reviewed, in order to identify and locate the constraints. This can be used in conjunction with value stream mapping and the gemba of Lean may help to track the constraints. Alternatively, simply looking for the amount of WIP queues in front of resources (Trojanowska & Pająk, 2010); or areas where process expediting frequently takes place; or finding the equipment with the longest cycle time; or just asking the operator the location of the resource that does not keep up with demand (Sproull, 2009), will help to track the constraints.

A constraint is the item that creates the highest blockage to process flow and throughput and therefore, in order to make improvements, management must focus on this particular constraint. This step can be used to create substantial improvement to the CS-VSM and to draw up the FS-VSM in the Lean process. If this focus step is ignored, it will potentially result in a minimal impact on bottom-line profit, because efforts for improvement might be focused on non-constraint operations.

2.6.2. Step Two: Exploit the Constraints

The objective of this step is to maximise the output of a current constraint, by squeezing the most out of it, without any major investment or upgrade (Dettmer, 1997). This is in line with the Lean idea of making the most of what is already in the manufacturing area (D. Jacob, Bergland, & Cox, 2009b). For example, remove waste so the constraint can operate at its optimum capacity. Lean tools, such as quality at source, 5S, SMED, visual factory, standardised work and Kaizen (Sproull, 2009), can help to identify all existing forms of waste and discover hidden capacity (both constraints and non-constraints) that prevent the system increasing throughput. However, in this

step, it is necessary to only focus on constraints, because the constraints dictate the throughput, unless an upstream and downstream problem is seen as a potential disruption to the constraints — if identified in the CS-VSM (or during TOC Buffer Management).

The job needs to be prioritised, in terms of how effectively the constrained resources are being used (Wright, 2011): and this is also another way of exploiting the constraint, in order to increase throughput. The constraint is wasted if it is used to process a job that has less profit, compared to another which is not able to be made because of a shortage of capacity. This decision can be taken by prioritising jobs according to the amount of throughput margin per unit of constraint resource — and thus more profit is generated.

2.6.3. Step Three: Sub-ordinate Everything Else to the Above Decision

The system output depends on its constraints and therefore, other activities must be coordinated, in order to optimise the constraints output — and actions that contradict the subordination rationale should be avoided. This means non-constraint activities must be paced to the constraints ‘drum’ and any excess capacity is used as protective capacity to protect the system from any fluctuation, in order for the constraint to operate at its maximum effectiveness. This idea is similar to the Kanban concept of Lean, which is used to limit the supply of material into the production process to a rate of capacity constraint resources can handle. The ‘drumbeat’ (rate of the constraint) is similar to the Takt time of Lean.

The average speed of non-constraints is paced to the rate of the constraints, in order to ensure that constraint resources always have the correct amount to be processed. Therefore, when jobs enter into the system, the non-constraints must work as soon as possible and pass on their completed work for the constraints to work on, as soon as they are received: this is known asa rely-running works ethic. This reduces cycle time and improves on time delivery (AGI-Goldratt Institute, 2010) The idea of balancing capacity with

workload, based on Takt time, may increase the efficiency, but it can deteriorate the system when 'Murphy' strikes, if protective capacity has been eliminated. Just a small changed in demand can cause a negative impact that often takes a costly task to recover (Rhodes, Warren, & Carter, 2006). Moreover, according to Dr. Deming (Cox & Schieler,2010) , there will always be variations in systems, but these can be absorbed by time buffers and protective capacity, which are adopted by DBR (Institute TOC-Lean, 2008). Therefore, only an unbalanced line (in terms of capacity) can work well, in order to protect throughput.

Although an unbalanced capacity line technique is seen as not being totally 'efficient' from a cost world point of view, the ability of unbalanced capacity to provide backup capacity, in order to protect a system from any disruption and enable a system to produce more throughputs, compares well to the balanced-line of the Lean technique. Therefore, it is important to understand that, in this step, Lean can be used to define, measure and analyse the waste and variation that exists, but it does not balance resources in the non-constraint (Sproull, 2009). This is to avoid the non-constraint becoming a constraint.

As Figure 2.14 of TOC-DBR shows, material is only released into the system when there is a pull signal from a customer order and it does not exceed what the constraints can produce. Therefore, inventory is not needed at every work centre (Wright, 2011). The amount of work-in-progress is based on processing time on the constraint resources. Variations in the system will be absorbed by buffers, in order to protect constraints and to meet job order due dates. In addition, the unbalanced line of DBR provides additional protective capacity at non-constraint resources, when there is a disruption in supply. This means non-constraints have the capacity to re-produce more at faster rates than constraint operations and thus, this allows non-constraints to be quick enough to resupply before the buffers runs out of inventory. Those extra resources can also be used to handle greater product diversity and volume, without acquiring a new resource (Noreen et al., 1995).

Furthermore, the inventory-based system (Kanban) will not work effectively in volatile environments, because variability and uncertainty, in combination with dependency, can lead to instability of Takt time. In such environments Takt time must be adjusted frequently, which is often a costly task (Jacob et al., 2009)b . Furthermore, if the system fails to work at a pace with the adjusted Takt time, then the Kanban system cannot work, especially if the line is prone to breakdowns, which can cause a bottleneck and disrupt the flow and therefore it results in a negative impact on throughput (Cox & Schieler 2010) .

Previous discussion on the unbalanced line has showed that a time-based system will work well under variation and uncertainty, as it is protected by time buffers, which result in a small amount of inventory (equal to an amount of constraint processing time adequate to cover most forms of fluctuation) at the constraint and shipping points, which protect throughput. This indicates that a time-based system provides early system stability and it works best in all environments, compared to the Kanban system (inventory-based signal). DBR unbalanced and time-based signals also adopt the pull concept and they work well with high variation and uncertainty, compared to the Lean Kanban system and therefore, DBR of TOC is the best option to be adopted in these steps. After implementation of this step, the overall system is evaluated, in order to determine if the constraint has moved to another location. If the constraint has been eliminated, then go back to Step One: if not, then continue to Step Four.

2.6.4. Step Four: Elevating the Constraints

If the constraints still exist, ‘elevate’ the constraint, by taking whatever action is necessary to increase the current constraints capacity to produce more throughput to meet market demand (Sproull, 2009). This step is only considered, if Steps Two and Three have not been successful. Once control has been achieved through subordination, it is then essential to improve the capacity of the constraints, whilst ensuring that there is a market for that capacity. Major changes to the constraints are considered at this step, such

as adding additional resources to satisfy the needs of the market, if the benefit of elevating the constraints exceeds the cost of acquiring more constraint resources (Noreen et al., 1995; Sproull, 2009) and the cost of changing the system alignment to suit the new constraint.

2.6.5. Step Five: If the constraint has been broken - repeat Step One, but do not allow inertia to become a systems constraint

This step is a continuous improvement cycle. If the improvement efforts are successful in the constraints, then any further improvement on that link will provide little or no benefits. At this point, repeat Step One to identify new constraints and to make improvements to that link, but do not to allow inertia to cause a constraint. Value stream maps that have been created can be used to identify where the next constraint is most likely to be located (if it is internal to the process) — and begin planning and identifying resources that will be needed when this new constraint appears.

2.7. Potential Contradictions between Lean and TOC-DBR

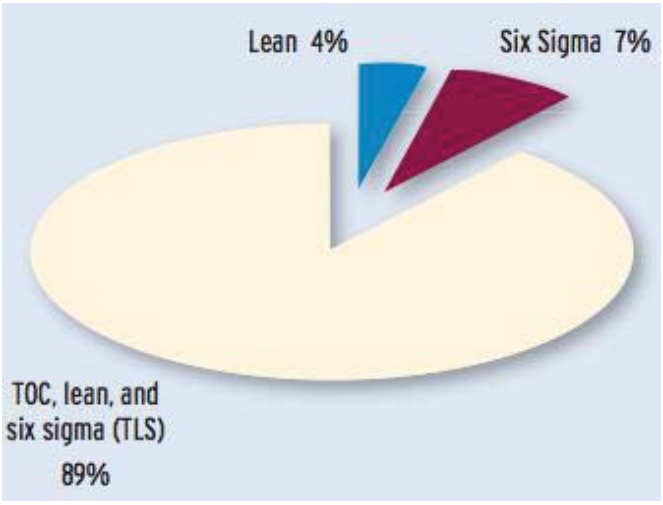
This section focuses on the potential contradictions of TOC-DBR and Lean that have to be addressed, in order for them to work together harmoniously for the best possible outcome. The potential contradictions are now discussed.

There is a conflict between the DBR unbalanced line and the Takt time balanced line. The Lean method attempts to balance the capacity of resources and equipment based on Takt time. Any capacity greater than Takt time is considered to be a waste: and hence it must be eliminated, so that the result is a balancing out of capacity to equal demand. As per the previous discussion, this balanced line will not work well with high variation in demand, product mix or process time (Wilson, 2010) and therefore, the TOC-DBR unbalanced line becomes the best choice to protect constraints, in

addition to throughput from variation. It can be noted that an hour lost on constraints is an hour lost from the whole system (Golratt, 1984).

Another potential conflict is between the DBR time-based materials release (buffer time) and the Kanban Lean inventory-based materials release (Kanban). As discussed earlier, in DBR methods the materials are released into the process according to a customer order and what constraints can produce to meet the order due date. The WIP inventory at the constraint represents only the next products that the constraint needs to produce in the next short period — and it can represent a variety of products. The content of the buffer varies dynamically across time to match demand and it is best thought of as a queue. The content of the buffer is thus not a static, standard number or mix of WIP items: it is static/constant only in the sense of the constraint process time that it represents. This is different to the Kanban system that requires a standard level of inventory for each product to be produced, at each work centre across the system (Cox & Schieler, 2010; Jacob & Chase, 2008). .

Management must consider the above contradiction when attempting to integrate TOC-DBR and Lean. In the case of DBR versus Kanban, it is a choice that can be made based on circumstances. In some cases, hybrids can be adopted, for example, DBR for the major flow, with Kanban for the subsidiary flow of common parts used in many different products, thus feeding the main DBR controlled flow. Indeed, an experiment in 21 plants (see Figure 2.22) that synergised TOC-DBR with Lean and Six-sigma (a programme named TLS) was shown to have delivered 89% of overall cost saving, compared with plants where only Lean or Six-sigma were solely implemented (Pirasteh & Farah, 2006).



Source: (Pirasteh & Farah, 2006, p. 33)
Figure 2.22 Cost saving results from TOC-Lean-Six Sigma (TLS) trial

This figure proves that the DBR technique, which focuses on throughput is far superior compared to Lean thinking, which sees unbalanced capacity as waste and inefficient.

2.8. Conclusion

Lean and TOC are compatible and complementary problem-solving methodologies aimed at the elimination of non-value added activity, through slightly different approaches. Lean balances TOC through an emphasis on team orientation and cultural change, in addition to relying on intuition and incremental problem solving. By focusing on all NVA activities, Lean identifies tasks and activities that should be eliminated, regardless of the existence of constraints.

This approach creates a weakness in Lean, due to the existence of uncertainty and variation in the systems, such that it is more appropriate to use an empirical approach such as TOC. The TOC emphasises the advantages of unbalanced resources for dealing with variability and it places a focus on constraints, while subordinating everything else to the constraints. Once a constraint is eliminated, it is necessary to find the next one and

therefore, TOC can be used on the primary constraints, whereas Lean helps to identify all waste.

Although TOC and Lean are complementary, they also have potential differences, which should be carefully managed. Lean uses a balance line based on the constraints pace to manage resources — and any capacity to produce at more than the pace of constraints should be eliminated. This is contrary to the TOC principle that accepts unbalanced resources, in order to cope with uncertainty and variation. In other words, the TOC advocates that excess capacity should be used as “protective capacity” (Kim, Cox, & Mabin, 2010; Smith, 2000), in order to protect the constraint from unforeseen circumstance and fluctuations that hit the system.

CHAPTER 3: RESEARCH METHODOLOGY AND DESIGN

3.1. Introduction

This chapter provides details about the chosen research methodology and the methods used to address each question, in addition to the rationale for the selected methodology and design.

3.2. Qualitative versus Quantitative Research

The use of qualitative research provides the ability to study human or systems' dynamic and complex behaviour that is not well captured by quantitative techniques. Qualitative research can help a researcher to study the variations of complex, human behaviour in context (Merriam & Associates, 2002). This means that qualitative research is better than quantitative, when researchers are attempting to do the following:

3.2.1. Develop an initial understanding of an issue or problem

The qualitative research approach is used when observing and interpreting reality, with the aim of developing a theory that will explain what was experienced (Newman & Benz, 1998). It explores questions such as *what, why* and *how,* rather than *how many* or *how much.* It helps the researcher to understand why an individual or group thinks and behaves in a particular way (Keegan, 2009).

Qualitative research facilitates the study of issues in depth and in detail. Fieldwork can be approached without being constrained by predetermined categories of analysis, which then contributes to the depth, openness and detail of the qualitative inquiry. Quantitative research, on the other hand, requires the use of standardisation measures, so that varying perspectives and experiences of people can be fitted into a limited number of predetermined response categories, to which numbers are assigned (Patton, 2002).

3.2.2. Understand the process and dynamic nature of reality

Quantitative research allows the researcher to establish relationships among variables, but is often weak when it comes to exploring the reason for those relationships. A qualitative study can be used to help explain the factors underlying the broad relationships that have been established (Brannen, 1992).

Qualitative research assumes that there are multiple perspectives on action and its meaning and thus, it seeks to describe the actors' perspectives. The aim is to gain access to the way the system or process is viewed by the people being studied, in order to understand their behaviour (Bryman & Bell, 2011). Qualitative research is used when observing and interpreting reality, with the aim of developing a theory that will explain what was experienced. The quantitative approach is used when one begins with a theory or hypothesis and tests for confirmation or disconfirmation of that hypothesis (Newman & Benz, 1998).

3.2.4. Improve findings from quantitative study

Quantitative research is good at handling large amounts of information and using those data to project some generalisations onto the population. However, qualitative research can help to explore the topic from the perspective of the participant and it can uncover rich details that provide insights for eventual quantitative studies (Hesse-Biber & Leavy, 2004).

Qualitative research can make visible and pick out the mechanisms which link particular variables, by looking at explanations, or accounts provided by those involved. Quantitative research excels at identifying statistical significant relationships between variables, such as social class and health status and frequently it produces diagrams which show the strength of population distributions. However, what eludes such an approach is that the capacity of quantitative research to explain how the macro (social class position, gender, locality) guides individual behaviour. This is where qualitative research can provide a complete picture (Barbour, 2008).

Quantitative research tries to describe numeric characteristics and coherences as precisely as possible: and to make them predictable (Howard & Borland, 2001). The random sample is chosen to be as large and as representative as possible. Aiming to keep the same conditions for data generation, quantitative research methods are fully standardised and structured (for example, the same question in the same order and scale). Quantitative research deploys a deductive mode of analysis, by making use of statistical methods: the result is objective and independent of the researcher; and the researcher is almost invisible. As a result, findings are precise, which allows for comparing and interrelating answers and finally for generalisation to populations.

In contrast, qualitative research has its roots in phenomenology and symbolic interactions (Cooper & Schindler, 2008). Since the focus of interest is the nature of issues, qualitative methods are rather open or partly structured and they have an explorative character. Qualitative research is identical to the fieldwork (ethnographic or subjective), in which the choice of sample is theory driven and where a small group of typical cases for a specific field is chosen. The investigator's subjectivity is considered and made explicit: the researcher is part of the study (Brannen, 1992). The researcher is primarily the instrument for data collection undertaken during fieldwork. Inductive analysis is undertaken by researchers to describe multiple realities and a deep understanding of human experiences will lead to comprehensive, expansive, often holistic findings, which do not allow for generalisations — but they can offer a direction for further investigation (Merriam & Associates, 2002; Taylor, 2005).

3.2.5. Flexible procedures for subject selection

Qualitative research is highly flexible in that data collection is ongoing and it occurs simultaneously with data analysis, which allows the research plan to be altered as needed (Krysik & Finn, 2010). Initial data may reveal an aspect of collection efforts that could then be targeted to shed additional light on that

particular area. As new insights arise, the focus of data collection can change accordingly (Brannen, 2005).

The methods for obtaining qualitative data are less structured than those used in the sample of a survey in quantitative research, where questions are designed with a limited structure, in which respondents provide answers within a format that is rigidly controlled by the researcher.

By comparison, the qualitative research method tends to be more flexible because it uses open-ended questions that get to the *why and how* underlying the phenomenon (Bryman & Bell, 2011; Cooper & Schindler, 2008). Respondents are allowed to give longer answer and use their own words. Since questions are open-ended, interviewers usually probe further, in order to gain clarification or to focus respondents on specific elements of their answers that are more interesting to study. These unstructured answers also allow for the possibility of discovering new explanations or relationships that the researcher did not know to be important priori, for example, how different brands are perceived as relating to one another (Keegan, 2009). The result of findings would be recorded in a textual form of data.

Qualitative research emphasises the importance of multiple measures and observations and therefore, guiding research questions tend to be more broad and open-ended. This allows the researcher to collect a wide variety of data, aimed at getting a holistic picture of the phenomenon under study. This also permits the researcher to engage in triangulation, in order to gain a ‘better handle’ on what is happening in reality — and to have a greater confidence in the research findings.

Quantitative research has been founded on the development of a valid and reliable measurement instrument. However, when tests and measurements are used to study a person or a complex system, it becomes difficult because the limitations and unique self-expression of the person/s may remain outside the scope of the enquiry. This is where qualitative research becomes superior, when used as a human measuring instrument, due to its ability to observe subtle behavioural changes and verbal and no-verbal cues, in

regards to the subject being studied. Furthermore, as the investigation progresses, the human 'instrument' becomes more aware of what is happening and (as the data is cross-checked with each other's point of view) the data collection becomes accurate.

Quantitative research is an approach that seeks to determine the relationships between variables (and particularly cause and effect relationships) through statistical meaning. Although quantitative research provides precision and control within the research process, this type of research is too mechanistic to adequately capture the complexity of human behaviour, which can only be undertaken through qualitative research. The researcher needs to acknowledge this complexity, by studying phenomena as they occur in natural settings, rather than through the artificiality of limited experimentation (Kervin, 2006).

3.3. Research Methods and Design

There is no single qualitative research method, which can be considered the best in all circumstances. The method chosen for this research is a case study, because it allows the researcher to place the theory into the context of the environment in which it takes place in a natural setting (Myers, 2009; Yin, 2009), with the aim to explore questions such as *what, why* and *how* the phenomenon takes place (Keegan, 2009). This method is well suited to this research, in order to answer the research questions. The key element of this case study focuses on the TLS-P process within the offices of the ADN and NPC.

3.2.1. Type of data collection

A good case study research can be provided by using multiple types of data collection. There are six common types of data collection: direct observations, interviews, archival records, documents, participant observations and physical artifacts. The combination of these types of data

collection is dependent on what is available and relevant to the study. The major data collection strength of the case study is the opportunity to use more than one source of evidence, which allows the researcher to perform a data triangulation process. Thus, any finding or conclusion in the case study is likely to be much more realistic and accurate (Yin, 2012).

According to Simon (2009), the observations, interviews and document analysis are mostly used for case study data collection. Each type produces a different level of understanding of the research problem, thereby strengthening the overall outcome of the result. For example, observations can be cross-checked with interviews and documents recorded. This brings different types of information to bear on the problem and produces deeper insights. It not only allows two or more independent sources for the same event and facts and interpretations to be cross-check for validation, but it also allows for one method to compensate for the weakness of the other.

In the following sections, each of the methods of data collection used in this research is discussed.

- **Direct observation**

Observation is one of the main data collection methods for the naturalistic or fieldwork setting. The intent is to adopt a systematical and selective way of watching, listening and recording any interaction or phenomenon, as it takes place. For example, to study interactions within a system and ascertain the functions performed by employees in their workplace (Kumar, 2005).

During fieldwork, the researcher can choose to remain free or become part of the subject. Field notes and photographs are most important during data collection through observation. The field notes can be supplemented by tape recordings and they should be transcribed as quickly as possible for study and analysis (Gray, 2009).

This observational technique is normally disguised and it provides information of actual subject behaviour or events without interference, as it

takes place. In other words, what has been seen and heard is written down without alteration and it is just recorded as it happens. According to Srivastava & Rego (2011), this method is suitable to study a process, where an expert person walks through and observes the process critically and writes down observations about the process.

In order to avoid knowledge of being observed, field notes are written about all the interesting terms and ideas that have been heard and seen during the observation, but this is only done in great details after leaving the field. People's actions and interactions are observed and they can then be described and organised into a type of chronological order. This allows the researcher to collect non-written and non-verbal information. This information can be seen as complementary to the documentation and interview methods of data collection (Bajpai, 2011). The observation records would be analysed and written down, based on interpretation of what had been observed. According to Yin (2012), this type of record is acceptable because it accords with the goal of data collection for a case study.

- **Unstructured interviews**

This observation method is suited to the study of human behaviour or system processes. It cannot be used to gain information about a person's perceptions, beliefs, feelings or experiences of the system. This type of information can be collected through interviews. This method may be used as an extension of observation, because sometimes it is necessary to find out what was happening during the observation (Zhang & Wildemuth, 2006).

It is most likely that, during an interview, people may enjoy talking about their work and this allows them to reflect on events without having to commit themselves in writing, especially if they feel that information may be confidential (Gray, 2009). There are three main types of interviews: structured, semi-structured and unstructured (informal conversation). Unstructured interviews provide the freedom to formulate the questions around the issues being investigated. On the other hand, structured and

semi-structured are less flexible because the researcher has to determine the questions beforehand (Kumar, 2005).

The type of interview methods to be used depends upon the nature of the problem being investigated and the information required. An unstructured interview relies on the spontaneous generation of questions, which depend upon the context of discussion as the interview takes place. In addition, this allows the researcher to elicit information by involving the interviewee in free and open discussion on the topic of interest. The researcher can use whatever sequence, wording and way of explaining questions: and the interviewee can talk freely about what s/he considers to be important (Myers, 2009). This approach allows the researcher an opportunity to explore, in depth, issues that have been raised during the interview.

According to Yin (2012), the flexibility of unstructured interviews can reveal how case study participants construe reality and what they think about the situation, which can provide important insights into the case, rather than just providing answers to the questions. He also states that these insights could gain more value if the participants are key persons within the organisation because, due to their roles, they can provide distinctive insights or information that cover a whole set of issues, which is not likely to be obtained from other sources.

Simons (2009), in his book "*Case Study Research In Practice"*, identifies four major purposes of the unstructured interview (in-depth interview). The first is to find out what the other person thinks. Secondly, is active engagement and learning for both the interviewer and interviewee, when identifying and analysing the issues. Thirdly, it provides flexibility to change direction and pursue emergent issues, by probing topics and deepening responses from participants. This can allow researchers to constantly modify the questions, thus making them more suitable for analysis of the problem being studied. The fourth purpose is to uncover information that cannot be observed.

This type of interview technique is well suited to this research, because it provides flexibility in terms of what path the interview should follow. This is

because the current organisational environment is very dynamic and rules driven. By obtaining a deeper understanding of the critical issues involved, the researcher will be better able to clearly define the research problem and thus it will help to answer the research questions.

- **Documentation**

According to Yin (2003), documentary information can be of use in every case study and it should be in accordance with the data collection plans. Documents, such as transmittal letters; memoranda; project documents; minutes of meetings; written policies; rules and regulations; and other written reports of events related to the research are useful. These documents can provide specific information to confirm and augment evidence from other sources.

These written documents may provide information about the organisational culture and processes; the value underlying policies; and beliefs and attitudes. This can help the researcher to understand, for example, the reason for (and context of) policy and how it is being implemented within the current practice. Document analysis is also helpful to initiate observations and interviews, because it can provide information that may be useful to explore in the case study and also to provide a context for the interpretation of interviews and observational data (Simons, 2009).

3.4. Data Collection Process

The following are the steps of the data collection process adopted in this study.

3.4.1. Staff opinion survey of UDEs

The first step was to conduct a staff opinion survey which could provide valuable information about current procurement processes. The goal was not only to explore some preliminary information, in order to establish priorities, but also to identify new/unexpected problems prior to conducting fieldwork for the data collection.

A simple undesirable effects (UDEs) survey questionnaire (see Appendices A) was designed, based on the researcher's experiences within a similar process. This questionnaire was sent to key personnel in both case study organisations, in order to verify whether or not the UDEs proposed did exist. The results showed that 80% (i.e. 9 out of 11) of the proposed UDEs existed within the procurement process.

3.4.2. Documentation review

The second step was to investigate relevant documents related to current regulations, guidelines, policies and procedures: and project documents used at NPC and ADN. This investigation was aimed at allowing the researcher to review historical and current data on projects that were particularly related to procurement activities, in order to find evidence as to why undesirable effects (UDEs) existed.

3.4.3. Staff interviews

The final step was to observe the system and interview the key personnel involved in the procurement process, in order to identify other UDEs that currently existed, other than the UDEs listed in the preliminary questionnaire

survey (Step One). The interview method is useful to capture employee's experiences in regards to the systems and thus, to gain a dynamic understanding of the methods used and what employees perceive as opportunities and hindrances. It also was aimed at helping the researcher to validate and to understand the cause and effect relationships between the UDEs discovered in earlier steps.

3.4.4. System observations

Observations aimed to help gain a better understanding of the process, especially as it enabled the researcher to relate concepts and methods in theory to the reality. The CS-VSM was planned to be used, in order to support the observations and capture the flow of information (procurement project document) that takes place along the work processes, in order to complete a service. The researcher aimed to then walk through this CS-VSM to collect information, such as processing time (P/T), lead time (L/T), change-over time (C/O), number of WIP and demand rate.

3.5. Data Analysis Process

According to Yin (2012), a good use of theory is to use it as the basis for helping with research design and analysis. At the analysis stage, data can be analysed and thus it can be construed to what extent theoretical understanding can be supported or rejected (Gray, 2009). For the data analysis, TOC-TP tools and a value stream map of Lean, as outlined by Dettmer (1997) and Keyte and Locher (2004) respectively, were to be used to aid the analysis, in order to determine to what extent the system could be improved; and to assess the potential for the use of TOC-L towards system improvement. TP Software tools, such as Flying Logic and Microsoft Visio, were used during the analysis process and design of the TP tools and VSM.

The first step is to conduct a document analysis in order to understand how the TLS-P works. This action takes place, in order to understand how the

TLS-P systems interact to produce the ultimate output. The information includes their goals and measurements.

The second step is to identify the constraint(s) and whether it is (or they are) policy or physical constraints. Compared to the physical constraints, policy constraints have a more damaging impact — but policy is difficult to find and break. Therefore, the fastest way is to first identify physical constraints, which may provide a path to the policy constraint that may cause physical constraints to exist. The CS-VSM, the Flow Charts and CRT of TOC-TP are useful tools, which can be used at this stage to identify the constraints and their underlying core problems, in order to answer the second research question.

The third step is to use the CRD, FRT and FS-VSM to help in the identification and development of the direction for improvement. The final steps, if time allows, are to use the PRT, TT, DBRs and other Lean tools for an implementation plan to improvement the system

The combination of a case study and TOC-L approach bring different types of information to bear on a problem and they produce a deeper insight, which not only allows different independent sources for the same event, facts and interpretation to be cross-checked for validation, but it also allows for one method to compensate for any weakness of the other.

CHAPTER 4: ANALYSIS AND DISCUSSION

4.1. Introduction

This chapter presents the results of data collection during the enquiry, according to the research questions. There are three main sections in this chapter, which are as follows:

Section 4.2: Discuss how the TLS-P process works and what problems (i.e. UDEs) prevent the system from improving the information flow between agencies, at each stage of the procurement process. The process includes mapping the flow of documents and information (using CS-VSM and flow charts) within the TLS-P process. These captures contain a number of possible UDEs (using FRT and CLR), which have been obtained during observations and checking with the staff involved, for both validation and confirmation as to the accuracy of the UDEs. Once confirmed, the UDEs are placed into their respective locations on the map and the storyline is written, followed by checking-back with the people concerned. This process continues until the flowcharts and a definitive UDEs list are completed. This process involves eight keys staff members (directors, commissioners and advisers) and general staff, who are involved directly with the procurement process at MPS, ADN and NPC. This TLS-P complicated process takes approximately two and a half months to ‘walk through’.

Section 4.3: The purpose of this section is to identify the constraint/core problem within the TLS-P system, by using a Current Reality Tree (CRT), in order to find the answer to the question: “What to change?” and a Evaporating Cloud (EC) is used to identify why such a constraint/core problem exists within the system.

Section 4.4: This section discusses details on how to apply CRD, FRT and PRT towards system improvement. Firstly, EC is used to identify the best possible injection of a ‘win-win solution’, in order to break the conflict cloud that is the cause of the dilemma within the TLS-P systems. Later, this injection is used in FRT to change UDEs to DEs, in order to answer

Research Questions Three and Four: “How the system can be improved?; and “Can TOC-L help towards system improvement?”

4.2. The TLS-P Process

There are reasons why a formal procurement process must be followed, which include the prevention of fraud and compliance with management, in regards to risk and control. This leads to a segregation of responsibility and an approval process within the TLS-P process. TLS-P involves various agencies at each stage of the procurement cycle.

4.2.1. Agencies Involved

The TLS-P process has undergone significant transformation since reforms (initiated in 2008) were undertaken, which were aimed at strengthening the principles of transparency, fairness, effectiveness and efficiency, in line with established procurement roles and regulations. These reforms included a restructuring of the workflow process based on segregation of duty and responsibility for the procurement activity (see Appendices B). This procurement process involves various tasks and agencies, as follows:

- Planning and specifications requirement: responsibility of the Line Ministries (LMs) or Project Owner
- Budget and commitment: responsibility of the Major Project Secretariat (representing the Minister of Finance and the Council of Administration for Infrastructure Fund - CAFI)
- Quality control function: responsibility of the National Development Agency (ADN)
- Tender and contract establishment: responsibility of the National Procurement Commission (NPC)
- Contract Management and hand-over: responsibility of the ADN and Project Owner

The separation of workflow (as shown in Appendices B), on the one hand, may provide better control and spread the work to other agencies, thus reducing the workload but, on the other hand, it also increases bureaucratic procedures and reduces responsiveness. Figure 2.22 shows the basic TLS-P cycles, which consist of eight steps within the procurement process, in addition to the agencies involved.

- **The Major Project Secretariat (MPS)**

The Major Project Secretariat (MPS) is an agency that has been set up within the Ministry of Finance (MoF) and it has responsibility for appraising and preparing major infrastructure projects, which are essential to support the country's economic growth. Project appraisal is a prerequisite for funding. Although a project may appear to be most desirable on paper, it may not be viable from the point of view of technical feasibility; financial feasibility; market potential; or environmental impact; and these factors have to be systematically reviewed and assessed.

The appraisals include estimating the project cost and benefits, in order to determine whether the benefit (such as the economic welfare of society) is at least sufficient to compensate for the cost of investment. This involves assessing its feasibility and to ranking the project based on the Timor-Leste Strategic Development Plan (TSDP) priority project. The appraisal includes identification of the source of funding.

The MPS also provides support to the Council of Administration for Infrastructure Fund (CAFI), in addition to raising and creating Committed Payment Vouchers (CPVs), Purchases Orders (PO) and Payment Requests (PR). The MPS is comprised of four main units: Public-Private Partnership (PPP); CAFI Support; Development Sector; and Loan Unit.

- **National Development Agency (ADN)**

The ADN reports directly to the Prime Minister. It monitors and administers the implementation of the Timor-Leste Strategic Development Plan (TSDP), which includes large and complex national development projects. The responsibility of the ADN is to review the merit and feasibility of major infrastructure proposals in terms of project quality; all technical aspects; cost and quantity estimates (and if necessary suggesting changes); monitoring and reporting on the execution of the infrastructure project; the entire government coordination; national planning and evidence based on policy development; and the monitoring and evaluation of major government projects and programmes.

ADN work with NPC to ensure that major infrastructure projects are delivered on time, within budget: and in accordance with the contract's scope and specifications. According to Government Decree Law No. 11/2011 (Timor-Leste, 2011a), the tasks of ADN are to:

- pronounce on the Plan of Infrastructure, upon request of authority;
- offer advice on the merits and feasibility of projects, which will be sent either in the preliminary phase of the project or in draft form;
- conduct a detailed evaluation of the quality of the project; checking all technical aspects, including cost estimates and quantities and (if necessary) propose amendments;
- check and verify whether the project complies with the standards;
- supervise and monitor the construction or implementation of the project;
- assess, review and recommend changes or adjustments required during the construction phase or implementation of projects;
- recommend payments as a result of the severity of the project and the quality required;
- submit certification of quality of construction, infrastructure or other project; and
- develop and propose the adoption of standards and special standards of quality certification.

As shown in Appendices C of the organisation's charts, the ADN will also be responsible for the management of the Millennium Development Goals Suco (MDGs Suco) Program and the Program for Decentralized Development (PDD) I & II. This includes participation in the process of selecting contractors to undertake works; evaluation of the timeliness and quality of the works; and management and approval of contractor payments for implementation of small value projects. Currently, ADN has 48 technical staff and 27 support staff available for quality control functions.

- **The National Procurement Commission (NPC)**

Similar to ADN, NPC is also under the direction of the Prime Minister and it was established to carry out tender procedures for major project and complex construction works, which have been appraised by the MPS and which have a priority that is sufficiently high under the TSDP to achieve the most economic value for the Government and quality control by the ADN.

The NPC also has to monitor and provide technical assistance to other procurement entities for procurement processes, in regards to projects costing less than one million U.S. dollars. This is to ensure that the procurement process is managed at the highest levels of integrity and professionalism. NPC currently has 12 procurement specialists and six support staff.

According to Government Decree Law No.14/2011 (Timor-Leste, 2011b), NPC tasks and responsibility are to:

- carry out procurement procedures equal to (or greater than) one million U.S. dollars;
- provide technical support and assistance in procurement procedures up to one million U.S. dollars; and
- collaborate with the National Development Agency, the Office of Major Projects, ministries and other public entities, in order to carry out their tasks.

The aim is to ensure that a competitive process is in place that leads to high quality and cost efficient procurement, which achieves the best value for money — and also transparency.

- **The Line Ministries (LMs) or Project Owner**

The responsibility of the LMs is to prepare their detailed procurement project for the current financial period, prior to the procurement process commencing. Complex projects that equal or exceed one million US dollars, must be forwarded to MPS (as the secretariat of CAFI) for approval. Such approved projects are hence sent to ADN and NPC to begin the quality control function and tender processing.

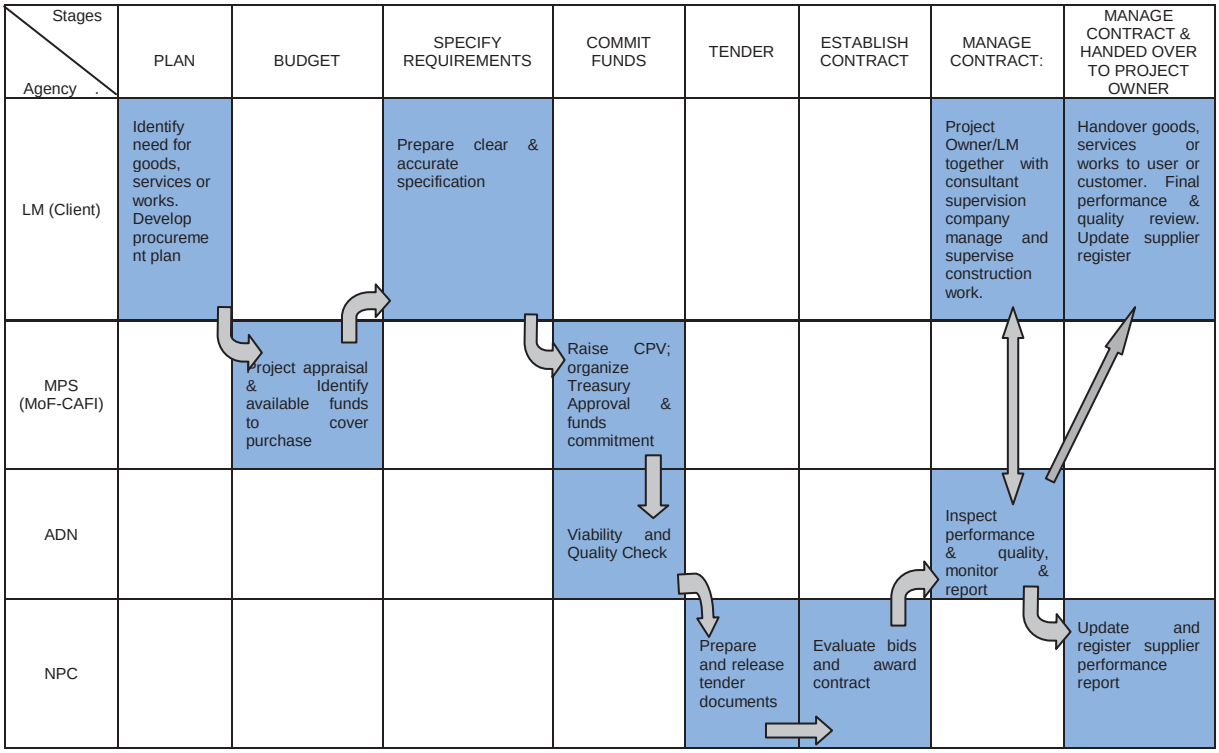
4.2.2. Current State of Value Stream Map (CS-VSM)

The first step of the data gathering exercise is to draw a current state value stream map to show how information flows through each procurement cycle: and to identify the cycle time of the process, as it is currently executed. For this purpose, the researcher needed to measure the touch time required for each process step and then add those times together. The time that documents stay in each of the steps varies and depends on project complexity and the skills of staff involved. Therefore, it was found to be very difficult to measure average touch time for each stage.

In addition, as a result of current procurement reform, ADN and NPC are only involved from the third stage of procurement and onwards. The researcher was thus only able to identify touch time for the tender, contract establishment and handover stages. Contract management is dependent on contractual agreements, which vary, depending on the size of the project. Therefore, it has proven to be very difficult for the researcher to draw a complete current state value stream map of TLS-P.

Figure 4.1 shows the TLS-P current state value stream map (CS-VSM) that it has been possible to create. It is true that, without a completely drawn CS-

VSM, it is difficult to find the longest touch time. However, it does indicate the tender and contract establishment stages, which are under the responsibility of NPC: and these stages include the longest touch time. Figure 4.1 shows that it takes 109 days (more than three months) to produce a contract through this process. The actual process is, therefore, a potential constraint, if project documents do not arrive on time (Kendal, 2012). There are 128 projects listed on the Government's annual "Budget Book Six": and hence, NPC must receive at least 32 complete project documents every three months, in order to conduct a proper procurement process.



Source: The researcher
Figure 4.1 TLS-P cycle and agency involved

4.2.3. The Procurement Cycles

The above value stream map does not provide sufficient information on how the current TLS-P works. In order to overcome this problem, the researcher decided to construct flowcharts to describe how the TLS-P works. These flowcharts are based on the researcher's observations at the ADN and NPC

offices, during data collection periods of almost three months duration. This data gathering activity included observations of meetings between MPS-ADN-NPC; discussions between the researcher and agency staff about infrastructure funds workflow; and a researcher conducted document analysis related to the flow of the process.

The TLS-P cycle consists of a series of events, actions and decisions leading to completion in a single procurement transaction. The cycle starts with the receipt of a procurement plan and it ends with the completion of a contractual performance. Based on the researcher's past-experience as a senior procurement adviser, it was noticed that changes occur within procurement workflows, by adding MPS, CAFI and ADN into the loop. This addition increases the complexity of the flow of procurement project documents, compared to the time when procurement was centralised at the MoF Office.

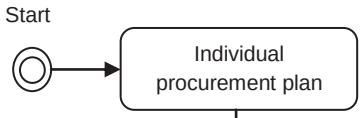
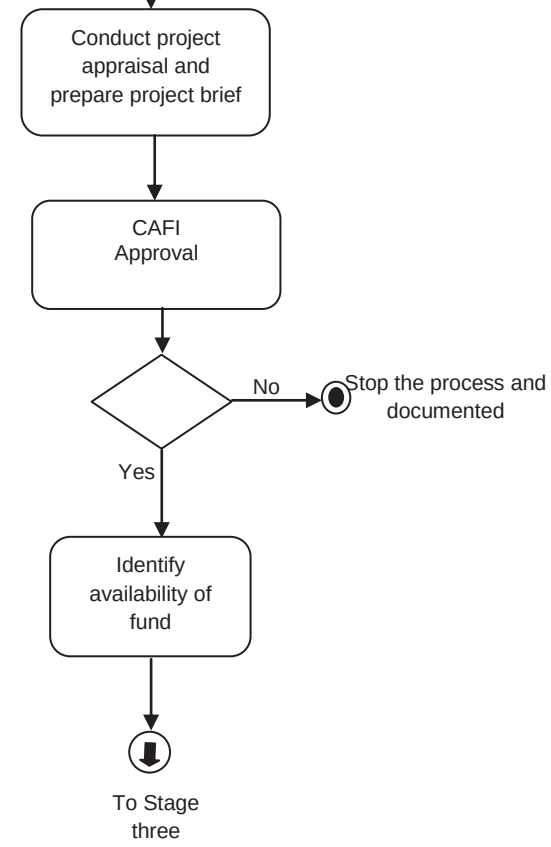
The major procurement cycles identified during the data collection process are summarised in the flowchart below.

4.2.4. Planning and Budget Stage

The procurement plan describes the goods, services or works to be procured and can be used to plan, budget and manage the procurement function. The procurement plan lays out details of the procurement process and action required to acquire the goods, services or works. It involves consideration of *what, how, how much* and *when* to procure. The procurement plan can help agencies to optimise the flow of information along the procurement cycle in a timely manner, in order to avoid last minute emergency procurement.

The TLS-P process starts with LMs preparing their individual procurement plan, in order to clarify what is needed and by what time. The information relating to the individual procurement plan from LMs should then be submitted to MPS at the beginning of the financial year (every January), since the secretariat of the CAFI and the MPS conduct an appraisal of the proposed project investment of each project, in addition to seeking a source of funding.

The MPS must submit the result of this analysis to the CAFI for approval or rejection. Their decision focuses on prioritising those projects that will best achieve the TSDP target (Timor-Leste, 2010b). Rejection means the process for that proposal is stopped. If the project is approved, then MPS sends a request to MoF to identify the source of funds and it raises CPVs to commit the budget for that project. The procurement plan is always based on projects that are listed in the annual "Budget Book Six" (see Appendices D).

Stages	Agency	Work Flow
One	LM	
Two	MPS	

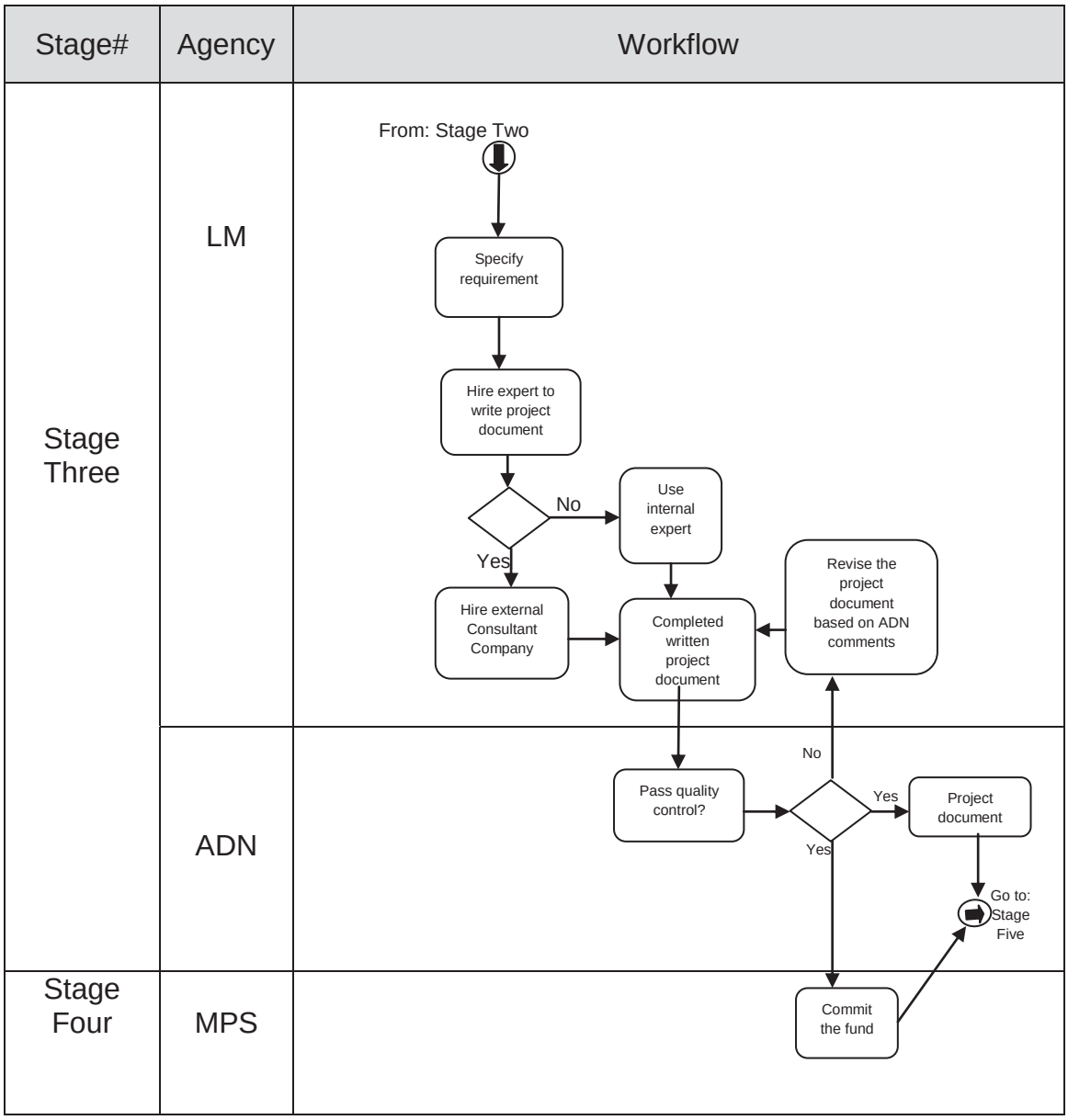
Source: The researcher

Figure 4.2 Stages one and two of the procurement cycle

4.2.5. Specification Requirements and Commitment to Funding

In this step, the relevant LM's responsibility is to prepare clear and accurate detailed specifications, containing sufficient information to enable the potential companies to decide what goods, services or works to offer. The specifications should also be clear and generic, in order to allow all companies to offer in a competitive manner.

In order to write detailed specifications, the LMs may use their internal expert(s) or decide to hire external expertise, if internal expertise is not available. However, NPC and ADN can also be invited to provide additional information, if necessary, in order to complete the job. The completed written specification is sent to ADN, who are responsible for the quality control function: that is, ensuring that there are no quality defects. At the same time, ADN also requests MPS to commit the funds.



Source: The researcher

Figure 4.3 Stages three and four of the procurement cycle

4.2.6. Tendering and Contract Establishment

The main responsibility of NPC is to conduct the tender processing: that is, to select and establish a contract with the most suitable company that can undertake the services or works. Although every project document forwarded to the NPC has already passed a quality check by ADN, NPC also conducts a quick quality review, in order to detect any error/s that may have been

missed during previous steps. NPC will send back the project documents to ADN, if they contain significant quality issues.

If the documents pass the quick quality review, NPC starts to prepare the standard bidding documents (SBD), according to the project documents requirements and these contain evaluation criteria, against which all the bidders will be evaluated. The SBD is a document used to request potential contractors to offer their proposal to provide the required goods, services or works. The SBD includes the bidding procedures, the project document and a draft sample of a contract form.

Table 4.1 Example of project to be tendered and a typical time frame

No	Project	Prepare SBD	SBD review and approval	Invitation to Bid or RFP	Tender evaluation	Approve evaluation report	Intent to award notification	Contract negotiation	Bid challenge	Contract award	Contract signing	Total
1	Rehabilitation and maintenance of Dili-Tibar-Liquica road	14 days	7 days	30 days	14 days	3 days	1 day	14 days	5 days	7 days	14 days	109 days
2	Rehabilitation and maintenance of Dili-Tibar-Gleno road	14 days	7 days	30 days	14 days	3 days	1 day	14 days	5 days	7 days	14 days	109 days
3	Construction of Zumalai-Suai road (L=25.00 km)	14 days	7 days	30 days	14 days	3 days	1 day	14 days	5 days	7 days	14 days	109 days

Source : (Kendal, 2012).

The preparation of the SBD and approval process takes at least 21 days before the tender or procurement notice inviting potential contracting companies is issued. A technical and a financial offer/proposal) must be submitted in two separate sealed envelopes before or on a deadline date. During the tender period, which is open or valid for 30 days, the interested bidders are allowed to send in a request for clarification. Responsible people within NPC must respond to all clarification requests, at least 10 days before the submission deadline. NPC may extend the tender deadline if clarification causes a significant change in SBD, or it is time-consuming.

Interested bidders must submit their proposal in hardcopy to NPC, on or before the deadline and any late submission will be rejected. The received

proposals (only the technical envelopes) shall be opened immediately after the submission deadline, in front of all bidders who wish to attend.

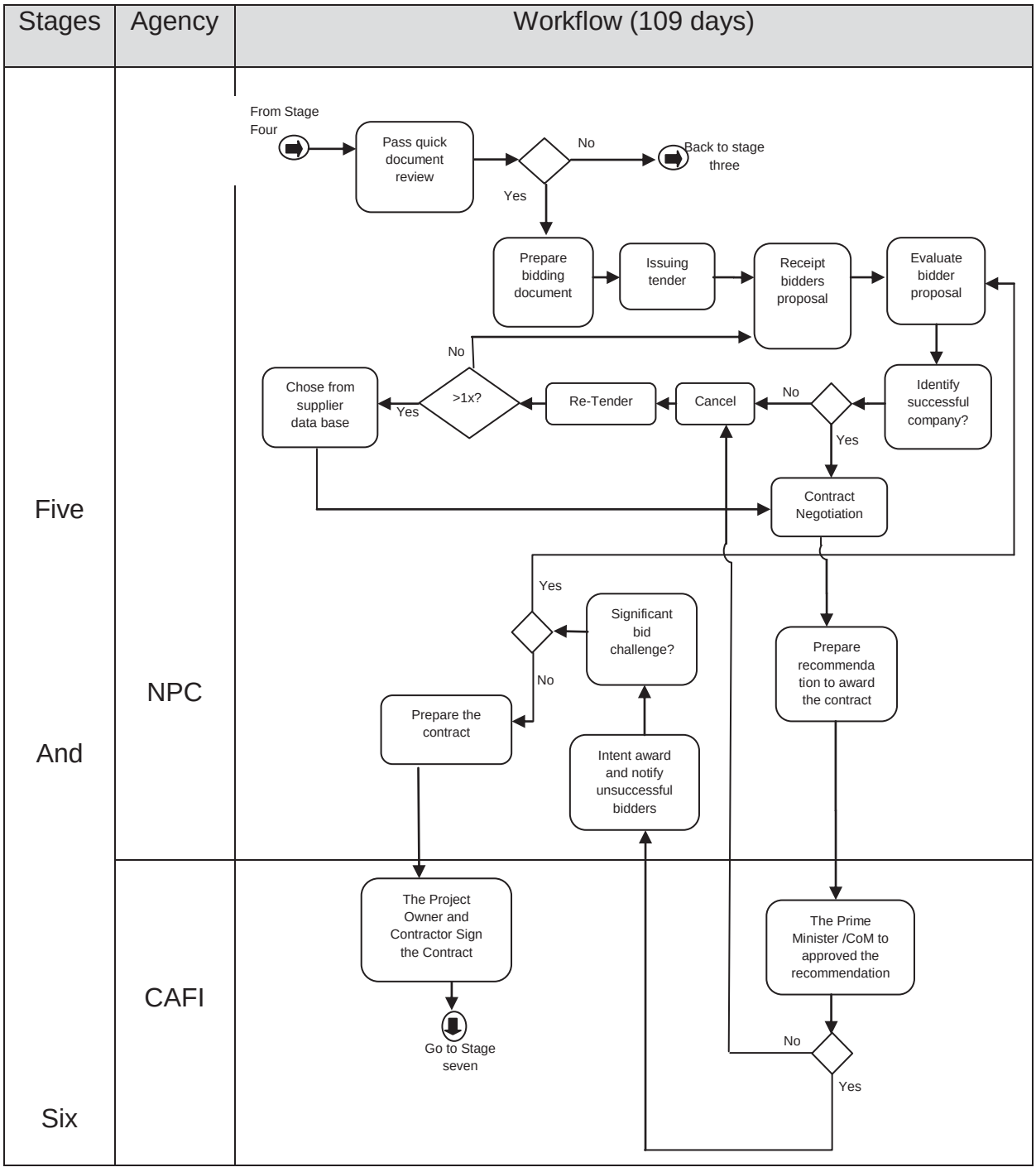
The evaluation team (comprised of NPC and LM) then begin the evaluation process to select the potential bidder, based on criteria set out in the SBD. Only bidders who have passed the minimum requirement, for example, those with at least 70/100 of technical and financial capability are invited to open their financial proposal, which contains a detailed breakdown of costs for the intended project. The evaluation team checks the financial proposal to ensure there are no arithmetical errors and that it covers all items listed in the Bill of Quantities (BoQ). The next step is to compare those financial proposals, in order to gain additional marks of at least 30/100. The bidders will be ranked, based on a combination of technical and financial evaluation results.

In cases where there are no bidders who have passed the minimum technical and financial capability criteria, then NPC must cancel the process and retender again – up to a maximum of twice (if there is sufficient time to do so). If no time is available, or the process is already a 'retender', then NPC has the option to choose the potential company from the supplier database.

The evaluation team must invite the first ranked bidder to attend negotiations, in order to minimise any risks, uncertainties and costs that may arise during project implementation. These negotiations should not go over issues already agreed to during the selection process. If negotiations with the first ranked bidder fail, the evaluation team must eliminate this first ranked company and invite the second ranked bidder to negotiations. The same methods must be used if the second ranked company also fails in the negotiations. The evaluation and negotiation process takes a minimum of 28 days.

Once negotiations have been successfully completed, NPC must prepare the 'award recommendation document' based on the evaluation report: and then seek approval from the Prime Minister (if the value is between one to five

million USD) or the Council of Ministries (CoM) for values above five million USD. In a case where a recommendation is not approved, the NPC must cancel the process, inform the bidders and initiate a retender process.



Source: The researcher

Figure 4.4 Stages five and six of the procurement cycle

The approval process takes three days. NPC should immediately notify the unsuccessful bidders about their decision and allow them to submit bid

challenges, if they so desire. NPC must respond to bid challenges within five days. If the challenge is significant, NPC may consider postponing the contract award: otherwise, NPC must publish the intent to award the contract publicly within seven days. At the same time, the awarded company must review the draft contract and request any proposed changes or modifications to the text, which must be provided in writing and justified. After 14 days of receiving the intent to award notice, the awarded company and project owner must sign the contractual agreement. This stage requires approximately three months, from tendering until signing a contractual agreement.

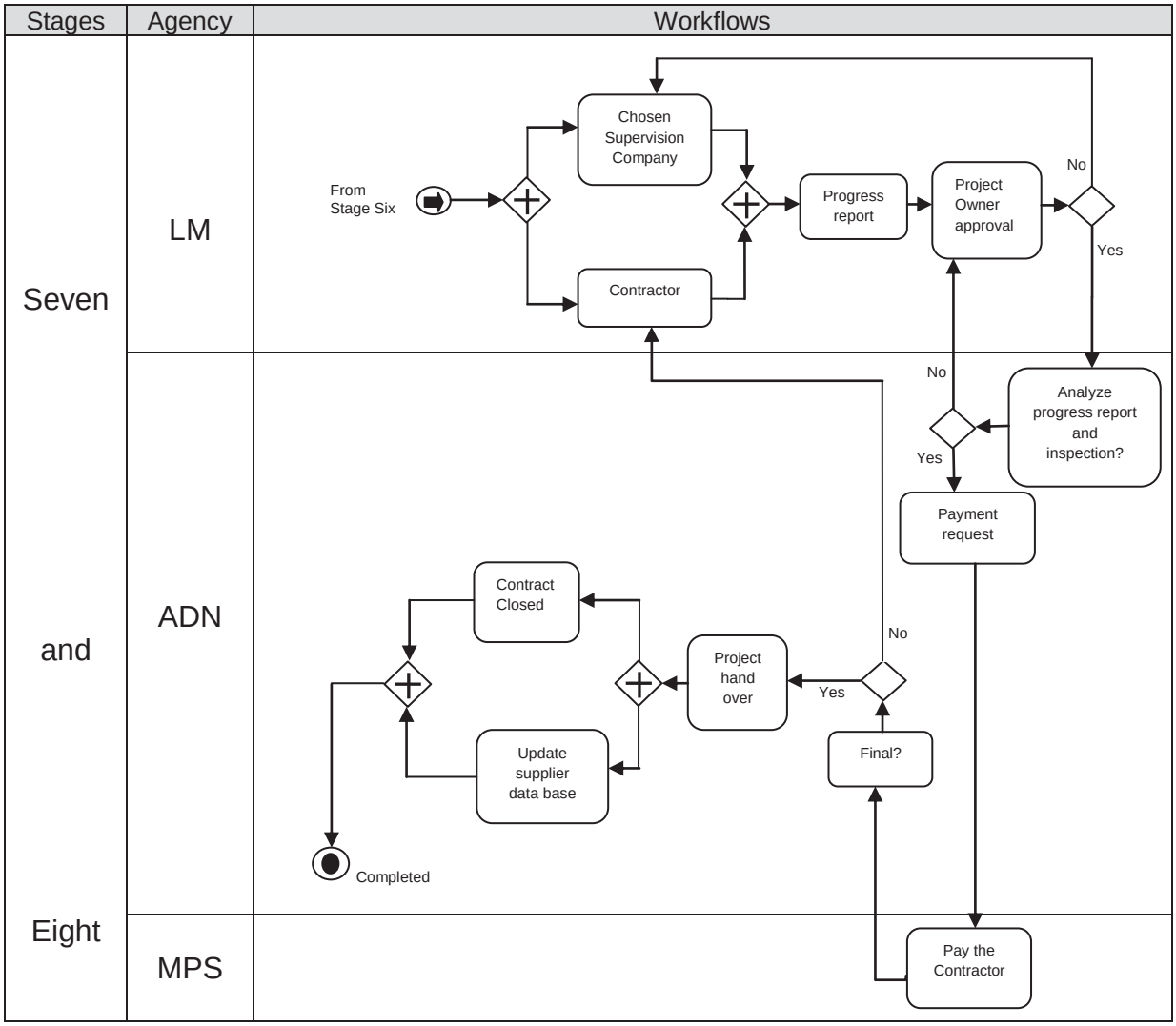
4.2.7. Contract Management, Completion and Hand-over

Contract management is the management of a contract during project implementation. This is to ensure the project owner and contractor fully meets their obligations in accordance with the contractual agreement. It also protects the rights of both parties and ensures a required performance, if circumstances changes. Contract management should be aimed not at finding fault, but rather at identifying problems and finding solutions collaboratively with the contracting parties involved. This includes monitoring and documentation of performance: and it effectively deals with potential changes and disputes.

After signing the contract, the contractor, under the supervision company (the representative of the project owner), must start the project as soon as possible. As the representative of the project owner, the supervision company must prepare progress reports of the project (weekly and monthly) and submit these reports for the project owner's approval. If approval is not given, the progress report is sent back to the supervision company for correction. If approved, the project owner must send the approved progress report to ADN for analysis and the conducting of inspections and quality control.

It is important that the GoTL only pay for the work according to the actual work progress performed, as certified and approved by ADN. If the progress

report does not comply with the quality control report, it is sent back to the project owner, who must take the necessary action to fix the problem. If approved, ADN send the certification of quality check to MPS, so they can prepare the payment for the contractor. If this is the final payment, ADN should prepare a project hand-over document for the project owners. Finally, ADN closes the project and updates the supplier database and the procurement process is completed.



Source: The researcher

Figure 4.5 Stages seven and eight of the procurement cycle

4.2.8. Problem Identification

The description above not only provides information about the flow of the processes in each stage, but the researcher was also able to identify undesirable effects (UDEs) that are occurring within this TLS-P procurement cycle. Due to the complexity of the system and limited time available for data collection, it was not possible to examine the TLS-P process in full detail: and therefore, this research only focuses on information flow (document flow).

Using the same methods of data collection and analysis mentioned in Chapter 3, the researcher collected and analysed relevant documents, such as the audit report on the procurement process (Deloitte, 2008), and he observed procurement activities at the offices of ADN and NPC, in order to gain more details on UDEs (preliminary staff survey questionnaire - see Appendices A). It would have been useful to quantify the magnitude of the impact of those UDEs, but the researcher was unable to obtain such information, due to the fact that most of the filing systems of both agencies are poorly organised. In order to overcome this problem, the researcher decided to interview key stakeholders, including the Director of ADN and NPC commissioners and advisers from both agencies, in order to obtain their perspectives on which UDEs are important. These modes of data collection were then compiled and the UDE list (for inclusion in this report) was shortened to the most important UDE, which are discussed below.

- Projects are often over budget: Almost all project decisions are controlled by budget allocation and therefore, the success or failure of a project is often determined by completing the project on time and within budget. However, a very common occurrence is that projects are often over budget. For example, based on observations of various meetings between MPS, ADN and NPC, the researcher found there was a quality defect of design in regards to the border security post for the national defense forces, because the design did not include road access to the site. According to MPS, this problem increased the project cost to three times (300%) the original budget allocation.

The researcher also noticed that delays in payment, by the government to contractors, can result in increases in construction material and labour costs, which contractors may transfer to the project owner. These late payments also result in the contractors being unable to complete some projects on time, due to the levels of cash flow needed to finance projects. For example, the construction of the National Election Commission (CNE) building was temporarily halted, due to the contractor running out of cash because of delays in the payment process. This project is behind schedule and it has forced the government to provide an additional budget, in order to speed up the project completion time.

- Procurement plans and schedules are often not achieved: The Procurement plan is used as a strategic tool to identify the best way to plan the use of resources ahead of schedule. In order to achieve this objective, the LMs should send their project documents at the time when the Government is about to begin discussions on the following year's budget — but this often does not occur.

  Under 'normal procurement procedure', construction services and works are not procured using a 'single source' process: and when project documents arrive very late (and those projects are important for public welfare) normal procurement procedures are then impracticable. This puts pressure on NPC to use a single source process and to select a company in a non-competitive situation.

  This often occurs when LMs send their project documents very late — usually when they realise that they will face budget cuts in the following year's round, if they do not use all their current budget. The purpose of the budget is to provide goods and services for the public and these people are going to suffer if such services are not provided. In order to avoid such problems, the LMs rush to find a use for their remaining budget before the end of the financial year (December).

  As a result, a great deal of (late) project documentation starts to flow through the procurement process at the same time and MPS/ADN/NPC

receives requests to complete the procurement process before December each year. This type of unscheduled procurement requests result in MPS/ADN/NPC being swamped with a vast number of project documents that need to be 'compressed' into a short time-frame. The staff members of these agencies are then seriously overloaded by the un-scheduled arrival of work and thus, there is considerable 'fire-fighting', and multi-tasking. This situation often results in project documents being passed through without proper scrutiny. During the interview, the researcher found that these numerous emergency requests lead to the majority of staff not working according to their job descriptions: that is, they have to leave their unfinished task in order to respond to these emergency requests.

- Projects are often completed late: One of the contract management obligations is to monitor and to take any necessary actions to resolve any problem that can delay a project's completion. The researcher identified that some projects had passed their completion date and they had to be amended with an extension. Delays in contract commencement and late payments also contribute to delays in project completion. Based on the researcher's experience, payments are often received more than 90 days after the date of invoice.

- Project documents often do not reach the NPC office on time: The project document is the most important document in regards to procurement processing. Any delays or late arrival of documents can result in emergency procurement requests.

  In order to facilitate management to make prompt decisions, LM should submit their procurement plan to MPS/ADN/NPC, so that the procurement process can be started. According to "Budget Book Six" (see Appendices D), there were approximately 800 million US dollars available to fund 128 major infrastructure projects for the year 2012. The project documents for those projects should have started to arrive at the MPS office in January 2012, in order to begin the procurement process.

From January to April 2012, only 15 project documents were received on time, through the procurement process: and 14 projects' documentation had been sent back to the project owner, due to quality deficiencies (see Appendices E). An email conversation between NPC and MPS indicates that (as of 14 August 2012) from 128 projects, only 22 project documents are currently under tender processing (see Appendixes F). This would suggest that 106 projects (83%) are either in the procurement process, or still to be released, with little more than four months of the financial year (33%) remaining. The level of overload is thus dramatically demonstrated in this situation.

- The due date scheduling of document flow does not exist: The due date represents the target of flow allowance (or amount of time) that the projects' documentation will spend in the system. When due dates are unknown, it is difficult to synchronise the flow of information (documents) between agencies. Each agency could potentially use the due date as a method of measuring and monitoring performance internally, which could then be used to support procurement at a system-wide level and for overall procurement system improvement. During the interviews with MPS/ADN/NPC, it became clear that they do not establish due dates when each LM submits their project documents.

- Contractors are experiencing low cash flow: Prompt payment is important for the contractor, in order to maintain positive cash flow. Generally, the contractor depends on progress payments, in order to have sufficient cash to pay labour and suppliers.

  It is common that contractors face low cash flow at the early stages of a project. In order to recover monies, the contractor will send their monthly running bill based on work progress, in order to recover their cash flow. On time payment is important for the contractor to maintain an adequate cash flow, in order to buy necessary materials and resources to construct the project.

The payment begins with the issue of the certification of payment request. No payment should be made unless the certification payment is confirmed and approved. The proper authorisation of a payment requires 12 separate signatories, who can be situated within several different agencies (LMs/ADN/MPS/Treasury). This results in considerable delays in processing. This time-consuming authorisation is potentially causing late payments to contractors.

Here is an example of this situation: Based on a conversation in a meeting between MPS/NPC/ADN, it became apparent that construction of the CNE building was temporarily halted because the contractor is running a negative cash flow, due to the government's late payment of up to three months. This problem not only results in a slow-down of work, it can also attract additional costs, which the contractor can transfer to the project owner (due to late payment by the Government).

- Quality defects are common: Quality control is needed to ensure that all design and project specifications are free from error (quality defects). This requires an examination of the project document, to determine that it meets the specification requirements. Quality control should reject the document, if it does not conform to specification requirements. ADN has responsibility for the quality control function and it checks every project document, to ensure that project specifications are error free before submission to NPC for tendering.

  From 15 projects documents (see Appendices E) received by NPC, 14 needed to be reworked, because bills of quantities were incomplete and they did not cover all items of the work. In addition, there were no time schedules and therefore, the completion date cannot be determined. As a result, NPC needs to coordinate with the project owner in order to complete the items on the bill of quantities (BoQ), before the tender can be processed.

- Construction projects are often late starting: Contracts should be commenced as soon as the contract is signed. The contractor must

mobilise his/her resources to the work site without delay, in order to meet the project's completion date. It is the responsibility of the Government to provide site access and assign construction supervision, before the contractor commences the work.

The GoTL is generally responsible for assigning supervision (individual or company) and providing the contractor with access to the work site in a timely manner. Failure to provide both requirements can prevent the contractor from starting the construction according to the contract schedule. The researcher has been informed (and also observed) that delays in the commencement of a project are often due to the lateness of land acquisition, or the late assignment of a construction supervision company by the project owner.

- Staff are lacking in English language skills: All project specifications are written in English. This is a language not readily understood by most ADN technical staff. As a result, tender documents may not be clearly articulated or understood by ADN staff, when performing their quality control function. If the project specifications are not clear, it is difficult to expect bidders to provide an appropriate response at the tendering stage. This may cause problems, when 14 from 15 project documents received by NPC are sent back to ADN for reworking, due to quality problems.

- Staff members are performing extensive multi-tasking: Some managers may believe that multi-tasking is an efficient use of resources. However, when multiple activities are activated simultaneously, the result (on many occasions) is bad multi-tasking. This happens when staff members are 'jumping' between unfinished work on different projects or assignments. This becomes worse when emergency requests arrive, which require staff to shift from their current activities. According to Kerzner (2006), this multi-tasking behaviour results in loss of focus and it extends the duration of the task, which also causes delays in document processing — and it can introduce quality errors.

- There are too many approval processes within the procurement process: Appendices B shows the flow of the approval process for infrastructure funding through the procurement cycle. This workflow typically recognises that the procurement plan (LMs and NPC), the budget controller (MPS), the quality control (ADN), the buyer (NPC) and the payer (MoF) should be separated: in order to provide appropriate organisational checks and balances and to permit specialisation within their respective professional areas. This overly bureaucratic system, involving multiple layers of authorisation, is likely to cause increased delays in the process, rather than improved integrity.

  It may be true that levels of authority and responsibility are clearly defined and communication channels are well structured. However, integration and coordination of activities amongst agencies becomes difficult and complex, thus slowing the decision-making process. This workflow also creates additional lead-time, which is extending the time of the decision process.

  There is a perception that the division of work, according to the specialisations within an activity, that is, payer (MPS), buyer (NPC), users (LMs) and quality control (ADN), works well when many similar items/tasks have to be processed on a recurring basis — and the expertise of a specialist is required. This quest for local efficiency can lead to the 'batching up' of projects and thus, this delays the flow. Appendices G shows how MPS and ADN are sending projects to NPC in batches (15 projects), thus introducing considerable queuing time for the projects.

  Another problem is that the staff members within MPS/ADN/NPC may not collaborate sufficiently with LMs, in order to provide clear information about the responsibility of each of the agencies (including the LMs) within the procurement process. This may result in some of the LMs' staff passing on problems (which are actually their responsibility) to other agencies. For example, from 15 projects' documentation received at NPC, 14 had quality deficiencies.

- Collaboration often breaks down between ADN, NPC, project owners and contractors: Coordination between agencies is important, in order for them to resolve any problems that may arise in a timely manner and avoid delays. Each agency appears to view the other agencies with minimal trust or respect. In addition, it appears that each agency believes that it can only benefit at the others' expense and therefore relationships are often confrontational and even hostile.

  A lack of coordination and cooperation amongst agencies remains a serious concern. Agencies may resist change and not want to collaborate with other agencis. For example, LMs resist submitting their procurement plan (including project documents) to MPS, because it is not the MPS's responsibility to undertake the actual procurement. In order to solve this misunderstanding, MPS proposed that NPC contact every LM to request that they submit their procurement plan to NPC and a copy to MPS. However, NPC insists that it is the responsibility of MPS to collect and appraise the project. NPC only wants to receive project documents which have already have been appraised by MPS and passed the quality control at ADN. Therefore, project documents are not submitted to NPC without passing through these prior steps

- There is no procurement system-wide measurement: Clear goals and system measurements usually embrace all the major units and functions, so that they work together for a common goal. A lack of defined goals and measurement is similar to setting off on a journey without having a destination or a road map.

  During the data collection process, the researcher was unable to identify measurements that are regularly or consistently used by MPS, ADN and NPC, to measure the productivity of the system as a whole. Performance indicators such as 'cycle times' or 'touch time' are not in place, except the service level agreement (SLA) of 109 days required for NPC to produce one contract. It is, therefore, not possible to obtain an accurate picture of the status or trends within procurement activities.

- Filing systems are disorganised: Easy accessibility to information is the most important purpose of maintaining a proper filing system. The faster the retrieval of information, the better the filing system. Filing is a system of keeping records in proper order so that, whenever needed, they are available with ease and without wastage of energy and time. This situation helps to provide faster information for decision-making processes. A poorly organised filing system means a large amount of wasted time is spent on finding missing documents resulting in constantly missed important deadlines.

ADN filling systems

NPC filing system

Source: The Researcher

Figure 4.6 Filing systems of ADN and NPC

When inspecting the ADN and NPC archives, the researcher noted a large number of loose project documents on the floor and on top of filing cabinets. It would be very difficult, under such conditions, to find and match to which file a document belongs. This often results in some documents from ADN arriving to NPC in incomplete sets. Incomplete documentation means that there are subsequent delays in NPC and in the overall procurement process.

- Advertising of procurement opportunities is not globally accessible: In order to increase the opportunity for a competitive bidding process, TLS-P tender information is usually advertised on the Ministry of Finance

website (MoF, 2012a): however, this media is not widely or globally recognised. Another problem is that, even if the information may be accessible, it also difficult for international companies to submit their proposals in hard copy, since an electronic bid submission procedure does not exist. In addition, Timor-Leste does not have an efficient postal system and there are high travel costs incurred, in order to deliver proposals from overseas in hard copy form.

4.2.9. Conclusion

TLS-P is a complex interaction with many approval processes at every stage of the TLS-P procurement cycle. The findings reveal 15 major problems (UDEs) that are widespread across the procurement cycles, as shown in Table 4.2 below

Table 4.2 List of Identified Problems (UDEs)

No.	UDEs
1	Projects are often over budget
2	Procurement plans and schedules are often not achieved
3	Projects are often completed late
4	Project documents often do not reach the NPC office on time
5	Due date scheduling of document flow does not exist
6	Contractors often experience low cash flow
7	Quality defects are common
8	Construction projects are often late in starting
9	Many staff are lacking English language skills
10	Staff are often performing extensive multi-tasking
11	There are too many approval processes within the procurement process
12	Collaboration often breaks down between ADN, NPC, project owners and contractors
13	There is no procurement system-wide measurement
14	Filling systems are disorganised
15	Advertising of procurement opportunities is not globally accessible

The result of the data collection above provides in-depth information about the flow of the process at each stage of the TLS-P, which highlights 15 undesirable effects within the procurement cycle, thus enabling the researcher to identify the constraint/core problems. This information should

allow answers to the second research questions (which will be covered in the following sections).

4.3. Applying TOC–TP

TOC acknowledges that there are interdependencies existing within organisations and there is always at least one constraint that limits the flow of information and material throughout a system. Therefore, the first step for improvement is to identify this constraint. The TOC-TP developed by Goldratt (1994) can help to discover and solve policy, in addition to physical constraints (Ghodous, Dieng-Kuntz, & Loureiro, 2006, p. 562) and hence, these tools have been chosen to help analyse this case study system: and to propose solutions to problems that have been identified as existing within this particular system.

4.3.1. Current Reality Tree: What to change?

The first step of the TOC-TP is to use a Current Reality Tree (CRT), in order to find the answer to the question "*What to change?"* In other words, to identify the core problem that is driving the undesirable effects within the system. In essence, this will help to identify the constraints on the systems that are limiting the throughput value and the reasons for their existence.

The first step in the construction of the CRT is to list the problems that are apparent in the TLS-P as UDEs and then link those UDEs to each other, based on their cause-and-effect relationships. These causal linkages are then checked using the categories of legitimate reservations (CLR) (Dettmer, 2007). Once completed, the core problem is usually found at the bottom of the CRT Map, (the entity that has no UDEs arrow coming into it).

Table 4.3 shows a list of fifteen, significant, current “Undesirable Effects” of the system, as identified in the research of the case study and detailed above.

Table 4.3 List of Identified Problems (UDEs)

No.	UDEs
1	Projects are often over budget
2	Procurement plans and schedules are often not achieved
3	Projects are often completed late
4	Project documents often do not reach the NPC office on time
5	Due date scheduling of document flow does not exist
6	Contractors often experience low cash flow
7	Quality defects are common
8	Construction projects are often late in starting
9	Many staff are lacking English language skills
10	Staff are often performing extensive multi-tasking
11	There are too many approval processes within the procurement process
12	Collaboration often breaks down between ADN, NPC, project owners and contractors
13	There is no procurement system-wide measurement
14	Filling systems are disorganised
15	Advertising of procurement opportunities is not globally accessible

This list of undesirable effects is used as the starting point for the TLS-TP CRT construction. However, during data analysis, more intermediate effects (IEs) are included as preconditions, thus ensuring that the CRT is clear and rigorous.

Appendices I (electronic version also attached), TLS-P CRT shows the result of complete construction of the CRT. For simplification and ease of understanding, The TLS-P CRT has been divided into seven parts and these are described accordingly in the sections of this chapter which follow. The first CRT segment, Part One, starts from the bottom of the CRT — and thus it starts from the core problem: whilst the remaining segments are subsequent branches of cause-and-effect relationships arising from the previous parts.

This CRT can be read using cause-and-effect relationships that are read from the bottom to the top: “If *this* cause ... then *next effect (may be a UDE or IE) as shown in Appendices H.*

However, in order to make it more interesting for the reader to read the sections which relate to the CRT, the researcher has attempted to write a version of each CRT segment, which uses more varied terminology and linking statements (similar to regular discussion). This format is intended to mirror the logic depicted by the CRT and hence, the reader is welcome (if preferred) to read the CRT map using the 'if-then cause-and-effect relationship' format mentioned above.

TLS-P CRT Part One: The Core Problem

TLS-P CRT (Figure 4.7) analysis reveals that there is no clearly agreed coordinated approach across all the agencies involved in the procurement process. This is a core problem (UDE48), which leads to the situation where agencies (in the absence of any system-wide measures for the procurement system [UDE50], that such a coordinated approach could provide) use their own internal measures to judge staff performance (UDE96). As a further result, staff members at each agency focus on their own internal activities and measurements (UDE20).

These measurements are often not consistent with the creation of a holistic performance and flow of procurement documentation: and this situation contributes to the frequent lack of cooperation between agencies. This lack of a coordinated approach (UDE48) and internal focus (UDE20) also means that no attempt is made to schedule and synchronise the flow of procurement documentation through the agencies (UDE21).

Effective scheduling systems control the release of work to match key resource capacity (PC122) but, in the absence of such a system (UDE21), it has been discovered that procurement projects are released into the agencies as they arrive (IE123). This creates a situation where in-trays and filing systems are overflowing (UDE81).

The idea of cooperation is to have good collaboration between agencies, in order to streamline the information flow within the procurement process between these agencies (for mutual benefits) (IE47). However, this becomes

difficult to achieve without system-wide measurements (UDE50) and where the most agencies are focusing on their own performance. In addition, it is also important to synchronise the flow (UDE21), in order to be able to set proper due dates for procurement documents, so that all agencies can collaborate and meet these due dates. There is a lack of cooperation (IE47) and clear due dates (UDE39) and therefore, collaboration is often seen to breakdown between MPS, ADN, NPC, project owners and contractors (UDE8).

Local measurements tend to encourage each agency to focus on internal activities (UDE20), in order to maximise resources utilisation (a key local measure) and this means that everybody is kept very busy on many different types of work (PC68). As a result, in-trays are full with documents waiting for processing (procurement documents and others) (UDE81). This situation becomes worse when procurement work is released into the system without consideration of its load on resources (UDE123)

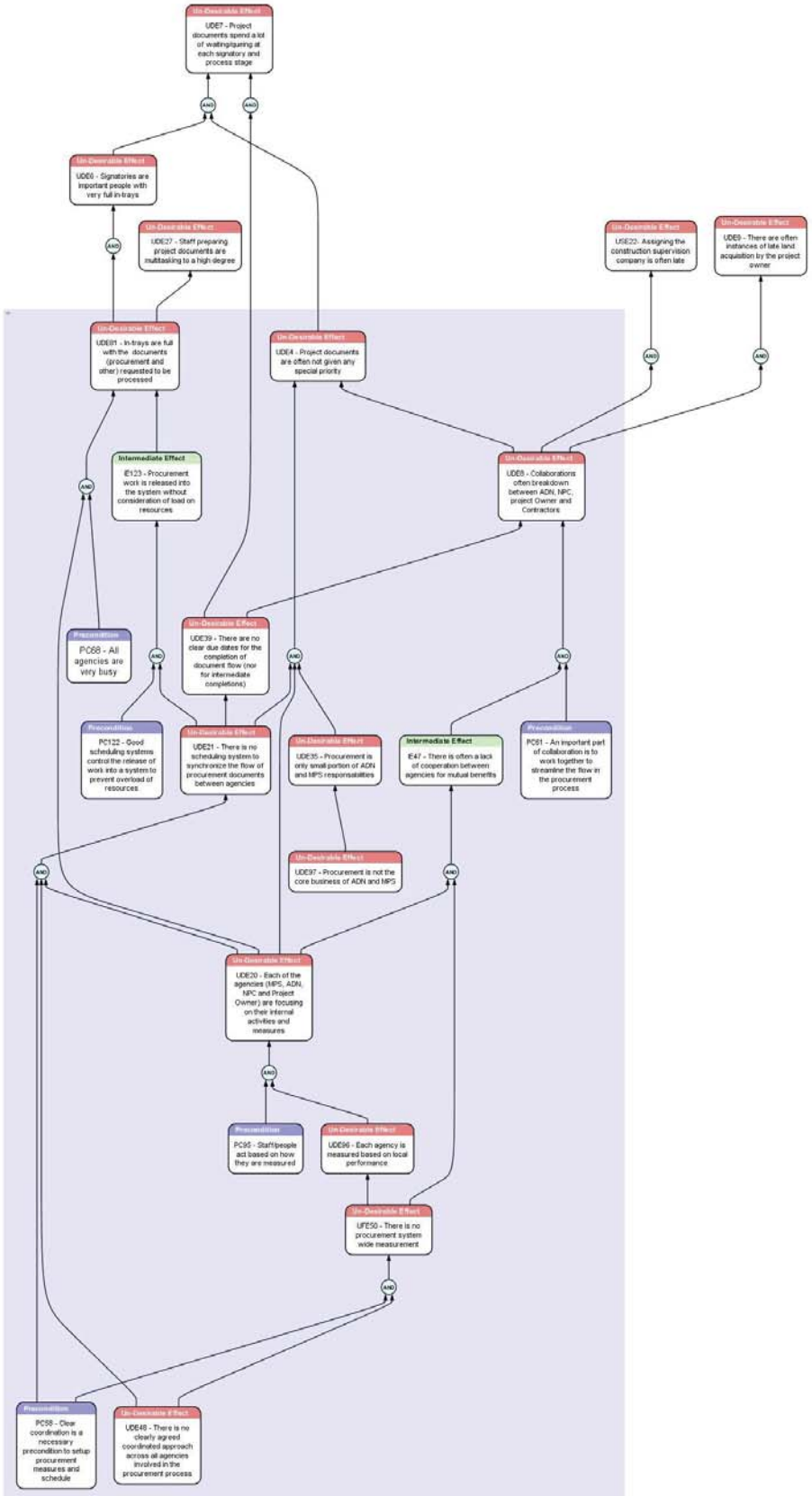


Figure 4.7 TLS-P CRT Part One

TLS-P CRT Part Two

Full in-trays (UDE81) might offer the perception of efficient usage of resources, but research and modern systems thinking suggests otherwise. Staff members faced with many choices and pressure will usually fall into a pattern of jumping from project to project, thus completing only part of the work required on a project and then leaving that project to temporarily work on other projects and assignments. This is known as ‘multi-tasking’ and it actually leads to serious negatives (UDE27), especially when made worse by many unscheduled procurement requests (emergency procurement) (UDE52 being added to the workload – negative loop). This multi-tasking can increase the processing time for any particular project, because it sits awaiting attention (queuing) (UDE7) and it is not given priority, since there is no clear due date for completion of document flows (UDE#39). In particular, the majority of documents are not given special priority (UDE4) for sign-off by high level staff at various stages (UDE6). Multi-tasking increases the touch time required, as each time the work is revisited there is a period of re-setup/re-learning about what stage the task has reached and what still needs to be done (UDE7) (‘non-value-added waste’ in Lean terminology).

Within public procurement systems that consist of many layers of approval (UDE5), a better sense of control may be felt — but it can also result in an increase in the total waiting time that goes far beyond the actual touch time (UDE62): that is, when the project documents consume a great deal of waiting time at each signatory (UDE7). As a result, project documents are often very late, versus the date the project was expected start (UDE26), which is defined loosely by the budget (PC63]). Late documents usually stimulate emergency procurement requests (UDE114) and thus, when many project documents arrive at NPC very late (UDE26), it becomes difficult for NPC to follow the normal procurement procedure. At the same time, LMs face budget cuts if their projects are not executed before the end of the financial year. It has, therefore, become normal practice for LMs to request emergency procurements (UDE52). This type of emergency request not only causes staff members to perform multi-tasking to a higher degree (negative loop to UDE27), it also leads to some signatories signing-off late without full

scrutiny (UDE2), due to there being insufficient time for staff members to carefully perform quality checks(UDE76).

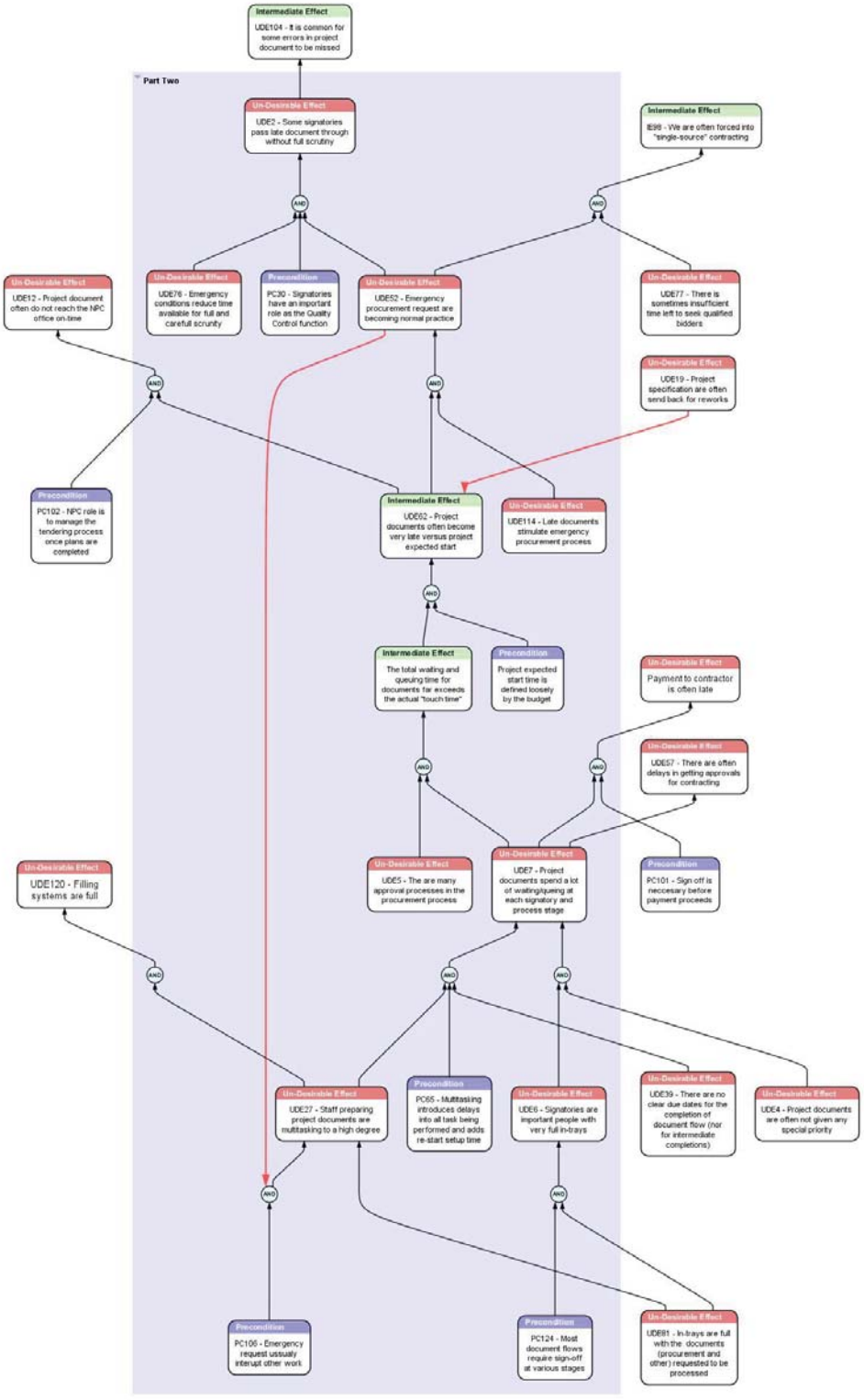


Figure 4.8 TLS-P CRT Part Two

TLS-P CRT Part Three

If staff members perform multi-tasking to a high degree, with many open project files in the system at any one time (UDE121), this leads to the filing system being full of documents waiting for processing (UDE120). It becomes difficult and time-consuming for staff members to organise their filing systems (UDE115) and hence filing is often poorly executed. This type of disorganisation makes it frequently difficult to find things immediately and time is wasted searching for documents (IE116). This can cause some elements of a full set of documents (for example, part of the bidding documentation) to arrive late (UDE109).

This multi-tasking also increases the probability of there being quality defects in work undertaken by multi-taskers (PC66), which is a cause of project documents often being delivered with deficiencies in quality (UDE11). Since it has the quality control function, the responsibility of ADN is to check project documentation (PC105) written in English (PC53) and ensure it does not contain errors or omissions. However, the majority of ADN staff are not sufficiently skilled in the English language (PC54) and thus, some errors are missed (104). This is especially true when documents are passed through late without full scrutiny (UDE2). These problems increase the likelihood of quality defects and omissions within project documents (UDE11).

If any quality problem is found in a project specification during SBD preparation (final quality check prior to tender – PC28), then those project specifications are sent back to the project owner for reworking (UDE19). This creates a negative effect (negative loop) when project documents are often very late versus their expected start date (UDE26), because it takes additional time to fix any problems. As a result, project documents very frequently do not reach the NPC office on time (UDE12).

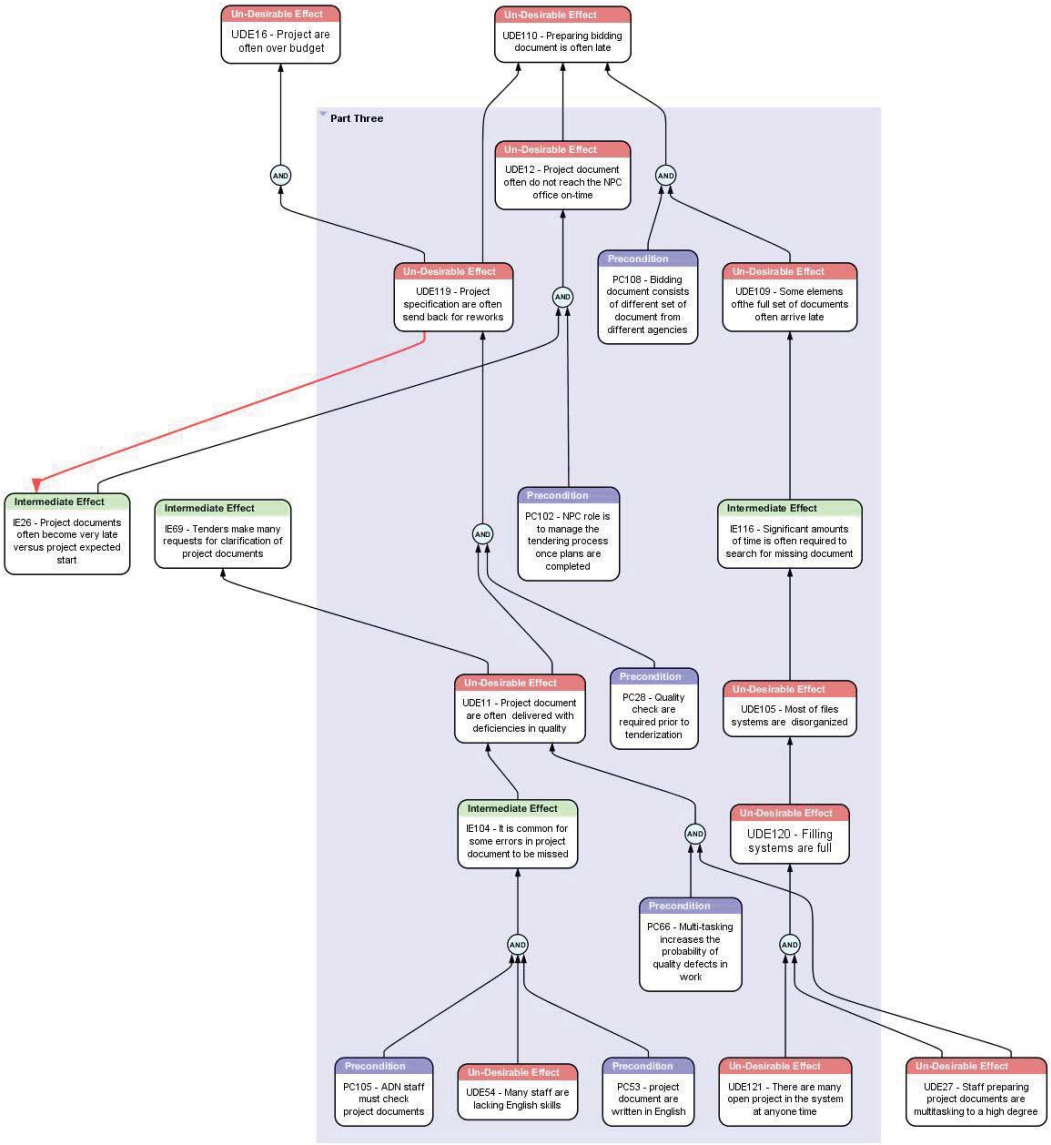


Figure 4.9 TLSP- CRT Part Three

TLS-P CRT Part four

Similar to other post conflict countries, Timor-Leste does not have an efficient postal system (PC92) and sending documents through courier post is expensive (PC93). This creates problems for many overseas companies wanting to submit their bid in hardcopy form on time (UDE91), especially when there is no electronic bid submission procedure (UDE90). In addition, tender information is not globally advertised, so that it is accessible to many overseas companies (UDE85). These problems contribute to the failure to obtain a satisfactory quantity and/or quality of bidder responses, on some occasions (IE86).

Public tender is a requirement for competitiveness and transparency within a procurement process (PC103). Failure to gain satisfactory bidder responses lowers the level of competitiveness and there are, therefore, fewer options to choose the most suitable company for the project. As a result, tenders are often cancelled (UDE87) and a call for re-tendering has to be made (UDE113) This second call for tendering can lead to the re-issuing of late tender documents (UDE25).

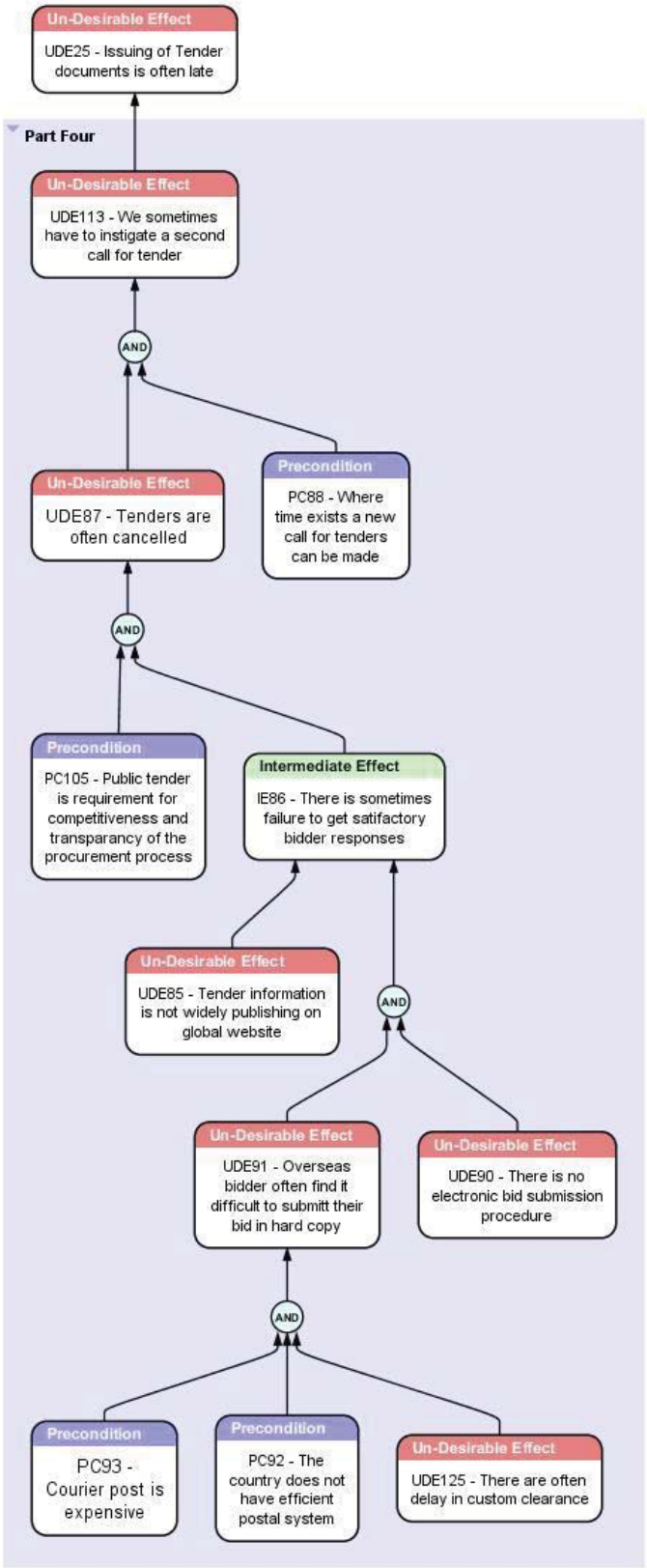


Figure 4.10 TLS-P CRT Part Four

TLS-P CRT Part Five

Tendering on time depends on project documentation. If project documents are late (or they are an incomplete set) then preparation of tender documents often becomes late (UDE110), thus resulting in the late issuing of a tender (UDE25). Late tendering means less time to seek qualified bidders (UDE77), which can lead to single source contracting (IE98) under the emergency procurement request procedure (UDE52). If tenders are issued late (or under emergency conditions) the time left for bidders to prepare a fully detailed proposal is insufficient (IE84): and NPC are then pressured to select a company based on those proposals received (PC99). Under such conditions of urgency and poor proposals, it is often the case that contracts are awarded to bidders with inadequate qualifications (UDE83).

If tender documents contain quality problems (deficiencies in project documentation (UDE11), it is normal that NPC will receive many requests for clarification from interested bidders (IE69). Responses to those clarifications depend on the magnitude of the quality problem found: and the available time for the project owners to provide information to NPC on time. If time is not sufficient and the system has already been late in issuing tender documents, then the only option is to extend the tender deadline (IE73). Selecting qualified contractors is, therefore, often late (IE75).

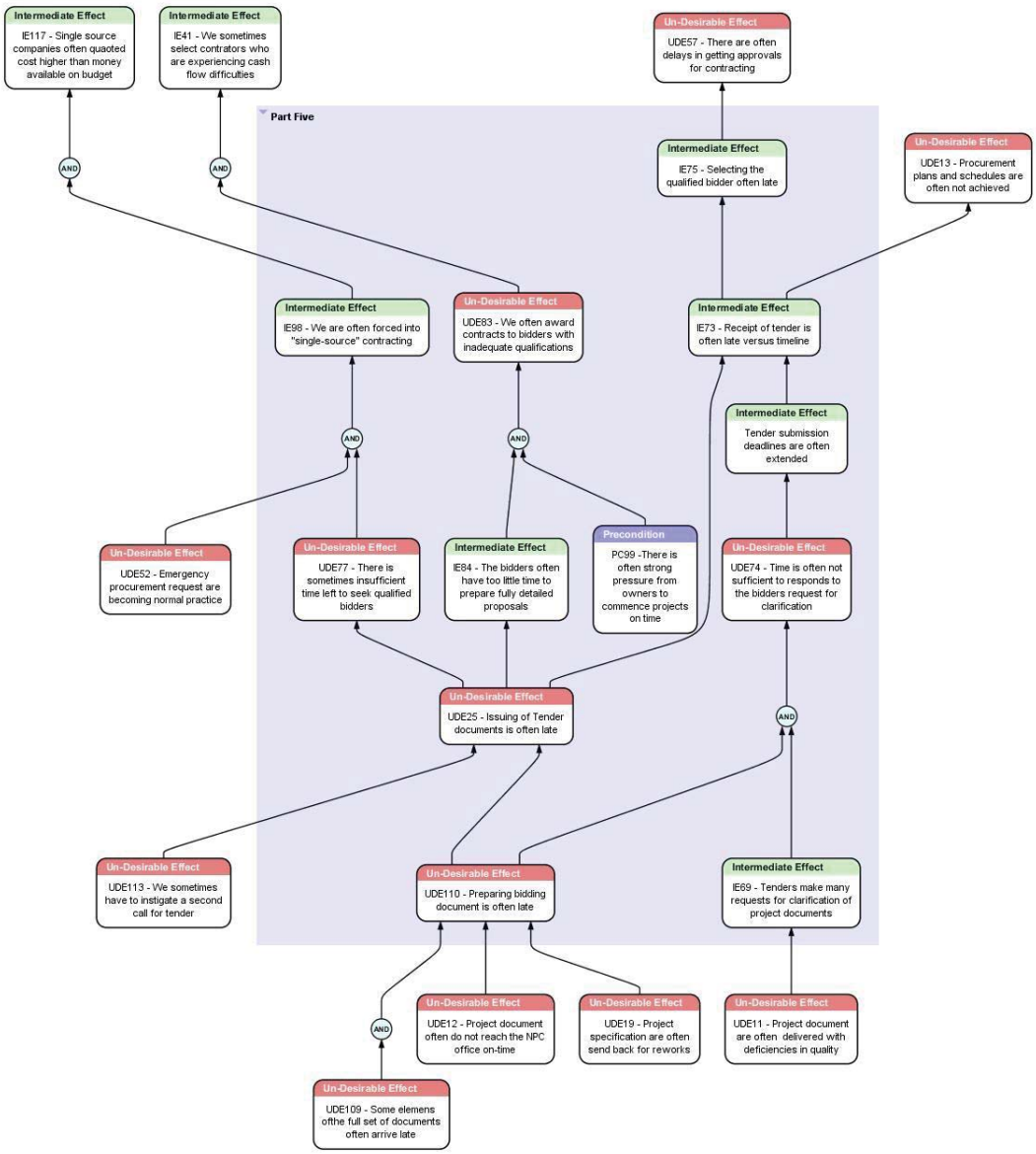


Figure 4.11 TLS-P CRT Part Five

TLS-P CRT Part Six

It is the responsibility of the Government to vacate the land of residents, in order to provide work site access and also to assign a construction supervision company ahead of a contract signature. If land/work site is still occupied by residents (UDE9), this delays the contractors' access to the site (UDE10). Lateness in assigning a supervision company (UDE22) can also cause a delay, because a project cannot start without supervision. It is often difficult, when there is lack of collaboration amongst agencies (UDE8), to solve such problems in a timely manner (or prevent them from occurring). This type of problem, together with a delay in contract approval, often results in the late commencement of construction projects. (UDE14).

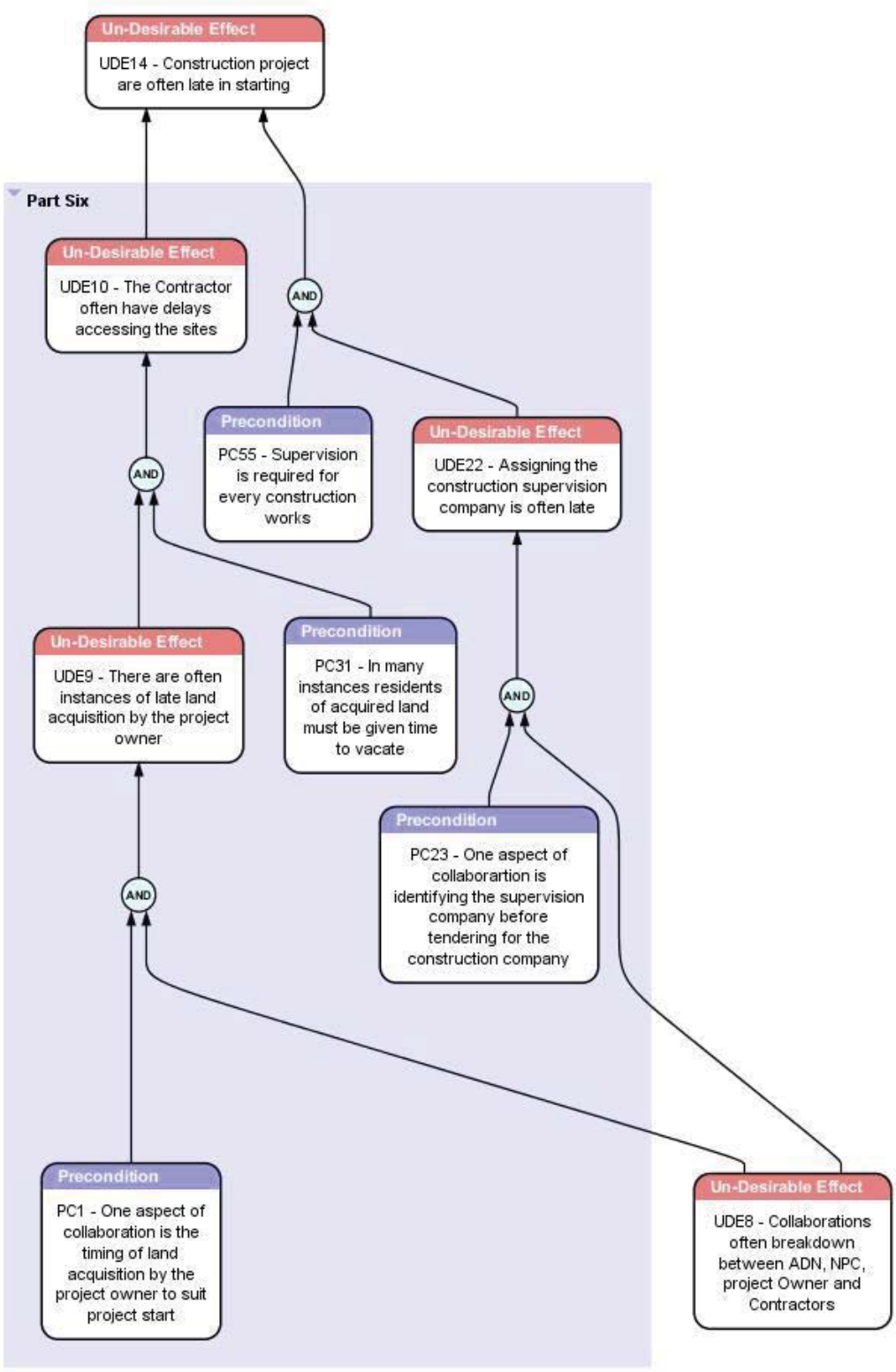


Figure 4.12 TLS-P CRT Part Six

TLS-P CRT Part Seven

The selection of qualified bidders is dependent on detailed information provided in the bidders' proposals. If those proposals do not provide sufficient information, it is difficult to determine qualified bidders and thus, NPC often awards contracts to bidders with inadequate qualifications (UDE83), for example, inadequate in terms of financial resources (PC100). In every construction project, it is normal for contractors to experience low cash flow and they depend on government reimbursement payments to recover their cash flow position. If the contractors' payments are late (UDE43), due to document processing time being too long, for example, queuing for a signature (UDE7) and if the contractor has serious negative cash flow (IE41), then sometimes a contractor has to temporarily stop the construction work (UDE112). In order to attempt to recover delayed construction projects, for example, one that is temporarily stopped or one late in starting (UDE14), so that completion dates are not delayed (UDE15), additional funding is required and often expended, in order to speed-up the completion (PC29).

Projects running over budget are also the result of situations where there is pressure to use single source contracting (IE98): but single source contracting does not allow a competitive market to operate (PC119). Since they are aware of this situation, single source companies will often quote their price higher than the money available in the budget (IE117). In addition, projects can run over budget when project specifications are sent back for reworking. This is because the project owner must find additional funds to re-hire the same contractor to fix the problem/s.

The problems over budget projects; failure to achieve procurement plans and schedules; and projects often completed late indicate that Government projects are not executed well (UDE17).

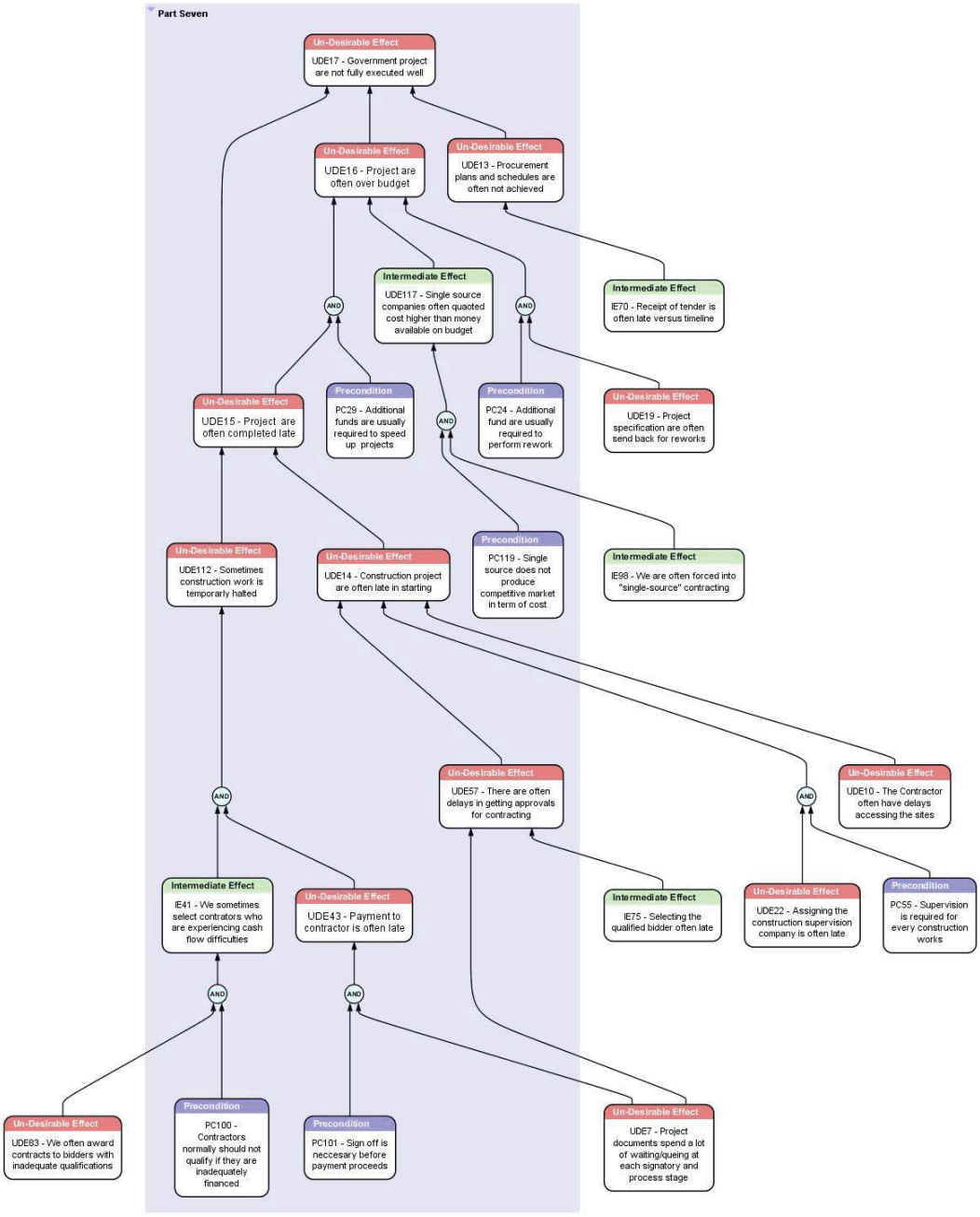


Figure 4.13 TLS-P CRT Part Seven

The TLS-P CRT reveals that the absence of a clearly agreed and coordinated approach, across all agencies involved in the procurement, is the core problem (UDE48 Part One). According to TOC-TP principles this core problem generally exists due to some hidden conflict/dilemma within the system — or otherwise, the problems would have already been solved. This is where EC can be used to identify those conflicts shown in Figure 4.14.

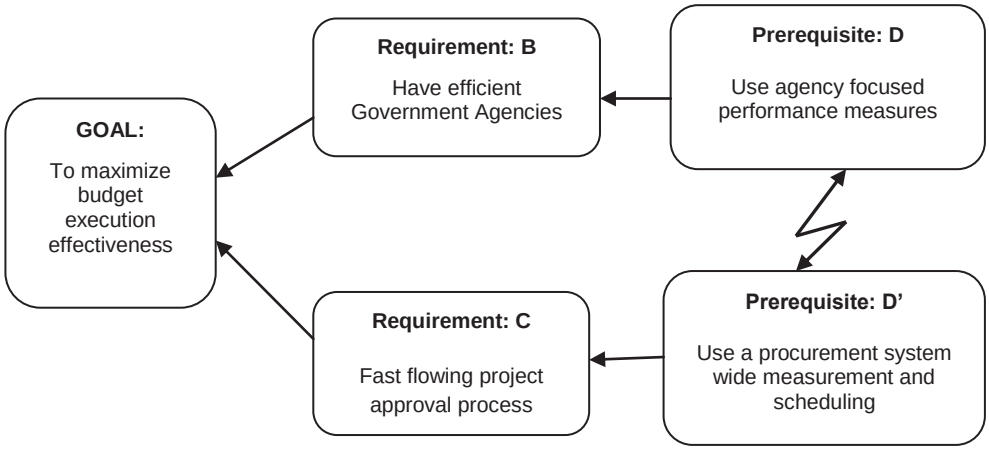


Figure 4.14 TLS-P EC systems dilemma

This figure reveals that all agencies are using local performance measurements, UDE96 (Prerequisite D). This use leads to each agency (MPS, ADN, NPC and project owners) focusing on their internal activities and measurements (UDE20), because staff members and other people involved in the process act based on how they are measured (PC95). .Therefore, each agency tends to keep all their staff members busy in an effort to optimise the resource utilisation, in the belief that this will maximise the Government's efficiency (Requirement B), so that they can maximise budget execution effectiveness (GOAL). However, the CRT shows that projects are often over budget (UDE16) resulting in Government projects which are not fully executed well-(UDE17). This situation indicates that using locally efficient agencies does not always translate into maximising budget execution effectiveness.

Using local agency performance measurements, based on individual agencies' performance, is irrelevant to maximising budget execution

effectiveness in a coordinated manner, particularly within current complex interagency relationships. Therefore, all agencies should focus on an effective approach, which will speed up the flow of the approval process within the TLS-P system, in order to maximise budget execution effectiveness (GOAL).

An emphasis on fast-flowing project documents (Requirement C) requires all agencies to have a procurement system-wide measurement and scheduling (Prerequisite D'). This new measurement has the potential to be in conflict with current local agency measurements. It is, therefore, difficult to have a system-wide measurement for all agencies (Prerequisite D'), if at the same time everybody is focused on their own internal measurements (Prerequisite D).

This means that there is no apparent way to have both (prerequisite D and D'), at the same time. This is why ("no wonder") people are stuck in this dilemma. The EC reads as follows:

In order to maximise budget execution effectiveness [THE GOAL], we must have efficient government agencies [REQUIREMENT B]: and in order to have efficient government agencies [REQUIREMENT B], we must use agency focused (local) performance measures [PREREQUISITE D].

On the other hand, in order to maximise budget execution effectiveness [THE GOAL], we must also have a fast-flowing project approval process [REQUIREMENT C]: and in order to have a fast-flowing project approval process [REQUIREMENT C], we must use procurement with system-wide measurements and scheduling [PREREQUISITE D']. However, we cannot perform effectively [PREEQUISITE D] and [PRERQUISITE D'] simultaneously.

4.3.2 Conclusion

The research finds that CRT and CRD have proven to be an effective tool for this case study, in order to identify the core problem of the TLS-P complex

public procurement process. Through analysing and constructing a detailed cause-and-effect relationship between problems (UDEs) identified by the research and by using the CLRs, considerably more insight into the case study system has been generated. As a result of the application of the CRT and the CRD to this case study, the researcher has identified that “there is no clearly agreed coordinated approach across all agencies involved in the procurement process – UDE48”, as the core problem. The CRT logic confirms that this situation has caused many of the research-identified problems (UDEs) that exist within TLS-P systems.

This core problem has led to serious decreases in productivity and the use of complicated processes, which together increase the non-value-added touch time, thus causing delays to workflows, which result in making the TLS-P far less effective than it should be.

The EC reveals that this core problem exists, due to conflict between the prevailing localised (agency centric) measurements and the need for system-wide measurements (which are not seen to be strongly present within the system at the present time).

4.4. TOC-L: Towards a TLS-P System Improvement Process

4.4.1. Introduction

This section discusses details on how to apply the Evaporating Cloud; the Future Reality Tree; and Prerequisite Tree towards system improvement. Firstly, the EC is used, in order to identify the best possible injection needed to break the conflict cloud, which causes the core dilemma for TLS-P systems: this is the starting point for a win-win solution. Later, this injection is used in the FRT, in order to change ’undesired effects’ (UDEs) to ‘desired effects’ (DEs) and hence answer Research Questions Two and Three: “How can the system be improved?” and “Can TOC-L help towards system improvement?”

4.4.2. TLS-P system improvement

This step is to work out how to (through creative thinking) identify a breakthrough idea, which can break the conflict and thus solve the core problem. There must be some assumption that underlies the conflict and causes it to exist in TLS-P systems: that is, “Use agency focused performance measures versus the use of procurement system-wide measurements and scheduling.” The definition/depiction of this dilemma is accomplished by using the EC method. This method is then extended to identify the assumptions underlying the conflict and which seemingly trap us in the dilemma that causes the core problem. Once these assumptions are identified they can be challenged and a breakthrough idea — an injection: a change in reality — can be generated, in order to resolve the conflict. The injection is then the starting point to a more comprehensive solution (comprising several injections) that can be used to change the undesirable effects (UDE48 etc.) into desirable effects (DEs). According to Dettmer (1997), the injection can be an action, if you know exactly what to do: but if not, then injections are expressed as conditions or states that more detailed plans and actions can eventually make into realities. Figure 4.15 shows the system-wide measurements approach representing an opposite viewpoint to existing TLS-P local optima.

The TOC provides simple system-wide measurements, by focusing on increasing throughput (the rate at which a organization generates more value). It does this by focusing on system effectiveness, in contrast to local optima. This concept can also be applied to TLS-P, by focusing on executing more projects through a procurement system based on TPV. Therefore, all agencies must maintain a fast-flowing project approval process within the TLS-P system, by focusing on procurement output (whilst not sacrificing quality).

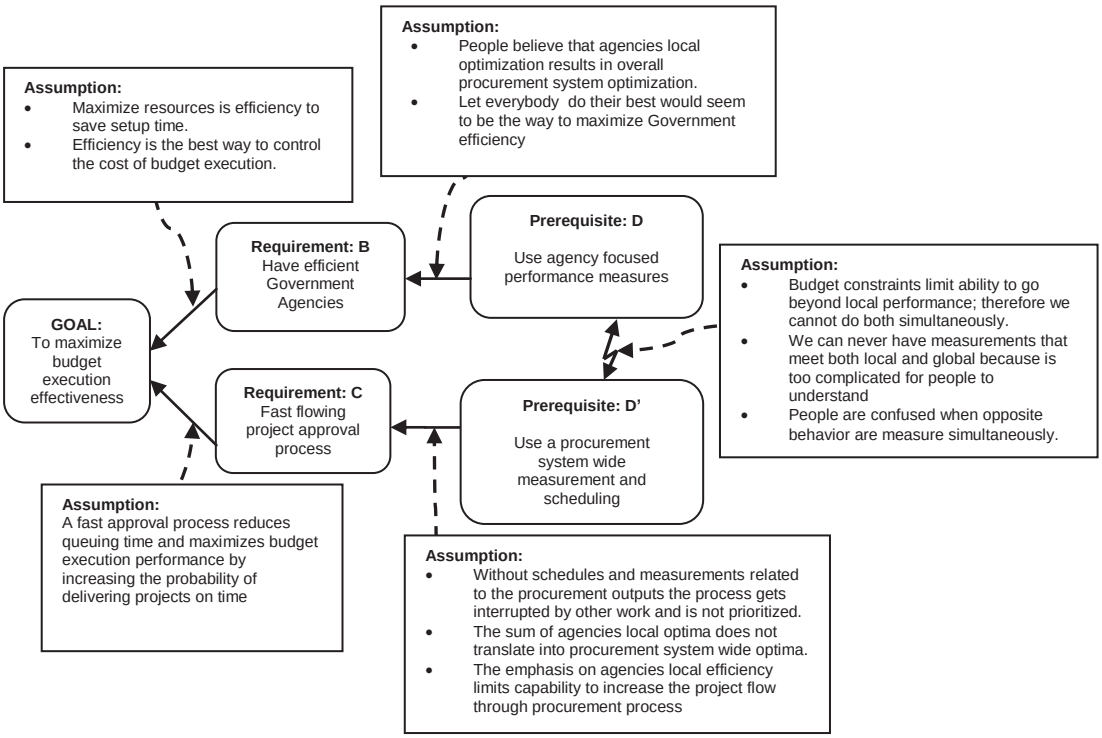


Figure 4.15 EC with assumptions

The assumption is that the emphasis on the agencies' local efficiency limits their capability to increase project flow through the procurement process. In addition, without schedules and measurements related to the procurement outputs, the process gets interrupted by other work and it is not prioritised. In other words: the sum of an agency's local optima does not translate into procurement system-wide optima. A fast-flowing project approval process can maximise budget execution effectiveness, because it means that queuing time is reduced; there is greater agility to correct planning problems without additional costs; and an increased probability of delivering projects on time (thus preventing project cost blow-outs).

The assumption is that the TLS-P system is complex and therefore, it can never have measurements that meet both local and global requirements, since these would be too complicated for people to understand. In addition, budget constraints and lack of focus limit the ability to go beyond locally focused performance — therefore, we cannot do both simultaneously. People are also often confused when opposite behaviour measures exist at the same time within a system. This opposite 'conflict' viewing of local performance measurements and systems-wide measurements can be solved

by either breaking the assumptions between Requirement B and Prerequisite D, or Prerequisite D and Prerequisite D'

TLS-P is a complex system and the majority of people are already using local measurements; in addition, they may resist if the solution seeks to make a break between Requirement B and Prerequisite D. Another problem is that, in order to use a systems-wide measurement as a standalone measurement, by breaking Requirement B and Prerequisite D, it is potentially too complicated and it may take time to achieve DEs. This is important, because TLS-P procurement regulations require staff members to avoid conflicts of interest when dealing with procurement (Timor-Leste, 2005b, 2010a). Therefore, the best way is to break Prerequisite D' and Prerequisite D, is allowing each agency (MPS-AND-NPC) to align their local measurements to the TLS-P systems-wide performance. The question is: How to make this happen? In answer to this question, the TOC method requires that the first step is to list possible injections that can provide a condition (or action) to break the conflict cloud between Prerequisite D' and Prerequisite D. The next step is to choose the best possible injection using the one that seems the easiest, cheapest and fastest way to break the conflict between Prerequisite D and Prerequisite D', as shown in Figure 4.16a.

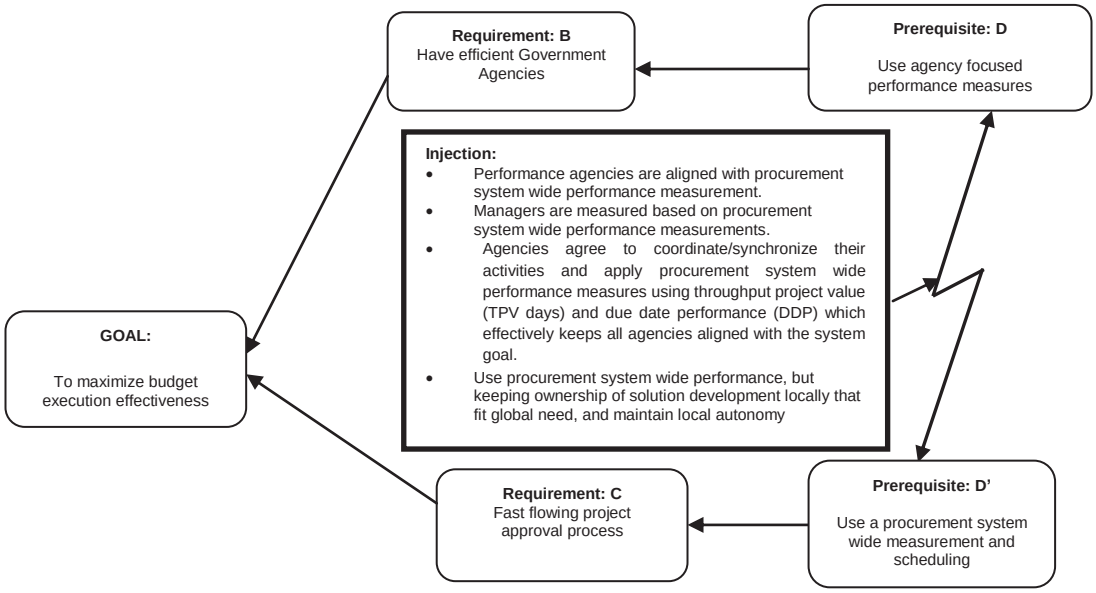


Figure 4.16a EC with list of possible injections

As shown in Figure 4.16b below, the best choice seems to be the third injection: “Agencies agree to coordinate/synchronize their activities and apply procurement system wide performance measures using throughput project value (TPV days) and due date performance (DDP) which effectively keeps all agencies aligned with the system goal".

This injection combines with some local measurements, by changing PC63: the project expected start time is defined loosely by the budget, in addition to setting up the contract signature due date, as the basis for the project start. In order to maximise budget execution effectiveness, all agencies need to also use ’throughput project value’ as their system-wide measurement. This will allow each agency to align their local performance, in order to meet delivery due dates (CCR) and contract signature, known as due date performance (DDP)

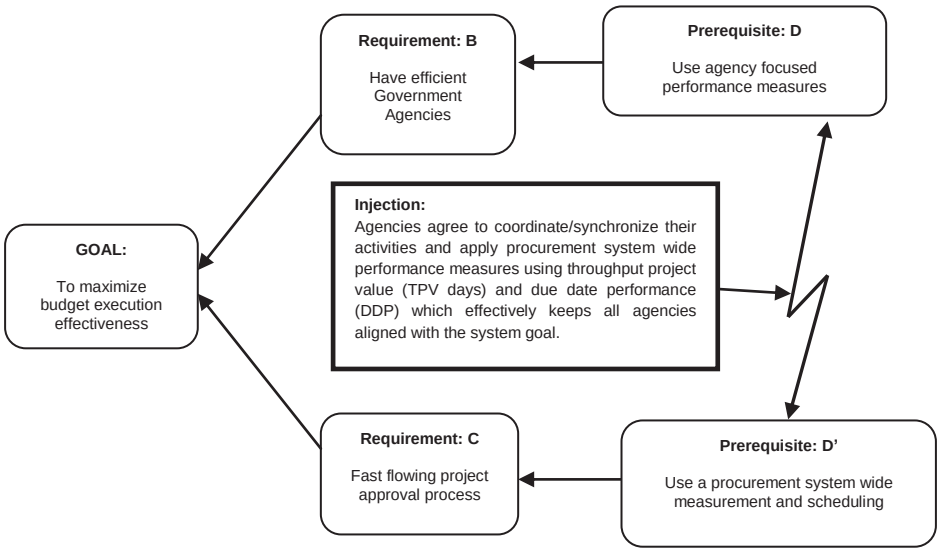


Figure 4.16b EC – with best injection

4.4.3. Future Reality Tree: What to change to?

The FRT is important, as it helps test the effect of the implementation of the identified injection from EC: and whether it is likely to change UDEs to DEs. In other words, this tests whether or not, when the identified injection is

inserted into the reality and replaces UDE48 (the core problem), it will change the UDEs caused by this core problem to DEs.

In most situations, the initial injection is not sufficient to eliminate all the UDEs, or the new reality creates negative side effects. In both these situations, additional injections are identified, in order to round out the full solution and thus create a truly positive change. These injections thus generate the answer to the question: “What to change to?” In effect, the FRT functions to map what the future reality is expected to look like after implementation of the injections, in addition identifying what to change to?

Appendices J (electronic version also attached) of the TLS-P FRT show the result of a complete construction of the FRT. For simplification and ease of understanding, the TLS-P FRT has been divided into twelve parts and these are described accordingly in the following sections of this chapter. The first segment starts from the bottom of the FRT: from the injection found at the core problem, whilst the remaining segments are subsequent branches of cause-and-effect relationships arising from previous parts. This FRT can be read using cause-and-effect relationships: that is, read from the bottom to the top, which is similar to TLS-CRT, as shown in Appendix H.

In order to make it more interesting for the reader to read the sections, which relate to the FRT, the researcher has attempted to write a version of each FRT segment, which uses more varied terminology and linking statements (that is, similar to regular discussion). This format is, however, intended to mirror the logic depicted by the FRT and hence the reader is welcome (if preferred) to read the FRT map using the ‘If-then” cause-and-effect relationships’ from bottom to top (or use both).

TLS-P FRT Part One: Injection to the core problem

Figure 4.17 demonstrates that FRT begins with inserting INJ133 and INJ21 (“Agencies agree to coordinate across the procurement process to streamline their schedule and measures” and “There is a scheduling system to synchronise the flow of procurement documents between agencies (which

includes control of releases based on load and definition of due dates)", in order to replace UDE48 ("There is no clearly agreed coordinated approach across all agencies involved in the procurement process") from the CRT to DE48 (there is clearly agreed coordinated approach across all agencies involved in the procurement process).

The injection of INJ133 and INJ21 requires all agencies involved in the procurement process to synchronise their activities, in order that they can have a clearly agreed coordinated approach (DE48). This allows each agency to work out (with some degree of autonomy) how to align their local goals and objectives, in order to maximise the procurement system-wide performance measurement (IE121). A further injections means that the management of all key agencies are using throughput project value (TPV) days and due date performance (DDP), as their key performance indicator for their procurement process work (INJ130). As a result, all agencies will start to focus on how to maximise a procurement system-wide performance (DE20), based on TPV days and DDP measurements (PC95).

These common measurements (TPV days and DDP) will also stimulate all agencies to work together and cooperate (PC152), because it is the only way to maximise their KPIs (local performance) as well as system-wide performance (DE47). In addition, in order to ensure a quick impact and motivate all agencies to use this system-wide performance measurement, the Government can establish a reward system to recognise all agencies' efforts (INJ147), when they execute government projects in a satisfactory manner (positive reinforcement loop - DE17).

In order to enable all agencies to focus on a procurement systems-wide performance (DE20), it is necessary to clearly define TPV days and DDP values (DE46). To reach this point, an agreed scheduling mechanism must be in place (PC151), to which all agencies are keen to agree, in order that TPV days and DDP can be used for procurement process control.

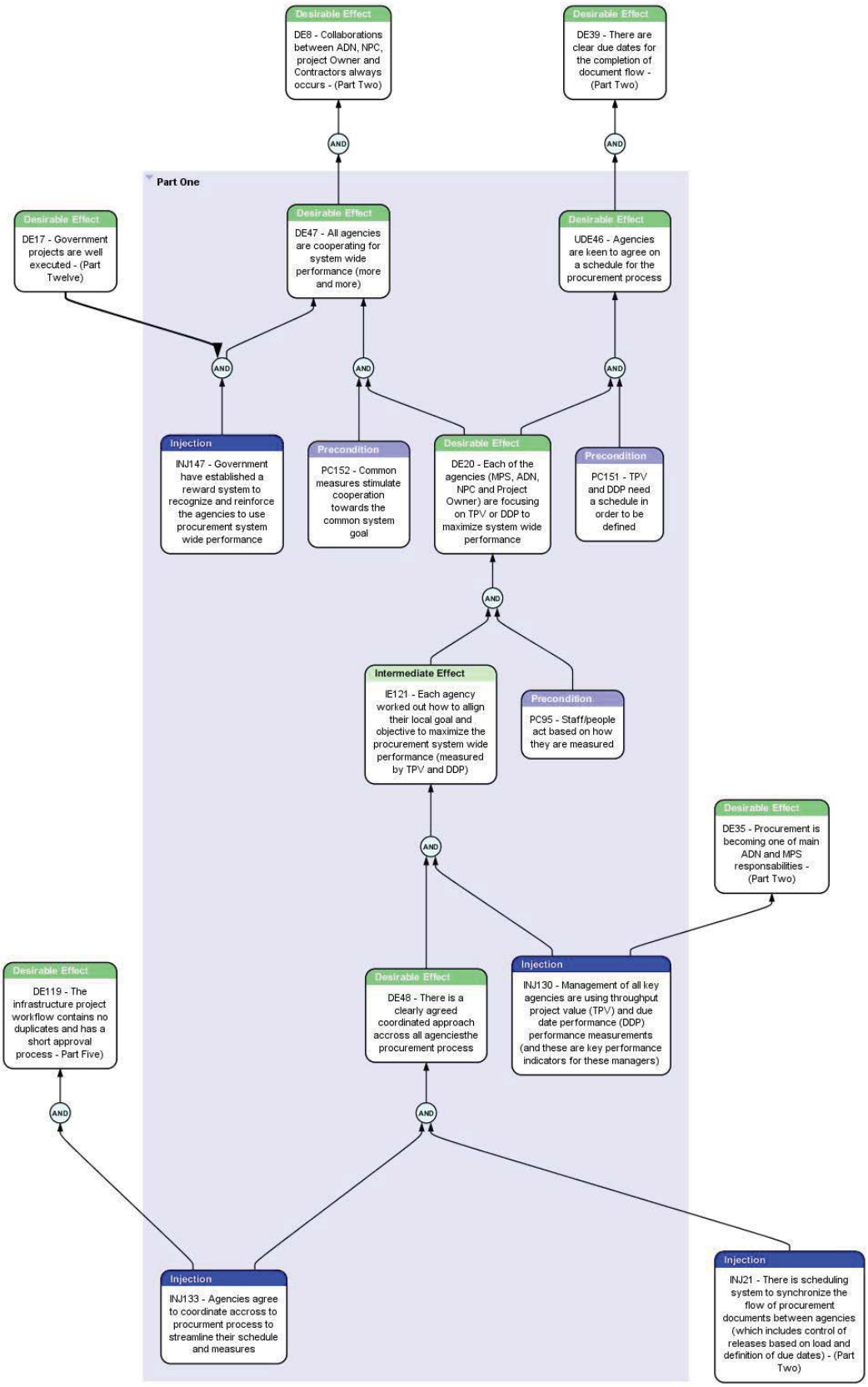


Figure 4.17 TLS-P FRT: Part One Injection to the Core Problem/s

TLS-P FRT: Part Two

Although all agencies are keen to agree on a schedule for the procurement process (DE46 of part One), they also need new scheduling systems to avoid new UDEs, and in order to synchronise the flow of procurement documents between agencies. This scheduling system needs to include control of releases, based on load and definition of due dates (new INJ21), in order that all agencies have clear due dates for the completion of document flows (DE39). This will allow collaboration to always occur, in order to meet the due date for document flows (DE8). This collaboration becomes more likely and effective when all agencies are equally and increasingly interested in achieving procurement system-wide performance targets (DE47). Through collaboration, streamlining of the flow within the procurement process becomes more likely (PC61) and agencies will be more likely to prioritise every project document appropriately (DE4).

Effective collaboration between agencies (DE8), coupled with an awareness that collaboration is important for setting the necessary timing of land acquisition prior to project start (INJ1), will ensure that it becomes far more likely that there will be no lateness in land acquisition by the project owner (DE9).

In order to ensure that procurement becomes the main responsibility for MPS and ADN (DE35), it is necessary to set up TPV days and DDP, as KPIs for their managers (INJ130). These keys performance measurements will drive all agencies to give special priority to project document processing (DE4). These measures will thus support (and be supported by) the scheduling system, in order to synchronise the flow of procurement documents between agencies (which includes control of releases based on load and definition of due dates) (INJ21).

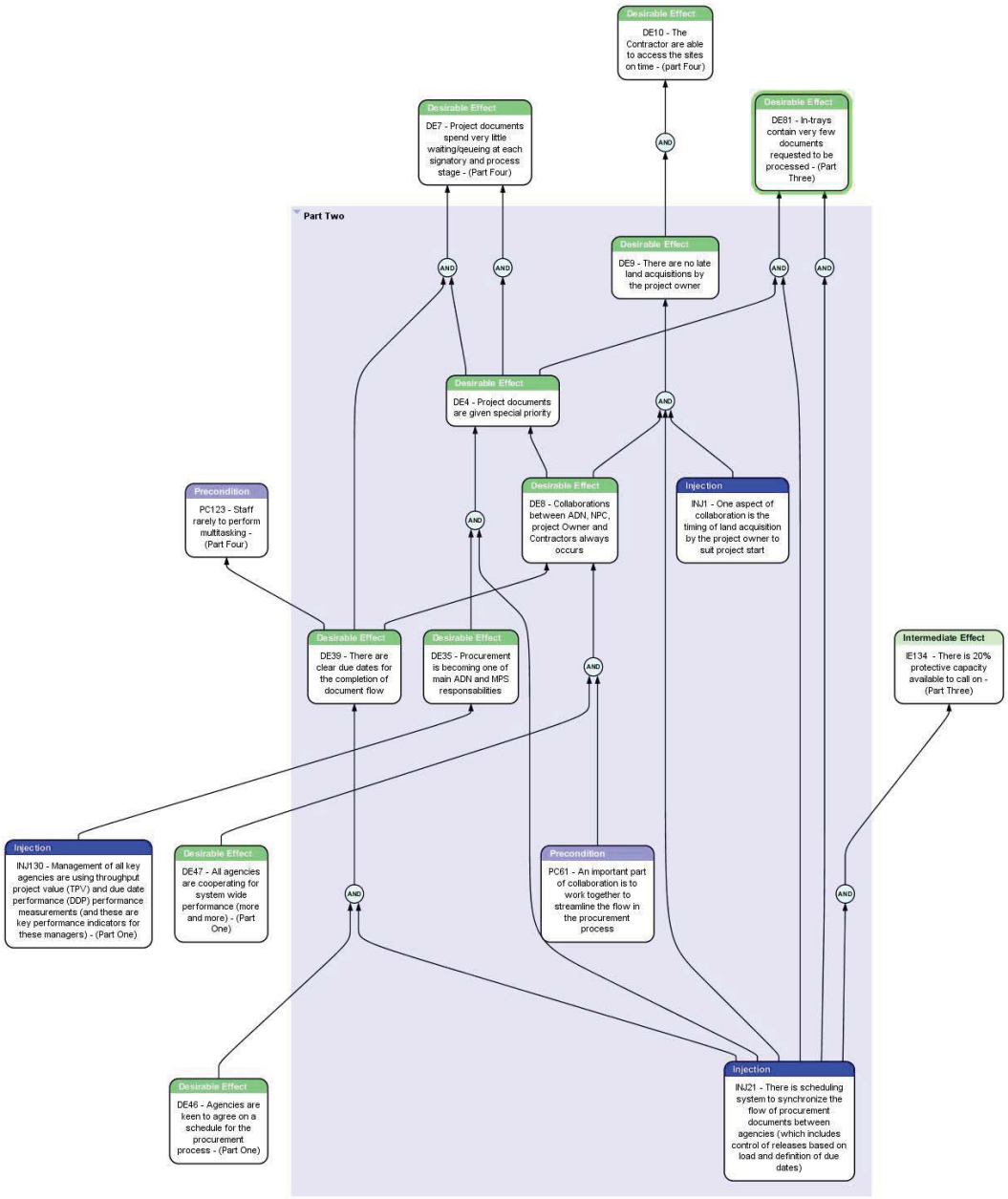


Figure 4.18 TLS-P FRT: Part Two

TLS-P FRT: Part Three

Given that a scheduling mechanism to synchronise the flow of procurement documents (INJ21) and project documents are given special priority (DE4) (based on load and definition due date), it could be expected that the flow of the work will accelerate. However, all agencies are busy (PC68) organisations, so there is a need to prevent overload, which could threaten the meeting of delivery due dates. The scheduling system must,therefore, have an additional component that controls the release of projects into the procurement process, in order to prevent possible system overload (PC153). The control of releases will lead to very few documents queuing at in-trays, waiting for processing (DE81).

Projects are very varied in complexity, thus making very accurate predictions on procurement processing time virtually impossible. In order to enable the system to cope with this and other uncertainties, the scheduling mechanism (INJ21) will plan to provide an estimated 20% of protective capacity, at the time of planning the schedule. It is anticipated that uncertainty and fluctuations will mean that, on many occasions, this capacity will need to be called upon. The source of this protective (or surge) capacity is twofold:

1. Planning will set the load of normal bottleneck resources to approximately 90%, thus reserving 10% as protective capacity (INJ135).
2. An expert pool of external resource people skilled in most aspects of procurement will be available to deal with 10% of the bottleneck capacity (INJ154). This expert pool can help staff members to prevent the system from overloading, in addition to helping staff solve technical difficulties with ‘on-the job’ training.

This protective capacity is aimed at protecting the system from disruptions such as emergency procurement requests (PC106) and it will encourage a smooth flow. Emergency requests can be scheduled to an available time slot using this protective capacity (DE125) and unexpected overloads can also be remedied.

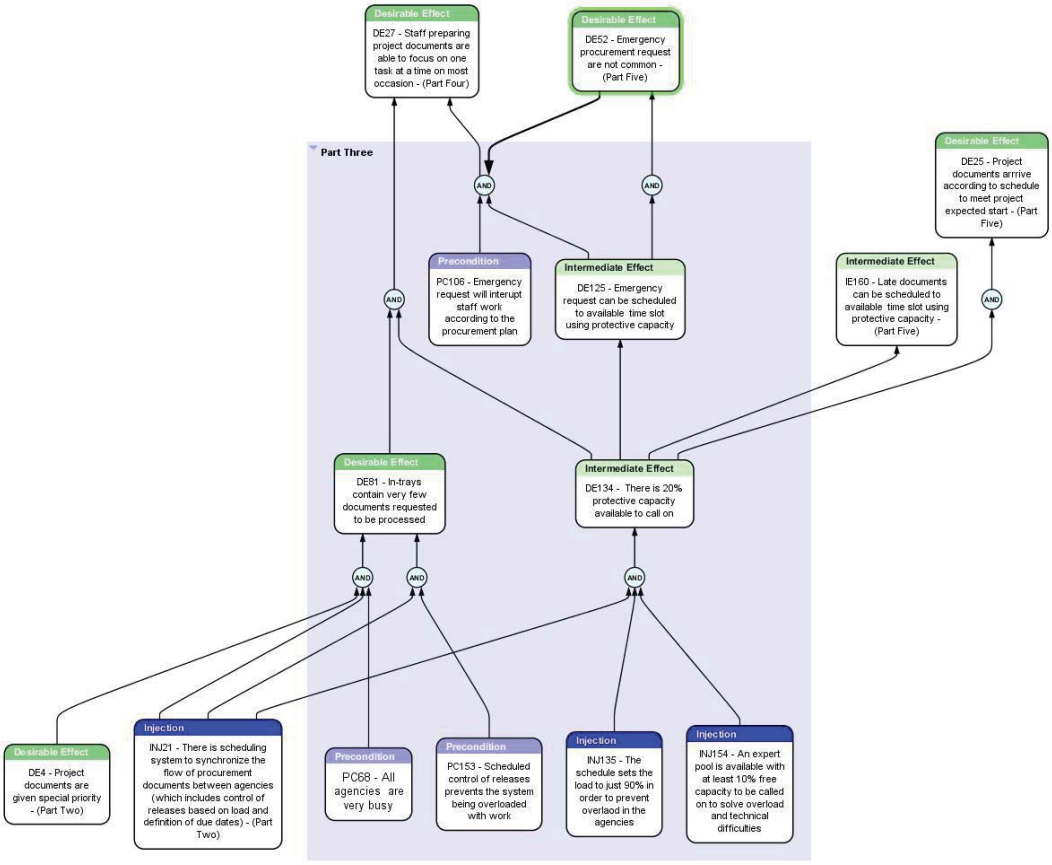


Figure 4.19 TLS-P FRT: Part Three

TLS-P FRT: Part Four

If there are clear due dates for the completion of document flows (DE39), then staff members preparing project documents are able to focus on one task at a time on most occasions (DE27), because in-trays will contain very few document requests to be processed (DE81). As a result, staff members will rarely be required to perform multi-tasking (IE123), due to the 20% protective capacity available on-call for any unscheduled requests (IE134)

When project documents are given priority (DE4) through each process and by signatories (PC6), based on a clear due date for the completion of the document flow (DE39), these documents will spend far less waiting/queuing time at each signatory and process stage (DE7), specifically when multi-tasking is a rare event (IE123).

In another part of the process, the elimination of late land acquisitions, by the project owner (DE9), means that residents of acquired land are given sufficient time to vacate (PC31) before the contract signature, thus enabling the contractors to access the work sites on time (DE10).

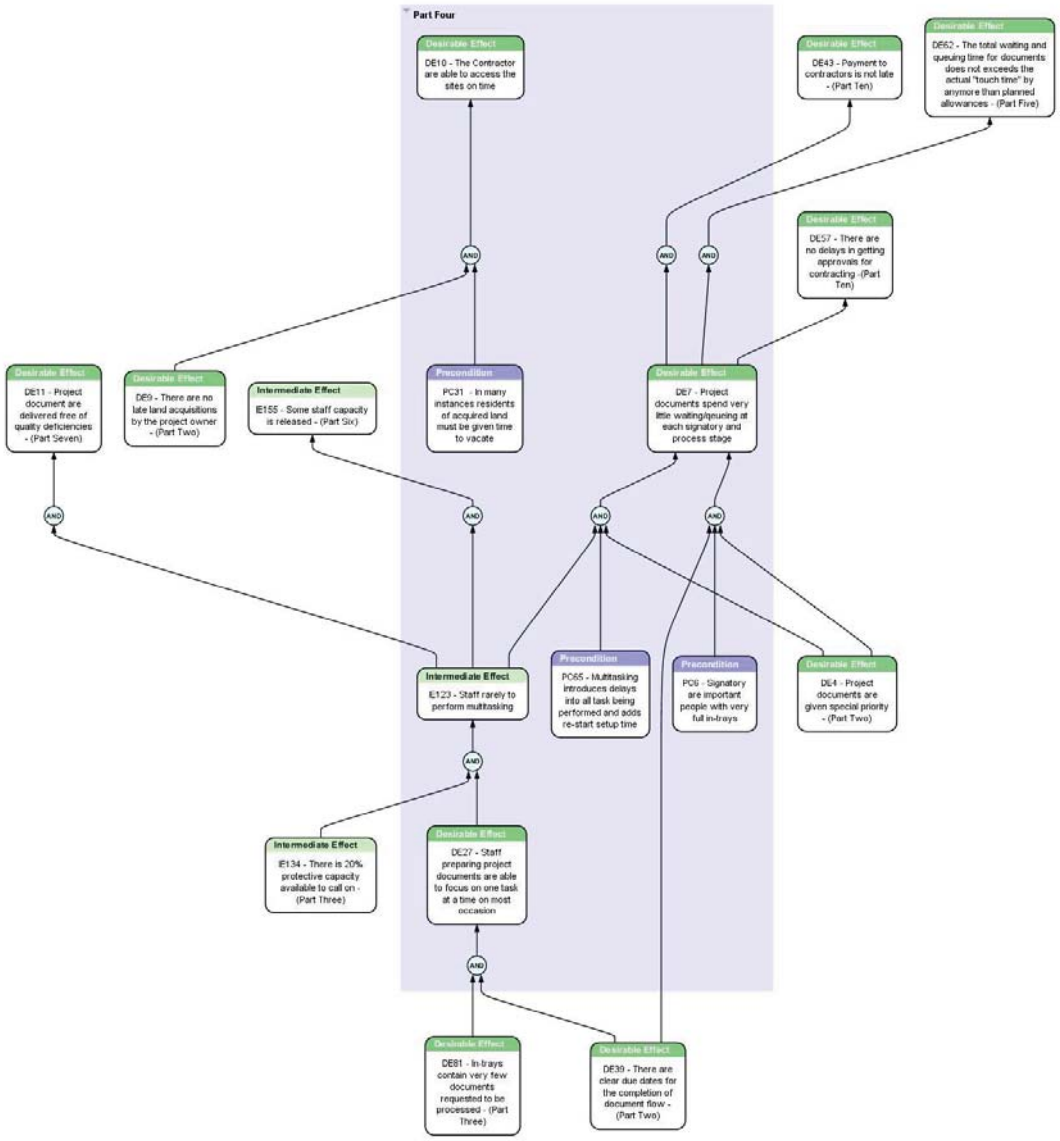


Figure 4.20 TLS-P FRT: Part Four

TLS-P FRT: Part Five

If the Prime Minister becomes satisfied with procurement performance (IE161), it can lead to a positive opinion, in relation to the process and an agreement to simplify the flow of documentation within the procurement cycle (DE164). Consequently, the infrastructure project workflow will not contain any duplicates and there will be a shortened approval process (DE119), which can reduce processing times and result in project documents spending very little waiting/queuing time during the approval process at each signatory (DE7). As a result, the total waiting and queuing time for documents will not exceed the actual 'touch time' by anymore than the planned allowances (DE62)

When the project document processing time begins to get close to the actual touch time (DE62), the project documents will arrive according to the schedule. This means that, as long as project documents are delivered on-time, projects will start according to the planned allowed time. Therefore, project documents will arrive according to schedule, in order to meet project expected start dates (DE28), because the expected start time of a project is based on the due date scheduled at CCR, plus DDP buffer time (INJ63)

The existence of a 20% protective capacity (DE134) will provide a stable and flexible scheduling mechanism to protect the system from disruption, for example, requests for reworking (DE19) and it will allow for delayed documents to be rescheduled to available slots (IE160). Therefore, late documents will rarely remain late and they will not stimulate emergency procurement requests (IE144).

When project documents arrive according to the schedule (and late documents not disturb the procurement process), emergency procurement will not be common (DE52). As a result, staff members preparing project documents will be able to focus on one task at a time, on most occasions (positive reinforcement loop) (DE27).

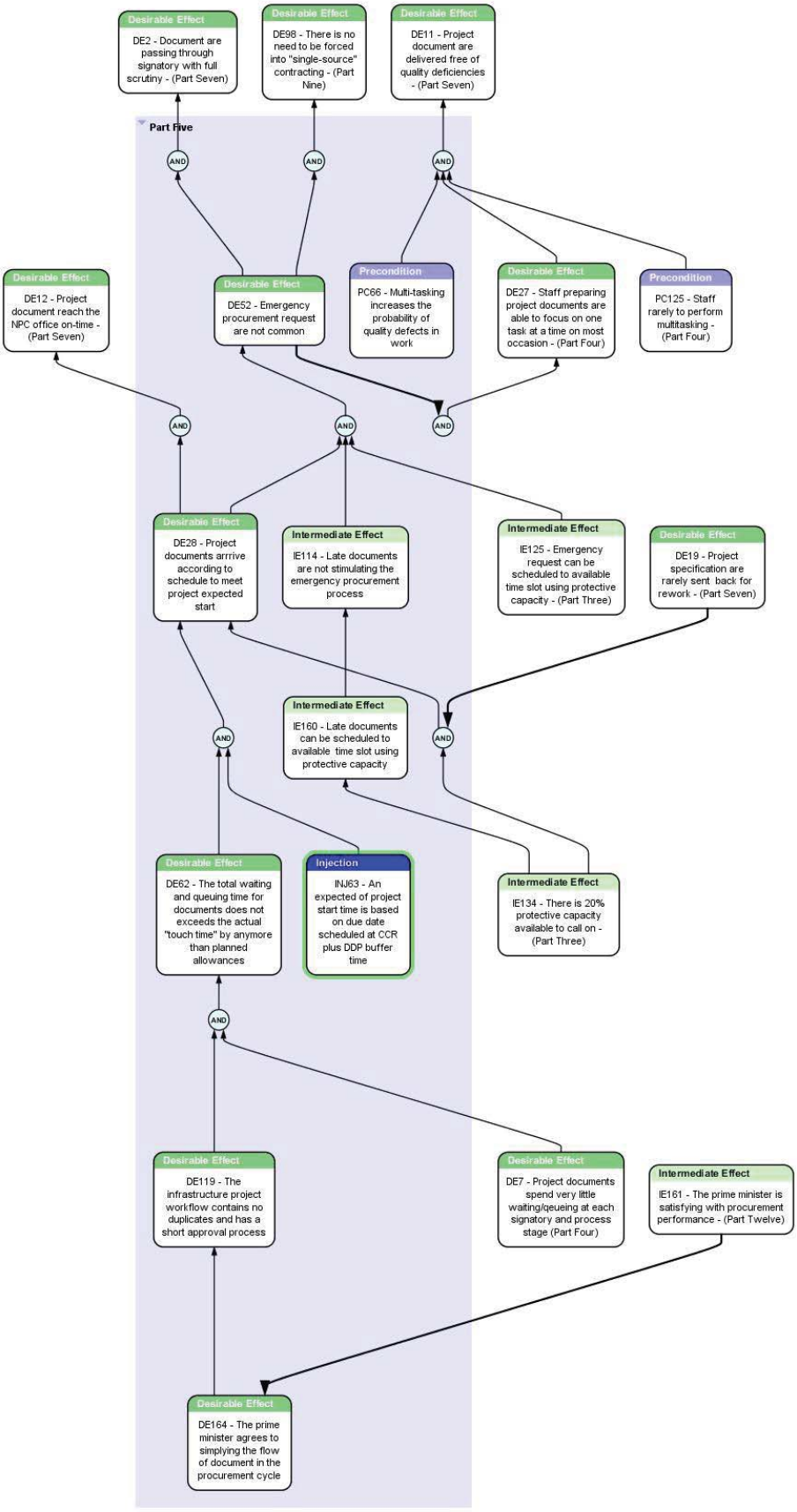


Figure 4.21 TLS-P FRT: Part Five

TLS-P FRT: Part Six

If staff members preparing project documents are able to focus on just one task at a time (DE27), then some staff capacity is released (IE150) and thus there is sufficient time to prepare filing systems in an organised manner (IE115). This can reduce the time spent on searching for missing documents (DE116), which further allows project documents to arrive within the procurement schedule (IE109).

It is difficult for staff members at ADN, to be required to undertake quality checks on project documents (PC106), since these documents are written in English (PC53) — a language that is not well understood by most of staff. By employing new staff, who have the ability to understand both languages (English and local) to assist local staff review the technical specifications (INJ131), errors in project documents are more likely to be identified and corrected (IE104).

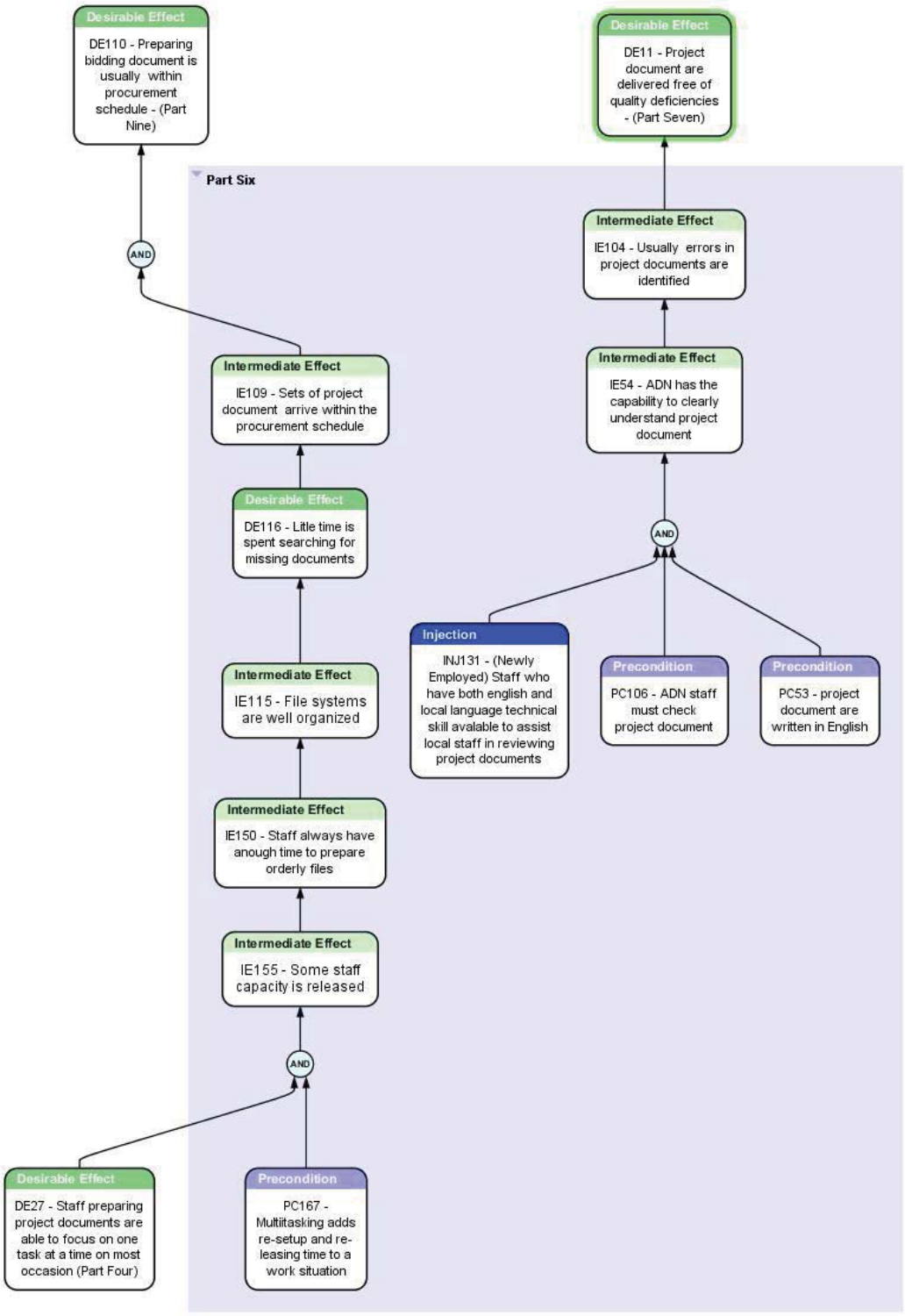


Figure 4.22 TLS-P FRT: Part Six

TLS-P FRT: Part Seven

Emergency procurement requests are not common in the new reality (IE52), since staff at each agency will have sufficient time to give every project document their full scrutiny before passing it to the next stage (DE2). At the same time, when project staff members are preparing project documents, they are able to focus on one task at a time on most occasions (DE27): and they are able to work carefully. As a result, project documents are delivered generally free of quality deficiencies (DE11), especially since errors are now be identified in project documents (IE104). This means that project specifications are rarely be sent back for reworking (DE19).

Having clear project documents also reduces the number of requests for clarification of project documents from tenderers (DE69). Meanwhile, if project documents arrive according to schedule to meet project expected start (DE26)), then project documents are very likely to reach the NPC office on time (DE12).

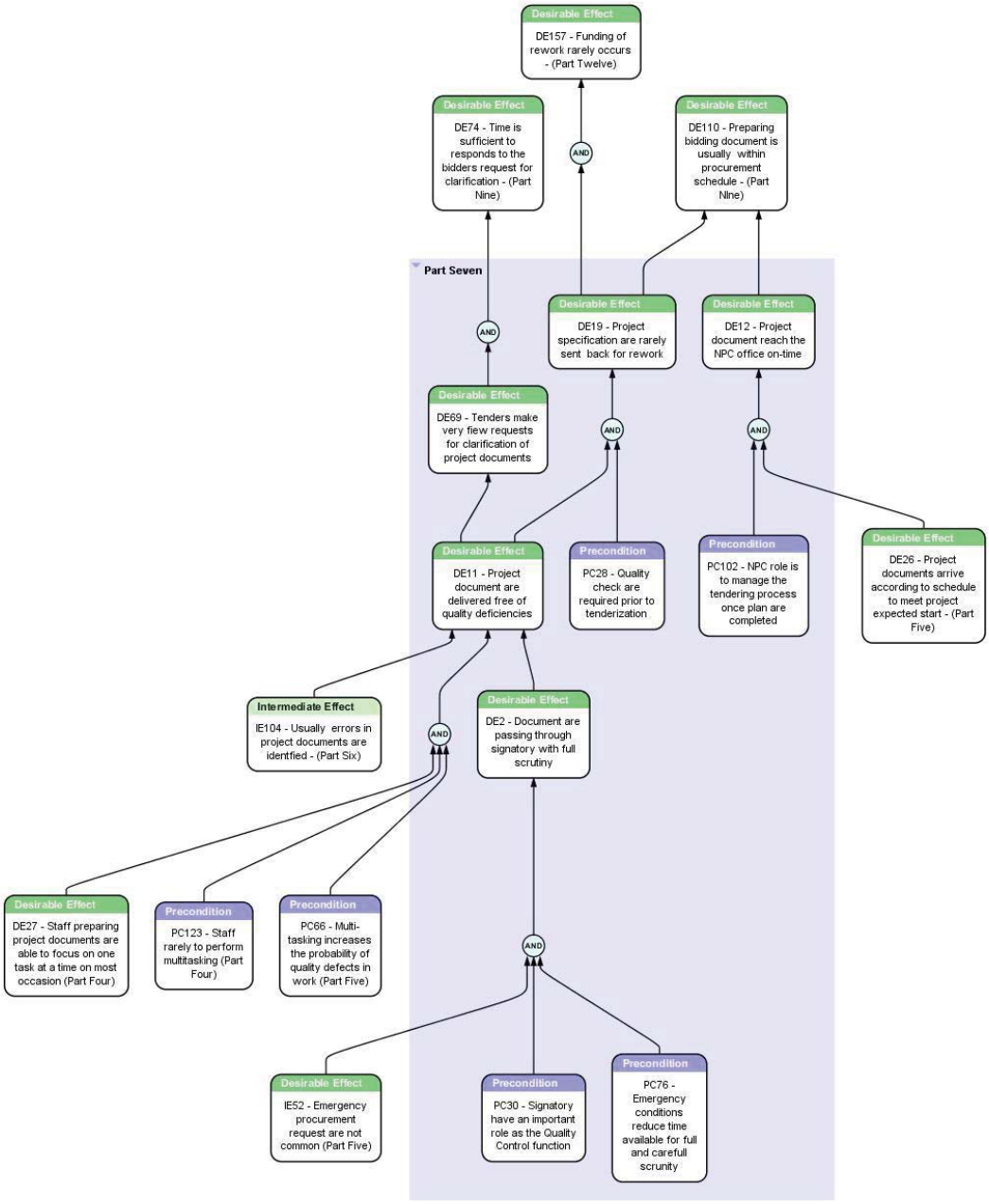


Figure 4.23 TLS-P FRT: Part seven

TLS-P FRT: Part Eight

The absence of an efficient postal system (PC92) in Timor-Leste makes it difficult for bidders to submit their bid in hard copy (PC91), because sending the bid documents through courier post is very expensive (PC93) and they often arrive late, since it takes some time to get through customs clearance procedures (PC168). This problem reduces the time for bidders to prepare detailed proposals, if they plan to send their proposal to meet the closing date and time. To overcome this problem, there should be electronic bid submission procedure (INJ90). This can help lead to NPC always being successful in getting satisfactory bidder responses (DE86), because overseas bidders would then be able to submit their bid electronically (INJ124).

Meanwhile, publishing the tender information in the DGMarket (INJ129) would also allow NPC to receive more responses from bidders. This should lead to being more successful, than at the present time, in getting qualified bidders (DE87), because this website is accessible globally by overseas companies (DE85).

The development of fast contract approvals and payment processes, which are on time, will further attract more bidders to participate in Government tender projects (positive reinforcement loops from IE165).

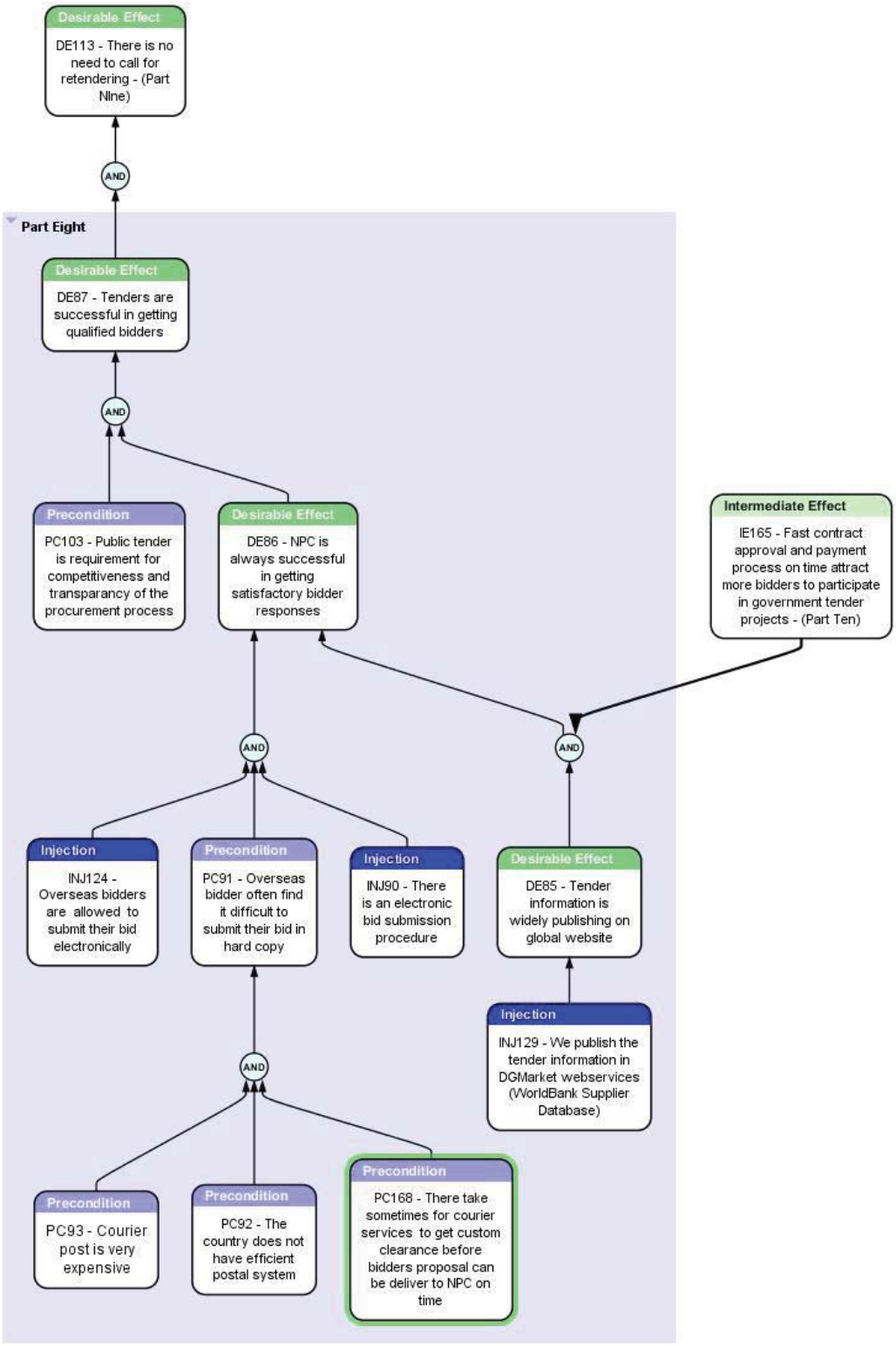


Figure 4.24 TLS-P FRT: Part Eight

TLS-P FRT: Part Nine

If project documents arrive on time at NPC (DE109), in a complete set (DE12) and without quality problems (DE19), then preparing the bidding document is very likely to occur within the procurement schedule (DE110). This will allow sufficient time to respond to bidders' requests for clarification (DE74), because tenderers (given the document's quality) will make very few requests for clarification (DE69). As a result, the tender submission deadline will rarely need an extension (DE73) and receipt of tender documents will not be late, versus the timeline (DE70) needed to select the qualified bidder (DE75). This is especially true, when there is no need for retendering (DE113), since tenders are successfully selecting qualified bidders (DE87) that have strong technical and financial capability to do the work (positive reinforcement loop - DE41).

There will always be sufficient time to seek qualified bidders (DE77), since the issuing of tender documents will nearly always be consistently on time (DE25), since the preparation of bidding documents will be within the procurement schedule (DE110). The frequent absence of the need to call for retendering (DE113) will makes this especially so. In this kind of situation, there is no need to be forced into 'single-source' contracting (DE98), because there will not be any emergency procurement requests (DE52).

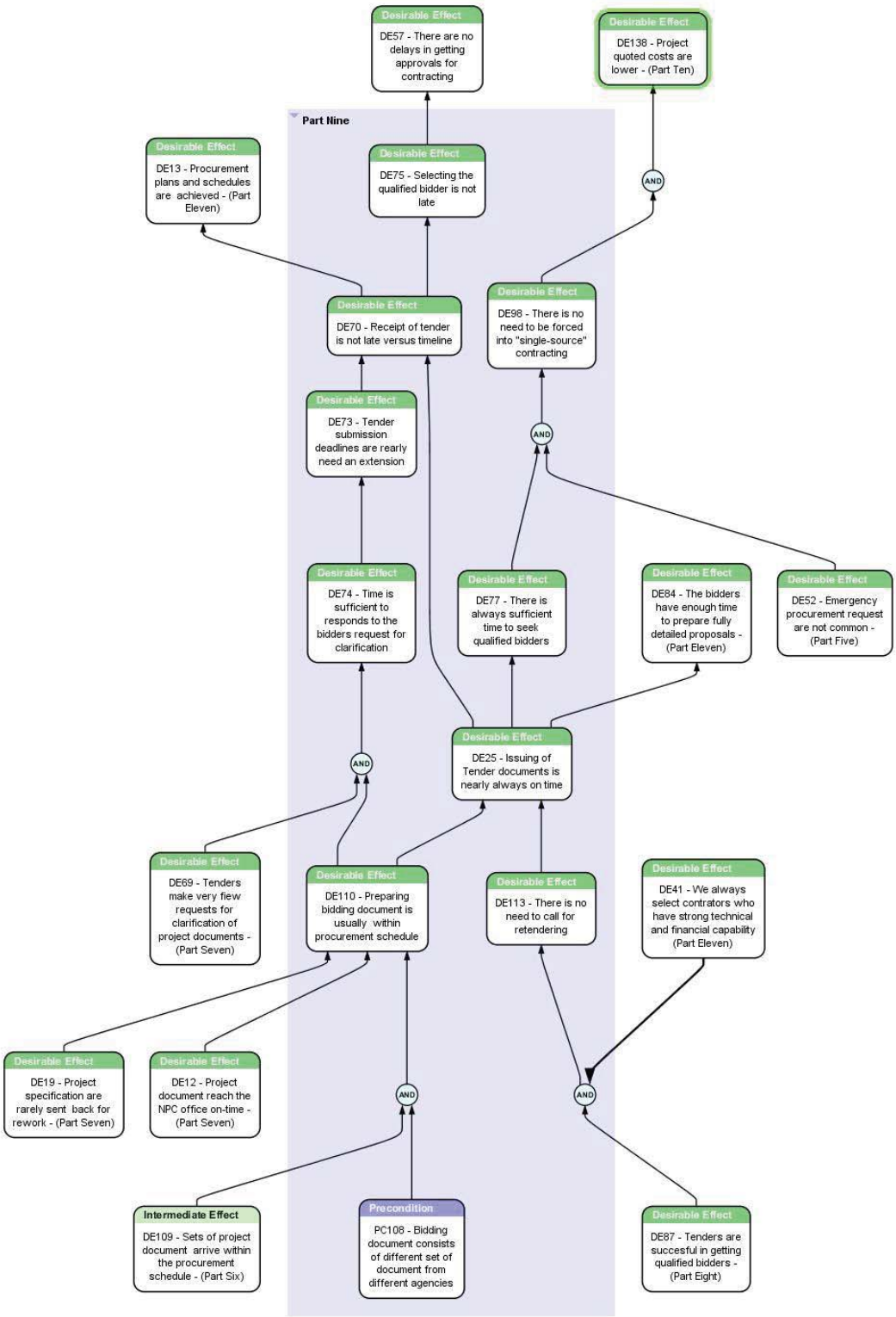


Figure 4.25 TLS-P FRT: Part Nine

TLS-P FRT: Part Ten

If collaborations between ADN, NPC, project owner and contractors always occurs (DE8 Part Two) and one aspect of collaboration is identifying the supervision company before tendering for the construction company (INJ23), then DE22 occurs: assigning the construction supervision company on time. Ensuring that a construction supervision company (to supervise the contractor) is assigned on time (DE22) usually allows the construction project to start on time (DE14), after they are given timely work site access (DE10).

Construction projects starting on time can thus be seen to be the 'natural' outcome of the elimination of delays in the contract approval process (DE7): and also in the acquisition of qualified bidders (DE75).

The majority of potential companies will be interested in participating in Government tender projects, when there are faster approval (IE165) and payment processes (DE43). This can be undertaken by allowing documents to spend very little time queuing for a signature at each stage (DE7).

In public procurement, selecting contractors through a tender process that produces a competitive market is compulsory (PC140) and it helps to avoid single source contracting (DE98). With more bidders competing, this increases the probability of quoted prices being within the budget allocation (DE138).

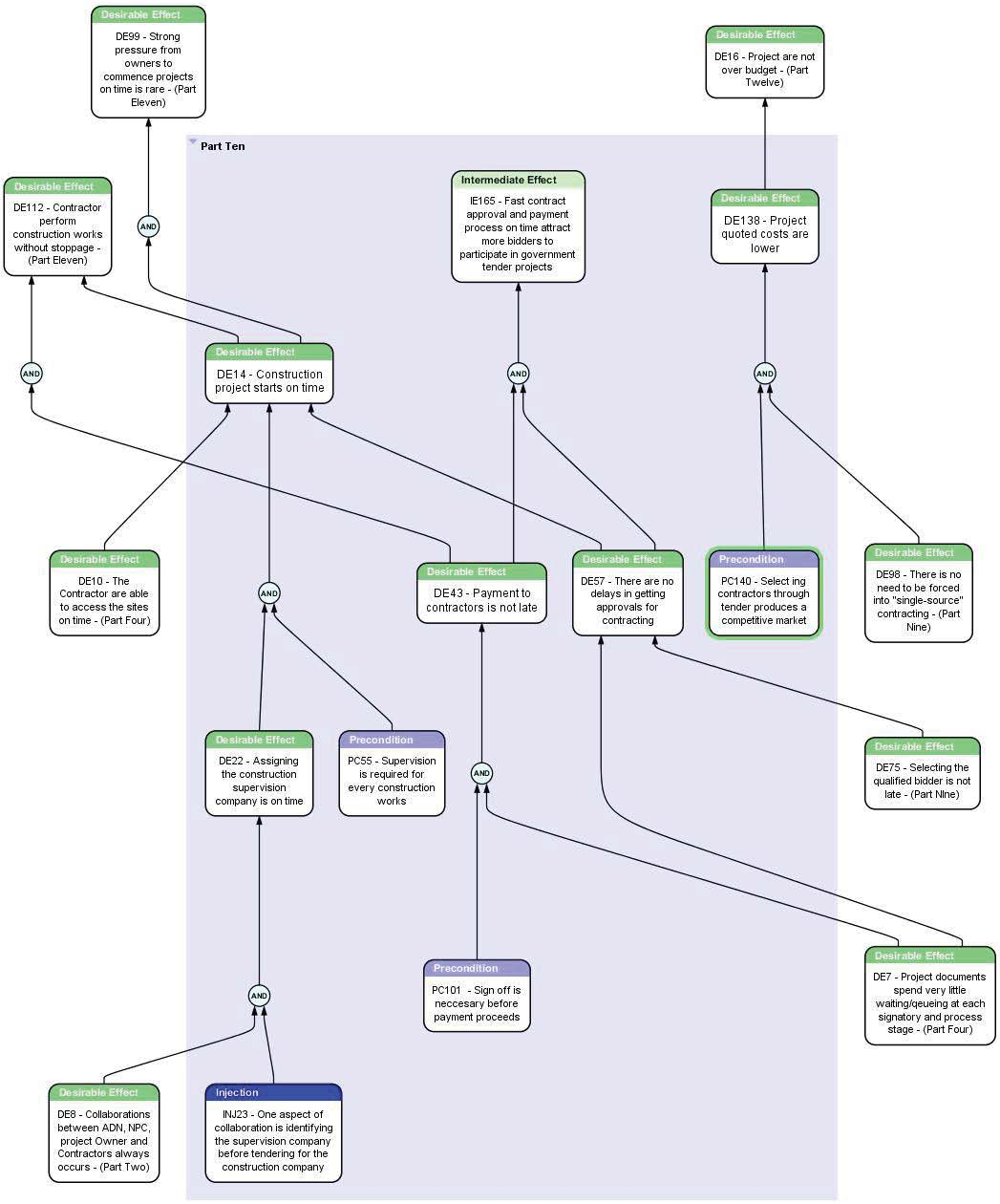


Figure 4.26 TLS-P FRT: Part Ten

TLS-P FRT: Part Eleven

Bidders have sufficient time to prepare a fully detailed proposal (DE84) when the issuing of tender documents is on time (DE25). A full detailed proposal reveals bidder qualifications, which allows the NPC to select and always award contracts to bidders with strong qualifications (DE83). This is helped when there is an absence of strong pressure from owners to commence projects within a shortened time frame (DE99).

The bidder (contractor) who has a strong technical and financial capability (DE41) is usually more able to perform construction works without stoppages (DE112): and this is helped by payments to the contractor always being on time during construction (DE43)).

Receipt of tender documents, as per the timeline (DE70), means procurement plans and schedules are achieved (DE13). This situation, together with the ability of the contractor to perform construction works without stoppages (DE112), leads to projects being completed on time (DE15). Finishing projects on time not only prevents any additional funds being required to speed up the project (DE158), but it also reduces (positive reinforcement loop) any strong pressure from the project owners to start the projects on-time (DE99), since construction projects always starts on time without such pressure (DE14)).

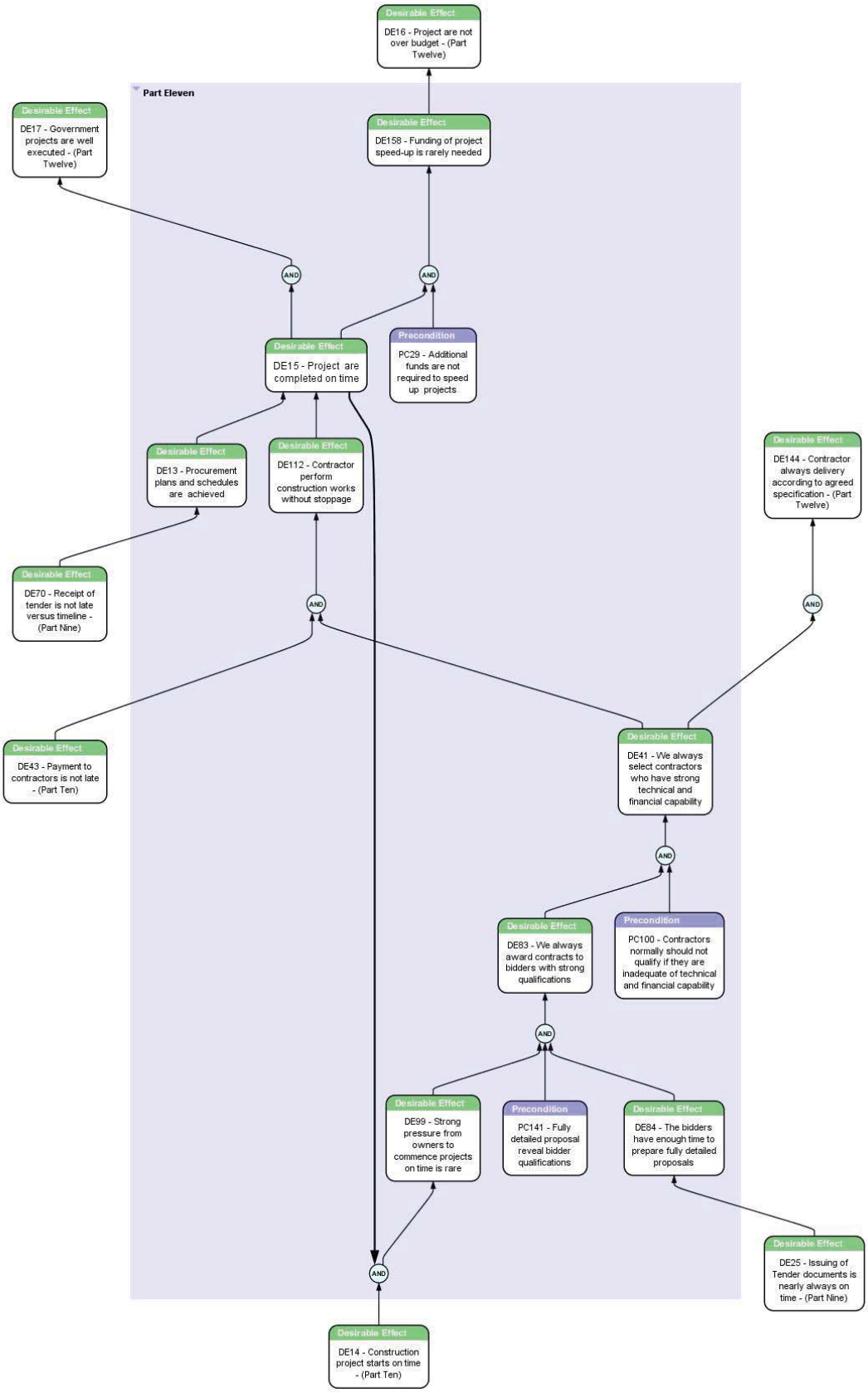


Figure 4.27 TLS-P FRT: Part Eleven

TLS-P FRT: Part Twelve

In order to ensure that projects are delivered with good quality (DE145), it is necessary to always select contractors who have strong technical and financial capabilities (DE41). This is because only strong technical contractors are sufficiently capable to consistently deliver projects in accordance with the agreed specifications (DE144).

It is also important to ensure projects are not over budget. This can be achieved if bidders are quoting their price lower than budget and additional funds are not required to speed up projects, or to perform quality rework. Conformance to budget, schedule and quality leads to the observation that Government projects are satisfactorily executed (DE17).

In such a situation, the Prime Minister will be very satisfied with the procurement performance (IE161) and thus, he is likely to be more comfortable with the proposal to further improve the performance by simplifying the flow of documents within the procurement cycle (DE164).

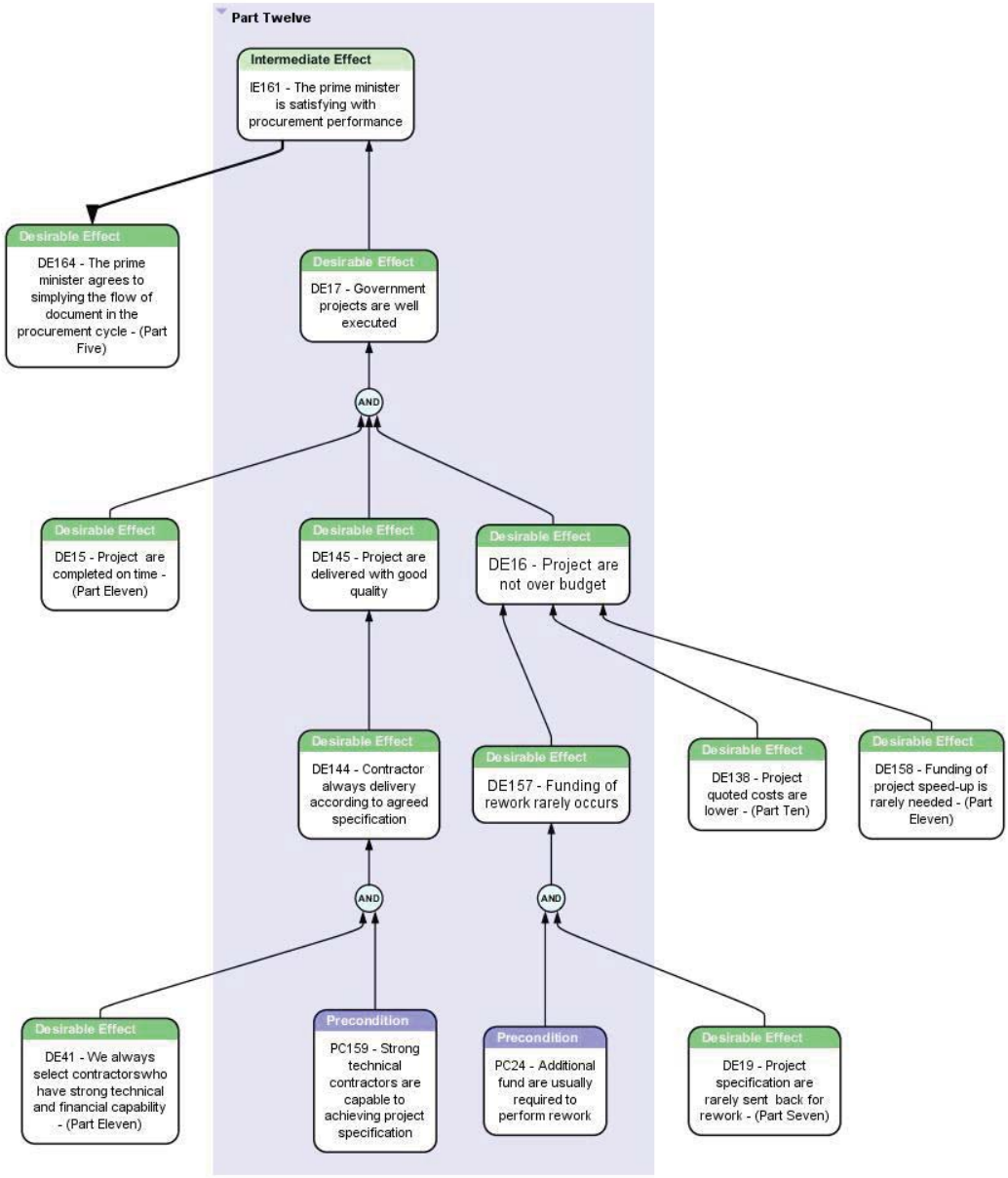


Figure 4.28 TLS-P FRT: Part Twelve

This TLS-P FRT begins with the injection identified by the EC:

> INJ133 “Agencies agree to coordinate across the procurement process to streamline their schedule and measures”

However, the rigorous rules of logic applied in the FRT creation reveal that this injection is not sufficient, on its own, for the TLS-P to achieve its goal.

In order to realise all the desired effects, additional injections will be required, for example:

- INJ21: “There is a scheduling system to synchronise the flow of procurement documents between agencies (which includes control of releases based on load and definition of due dates)”;
- INJ135: “The schedule sets the load to just 90%, in order to prevent overload within the agencies”; and
- INJ154; “An expert pool is available with at least 10% free capacity to be called upon to solve overload and technical difficulties”.

This validates that FRT not only shows the probable future of the system after implementation of the starting injection, but it also provides the way to determine what else is needed to really improve the system: and thus, this helps the researcher to answer the second research question.

The full list of additional injections thus determined to be required to produce a robust solution, which would result in the desired improvement, is provided in Table 4.4.

Table 4.4 Injections for TLS-P system improvement

INJ#	Descriptions
133	Agencies agree to coordinate across the procurement process to streamline their schedules and measures
130	Management of all key agencies are using throughput project value (TPV) days and due date performance (DDP) measurements (and these are key performance indicators for these managers)
21	There is a scheduling system to synchronise the flow of procurement documents between agencies (which includes control of releases based on load and definition of due dates)
135	The schedule sets the load to just 90%, in order to prevent overload within the agencies
154	An expert pool is available with at least 10% free capacity to be called upon to solve overload and technical difficulties.
63	Project expected start time is defined by the DDP
1	One aspect of collaboration is the timing of land acquisition by the project owner, to suit project start
23	One aspect of collaboration is identifying the supervision company prior to tendering for the construction company
131	(Newly employed staff (who have both English and local language technical skills) are available to assist local staff in reviewing project documents
90	There is an electronic bid submission procedure
124	Overseas bidders are allowed to submit their bid electronically
129	Tender information is published in DGMarket webservices (WorldBank Supplier Database)
147	Government establishes a reward system to recognise and reinforce the agencies to use procurement system-wide performance

4.4.4. Solution for TLS-P System improvement

The EC discussed previously has revealed the solution direction: “We have defined and applied procurement system-wide performance measures using throughput project value (TPV) days and due date performance (DDP) which effectively keeps all agencies aligned with the system’s goal." This requires all agencies to agree to coordinate across the procurement process and to streamline their schedules and measures (INJ133), by using TPV days and DDP performance measurements (INJ130), in order to change UDEs to become DEs.

At the same time, the FRT provides additional injections (INJ21, INJ135 and INJ154), which provide a new scheduling mechanism to synchronise the flow

of documents through the TLS-P system, based on clearly defined due dates.

Appendices K (electronic version also attached) shows how the researcher used the TRUE/FALSE testing feature of the Flying Logic software programme to test the logical connection of those injections. The results suggest that those injections are sufficient to cause TLS-P to achieve its goal — whereas the other injections play a lesser role in the logic of the solution.

Through this analysis, the researcher is more able to focus on the answer to the third research question: “How can the systems be improved?”

Injection 130: Management of all key agencies is using Throughput Project Value (TPV) days and Due Date Performance (DDP) measurements — and these are key performance indicators for these managers.

The purpose of measurement is to ensure the effects of local agency decisions impact positively on the overall system performance. The assessment needs to determine whether an improvement has occurred against some key indicators. There are two measurements proposed as important KPIs for the manager of each agency: ‘Throughput Project Value (TPV) Days’ and the ‘Due Date Performance’ (DDP). These KPIs can be used to track and drive all agencies’ behaviour towards the goal, because they govern how employees do their jobs.

‘TPV Days’ (TPVD) measures activities that are undertaken too late and therefore, if agencies are holding project documents late, versus the scheduled due date, this indicates poor performance. TPVD is calculated based on the number of days the project is late, times the value of the project. The ideal value of TPVD days is zero, which indicates on-time delivery (Chang & Huang, 2011 ; Stein, 1996).

This TPVD and DDP are set as KPIs for agency management, which can also be used as the basis for a reward system (such as promotion, pay rise or holiday) that recognises and reinforces the agency’s system-wide success using these measurements (INJ147). Such rewards would encourage

agencies to coordinate and cooperate further towards a TLS-P systems-wide improvement process. Setting up those KPIs would involve the establishment of a scheduling mechanism (Injection 21), so that due dates can be fed into the measures.

TLS-P Injection 21: Scheduling system to synchronise the flow of procurement documents between agencies

According to the TOC concepts (as described in chapter two), in order to increase the throughput (the flow) every workstation activity must, on average, keep pace with the weakest link (the constraint). This synchronisation is undertaken through a scheduling mechanism known as Drum Buffer Rope [DBR], which produces signals to communicate and coordinate workstation activities to support the constraint operation.

This idea can be adapted to synchronise the flow of procurement documents between agencies, which also includes control of releases based on load and definition of due dates (INJ21).

TLS-P is ruled and policy driven, which requires TLS-P to have some flexibility, in order to adapt capacity, especially when services are required to deliver, based on speed, cost and quality that only work well under the Drum Buffer Rope for Services ($DBR_{S)}$ environment (Ricketts, 2008).

The Government's "Annual Budget Book Six" provides accurate information for TLS-P about the number of projects to be procured, which allows TLS-P to control input and the scheduling of works on the capacity constraining resource (CCR) (NB: it is believed that this resource in the TLS-P is the NPC) using DBR for Goods (DBR_G) principles. However, when project documents are entered into the system, processing times at MPS and ADN are difficult to predict, due to 'red tape' requirements that are often beyond their control and influence. In addition, when tenders are released, it would be difficult to control the number of proposals submitted by the bidders to NPC. Less numerous proposals mean less capacity utilisation and vice versa and thus, it is difficult to use DBR_G. Therefore, it is difficult for TLS-P to solely

use either DBR_G or DBR_S: and it may create confusion if both were to be used simultaneously.

In order to overcome this problem, the researcher proposes combining DBR_G and DBR_S into a hybrid system (hereafter called Dynamic-DBR or "DBR_D") to suit the TLS-P. This DBR_D system is diagrammatically represented in Figure 4.29 at page 151

- Individual procurement plans from each of the LMs are collected and MPS consolidates them into a single Procurement Portfolio Plan for releasing project documents. MPS/ADN/NPC set the schedule for release, based on CCR time buffer size.
- The CCR buffer times represent the amount of time required at the MPS and ADN before it can deliver to NPC, while the due date buffer time represents the time required by NPC to produce the amount of contracts to meet projects' due dates. Buffer times include a safety allowance for uncertainty and unexpected events.
- The dotted (rope) line represents information flow, while the solid line represents services flow in the form of paper (project documents, SBD and contract). The rope also acts as the synchronisation mechanism that triggers MPS to release project documents into the system, in order that they arrive on time for NPC to start the tendering process. Release is controlled at the correct amount, which prevents NPC from being starved or overloaded. The rope also communicates schedule information (such as desired sequence for processing projects) back to upstream agencies (MPS and ADN) to coordinate the activities required to support the NPC activities.
- Project documents are released based on the project value. The first priority is given to projects that will produce high benefits or contribute to the achievement of Government goals – although other factors, such as creating a spread of projects throughout the year for each Ministry, are likely to be also considered.
- Q represents the number of of WIP projects in front of CCR — and also flowing to it.

- The capacity buffer (CB) at Q represents the maximum of flow rate that the CCR can handle.
- The capacity management (CM) system uses CB to adjust the flow rate through the CCR. This means that CM can increase or decrease the flow rate by simply increasing or decreasing constraint resource utilisation or available constraint capacity (via the expert pool), in order to ensure that projects are delivered according to the planned scheduled. This is the reason why elastic capacity is very important.
- Service Level Agreements (SLA) help the CCR to process the project based on speed, cost or quality. Short lead time requirements mean that CM must increase the capacity to speed up the process: whilst the quality requirement means CM must ensure that the CCR has sufficient time to undertake the job carefully. According to Ricketts (2008), the best way to achieve both conditions (and for cost effectiveness) is to maintain SLA on a target 'star'. CM is also used to adjust capacity utilisation, which depends on the number of proposals submitted to NPC for the evaluation and selection processes.
- An expert pool provides an additional 10% of protective capacity. Their role is to monitor and offer help when buffers (time or capacity) penetrate the red zone. They collect and analyse all the problems, in order to identify new ways in which the system can be improved

The following paragraphs provide a description of how the DBR_D would work.

The MPS collects the individual procurement plans from each LM and consolidates these into a single procurement plan for the year, or foreseeable planning horizon. NPC sets the due date for project completion based on the estimated number of contracts possible to be processed (per NPC available time) within one financial year (12 months) — this could also be called "constraint throughput rate". The due date schedules then shift backwards in time from December and they are linked to MPS (the gating point) to control the release of project documents into the system, according to CCR schedule in regards to starting the tender process.

The CCR rope provides the synchronisation mechanism to trigger MPS to release the number of project documents required to arrive at NPC on time, prior to work being scheduled to meet the due date. The buffers (due date and capacity) are then carefully monitored and appropriate responses are determined, based on a three coloured visual control mechanism. For example, if the capacity buffer shrinks to the lower red-level (33%), this means CM must increase CCR capacity usage, for example, by more project releases or bidders' proposals, in order to re-establish the buffer to green level. If the capacity buffer penetrates the upper red level (80%), the CB rope triggers an increase in capacity and therefore, 10% of CCR protective capacity and the expert pool are called in to help, until that buffer signal returns to green level.

This mechanism not only protects the NPC from becoming overloaded (exceeding 80% of CCR capacity), but it can especially cope with unscheduled (emergency) requests and (at the same time) allow NPC to adjust their capacity to meet project due dates. This directly provides a solution for Injection 134, which will make the system more stable and flexible, compared to the current TLS-P systems. In addition, DBR_D also allows all agencies to align their local performance to a system-wide goal, by using TPV Days and DDP performance measurements (IE121): and it also helps to ease buy-in (agreement on proposed solution), because it is a simple, easy to understand tool — all management agree to use TPV days and DDP as one of their KPIs (Injection 130 and 133).

At the same time, the expert pool monitors the time buffer (divided into green, yellow and red zones) to ensure that project documents are arriving in the correct amounts and at the right time to the NPC queue. The green zone indicates that the flow of documents is on track — therefore, no action is needed. If the buffer is penetrating into the yellow zone, this indicates that there is a potential delay upstream and the situation should be investigated.

er to expedite the situation.

n also learn (adaptively and continuously) what the correct buffer times ed on buffer penetrations. If the buffer is always at expedite mode (red ns that the buffer time is too small and therefore, the buffer time must be e buffer is never in the expedite mode, then this means the buffer can be

nitoring the buffer status, the system can provide signals and alert a problem. This will help everyone in MPS/ADN/NPC to coordinate their rder to solve problems and thus, the DBR_D not only provides a mechanism, it also allows the TLS-P system to be more stable and it tem from disruption.

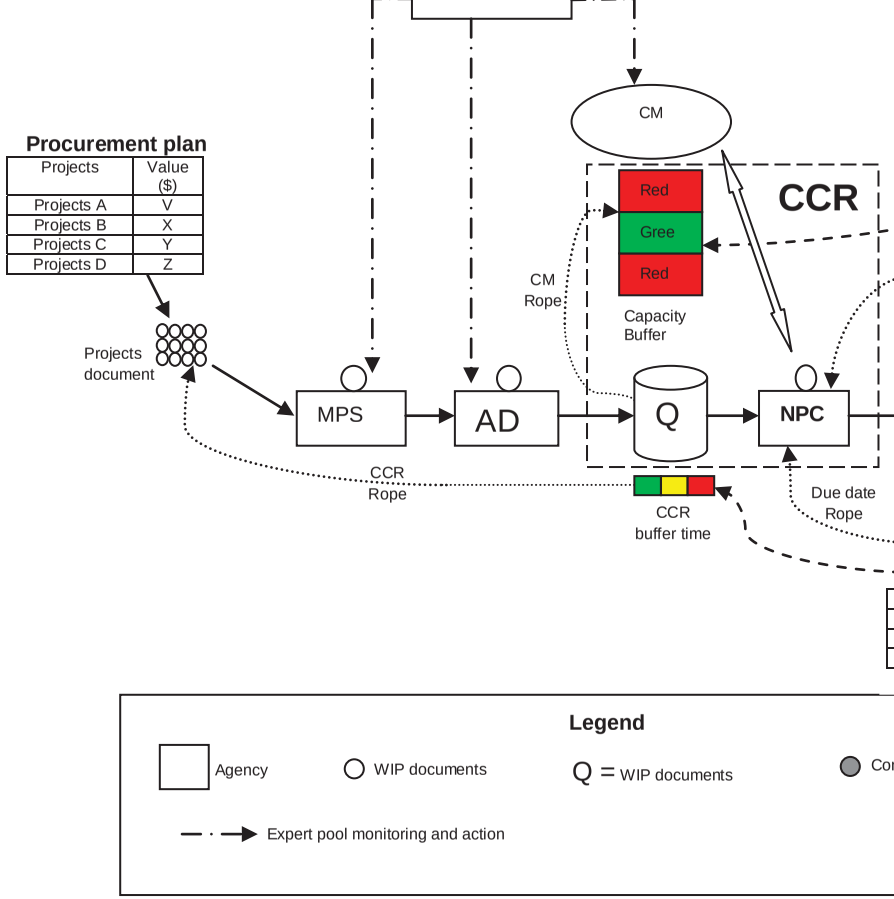


Figure 4.29 DBR_D for TLS-P systems

4.4.5. Prerequisite Tree (PRT)

The EC and FRT provide breakthrough ideas on how to improve the system (injections). However, they cannot become an implemented solution until obstacles that prevent implementation are identified and solved. The Prerequisite Tree (PRT) helps to 'cause the change' by mapping out any obstacles and necessary intermediate steps (actions, objectives or injections) needed to overcome the obstacles. These steps are then mapped in a time-sequence manner, all leading to the end point, where all necessary injections from the FRT become a reality: and hence the logic of the FRT occurs and the DEs replace the UDEs.

Appendices L show this TLS-P PRT. The PRT is read in a chronological way, in relation to the solution's implementation: and it starts from bottom to top.

The Prime Minister is the head of the Government, which includes all agencies involved in the procurement process (LMs, MPS, ADN and NPC). This means any proposed change must be approved by the Prime Minister. Without the Prime Minister's support, it will be difficult to make changes to procurement processes (OBS320). Therefore, the first step is the Prime Minister's buy-in to the procurement process (IO321), so that he fully supports the proposed changes. The support from the Prime Minister eases the buy-in of all agencies' management into the proposed overall solution and implementation of the plan (IO309), so that they have no doubt that the use of TPV Days and DDP are effective measurements — and that the overall planning system will facilitate synchronisation (OBS308).

Another form of the Prime Minister's support is to allow the Government to allocate an additional budget (IO286), thus ensuring sufficient funds to improve procurement control and effectiveness (OBS277). Part of this budget will be used to hire a TOC expert (IO285), who will help agencies to understand how to modify DBR and to provide training on how to use it for the scheduling system (OBS284). Once all agencies know how to modify the DBRs' scheduling system to suit the TLS-P systems' needs (IO283), they can provide the appropriate scheduling system to synchronise the flow (OBS282). As a result, there will be a scheduling system to synchronise the flow of procurement documents between agencies, which includes the control of releases, based on load and definition of due dates (INJ21).

The following are solutions provide by INJ21:

- To provide a clear definition of TPV Days and DDP (OBS289) and management. Consequently, they agree to use TPV Days and DDP as performance measurements (INJ130). This provides a clear mechanism which allows all agencies to coordinate in a timely manner (OBS300), so that agencies can agree to coordinate across the procurement process, in order to streamline their schedules and measures (INJ133). This clear coordination allows all agencies to collaborate in a timely manner (OBS280), which helps agencies to identify the supervision company before tendering (INJ23) and timing land acquisitions to suit project start times (INJ1). These two injections (INJ1 and INJ23) provide effective communication, to solve the current communication problem, so that projects can start on time (OBS307).

  When the management of all key agencies are using TPV Days and DDP as performance measurements (INJ130), it also means it becomes straightforward for the Government to use these two measurements, in order to provide a reward and reinforcement mechanism (OBS287) that recognises and reinforces the agencies use of the procurement system-wide measurement (INJ147). The aim is to motivate staff members to work with the ‘relay runner work ethic’ (working in a focused way on projects that arrive in their department and handing them on as quickly and as cleanly as possible to the next department) (Goldratt, 1997), in order to meet project delivery due dates (O301).

- To provide the overall loading estimation that allows management to set an appropriate buffer size for an expert pool (OBS313) and to set a schedule to prevent the CCR from overloading (OBS311). This will help to ensure the availability of an expert pool (at least initially equivalent to 10% free capacity), to be called upon to solve overload and help with technical difficulties (INJ154). This will also ensure that management agrees that (on most occasions) the CCR load will be targeted at only 90% of the estimated capacity of ‘normal’ CCR staff (excluding the expert pool). This is because it is expected that fluctuations, uncertainties, reworks and unexpected project processing will occur and thus 20% protective capacity will be available in total (10% from normal staff and 10% from the expert pool) to accommodate surges in the load on the CCR above

90%, for any of these reasons (INJ169). This example helps management to understand how to provide a 10% expert pool (OBS314) and that the existence of a 20% free capacity (total), based on the TOC concepts, is not counterproductive (OBS291). Buffer management, which occurs during normal operations, will allow management to learn about the appropriate level of reserve (protective) capacity to prevent system overload and multi-tasking (IO315). This will also enable them to more fully understand how to set the schedule to prevent the system from overload and multi-tasking (OBS306).

- To provide a scheduling mechanism to release the project documents based on due date at the CCR (OBS319), which will allow management to calculate project expected start time, based on due date at CCR, plus DDP buffer time (INJ63). Thus, this provides the management with a clear definition of project start time (OBS293).

Part of management buy-in to the proposed overall solution and implementation (IO309) is that they agree to become a member of DGMarket (OBS322), as part of the solution. Therefore, they have to pay the subscription fee and gain approval from the World Bank (IO279), through using the available budget (OBS277) which has already been allocated to improve procurement control and effectiveness (IO286). Once there is access to DGMarket, then tender information will be published in the DGMarket (INJ129), which is widely accessible worldwide (OBS305).

Since management does not have the knowledge to establish electronic bid submission procedures (OBS295), they can use some of the allocated budget (IO286) to hire a IT Consultancy Company with skills suited to the creation of an electronic bid submission process (IO295). This will ensure that there is an electronic bid submission procedure in place (INJ90). However, even with this in place, overseas companies will still have difficulty submitting a secure bid electronically (OBS297). Therefore, there must also be a designated bank account in existence, to allow bidders to submit their bid security in the form of electronic money transfers (IO298). Once bidders are allowed to submit their bid electronically, they will be able to submit their bids on time (OBS303).

The allocated budget (IO286) can also be used, by the management, to employ additional staff, who have both English and local language technical skills, to assist

local staff in reviewing project documents (INJ131). This will enable agencies to be able to review project documents clearly, accurately and to deliver them on time (OBS304).

By successfully overcoming all obstacles, TLS-P can implement a new system with a fast flow of information and document processing across the TLS-P, to meet project delivery due dates (OBJ276)

4.4.6. Application of TOC-L for TLS-P system improvement

The DBR process is designed as a means of implementing the TOC-FS process of ongoing improvement and it is comprised of the following steps:

- The first step is to identify the constraints. Section 2.2. of chapter 4 reveals the NPC as the potential physical constraint within the TLS-P system, because it has total lead times of 109 working days (number of days of the annual fiscal year for NPC to produce one contract). This lead time is defined by current procurement law and it allows for proper checks, balances and transparency (Timor-Leste, 2010a). According to (Ricketts, 2008), this can be used as a strategic constraint, because it is difficult to change and it is costly. Although this initial choice of constraint may be incorrect, it is not overly critical, since, during the DBR_D implementation, buffer management will quickly confirm the real constraint if a high red level penetration occurs at the supposed CCR. Adjustment to the DBR_D focus can then be made, or capacity can be adjusted at the real constraint to make it a non-constraint.

- The second step is to exploit the constraints. This means using the constraints as effectively as possible. The objective of this step is to maximise the output of the current capacity of the CCR (NPC), without major investment or upgrade. For example, the simplification of current infrastructure workflows (IE164) and implementation of E-Procurement (Injection 90 and 124), to replace the current paper-based tender process. The existence of 10% of the CCR excess (protective) capacity is also another way of exploitation, because it prevents

CCR from bad multi-tasking and thus reveals capacity. As a result, more output is likely to occur and this will build as the system stabilises. The expert pool (whilst more of an elevation) can also help with exploitation, since it means that technical difficulties do not cause long delays at the CCR, nor are they distracted by emergency procedures etc. This will enable the CCR to work smoothly, effectively and be increasingly efficient

Lean tools, such as quality at source, 5S, SMED, visual factory, standardised work and kaizen (which are discussed in a previous chapter) can also be used at the MPS/ADN/NPC to identify waste that prevents the TLS-P process operating more effectively, for example, using 5-S of Lean tools as follows:

- Sort and remove unnecessary documents;
- Straighten: ensure that document files are easy to locate and available when needed;
- Shine: clean the workplace by removing excess and relocating the remainder of completed files; observe, inspect and correct; and remove damaged items or scrap paper from desks or office space, so that it looks clean;
- Standardise: systemise the organisation by adopting the best practice; provide guidelines that everyone understands and knows where, how and when they should be use; and
- Sustain: maintain all the above procedures.

In addition, SMED can also be used to reduce time during the tender advertising period and the waiting for contract signatures.

- The third step is to subordinate everything else to the above decision. This means that non-constraints (MPS and ADN) must synchronise their activities to the pace of the constraint (NPC). This is undertaken by controlling the release of project documents according to the constraint capacity — not that of the preceding departments. This is because the TLS-P system output depends on the NPC and therefore, other activities must be coordinated, in order to optimise NPC output: and actions that contradict the subordination rationale should be

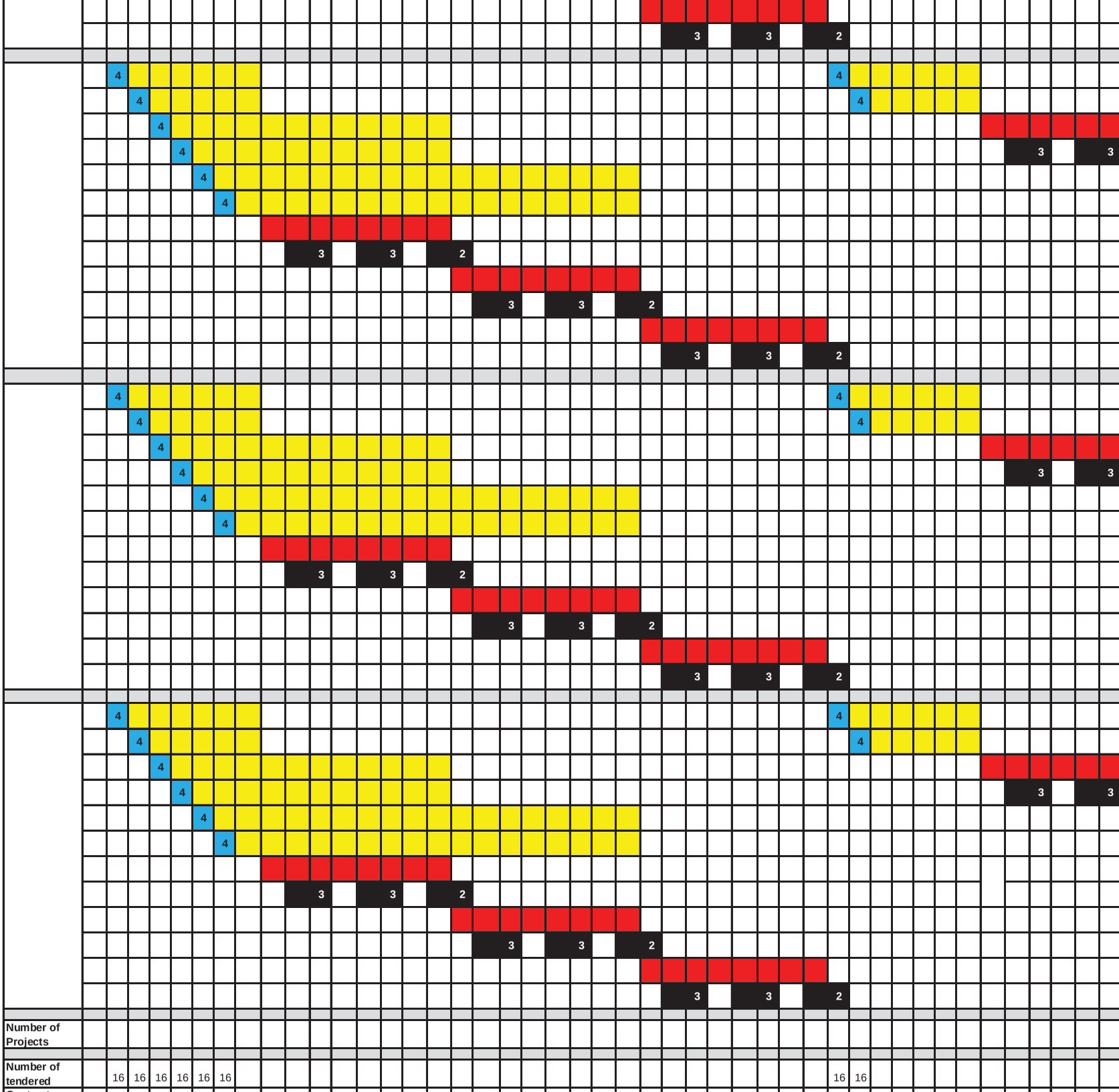
avoided. The DBR_D discussed above provides a new way of synchronisation for all agencies (INJ21) to improve their project flow and thus meet delivery due dates and increase project throughput (INJ130). In order to facilitate sub-ordination, the constraint should be scheduled, based on the throughput rate that it can handle.

Figure 4.30 shows that NPC is comprised of four groups and they are assigned to preparing tenders for processing. This scheduling shows important NPC steps (the NPC drum schedule) for other agencies (MPS & ADN) to take, in order to align their schedules with that of NPC. MPS should release project documents so that they arrive for tender document preparation (blue colours). There are 32 tender document preparation processing blocks (blue coloured work blocks) and each block will comprise preparation of four projects' tender documents. This means that NPC is able to perform tenders for 128 (32 x 4) projects. This staggered flow of work means that the NPC will also able to produce all 128 ([3 x 32] + [2 x 16]) contracts (black coloured work block). Therefore, there will not be any open project documents at the end of the fiscal year.

INSERT GANTT CHART HERE

Figure 4.30 Hypothetic Gantt chart scheduling at NPC based on Table 4.4.

Agencies	NPC Status
NPC	Active
Bidders	Idle/Waiting
NPC	Active
PM/CoM	Idle/Waiting



The success of this scheduling depends on the ability of MPS to have project documents on hand to release into the system, accordingly. In order to achieve this situation, ADN must give a copy of the completed project documents (concept development and detailed design phase only) to MPS after final quality acceptance by ADN. These project documents would have previously already passed an appraisal at MPS and quality control at ADN. This means that project documents do not need to have a second review by both agencies — and thus, MPS and ADN workloads are reduced.

By receiving a copy of those completed project documents, MPS does not need to wait for them to arrive from LMs. This means that MPS has more time to collect the new concept design documents from LMs, while ADN can undertake quality control more carefully. MPS then commits the funds and coordinates with AND-NPC to prepare a procurement portfolio plan for releasing project documents into the systems.

This also reduces NPC waiting time and allows NPC to prepare tender documents according to the planned scheduled. In addition, this would allow NPC to issue the advance general tender opportunity notice and to inform interested bidders of an upcoming tender, which would allow them to prepare their plans in advance in a more effective and efficient way, in order to get better price and quality. For example, preparing in advance with their supplier; preparing bid security; and finance etc. which often take time to solve. By doing this the bidder would have sufficient time to prepare a full and detailed proposal and submit on-time, which would allow NPC to select the most qualified bidder to carry out the works.

The process of scheduling at NPC is to commit to the contract delivery due date, which is dependent on the arrival of project documents from MPS-ADN. Thus, firstly NPC must set the latest due date for MPS and ADN to deliver project documents to NPC. This due date is then backward scheduled, in order to identify an ‘ideal’ time for the gating point to release project documents early into the system, so that they can

arrive on time at NPC, to start the tendering process. This can be undertaken by connecting the gating point (MPS) to the constraint buffer, using the constraint rope (which is really a time interval) to ensure project documents are released at the same rate as the NPC (the drum) can process them. The time buffers (rope) ensure that the process meets contract delivery due dates.

The expert pool functions as a line coordination to ensure that the speed of other agencies is paced to the rate of the NPC. They monitor capacity and time buffers and they are called in when either buffer penetrates the red zone. This buffer management mechanism provides visual control to monitor workflows and it takes any necessary action before major problems occur, which thus ensures that the NPC always has the correct amount of documents to be processed (maintained at the green level).

This implementation highlights the importance of DBR_D in making NPC capacity known. DBR_D provides accurate information for all agencies to coordinate their activities across the procurement processes, thus improving document flow and delivery capability to meet project due dates. This process allows each agency to act like a relay runner and to ‘flow’ the work as quickly as possible to the next agency for them to work on.

Capacity management (CM) monitors the status of CB and only acts when the NPC (CCR) capacity required has penetrated into either red-level. If NPC capacity utilisation is penetrating the lower red-level (below 33%) of CB, it indicates that the CCR capacity utilisation is falling below the target level for the CCR, because fewer projects are entering the system, or less bidder proposals are arriving. Therefore, CM (through an expert pool) requests MPS to release more project documents into the system, or CM must release more bidder proposals for CCR to evaluate, so that it increases the load and capacity at NPC — thus, re-establishing CB to the green level.

In contrast, if CB is penetrating the upper red-level, this means that NPC capacity is going to be overloaded (above 80%), which can have a negative impact on the quality of services. At this time, CM must call in the protective capacity to handle some project documents, in order to re-establish CB back to green-level. By monitoring and controlling the CB always in the green-zone, this means that NPC is always able to meet its SLA, in term of quality, cost and time, which allows TLS-P to deliver good quality projects on-time and within budget.

This situation is in line with Ricketts (2008) suggestion that, by monitoring and controlling the CB always in the green-zone (the zone between lower and upper red-level) it can provide acceptable services in terms of quality and time.

- The fourth step is to elevate the constraints. If the constraint (NPC) still cannot produce output to meet demand, the alternative way is to elevate the constraint. This step is where costly changes take place, in order to eliminate the constraint, if practically and economically justified. The aim is to increase the current NPC capacity. This may require additional resources, such as people and/or equipment. The existence of the expert pool in DBR_D provides another way of 'dynamic' elevation, because they act like a type of floating capacity that flows when there is a problem in the MPS, ADN or the NPC itself.

  Sometimes policy may also require a change, for example, allowing overtime or eight hours rotation. However, before thinking of elevating the current constraints, the management should consider the question: "Where will the next constraint be?" It may be possible that the next constraint might pose more difficulties to manage, compared to the existing constraint, which may reduce the margin for control over the system. The ability to always have control over the constraint will help the organisation to achieve better performance after elevation. Buffer management signals and FS-VSM of the Lean tools can be used to

identify where the most likely next constraint will be —and begin the planning and identification of resources that will be needed when the new constraint appears.

- The last step is to repeat Step One – but do not allow inertia to become a systems constraint. Since this is a continuous improvement process, if the four steps are executed successfully, the constraints will likely (or eventually) move to somewhere else. It is necessary to repeatedly check if the current physical constraint has moved, or policy may become an obstacle and no longer be of benefit to the entire system. Therefore, the system must be regularly re-evaluated, in order to identify where the new constraint is, by repeating step one to find that constraint. This continuous iteration process takes place as part of the process of ongoing improvement.

4.4.7. Conclusion

This analysis and discussion demonstrates that the EC, FRT and PRT can help to find the answers for Research Questions Three and Four.

Firstly, the EC was extended to identify the assumptions underlying the conflict (local vs. system-wide performance), which created the organisational dilemma that leads to the core problem. The assumptions were able to be identified and challenged to find a breakthrough idea (‘an injection’: a change in the reality) to resolve the conflict. It is proposed that the best way is to break the conflict between ‘Prerequisite D’ and Prerequisite D, by requiring each agency (MPS-ADN-NPC) to align their local measurement to TLS-P systems-wide performance: “Agencies agree to coordinate and apply procurement system-wide performance measures, which effectively keep all agencies aligned with the system goal".

Secondly, usage of the FRT enabled the testing of what the effect of the identified injection from EC would be — and whether it would change UDEs

to DEs. In some situations, some UDEs were not changed by this single injection, or negative side effects were created. Additional injections were needed for the total solution and thus became obvious: and these injections collectively answered the question “What to change to?” The process shows that the FRT function is to map what the future reality will look like after implementation of the injections and thus identify, “What to change to?”

Thirdly, the PRT helps to cause the changes by mapping out any obstacles to achieving the FRT’s injections and it identifies the necessary intermediate steps (action, objective or injection) needed to overcome these obstacles: and then sequences them in time. The focus is on overcoming obstacles that prevent implementation of injections, in order to achieve the ultimate desired effects.

Fourthly, the identification of injections has allowed the researcher to create a dynamic-DBR (DBR_D): a hybrid model of DBR_G and DBR_S. This DBR_D not only synchronises scheduling in the TLS-P system, but it also focuses the use of TOC-L concepts towards a TLS-P continuous improvement process — and it also allows each agency to use DDP and TPV days for their performance measurements.

The use of EC, FRT and PRT not only provide the answer to Research Question Three: “How the system can be improved?” — it has also enabled the researcher to answer the final research question: “Can TOC-L help towards system improvement?” The answer to this is a definite “Yes”.

CHAPTER 5 - CONCLUSION AND RECOMMENDATION FOR FURTHER RESEARCH

5.1. Conclusion

This thesis confirms that the use of TOC-L concepts, in this case study, has enabled the researcher to achieve the research objective, by providing answers to all four research questions, as follows:

5.1.1 Research Question One: “How does the system work?”

This thesis demonstrates how case study methodologies have enabled the researcher to closely study a real-life phenomenon through detailed analysis: and to investigate how the TLS-P systems works. At the same time, the TOC-TP extends the case study methodologies to an even deeper understanding of the causal logic that exists within these systems. The TOC-TP is also the creation of a logically tested proposed solution and implementation plan for improvement. It is therefore proposed, by this researcher, that the TOC-L approach does provide systematic analytic tools that help to amplify the insights gained by using the ‘normal’ qualitative research approaches of interview, documentation, observation and small surveys in case studies.

The VSM method also helps the researcher to map the flow of materials and information throughout a system, in addition to helping to define the sequential process steps and data that are pertinent to each step relating to the entire process. This has allowed the researcher to draw flowcharts, in order to show the TLS-P process flow from start to finish, as follows:

> TLS-P cycle starts with identifying the need for goods, services or works. A procurement plan is developed by each line ministry (LMs) in the form of a Strategic Procurement Plan (SPP). This SPP, together with project documents, are then submitted to the Ministry of Finance (MoF) through MPS, in order to identify if there are available

funds to cover the purchase, before preparing clear and accurate specifications and costings.The MPS then raises a Cashier Payment Voucher (CPV) and organises treasury approval and fund commitment. The project documents and CPV are passed to ADN for quality control, prior to being handed over to NPC for the tendering process and the awarding of the contract to the strongest suitable company to carry out the works. The contract is then handed over to contract management (LMs and ADN) for them to conduct inspections on performance and quality and monitoring and reporting, in order to ensure that the project is delivered according to the contract agreement. This procurement activity ends with the handover of goods, services or works from the contractor to the LM. The ADN conducts a final performance and quality review and then sends a report to NPC for updating the supplier register database.

An understanding of how the TLS-P works enabled the researcher to capture a number of possible UDEs (using CRT and CLR), during the data collection process. These UDEs were checked with the staff involved, for both validation and confirmation as to their accuracy and their importance. Once confirmed, UDEs were placed into the respective agency on VSM: and a storyline was written, in order to capture the logical context surrounding each UDE. This process continued until flowcharts and a definitive UDEs list was completed.

The results reveal that TLS-P is a complex interaction with five different government agencies and it is comprised of many approval processes. The use of the CRT indicates that there are at least 15 major problems (UDEs) currently existing, which are widespread across the agencies involved in the procurement process.

5.1.2. Research Question Two: “What are the constraints in the system that limit the throughput value and why?”

The research has found that the CRT and CRD have proven to be an effective toolset in this case study, in order to identify the core problem of the TLS-P complex public procurement process. By analyzing and constructing a detailed cause-and-effect relationship between research identified problems (UDEs), together with the use of CLRs, considerably more insight into the case study system has been generated.

As a result of the application of the CRT and the CRD to this case study, the researcher has identified: “there is no clearly agreed coordinated approach across all agencies involved in the procurement process – UDE48”, as the core problem. The CRT logic confirms that this is the cause of many research-identified problems (UDEs) that exist within TLS-P systems. This core problem leads to serious decreases in productivity and results in complicated processes, which increase the non-value-added touch time: and it also causes delay in workflows, thus making the TLS-P far less effective than it should be.

The EC reveals the reason why the core problem exists: that is, conflict between the prevailing localised (i.e. agency centric) measurements and the need for system-wide measurements (which are not seen to be strongly present within the system).

5.1.3. Research Question Three: “How can the system be improved?”

The EC has revealed that a core problem exists, due to a conflict between “the prevailing localised (i.e. agency centric) measurements and the need for system-wide measurements (which are not seen to be strongly present within the system)”. In order to break this conflict, “all agencies must agree to coordinate/synchronise their activities and apply procurement system-wide performance measures using throughput project value (TPV days) and due date performance (DDP), which effectively keeps all agencies aligned with the system goal". This injection would be a breakthrough to a ‘win-win’

solution, which would change the core problem and its intermediate effects from undesired situation to desired benefits. The FRT was then used to logically model the chosen injection from the EC, in order to show the likely future state of the system. It also helped to identify possible negative outcomes of changes (NB) and identified ways to trim them, prior to implementing the changes.

The results shows that the system can only be improved when injection-133 and 21 (“agencies agree to coordinate across the procurement process to streamline their schedule and measures” and “there is scheduling system to synchronise the flow of procurement documents between agencies (which includes control of releases based on load and definition of due dates))” are inserted into the current state. This converts UDEs to DEs, which lead to a situation where “projects are completed on-time” (DE15), with good quality (DE145) and within budget” (DE16) and thus, “the Government budget for procurement projects is executed well” (DE17). The use of FRT also reveals 12 additional injections are required to ensure that the TLS-P system operates at its full potential.

The EC and FRT provide breakthrough ideas on how to improve the system through those injections — however, they cannot become an implemented solution until obstacles and problems that prevent implementation are identified and resolved. The Prerequisite Tree (PRT) helps to “cause the change”, by mapping out any obstacles and the necessary intermediate steps (actions, objectives or injections) required to overcome such obstacles. These steps are then mapped in a time-sequence manner, which leads to the end point, where all necessary injections from the FRT become a reality: and hence the logic of the FRT occurs and the DEs replace the UDEs.

It can be seen that TOC-TP provides management with a practical process and logical structure, in order to develop strategies and tactics, in addition to defining and communicating information relating to all necessary and sufficient changes, as well as the sequence of implementation of these changes, in order to achieve the system’s goals. The TP also provides an intuitive, logical, framework which requires management to consider “what to

change" (using the CRT); "what to change to" (using the EC and FRT) at strategic level; and to decide "how to cause the change" at the tactical level (using PRT and TT). This means that the TPs provide a map for implementation, by laying out strategy and then developing details of implementation plans at the tactical level.

5.1.4. Research Question Four: "Can TOC-L help towards system improvement?"

This thesis demonstrates that TOC-L can help TLS-P towards system improvement, because both are a management philsophy and set of tools for organisational change toward continous improvement. The combination of TOC and Lean tools and philosophy creates a synergistic leap towards the potential for improvement of a system, because they provide a systematic framework for an ongoing improvement process, which can also be extended to improve a service sector organisation: and this has shown to be especially helpful in the case of TLS-P procurement.

The TOC tools (i.e. TPs, Five Steps and DBR_D, etc.) take a holistic, "systems perspective", in order to identify key process steps that provide the greatest leverage point: and thus, they work well to provide guidance for the focused application of Lean tools (i.e. 5S, SMED, VSM, Gemba, Kaizen and etc.) and the improvement of efforts that will be most beneficial. The TOC focus is on removing or managing constraints, in order to increase Throughput, while the Lean focus is on identification and removal of waste, in order to improve the flow and reduce lead time. By utilising them together within any organisation (including the public sector), a more positive impact will be achieved, than if both are used individually.

It is proposed that this research has addressed a current gap in managerial knowledge and thus, it provides a significant contribution to the current understanding, by extending the application of the TOC and Lean methodologies into the public sector, particularly with respect to the public procurement process.

5.2. Limitations and Recommendations for Future Research

This research has, in a large part, succesfully achieved it objectives. However, there are some identifiable limitations, as follows:

Firstly, the EC, FRT and PRT sections represent the potential interventions and implementation plan for system improvement — which is an acceptable part of a case-study approach. However, due to time and distance difficulties, the researcher was unable to implement such interventions during the course of this study. These plans can, however, provide a guide for future research and action within the TLS-P system.

The intermediate objectives, which have been identified using the PRT, can also be used within a Transition Tree (TT) plan, in order to identify the necessary detailed actions needed to achieve a successful implementation of the TLS-P improvement process.

Secondly, more research is needed on TOC-L in public procurement, in order to discover more empirical verification of whether or not the core problem is common/generic. This is necessary because studies, so far, have only covered the TLS-P procurement process, for which identification of the core problem may be unit specific to the particular setting. In order to validate the findings and the transferability of the TOC-L application, this needs to be also tested in another public procurement situation.

Thirdly, the modification of Dynamic-DBR (DBR_D) by the researcher is new — and it has not been identified in any literature sources in exactly the way it is proposed here. To date, this modification has not been implemented in this case study's organisation and therefore, the applicability of DBR_D for TLS-P is something that needs to be tested in future research. The researcher also suggests the testing of this hybrid DBR in the wider field of services, since it could well provide the way for TOC-L to also be implemented in other government organisations. This hybrid version of DBR is proposed, in order to overcome the limitations of DBR_G and DBR_S.

Finally, this thesis also indicates that it is difficult to use VSM within the public procurement setting, in order to calculate the processing time, because procurement is complex and very dynamic in nature. Proper procurement planning and the use of $DBR_{D,}$ with its controlled release mechanism, may overcome this limitation: however, this assumption needs to be tested in future research and actions.

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Appendix A - Staff survey opinion questions

I want to improve the **project value** to the customer/clients by managing procurement services effectively in getting **project delivery on time, on agreed specification and price at lower possible cost**. However, it is really concern that:

Table 1:

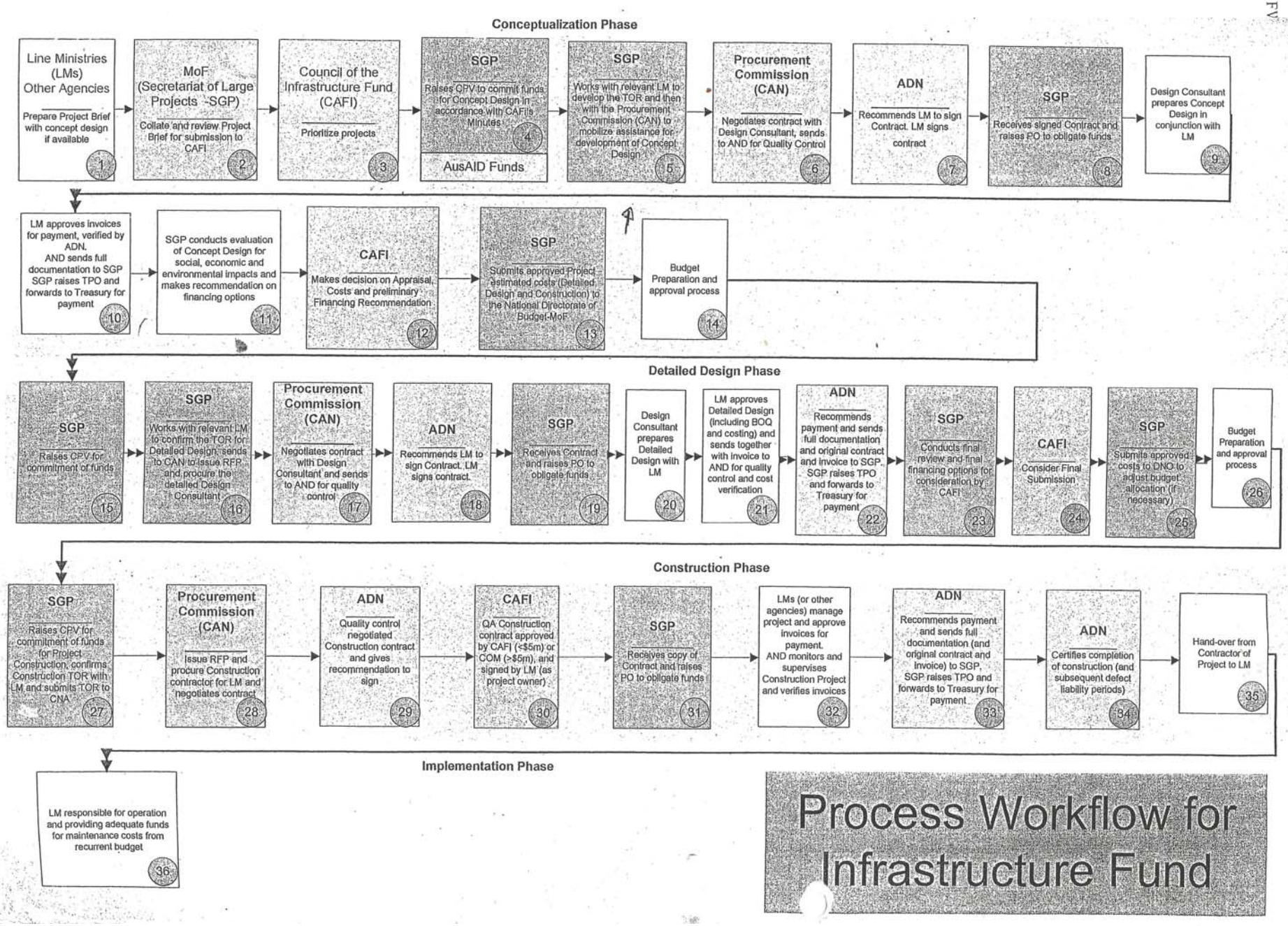
No.	Undesirable effects (UDEs)	Exists (please tick one)	
1	Project are often late in starting	☑ Yes	☐ No
2	Procurement plans and scheduled are often inaccurate and unrealistic	☑ Yes	☐ No
3	Projects are often over budget	☑ Yes	☐ No
4	projects are often completed late	☑ Yes	☐ No
5	Projects often deliver poor quality outputs	☐ Yes	☐ No ?
6	Payments to contractors are often late	☑ Yes	☐ No
7	Project documents often do not reach the procurement office on time.	☑ Yes	☐ No
8	The procurement office is inundated with many projects to be released in the first quarter of the year	☑ Yes	☐ No
9	Communications are often breakdown between the procurement office and the project owner	☑ Yes	☐ No
10	The number of bidders for each project is usually very few	☐ Yes	☑ No
11	Procurement staff are often overloaded	☑ Yes	☐ No

Table 2: Other undesirable effects or concern you may found in the above table:

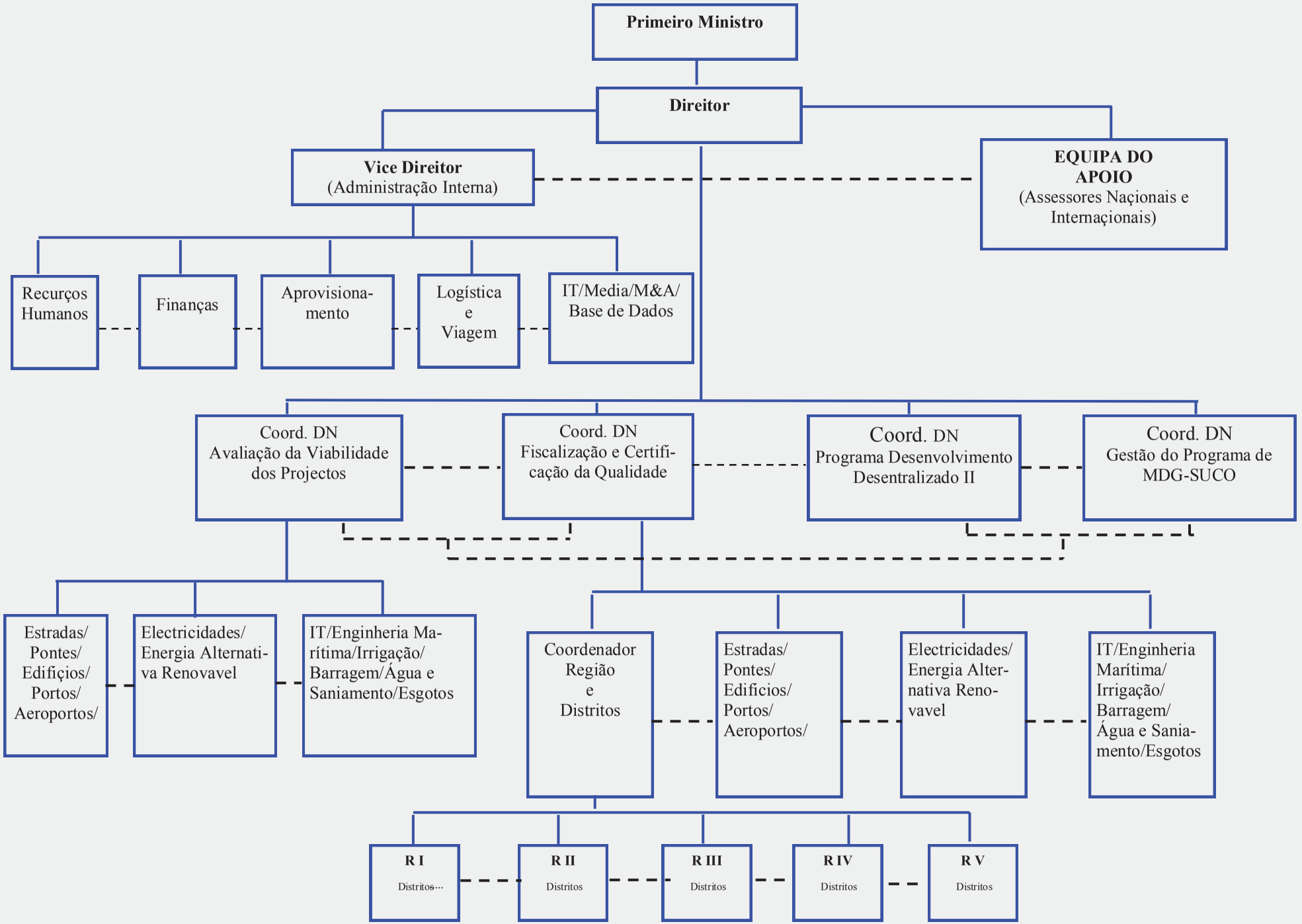
No.	Undesirable effects (UDEs)	Comments
(5)	Point 5, is dificult to measure ?	Dificult to measure it because it has be done an separate asesment Through an Independen Institution.

Commented by : Aniceto do Rosario
National Procurement commission (NPC)

Appendix B - Procurement workflow


Conceptualization Phase
Line Ministries (LMs) Other Agencies
Prepare Project Brief with concept design if available
1
MoF (Secretariat of Large Projects - SGP)
Collate and review Project Brief for submission to CAFI
2
Council of the Infrastructure Fund (CAFI)
Prioritize projects
3
SGP
Raises CPV to commit funds for Concept Design in accordance with CAFI's Minutes
4
AusAID Funds
SGP
Works with relevant LM to develop the TOR and then with the Procurement Commission (CAN) to mobilize assistance for development of Concept Design
5
Procurement Commission (CAN)
Negotiates contract with Design Consultant, sends to AND for Quality Control
6
ADN
Recommends LM to sign Contract. LM signs contract
7
SGP
Receives signed Contract and raises PO to obligate funds
8
Design Consultant prepares Concept Design in conjunction with LM
9
LM approves invoices for payment, verified by ADN.
AND sends full documentation to SGP
SGP raises TPO and forwards to Treasury for payment
10
SGP conducts evaluation of Concept Design for social, economic and environmental impacts and makes recommendation on financing options
11
CAFI
Makes decision on Appraisal, Costs and preliminary Financing Recommendation
12
SGP
Submits approved Project estimated costs (Detailed Design and Construction) to the National Directorate of Budget-MoF
13
Budget Preparation and approval process
14
Detailed Design Phase
SGP
Raises CPV for commitment of funds
15
SGP
Works with relevant LM to confirm the TOR for Detailed Design, sends to CAN to issue RFP and procure the detailed Design Consultant
16
Procurement Commission (CAN)
Negotiates contract with Design Consultant and sends to AND for quality control
17
ADN
Recommends LM to sign Contract. LM signs contract.
18
SGP
Receives Contract and raises PO to obligate funds
19
Design Consultant prepares Detailed Design with LM
20
LM approves Detailed Design (including BOQ and costing) and sends together with invoice to AND for quality control and cost verification
21
ADN
Recommends payment and sends full documentation and original contract and invoice to SGP. SGP raises TPO and forwards to Treasury for payment
22
SGP
Conducts final review and final financing options for consideration by CAFI
23
CAFI
Consider Final Submission
24
SGP
Submits approved costs to DNO to adjust budget allocation (if necessary)
25
Budget Preparation and approval process
26
Construction Phase
SGP
Raises CPV for commitment of funds for Project Construction, confirms Construction TOR with LM and submits TOR to CNA
27
Procurement Commission (CAN)
Issue RFP and procure Construction contractor for LM and negotiates contract
28
ADN
Quality control negotiated Construction contract and gives recommendation to sign
29
CAFI
QA Construction contract approved by CAFI (<$5m) or COM (>$5m), and signed by LM (as project owner)
30
SGP
Receives copy of Contract and raises PO to obligate funds
31
LMs (or other agencies) manage project and approve invoices for payment.
AND monitors and supervises Construction Project and verifies invoices
32
ADN
Recommends payment and sends full documentation (and original contract and invoice) to SGP.
SGP raises TPO and forwards to Treasury for payment
33
ADN
Certifies completion of construction (and subsequent defect liability periods)
34
Hand-over from Contractor of Project to LM
35
Implementation Phase
LM responsible for operation and providing adequate funds for maintenance costs from recurrent budget
36
Process Workflow for Infrastructure Fund

Appendix C - ADN Organization Charts


Primeiro Ministro
Direitor
Vice Direitor
(Administração Interna)
EQUIPA DO
APOIO
(Assessores Naçionais e
Internaçionais)
Recurços
Humanos
Finanças
Aprovisiona-
mento
Logística
e
Viagem
IT/Media/M&A/
Base de Dados
Coord. DN
Avaliação da Viabilidade
dos Projectos
Coord. DN
Fiscalização e Certifi-
cação da Qualidade
Coord. DN
Programa Desenvolvimento
Desentralizado II
Coord. DN
Gestão do Programa de
MDG-SUCO
Estradas/
Pontes/
Edifiçios/
Portos/
Aeroportos/
Electricidades/
Energia Alternati-
va Renovavel
IT/Enginheria Ma-
rítima/Irrigação/
Barragem/Água e
Saniamento/Esgotos
Coordenador
Região
e
Distritos
Estradas/
Pontes/
Edificios/
Portos/
Aeroportos/
Electricidades/
Energia Alter-
nativa Reno-
vavel
IT/Enginheria
Marítima/
Irrigação/
Barragem/
Água e Sania-
mento/Esgotos
R I
Distritos...
R II
Distritos
R III
Distritos
R IV
Distritos
R V
Distritos

Appendix D - Government budget book Six

5101- Fundo das Infra - estruturas ($'000)

30 - Commissão de Administracão do Fundo Infraestrutura - FI

Code	Program	Sub Program	Project Owner	Project Name	Project Type	2011	2012	2013	2014	2015	2016
797	Agrícultura	Irrigação	Agriculture	Continuação da Construção de Irrigação em Bebui Uatulari	MA	500	1,335	0	0	0	0
797	Agrícultura	Irrigação	Agriculture	Protecção de canal de irrigação e Zona Agrícola no esquema de irrigação de Casameta	MA	691	410	0	0	0	0
797	Agrícultura	Irrigação	Agriculture	Protecção de canal de irrigação e Zona Agrícola no esquema de irrigação de Tono	MA	628	439	0	0	0	0
797	Agrícultura	Irrigação	Agriculture	Construção e supervisao da Irrigação de Raibere	MAP	0	0	2,175	2,620	0	0
797	Agrícultura	Irrigação	Agriculture	Construção e supervisao da Irrigação de Maukola	MAP	0	0	2,750	5,479	0	0
797	Agrícultura	Irrigação	Agriculture	Construção e supervisao da Irrigação de Beikala	MAP	0	0	2,500	5,612	0	0
797	Agrícultura	Irrigação	Agriculture	Construção de Irrigação da Oebaba	MAP	0	0	2,200	5,332	0	0
797	Agrícultura	Irrigação	Agriculture	Construção e supervisao da Irrigação de Tono	MAP	0	0	2,750	4,537	0	0
797	Agrícultura	Irrigação	Agriculture	Construção de Irrigação da Buluto	MAP	0	0	3,496	3,000	0	0
797	Agrícultura	Irrigação	Agriculture	Construção e supervisao da Irrigação de Galata	MAP	0	0	1,540	1,940	0	0
797	Agrícultura	Irrigação	Agriculture	Construção e supervisao da Irrigação de Larisula	MAP	0	0	1,500	1,980	0	0
797	Agrícultura	Irrigação	Agriculture	Construção e supervisao da Irrigação de Dardau	MAP	0	0	1,200	1,208	0	0
797	Agrícultura	Irrigação	Agriculture	Desenho detalhado e estudos para construção de irrigação	MAP	0	2,000	0	0	0	0
797	Agrícultura	Irrigação		Projetu irigasaun Raibere, Hatudu (Ainaro)		0	2,500	0	0	0	0
797	Agrícultura	Irrigação		Projetu estudu teknikus no konstrusaun irigasaun Karau Ulun iha Same-Manufahi.		0	2,700	0	0	0	0
Total						**1,819**	**9,384**	**20,111**	**31,708**	**-**	**-**
798	Água e Sanitação	Plano mestre	MoF/MoI	Plano mestre, concepção de sistema e estudos relativos a Água e Saneamento (nível nacional)	GP	0	1,500	1,500	1,500	0	0
798	Água e Sanitação	Plano mestre	MoF/MoI	Construção e supervisão de Água e Saneamento (nível nacional)	GP	0	0	10,000	20,000	30,000	0
798	Água e Sanitação	Plano mestre	MoF/MoI	Plano mestre, concepção de sistema e estudos relativos a Esgotos em Díli	GP	0	2,000	0	0	0	0
798	Água e Sanitação	Plano mestre	MoF/MoI	Construção e supervisão de Esgotos em Díli	GP	0	10,000	5,000	5,000	0	0
798	Água e Sanitação	Esgotos		Dili Drainagem (Esgoto)		0	20,000	0	0	0	0
Total						**-**	**33,500**	**16,500**	**26,500**	**30,000**	**-**
799	Desenvolvimento Urbano e Rural	Desenvolvimento Urbano e Rural	MoF/MoI	Planeamento espacial na zona Sul de TL (Suai, Manufahi e Viqueque)	GP	900	163	0	0	0	0
799	Desenvolvimento Urbano e Rural	Desenvolvimento Urbano e Rural	MoF/MoI	Planeamento espacial nos distritos das terras altas (Ainaro, Aileu, Ermera e Bobonaro)	GP	0	1,750	0	0	0	0
799	Desenvolvimento Urbano e Rural	Desenvolvimento Urbano e Rural	MoF/MoI	Planeamento espacial na zona Norte de TL (Manatuto, Baucau, Lospalos, Liquiçá, Díli)	GP	0	0	2,000	0	0	0
799	Desenvolvimento Urbano e Rural	Desenvolvimento Urbano e Rural	MoF/MoI	Estudos e plano de concepção para Planeamento Urbano a nível nacional	GP	0	5,000	5,000	5,000	0	0
Total						**900**	**6,913**	**7,000**	**5,000**	**-**	**-**
800	Edificios Públicas	Edificio Pública	MTCI	Construção do mercado de Taibesi	MA	1,200	900	3,250	0	0	0
800	Edificios Públicas	Edificio Pública	CNE	Construção do Edifício Principal da CNE	MA	700	1,518	0	0	0	0
800	Edificios Públicas	Edificio Pública	PN	Edifício do Parlamento Nacional	MA	5,000	5,000	20,000	20,000	5,000	0
800	Edificios Públicas	Edificio Pública	CFP	Construção Edifício CFP	MA	600	1,476	0	0	0	0
800	Edificios Públicas	Edificio Pública	MoF	Concepção, construção e supervisão de edifício e instalações da Administração Pública em Díli	MA	100	5,000	5,000	15,000	10,000	0
800	Edificios Públicas	Edificio Pública	MoF	Concepção, construção e supervisão de edifícios do Ministério das Finanças em Díli	GP	1,300	9,500	10,000	10,000	0	0
800	Edificios Públicas	Edificio Pública	MSS	Construção Edifício MSS	MA	1,000	708	0	0	0	0
800	Edificios Públicas	Edificio Pública	MSS	Reabilitacao do edificio Banco Comercial	MED	0	2,000	0	0	0	0
800	Edificios Públicas	Edificio Pública	MSS	Casa de acomodacao aos Oficiais dos Postos Integrados Areas Fronteiriças de Batugade (Housing accomodation for Integrated Border Post Officers)	MoF	0	3,000	3,615	0	0	0
800	Edificios Públicas	Edificio Pública	MSS	Construção novo edificio de Investigacao Criminal	MoJ	0	2,708	5,000	4,496	0	0

5101- Fundo das Infra - estruturas ($'000)

30 - Commissão de Administracão do Fundo Infraestrutura - FI

Code	Program	Sub Program	Project Owner	Project Name	Project Type	2011	2012	2013	2014	2015	2016
800	Edificios Públicas	Edificio Pública	MSS	Construção edificios de Tribunais (STJ; TSAFC; CSM)	MoJ	0	0	5,048	1,683	0	0
800	Edificios Públicas	Edificio Pública	MSS	Construção edificio Defensoria Publica	MoJ	0	0	4,580	2,290	0	0
800	Edificios Públicas	Edificio Pública	MSS	Concepção, construção e supervisão do novo edifício do MAP em Díli	MAP	0	0	500	5,000	5,000	0
800	Edificios Públicas	Edificio Pública	MSS	Concepção, construção e supervisão do novo edifício do DNAS em Díli	MoI	0	0	1,500	0	0	0
800	Edificios Públicas	Edificio Pública	MSS	Desenho, Construcao e supervisao Stadion Nacional	JD	0	1,500	10,000	15,000	15,000	0
800	Edificios Públicas	Edificio Pública	MSS	Desenho, Construcao e supervisao multi-funcao Genasio "Indoor"	JD	0	500	4,628	5,000	0	0
800	Edificios Públicas	Edificio Pública		Projetu Konstrusaun Edificio CAC		0	800	0	0	0	0
800	Edificios Públicas	Edificio Pública		Construsaun Edificio Museu da resistencia Nacional.		0	2,500	0	0	0	0
800	Edificios Públicas	Edificio Pública	MJ	Construção de Edifício do Ministério da Justiça	MA	600	2,090	0	0	0	0
Total						**10,500**	**39,200**	**73,121**	**78,469**	**35,000**	**-**
801	Educação	Escolas	ME	Construção de Nova Escola Polo de Baucau, de Referência da Escola Portuguesa de Díli	MA	600	650	346	0	0	0
801	Educação	Escolas	ME	Construção de Nova Escola Polo de Same, de Referência da Escola Portuguesa de Díli	MA	600	650	0	0	0	0
801	Educação	Escolas	ME	Construção de Nova Escola Polo de Maliana, de Referência da Escola Portuguesa de Díli	MA	600	650	424	0	0	0
801	Educação	Escolas	ME	Construção de Nova Escola Polo de Oecussi, de Referência da Escola Portuguesa de Díli	MA	600	650	276	0	0	0
801	Educação	Escolas	ME	Construção das facilidades das escolas Polos de Ermera, de Referência da Escola Portuguesa de Díli	ME	0	750	1,000	1,500	0	0
801	Educação	Escolas	ME	Construção das facilidades das escolas Polos de Manatuto, de Referência da Escola Portuguesa de Díli	ME	0	750	1,000	1,500	0	0
801	Educação	Universidades		Construção de Politecnicas de Lospalos e Suai		0	2,500	0	0	0	0
801	Educação	Universidades	MoF	Construção e supervisão detalhadas relativamente à Universidade Nacional (Díli)	GP	0	4,571	15,000	20,000	20,000	0
Total						**2,400**	**11,171**	**18,046**	**23,000**	**20,000**	**-**
802	Energia Eléctrica	Energia Eléctrica	MoI	Reabilitação das linhas de Média Voltagem - Distribuição	MA	2,201	5,500	0	0	0	0
802	Energia Eléctrica	Energia Eléctrica	MoI	Reabilitação das linhas de Baixa Voltagem - Distribuição	MA	840	15,200	0	0	0	0
802	Energia Eléctrica	Energia Eléctrica	MoI	Geradores da Central Eléctrica de Hera + linhas de Distribuição eTransmição	MA	445,701	261,300	111,000	0	0	0
Total						**448,742**	**282,000**	**111,000**	**-**	**-**	**-**
803	Equipamento Informatico	Equipamento Informatika	MoI	Projecto de Conectividade Nacional III	MA	1,700	1,000	0	0	0	0
803	Equipamento Informatico	Equipamento Informatika	MoF	FreeBalance	MA	7,700	6,100	7,700	0	0	0
Total						**9,400**	**7,100**	**7,700**	**-**	**-**	**-**
804	MDG	Água e Saneamento	MoI	Água e Saneamento	MDG	20,420	20,420	20,420	20,420	20,420	0
804	MDG	Habitação		Habitações sociais / comunitárias (5 casas por aldeia, num total de 11.145)		44,580	54,580	44,580	44,580	44,580	0
Total						**65,000**	**75,000**	**65,000**	**65,000**	**65,000**	**-**
805	Saúde	Hospital / Clínica	Saude	Construção do Hospital de Baucau	MA	600	3,352	0	0	0	0
805	Saúde	Hospital / Clínica	Saude	Construção de Clínica de Maternidade	MA	1,070	0	0	0	0	0
805	Saúde	Hospital / Clínica	Saude	Desenho, construção e supervisao edificio de "Cuidado Intensivo de Cardiaco" Hospital Guido Valadares	Saude	0	0	1,300	0	0	0
805	Saúde	Hospital / Clínica	Saude	Desenho, construção e supervisao novo edificio de Pediatria Hospital Guido Valadares	Saude	0	0	1,000	2,500	0	0
Total						**1,670**	**3,352**	**2,300**	**2,500**	**-**	**-**

5101- Fundo das Infra - estruturas ($'000)

30 - Commissão de Administracão do Fundo Infraestrutura - FI

Code	Program	Sub Program	Project Owner	Project Name	Project Type	2011	2012	2013	2014	2015	2016
806	Segurança e Defesa	Segurança e Defesa	FFDTL	Caserna Hera	MA	1,000	1,000	0	0	0	0
806	Segurança e Defesa	Segurança e Defesa	FFDTL	Posto FDTL	MA	700	1,300	0	0	0	0
806	Segurança e Defesa	Segurança e Defesa	FFDTL	Construção do Edifício da Polícia Militar	MA	700	1,050	0	0	0	0
806	Segurança e Defesa	Segurança e Defesa	MDS	8 Quartéis de Distrito	MA	624	624	0	0	0	0
806	Segurança e Defesa	Segurança e Defesa	MDS	11 Esquadras	MA	288	288	0	0	0	0
806	Segurança e Defesa	Segurança e Defesa	FFDTL	Desenho detalhado e construcao Edificio Comando Componente Naval	FFDTL	0	1,200	1,486	275	0	0
806	Segurança e Defesa	Segurança e Defesa	FFDTL	Finalizacao residencia naval	FFDTL	0	2,168	0	0	0	0
806	Segurança e Defesa	Segurança e Defesa		Melhoramento infraestruturas PNTL		0	1,500	0	0	0	0
Total						**3,312**	**9,130**	**1,486**	**275**	**-**	**-**
807	Solidaridade e social	Monumentos	MSS	Monumento 12 de Novembro	MA	750	750	500	0	0	0
807	Solidaridade e social	Monumentos	MSS	Jardim dos Heróis	MA	900	500	0	0	0	0
Total						**1,650**	**1,250**	**500**	**-**	**-**	**-**
808	Tasi Mane	Aeroportos	MoI/SERN/MoF	Concepção de construção e supervisão para o desenvolvimento de infra-estruturas na costa Sul (reabilitação do aeroporto de Suai)	GP	6,500	5,000	0	0	0	0
808	Tasi Mane	Aeroportos	MoI/SERN/MoF	Betano Petrochemical-Estudo detailhado de "geotechnical e marine survey"	SERN	0	5,000	0	0	0	0
808	Tasi Mane	Estrados e Pontes	MOF/MOI	Construção e supervisão detalhadas relativamente a Estradas e Pontes (autoestrada Suai-Betano-Beaco)	GP	980	45,220	200,000	200,000	100,000	0
808	Tasi Mane	Petrolio e Gas	SERN/MoF	Concepção de construção e supervisão para o desenvolvimento de infra-estruturas na costa Sul em Suai - Base de Fornecimentos)	GP	11,500	100,000	120,000	100,000	0	0
808	Tasi Mane	Petrolio e Gas	MoI/SERN/MoF	Levantamento detalhado do local para o desenvolvimento de infra-estruturas na costa Sul em Beaco	GP	5,000	500	0	0	0	0
808	Tasi Mane	Petrolio e Gas	SERN/MoF	Concepção e supervisão para o desenvolvimento de infra-estruturas na costa Sul em Beaco	GP	800	3,500	0	0	0	0
808	Tasi Mane	Petrolio e Gas	SERN/MoF	Análise da rota do gasoduto para o desenvolvimento de infra-estruturas na costa Sul	GP	3,500	1,500	0	0	0	0
808	Tasi Mane	Petrolio e Gas	SERN/MoF	Estudos ambientais (S/B/B) para o desenvolvimento de infra-estruturas na costa Sul	GP	2,820	2,080	0	0	0	0
Total						**31,100**	**162,800**	**320,000**	**300,000**	**100,000**	**-**
809	Transporte	Estradas		Reabilitação de Estradas Baguia-Watucarbau		0	2,325	0	0	0	0
809	Transporte	Estradas		Construção e supervisão para o desenvolvimento de estradas Dili-Liquisa e Tibar - Ermera (L)		0	3,000	0	0	0	0
809	Transporte	Estradas		Construção e supervisão para o desenvolvimento de estradasDili-Mantuto-Baucau (L)		0	4,000	0	0	0	0
809	Transporte	Estradas		Desenho Manatuto-Natarbora, Supervisao e Outros Custos associados ao desenvolvimneto de estradas (L)		0	2,930	0	0	0	0
809	Transporte	Aeroportos	MoI	Reabilitação das Pistas do Aeroporto	MA	2,228	2,386	0	0	0	0
809	Transporte	Aeroportos	MoF/MoI	Concepção de construção e supervisão para o desenvolvimento do Aeroporto de Díli	GP	0	3,000	31,000	20,000	20,000	0
809	Transporte	Aeroportos	MoF/MoI	Concepção de construção e supervisão para o desenvolvimento do Aeroporto de Oecussi	GP	0	1,500	5,000	5,000	5,000	0
809	Transporte	Aeroportos	MoF/MoI	Concepção de construção (reabilitação e melhoria) e supervisão para o desenvolvimento do Aeroporto de Baucau	GP	0	0	1,000	3,000	2,000	0
809	Transporte	Aeroportos	MoF/MoI	Concepção de construção e supervisão para o desenvolvimento do Aeroporto de Maliana	GP	0	1,500	3,000	7,000	0	0
809	Transporte	Aeroportos	MoF/MoI	Concepção e estudos para o desenvolvimento de infra-estruturas na costa Sul (desenvolvimento de aeroporto de Viqueque)	GP	0	1,000	0	0	0	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Cassa-Wemassi	MA	500	1,524	0	4,000	4,000	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Uatucarbau-Baguia-Laga	MA	500	1,125	0	0	0	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Ermera-Atsabe	MA	500	2,387	0	0	0	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Ermera-Hatulia	MA	500	1,300	0	0	0	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Maubarra-Loes	MA	500	3,541	0	0	0	0

5101- Fundo das Infra - estruturas ($'000)

30 - Commissão de Administracão do Fundo Infraestrutura - FI

Code	Program	Sub Program	Project Owner	Project Name	Project Type	2011	2012	2013	2014	2015	2016
809	Transporte	Estradas	MoI	Reabilitação de Estradas Lospalos-Tutuala	MA	500	2,112	300	0	0	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Lospalos-Ilomar	MA	500	2,944	0	0	0	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Nacionais em Oecussi	MA	500	1,325	0	0	0	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Tilomar-Weleu	MA	500	1,063	0	0	0	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Maubesse-Turiskai	MA	500	1,708	0	0	0	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Ossu - Viqueque	MA	500	1,675	314	0	0	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Díli - Aileu	MA	500	1,900	2,515	0	0	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Aileu - Aituto	MA	500	1,650	1,196	0	0	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Lepo - Zumalai	MA	500	1,600	1,045	0	0	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Tumin - Oesillo	MA	500	1,192	0	0	0	0
809	Transporte	Estradas	MoI	Reabilitação de Estradas Atauro Villa - Beloi - Macadade/Biqueli	MA	1,000	1,171	0	0	0	0
809	Transporte	Pontes	MoI	Construção de Ponte Tono	MA	500	3,800	2,901	0	0	0
809	Transporte	Pontes	MoI	Construção de Ponte Dilor	MA	500	1,236	0	0	0	0
809	Transporte	Pontes	MoI	Construção de Ponte Taroman	MA	500	750	0	0	0	0
809	Transporte	Pontes	MoI	Construção de Ponte Daudere	MA	500	2,446	0	0	0	0
809	Transporte	Pontes	MoI	Construção de Ponte Belulik	MA	500	2,129	0	0	0	0
809	Transporte	Pontes	MoI	Construção de Ponte Baer	MA	500	1,615	0	0	0	0
809	Transporte	Pontes	MoI	Construção de Pontee Bukoli	MA	405	205	0	0	0	0
809	Transporte	Pontes	MoI	Construção de Ponte Lebaloa Bazartete	MA	405	205	0	0	0	0
809	Transporte	Pontes	MoI	Construção de Ponte Jct Laclubar para Manehat	MA	675	574	0	0	0	0
809	Transporte	Pontes	MoI	Reabilitação de pontes	MA	1,000	1,000	0	0	0	0
809	Transporte	Pontes	MoI/MoF	Construção e supervisão relativamente a estradas e pontos - estradas nacionais (300 a 600 km) e pontes	GP	1,500	59,468	146,617	89,808	20,000	0
809	Transporte	Pontes	MoI/MoF	Rehabilitação Ponte Loes	MoI	0	1,475	0	0	0	0
809	Transporte	Pontes		Rehabilitasaun Ponte Aisa		0	2,500	0	0	0	0
809	Transporte	Portos	MoF/MoI	Concepção e estudos relativamente ao porto multifunções de Suai	GP	2,500	0	0	0	0	0
809	Transporte	Portos	MoF/MoI	Construção e supervisão para o desenvolvimento de portos marítimos em Díli	GP	2,000	3,500	5,000	75,000	75,000	0
809	Transporte	Portos	MoF/MoI	Construção e supervisão para o desenvolvimento de portos marítimos em Vemasse	GP	0	0	750	4,000	4,000	0
809	Transporte	Portos	MoF/MoI	Construção e supervisão para o desenvolvimento de portos marítimos em Atauro	GP	600	5,000	5,000	0	0	0
809	Transporte	Portos	MoF/MoI	Construção e supervisão para o desenvolvimento de portos marítimos em COM (Reabilitação)	GP	0	600	2,000	3,000	0	0
809	Transporte	Estradas		Construção e supervisão para o desenvolvimento de estradas Dili-Liquisa e Tibar - Ermera (L)		0	10,000	0	0	0	0
809	Transporte	Estradas		Rehabilitasaun Estrada Aileu-Ainaro e Maubessi (L)		0	10,000	0	0	0	0
809	Transporte	Estradas		Construção e supervisão para o desenvolvimento de estradasDili-Mantuto-Baucau (L)		0	3,100	0	0	0	0
Total						**22,813**	**159,461**	**207,638**	**210,808**	**130,000**	**-**
815	Fundo não afectado (FI)	Fundo não afectado (FI)	WoG/MoF	Fundo não afectado (FI)	GP	0	0	53,598	174,940	129,600	530,000
Total						**-**	**-**	**53,598**	**174,940**	**129,600**	**530,000**
Grand Total						**599,306**	**800,261**	**904,000**	**918,200**	**509,600**	**530,000**

Appendix E - Project specification deficiency

Gmail

Deonisio Dos Santos <deonisio.santos@gmail.com>

Preliminary results of review of tender documents

1 message

Johann Tagwerker <jtagwerker@charleskendall.com> 22 May 2012 14:55
To: "Aniceto do Rosario (adorosario@npc.gov.tl)" <adorosario@npc.gov.tl>
Cc: "rrillo@npc.gov.tl" <rrillo@npc.gov.tl>, "'Romeo Chigawa' (rchigawa@npc.gov.tl)" <rchigawa@npc.gov.tl>, "hasoares@npc.gov.tl" <hasoares@npc.gov.tl>, "deonisio.santos@gmail.com" <deonisio.santos@gmail.com>, Jose Cuan <jcuan@charleskendall.com>, Emmanuel Ozigbo <eozigbo@charleskendall.com>, Virgilio Balandra <vbalandra@charleskendall.com>

Dear Aniceto,

NPC forwarded under cover of their letter 052/CAN/2012, 7 May 2012, the documents listed below for our review.

	Project Title/Name	Cost Estimate
1	Rehabilitation and New Construction of Microfinance Institution of East Timor	$2,000,000.00
2	Construcao Quartel Distrital Da PNTL Do Distrito De Oecusse	$232,750.00
3	Construcao Quartel Distrital Da PNTL Do Distrito De Lautem	$208,425.00
4	Construcao Quartel Distrital Da PNTL Do Distrito De Baucau	$191,520.00
5	Construcao Quartel Distrital Da PNTL Do Distrito De Ainaro	$204,750.00
6	New Construction PNTL Squadron Lospalos Villa-Lautem District	$155,755.32
7	New Construction PNTL Squadron at Bazartete-Liquica District	$139,851.16
8	New Construction PNTL Squadron at Letefoho-Ermera District	$144,544.47
9	New Construction PNTL Squadron at Quibselo-Oecusse District	$79,391.73

10	New Construction PNTL Squadron at Baucau Vila-Baucau District	$145,583.58
11	Construction of Bairos Da Policia Distrital , Liquica District	$1,157,373.27
12	Construction of Bairos Da Policia Distrital, Ailew District	$1,157,373.27
13	Construction of Bairos Da Policia Distrital, Erera District	$1,157,373.27
14	Construction of Bairos Da Policia Distrital, Manufahi District	$1,157,373.27
15	New Construction of Bairos PNTL, Oecusse District	$1,157,373.27

The documents submitted by NPC comprise more specifically:

- tender drawings
- bills of quantities
- technical specifications
- cost estimates

During our review for completeness we noted that the Technical Specifications are a mixture of conditions of contract and technical specifications. An example (project no 9) is attached for your information and review. The standard as shown in this example is typical for all project documents including the projects with estimated cost above US$ 1 Million. In order to verify that all 15 projects submitted are of similar quality, a thorough scrutiny of these documents was carried out from 8 until 16 May with the following global results:

1. Except for project 1 (Microfinance Institution) these projects consist of construction of the same type of buildings of up to 12 units.
2. Bills of quantities are incomplete and do not cover all items of the works or only partially.
3. Drawings are generally of an acceptable standard and show the works in required detail.
4. Time schedules are in most cases nonexistent or available in form of a cash flow schedule which is designated in the documents as time schedule. Accordingly, starting and completion dates cannot be determined and need to be coordinated with the stakeholders.

Prior of these documents to be issued for tender, their revisions will be required. After revisions are agreed and carried out, the documents will have to be produced in sufficient number to cope with the number of applicants requesting documents.

We propose, therefore, to jointly discuss next steps to be initiated to have these documents revised and updated, in order to permit the tender process to commence as soon as possible.

Best regards

Hans

Charles Kendall & Partners

Tagwerker, Johann

Project Director

Palacio do Governo - Building No.2 – 1st Floor

Dili, Democratic Republic of Timor-Leste

Mob: +670 718 1073

Email: jtagwerker@charleskendall.com

UPF Quibiselo - OeCusse.zip
5676K

Appendix F - Project ongoing tender as of 14 August 2012

Google adorosario@npc.gov.tl

Gmail

Inbox
Starred
Important
Chats
Sent Mail
Drafts
All Mail
Spam (1)
Bin
Circles
Notes
More

FW: Tender Packages Currently with the NPC

Aniceto do Rosario
to me

FYI-thanks

-----Original Message-----
From: rrillo@npc.gov.tl [mailto:rrillo@npc.gov.tl]
Sent: 14 Agustus 2012 18:01
To: jabel@mof.gov.tl
Cc: 'Aniceto do Rosario'; hasoares@npc.gov.tl
Subject: Tender Packages Currently with the NPC

Dear Jose,

Ardo has informed me that you need information about the tender pack

We will be happy to provide additional information you may need.

Regards,
Rolito Rillo
NPC-RDTL

List of Tender Packages with the NPC (as of 14 Aug 12).doc
26K View Download

LIST OF TENDER PACKAGES WITH THE NPC

(as of 14 August 2012)

A. PROCUREMENT OF WORKS

No.	Contract Package	Status
1.	Construction of the New Criminal Justice Building of the Ministry of Justice	Tender evaluation completed / NPC addressing some issues and then present its award recommendation to the Council of Ministers
2.	Construction of PNTL Esquadra in Lospalos Vila (Lautem District), Bazartete (Liquica District), Letefoho (Ermera District), and Baucau Vila (Baucau District)	Tender launched on 26 July 2012 / Deadline for submission of bids on 23 August 2012
3.	Construction of PNTL Bairos da Policia Distrital in Liquica, Aileu, Ermera, and Manufahi Districts	Tender launched on 26 July 2012 / Deadline for submission of bids on 24 August 2012
4.	Construction of PNTL District Headquarters (Quartel) in Oecusse, Lautem, Baucau and Ainaro Districts	Tender Documents under preparation by the NPC procurement firm, Charles Kendall
5.	Construction of PNTL UPF in Quibiselo, Oecusse District	Tender launched on 26 July 2012 / Deadline for submission of bids on 23 August 2012
6.	Rehabilitation and Construction of the New Microfinance Building of Timor-Leste	Tender Documents preparation by the NPC procurement firm, Charles Kendall
7.	Timor-Leste Road Network Upgrading Project – Tibar to Liquica Road (Contract Package No. RNUP/R-3) - ADB Loan Nos. 2857/2858-TIM	Bids received on 30 July 2012 / technical evaluation underway
8.	Timor-Leste Road Network Upgrading Project – Tibar to Gleno Road (Contract Package No. RNUP/R-4) - ADB Loan Nos. 2857/2858-TIM	Bids received on 30 July 2012 / technical evaluation underway
9.	Construction of the New Suai Airport	Technical documents received from ADN last week / for preparation of bid documents

B. PROCUREMENT OF CONSULTANCY SERVICES

No.	Contract Package	Status
1.	Detailed Design for the National Parliament Building	Tender evaluation completed. For contract finalisation meeting with the top-ranked consultant scheduled on 15 August 2012
2.	Construction Supervision Consultancy Services for the Ministry of Finance Building	Tender evaluation completed / Consultant (Oriental Consultants in JV with Asuza Sekkei) expected to mobilise soon
3.	Detailed Engineering Design for Ten (10) Irrigation Schemes and Preliminary Study for Fifteen (15) Dam Sites	Tender Documents under preparation by the NPC procurement firm, Charles Kendall
4.	Preparation of Designs, and Construction Supervision for the Timor-Leste Road Network Upgrading Project - ADB Loan Nos. 2857/2858-TIM	Proposals received on 27 July 2012 / technical evaluation underway
5.	Engineering Consultancy Services for the National Road No.1 Upgrading Project - JICA Loan No. TLS-P1	Shortlisting process completed / Request for Proposals issued to short-listed firms on 6 July 2012 / receipt of proposals on 21 August 2012

C. PROCUREMENT OF SUPPLY OF GOODS AND RELATED SERVICES

No.	Contract Package	Status
1.	Supply of Vehicles for the National Parliament of Timor-Leste	Bids were received on 8 August 2012 / technical evaluation underway
2.	Supply of Diesel Fuel for Electricidade de Timor-Leste (EDTL)	Technical documents received from MoI 2weeks ago / for preparation of bidding documents by NPC

Appendices G - Project document delivered to NPC by AND

REPÚBLICA DEMOCRÁTICA DE TIMOR-LESTE
COMISSAO NACIONAL DE APROVISIONAMENTO
Palacio do Governo, Edificio 2 -10 Andar Avenida Presidente Nicalau Lobato, Dili, Timor –Leste

Our Reference: 052/CNA/20R

Date: 7 May 2012

To: **Charles Kendall and Associates**
Infrastructure Fund Procurement Firm

Attention: **Mr. Johann Tagwerker**
Project Director

Subject: **Fifteen (15) Projects for Procurement**

Dear Johann,

Please find attached the bidding documents received from the ADN for the following projects:

No.	Project Title/Name
1	REHABILITATION AND NEW CONSTRUCTION MICROFINANCE INSTITUTION OF EAST TIMOR
2	CONSTRUCAO QUARTEL DISTRITAL DA PNTL DO DISTRITO DE OECUSSE
3	CONSTRUCAO QUARTEL DISTRITAL DA PNTL DO DISTRITO DE LAUTEM
4	CONSTRUCAO QUARTEL DISTRITAL DA PNTL DO DISTRITO DE BAUCAU
5	CONSTRUCAO QUARTEL DISTRITAL DA PNTL DO DISTRITO DE AINARO
6	NEW CONSTRUCTION PNTL SQUADRON LOSPALOS VILA-LAUTEM DISTRICT
7	NEW CONSTRUCTION PNTL SQUADRON AT BAZARTETE-LIQUICA DISTRICT
8	NEW CONSTRUCTION PNTL SQUADRON AT LETEFOHO-ERMERA DISTRICT
9	NEW CONSTRUCTION PNTL SQUADRON AT QUIBSELO-OECUSSE DISTRICT
10	NEW CONSTRUCTION PNTL SQUADRONAT BAUCAU VILA-BAUCAU DISTRICT
11	CONSTRUCTION OF BAIROS DA POLICIA DISTRITAL, LIQUICA DISTRICT
12	CONSTRUCTION OF BAIROS DA POLICIA DISTRITAL, AILEU DISTRICT
13	CONTRUCTION OF BAIROS DA POLICIA DISTRITAL, ERMERA DISTRICT
14	CONSTRUCTION OF BAIROS DA POLICIA DISTRITAL, MANUFAHI DISTRICT
15	NEW CONSTRUCTION OF BAIROS PNTL, OECUSSE DISTRICT

The documents for each project include the Bill of Quantities, Technical Specifications, Design Drawings, and Engineer's Estimates.

We request that Charles Kendall prepare the final bidding documents and proceed with the procurement activities for these projects.

Yours faithfully,

07 MAY 2012

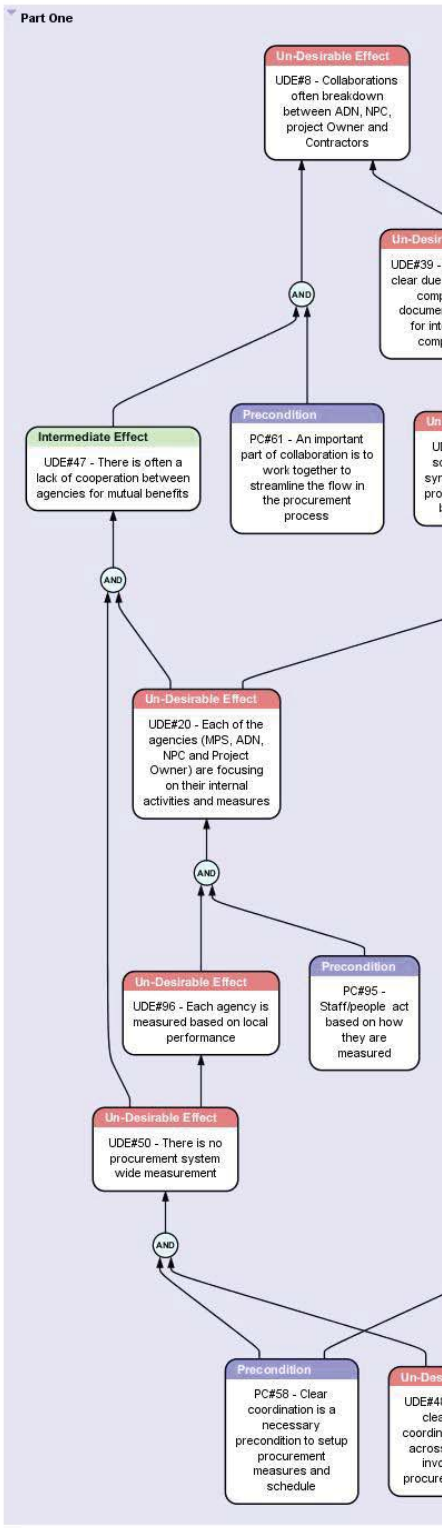
J. Tagwerker

Aniceto do Rosario
National Procurement Commission

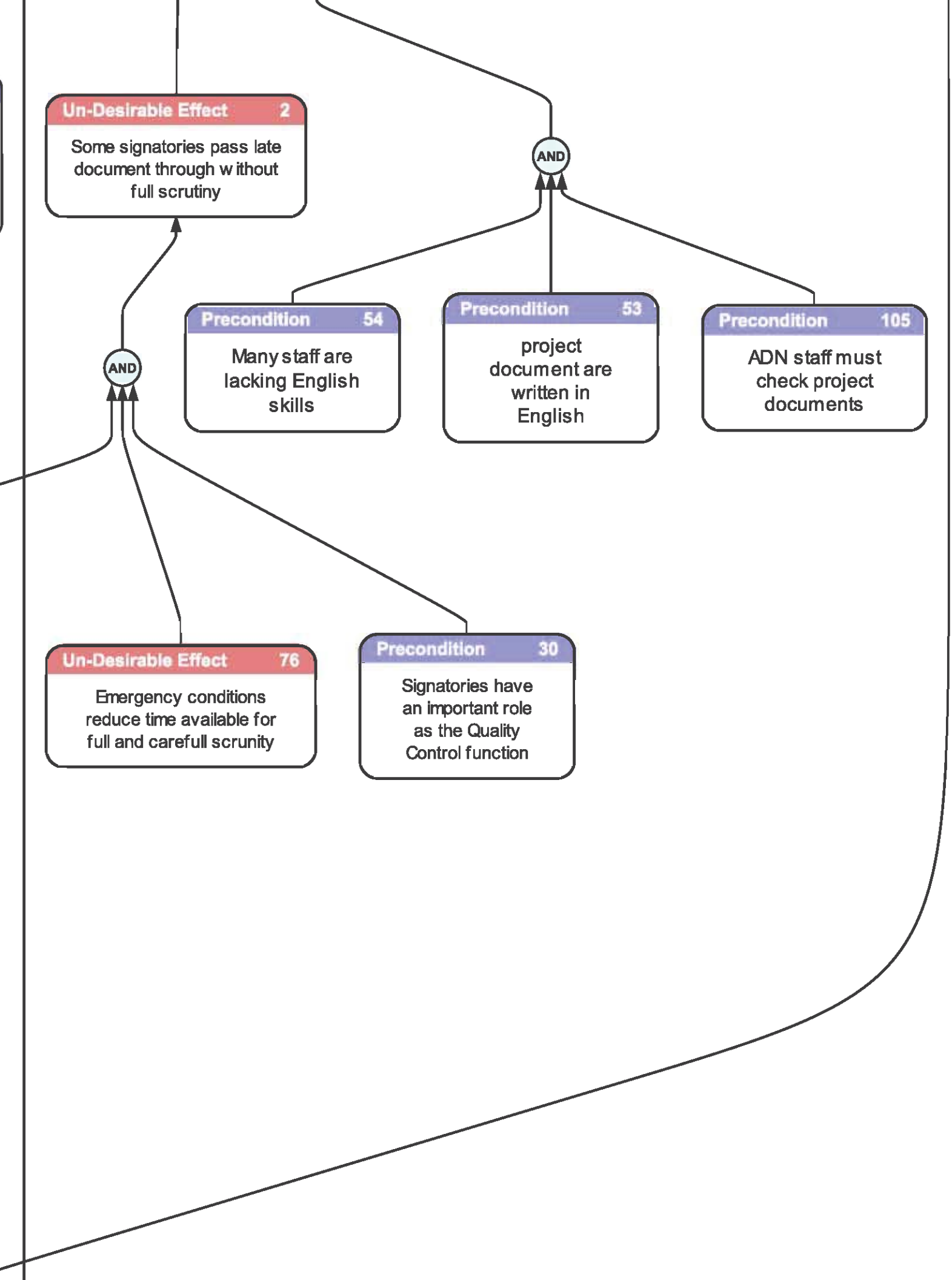
Appendices H - Example of how to read CRT using if-then cause-and-effects relationship

ere is no clearly agreed coordinated approach across all agencies involved in
t process and PC#58 - Clear coordination is a necessary precondition to
ent measures and schedule, then UDE#50 - There is no procurement
measurement. If UDE#50 - There is no procurement system wide
hen UDE#96 - Each agency is measured based on local performance. If
agency is measured based on local performance and PC#95 - Staff/people
ow they are measured then UDE#20 - Each of the agencies (MPS, ADN,
t Owner) are focusing on their internal activities and measures. If UDE#20 -
encies (MPS, ADN, NPC and Project Owner) are focusing on their internal
measures and UDE#50 - There is no procurement system wide
hen UDE#47 - There is often a lack of cooperation between agencies for

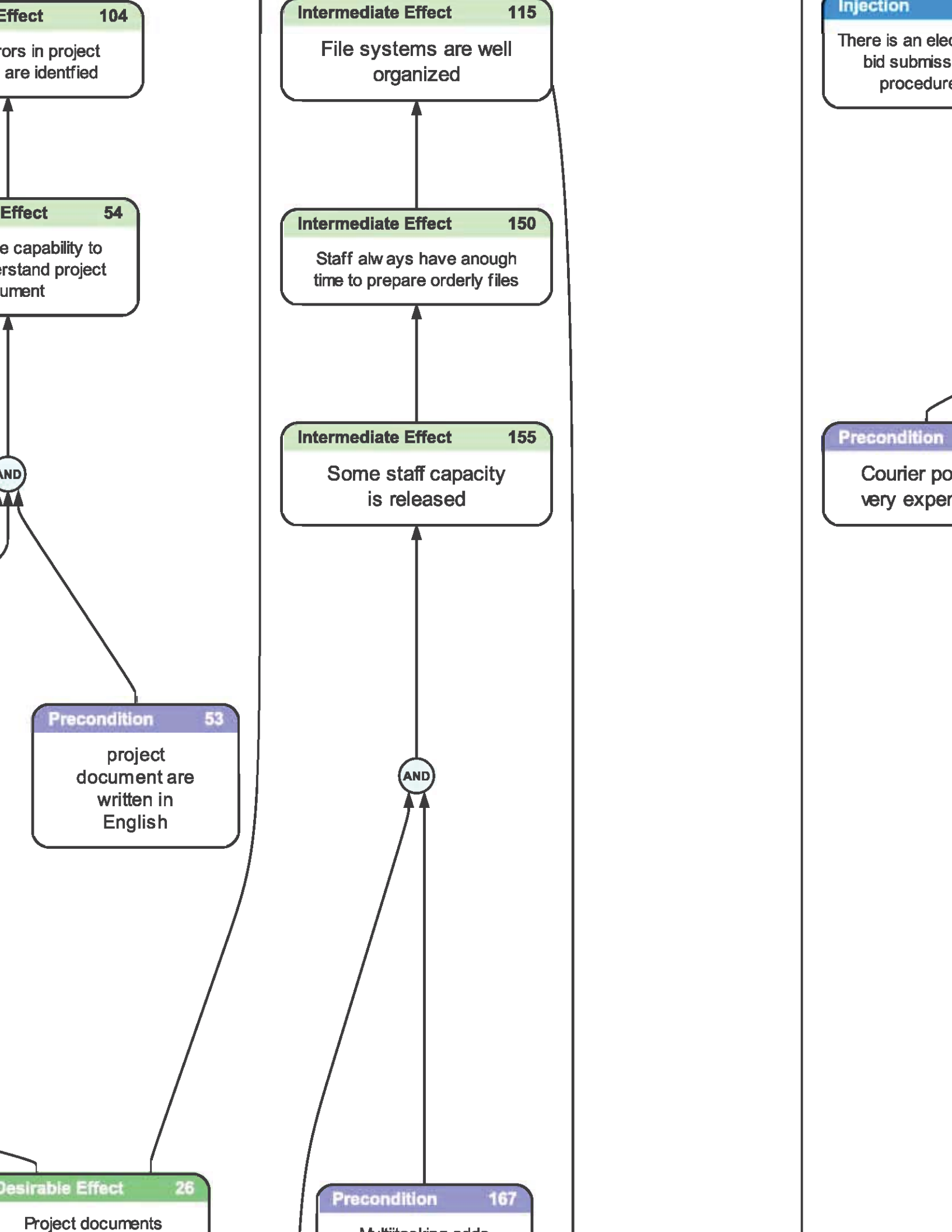
ere is often a lack of cooperation between agencies for mutual benefits and
portant part of collaboration is to work together to streamline the flow in the
ocess, then UDE#8 - Collaborations often breakdown between ADN, NPC,
and Contractors. If UDE#20 - Each of the agencies (MPS, ADN, NPC and
are focusing on their internal activities and measures and UDE#48 - There is
ed coordinated approach across all agencies involved in the procurement
C#58 - Clear coordination is a necessary precondition to setup procurement
schedule, then UDE#21 - There is no scheduling system to synchronize the
ment documents between agencies. If UDE#21 - There is no scheduling
ronize the flow of procurement documents between agencies and PC#122 -
g systems control the release of work into a system to prevent overload of
n UDE#123 - Procurement work is released into the system without
load on resources.



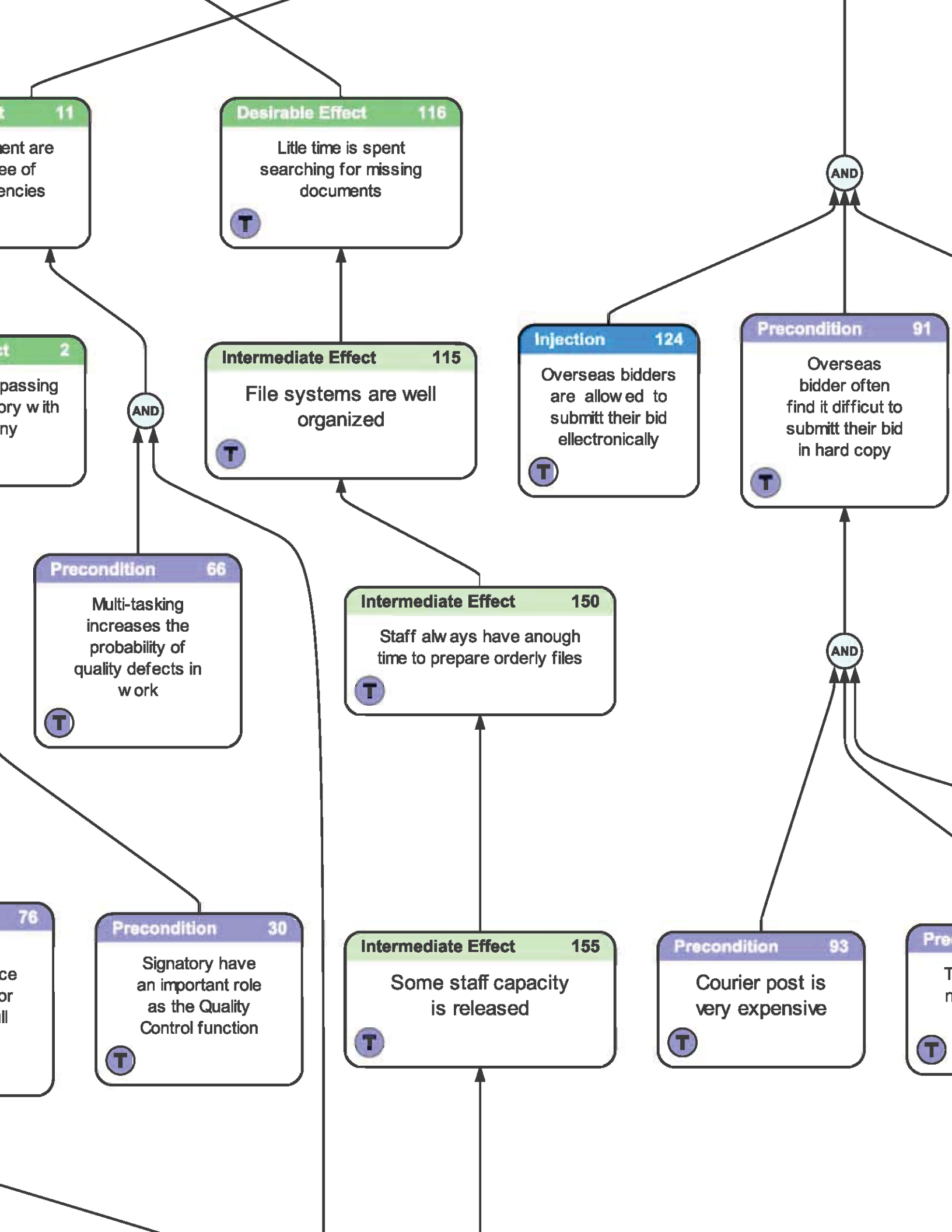
Appendix I - Completed TLS- P Current Reality Tree


Un-Desirable Effect 2
Some signatories pass late document through w ithout full scrutiny
AND
Precondition 54
Many staff are lacking English skills
Precondition 53
project document are written in English
Precondition 105
ADN staff must check project documents
AND
Un-Desirable Effect 76
Emergency conditions reduce time available for full and carefull scrunity
Precondition 30
Signatories have an important role as the Quality Control function

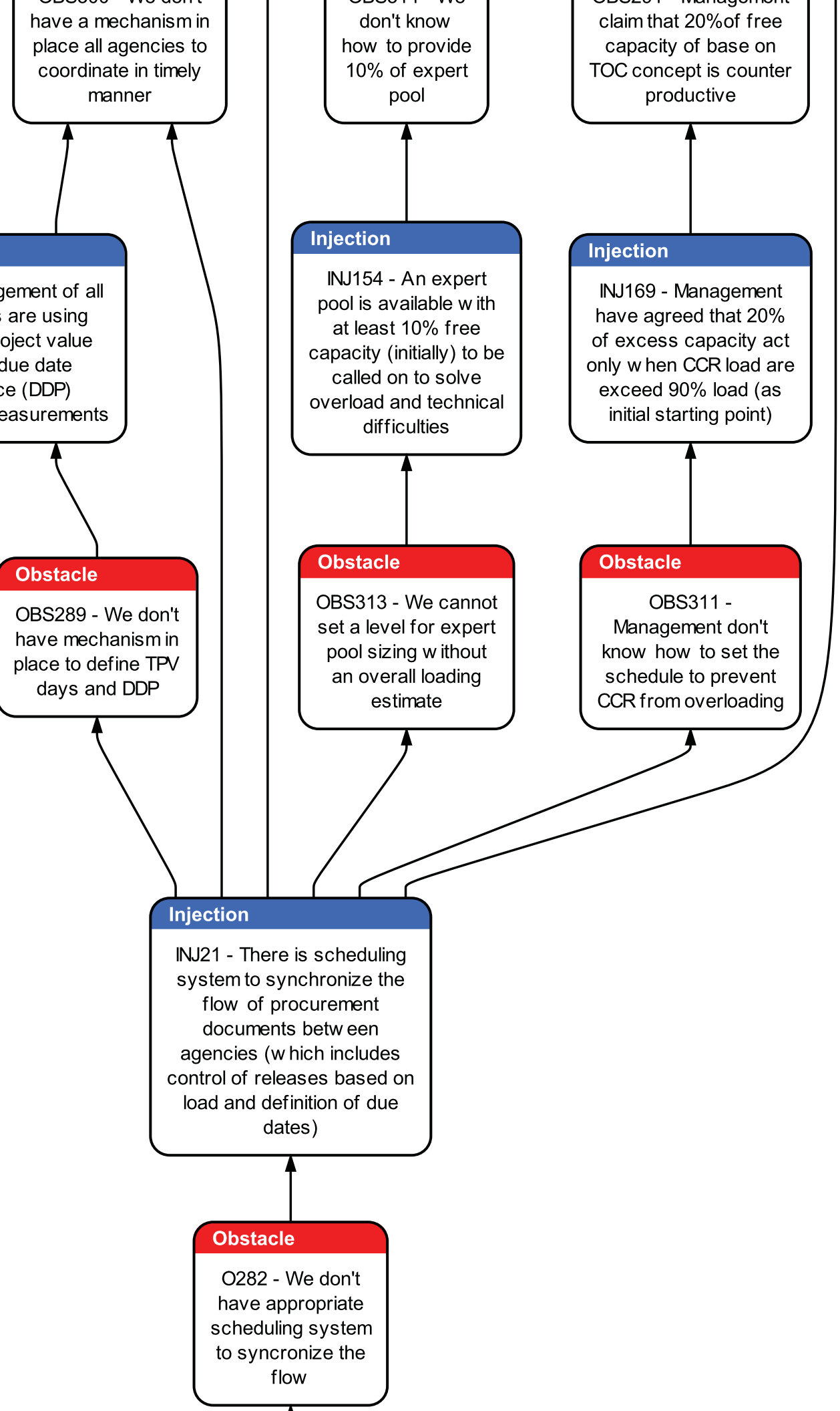
Appendix J - Completed TLS- P Future Reality Tree


Effect 104
rors in project
are identfied
Effect 54
e capability to
erstand project
ument
AND
Precondition 53
project
document are
written in
English
Desirable Effect 26
Project documents
Intermediate Effect 115
File systems are well
organized
Intermediate Effect 150
Staff alw ays have anough
time to prepare orderly files
Intermediate Effect 155
Some staff capacity
is released
AND
Precondition 167
Injection
There is an elec
bid submiss
procedure
Precondition
Courier po
very exper

Appendix K - Completed TLS- P FRT with TRUE/FALSE LOGIC Test


11
ent are
ee of
encies
Desirable Effect 116
Litle time is spent searching for missing documents
T
AND
2
passing
ory with
ny
Intermediate Effect 115
File systems are well organized
T
Injection 124
Overseas bidders are allowed to submitt their bid ellectronically
T
Precondition 91
Overseas bidder often find it difficut to submitt their bid in hard copy
T
AND
Precondition 66
Multi-tasking increases the probability of quality defects in work
T
Intermediate Effect 150
Staff always have anough time to prepare orderly files
T
AND
76
ce
or
ll
Precondition 30
Signatory have an important role as the Quality Control function
T
Intermediate Effect 155
Some staff capacity is released
T
Precondition 93
Courier post is very expensive
T
Pre
T

Appendix L - TLS-P Prerequisite Tree


have a mechanism in place all agencies to coordinate in timely manner
don't know how to provide 10% of expert pool
claim that 20%of free capacity of base on TOC concept is counter productive
gement of all
are using
oject value
due date
ce (DDP)
easurements
Injection
INJ154 - An expert pool is available w ith at least 10% free capacity (initially) to be called on to solve overload and technical difficulties
Injection
INJ169 - Management have agreed that 20% of excess capacity act only w hen CCR load are exceed 90% load (as initial starting point)
Obstacle
OBS289 - We don't have mechanism in place to define TPV days and DDP
Obstacle
OBS313 - We cannot set a level for expert pool sizing w ithout an overall loading estimate
Obstacle
OBS311 - Management don't know how to set the schedule to prevent CCR from overloading
Injection
INJ21 - There is scheduling system to synchronize the flow of procurement documents betw een agencies (w hich includes control of releases based on load and definition of due dates)
Obstacle
O282 - We don't have appropriate scheduling system to syncronize the flow

Appendix M – Permission Letter

Dili, 19 March 2012

To : H.E. Mr. Xanana Gusmao, the Prime Minister

Cc: Mr. Samuel Marcal, The Directors of the ADN
Mr. Aniceto do Rosario, The Commissioner of the NPC

From: Deonisio Dos Santos, the Researcher

Subject: Request for permission to conduct research at ADN and NPC office

My name is Deonisio Dos Santos and I am currently undertaking my master degree on logistics and supply chain management at Massey University of New Zealand. I am conducting a study on how to applying Lean tools and Theory of Constraints Concept (TOC-L) as an innovative approach to Timor-Leste public procurement process. I believe that it is important to find a new way to improve the current procurement process, thus, improve service deliver to its clients.

Therefore, I am writing to you to ask for your help and permission to conduct my research at National Procurement Commission (NPC) and National Development Agencies (ADN). This research project will study the procurement process in order to find answers for the following questions: How the Timor-Leste public procurement system works? What is the constraint that limits the system throughput value? How can the system be improved? Can TOC-L help towards system improvement?

I envision this study as a unique opportunity, because such as approach provide new way of continuous improvement for the public procurement process, specifically to the Government Timor-Leste public procurement process.

This project has been evaluated by peer and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committee. The researcher is responsible for the ethical conduct of this research. If you have any concern about the conduct of this research that you wish to raise with someone other than the research, please contact Professor John O'Neill, Director (Research Ethics), telephone +6463505249, e-mail: humanethics@massey.ac.nz

Request by,	Endorsed by,	Endorsed by,
Deonisio Dos Santos Researcher	**Aniceto do Rosario** Member of NPC	**Samuel Marcal** Director of ADN
Approved by, **Kay Rala Xanana Gusmao** The Prime Minister		