

**School of Information Systems**

**Intervention Framework for Quality and Assurance in  
Information Systems Projects**

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# Declaration

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

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

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# Abstract

This study created an intervention framework that could be used to reduce the risk of failure in information technology projects. The study investigated social, cultural, technical and economic issues that affect information technology projects and their ability to achieve positive outcomes. As information technology continues integrating deeper into our life, its complexity and challenges increase and overall project delivery remains challenged.

Software development and project management methodologies focus on processes and tools that address technical elements with the intention of ensuring positive project outcomes. However, information technology projects are also affected by social and cultural issues that frequently introduce challenges outside of the scope of traditional methodologies.

Since the 1980's software development and project management methodologies have been widely adopted and competence in the use of these methodologies is often a stated prerequisite for companies and individuals involved in information technology projects. However, project success rates have not improved during this period, despite the prolific use of the project management methodologies.

Research published in the area of information technology projects focused on critical success factors, but there is little published on how to actually address issues which cause failure.

This research utilised the case study research method covering multiple cases in Australia and South East Asia with the aim of answering the research questions. What are the underlying factors in IT development projects at risk of failure and how can management intervene in a holistic and structured way to address these factors and mitigate the risk of failure? The outcome is a framework for project managers which allows them to overcome challenges that they face during project delivery. The emphasis is on the social and cultural elements, which are frequently unaddressed by traditional project management approaches.

The study finds that projects varying in size, geography location, and work environments faced similar challenges. While many employed software development and project management methods, none were able to achieve the stated project objectives.

The intervention framework developed in this study is unique and builds upon well-established theories and models. It provides a new approach to social, cultural, technical and economic issues faced by information technology projects and complements existing industry standard software development and project management methodologies. This research informs both project management theory and practice, and indicates that the strengths of the proposed framework can be further elaborated to improve project success and remedy the weaknesses of established methodologies, while increasing the probability of successful delivery of IT projects.

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# List of Abbreviations

Abbreviation	Term
ANSI	American National Standards Institute
ASQ	American Society for Quality
B2B	Business to Business
BAU	Business as Usual
CIO	Chief Information Technology
CMMI	Capability Maturity Model Integration
COO	Chief Operating Officer
CSF	Critical Success Factors
DCCEE	Department of Climate Change and Energy Efficiency
DMO	The Defence Materiel Organisation
DOD	Department of Defence
DSDM	Dynamic Systems Development Method
ERP	Enterprise Resource Planning
FAT	Functional Acceptance Testing
FDD	Feature Driven Development
FSH	Fiona Stanley Hospital
ICT	Information Communication Technology
IEEE	The Institute of Electrical Electronics, Engineers
IS	Information Systems
ISO	The International Organization for Standardization
IT	Information Technology
ITIL	Information Technology Infrastructure Library

IVR	Interactive voice response
MCO	Mars Climate Orbit
OPM3	Organizational Project Management Maturity Model
PM	Project Manager
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMO	Project Management Office
PMP	Project Management Professional
PRINCE2	PRojects IN Controlled Environments 2
QA	Quality Assurance
RUP	Rational Unified Process
SDLC	Software Development Life Cycle
SME	Subject Matter Expert
UAT	User Acceptance Testing
UML	Unified Modelling Language
WBS	Work Breakdown Structure
XML	Extensible Markup Language
XP	Extreme Programming

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An ounce of action is worth a ton of theory

Fredrick Engels (1820-1895)



# 1 Introduction

## 1.1 Background

Projects are, by their nature, temporary organisations, and any learning accumulated will dissipate at the end of the project unless attention is paid to collecting, storing, and disseminating it (Williams 2008; Barnes and Wearne 1993). Yet, project success means more than just meeting time and budget goals. It involves additional success dimensions such as business results or preparing for the future (Sausser, Reilly and Shenhar 2009).

Project-based working is so widespread today that it can be seen as a component of the new ideology of modern capitalism as well as a pervasive element of social life (Kwak and Anbari 2009). Project management covers multiple domains by its very nature and has become a key activity in most modern organisations. Projects usually have a wide variety of objectives, involve numerous internal and external actors, and are conducted in various activity sectors.

Project management is now well-developed and well-accepted as a domain for the exercise of professional expertise and as an area for academic research and discourse. Numerous methods and techniques have been developed, covering all aspects of managing projects from their genesis to their completion and these have been disseminated widely in books, journals, and through the work of professional bodies. However, project management remains a highly problematic endeavour (Winter 2006). For information technology project implementation designed to bring benefits to organisations with objectives such as enabling organisational change, improving productivity or building competitive edge, the rate of information technology project failure remains high in comparison to other high-tech projects (Yeo 2002).

Wysocki (2009) identified a misalignment between the project management discipline and the needs of business. He argued that project management is trapped and needs alternatives and a working knowledge of their use, stating the high rate of failure as evidence. The problem from his viewpoint is that project management is the hammer, and all projects are seen as nails and the one-size-fits-all approach to project management simply does not work.

## 1.2 Research Problem

Projects are becoming an increasingly central activity in most organisations and companies are investing increasingly significant resources in projects such as new project development, process improvement, or building new services (Sauser, Reilly, and Shenhar 2009). Information Systems (IS) project evaluation and selection is concerned with the allocation of scarce organisational resources (Lee and Kim 2000). When the development of an IS necessitates the development of a related project it creates a technical interdependence. By selecting interdependent projects, valuable IS resources can be shared among IS projects, thus reducing the total resources expenditure (Lee and Kim 2000).

The most widely cited general definition of project success is a project that is completed on time, within budget, and meets customer requirements (Procaccino et al. 2005, citing Brown and Jones 1998; Baccarini 1999; Linberg 1999). Information systems are often considered to be the outcome of adequate system development. Failure perceptions often differ by stakeholders of an information system according to the individual expectations (Jiang, Klein, and Balloun 1998).

El Emam and Koru (2008) surveyed Information Technology (IT) software project failures and identified senior management involvement and scope changes as the top two reasons for project cancellation, which stood in 2009 at 24% of all projects as reported in the Standish Group CHAOS summary 2009 report (Standish 2009). The failure rate of major projects hovers around 70% (Drummond 2005). Such high failure and cancellation rates may be attributed to the increasing complexity of the systems.

The results are grave and very costly. Repeated public failures such as the London Ambulance System (Finkelstein and Dowell 1996), Denver Airport Baggage system (Richard 1994) earned the software industry a reputation for being 'troublesome' with huge cost overruns and schedule slippages. Other examples are Airbus A380, the world's largest passenger aircraft, which entered service three years late (Matlack 2006), and the F-35 joint strike fighter, which earned the title of the most expensive defence project in history, costing the United States defence budget at least US\$382 billion and being years behind schedule, with cost for each fighter jet being more than doubled (Jacobs 2012).

Lyytinen and Hirschheim (1987) defined four major categories of IT failures – correspondence failure, process failure, interaction failure and expectation failure. The drivers of system performance are identified as context, content, process and outcomes (Yeo 2002).

Studies of IS project failure reveal a number of interesting themes. For instance, failure can be caused by multiple factors, such as unrealistic expectations, lack of resources, uncooperative customers and weak management of contractors (Brown and Jones 1998a).

Jiang, Klein, and Balloun (1998) state that many of the perceived problems in projects appear in the latter stages of the project life-cycle, specifically in evaluation. Others believe, however, that organisations are entrapped within ‘cycles’ that can only improve if they learn from the past (Lyytinen and Robey 1999). The Project Management Body of Knowledge (PMBok) is recognised as the industry best practice and it is deployed in many organisations. It requires project reviews to be carried out, arguing that “the reasoning behind the corrective action chosen, and other types of lessons learned should be documented so that they should become part of the historical database” (Project Management Institute 2008, 134). However, Williams’ (2008) survey findings indicated that there is a wide disparity between what is done and what project managers feel ‘should’ be done in the area of learning from failed projects.

Busch (2008) notes that many of the same problems persist from project to project with the same organisation and these very same, very common problems exist in variations across all projects regardless of the nature, industry or culture that make up their landscape. With high project failure and awareness of the problem, the British government has reviewed a number of IT projects and issued the McCartney report which makes a number of useful recommendations concerning requirements management and testing (Farrell-Vinay 2008).

Traditional software lifecycle development methodologies grew out of a need to control ever-larger development projects, and the difficulties of estimating and managing these efforts to reliably deliver results. These methodologies drew heavily on principles from engineering such as construction management. As a result, they stressed predictability (one has to plan every last detail of a bridge or building before it is built), and linear

development cycles – requirements led to analysis which led to design which in turn led to development (Wysocki 2009).

Along with predictability, they inherited a deterministic, reductionist approach that relied on task breakdown, and was predicated on stability – stable requirements, analysis and stable design. This rigidity was also marked by a tendency towards slavish process ‘compliance’ as a means of project control.

While standards have been developed to manage IS projects, the spread of these standards demonstrates evidence of worldwide growth and acceptance of the need for formal project management methods (Papke-Shields, Beise, and Quan 2010). Opinion and project management methodologies, however, state that the early phase of project life-cycles is the most critical and includes the most challenging tasks.

Complex issues may arise when proven management concepts found elsewhere in business are applied to a project management setting (Checkland and Holwell 1998). While it is clear that the discipline of project management has, with considerable effort from academics and practitioners, advanced significantly to develop and define theories of best practices to successfully deliver project outcomes (Baccarini 1999; Hodgson 2002; Wateridge 1998), the same cannot be said for addressing the issues faced by information technology projects at the enterprise level.

One reason for the dominance of hard skills in project management (Finance and Efficiency) may be associated with the observation of Wysocki, Lewis, and DeCarlo (2001) who noted that project managers are often selected from the ranks of the technically competent. They argue that there is a range of other skills and knowledge sets that are required in project management that include technical, management, and interpersonal skills.

Regardless of the particular methodology, the traditional project manager is often seen as a ‘taskmaster’ who develops and controls the master plan that documents (often in excruciating detail) the tasks, dependencies, and resources required to deliver the project objectives. The project manager then monitors the status of tasks and adjusts the plan as necessary. Underpinning this mechanistic approach is the assumption that equates individuals to interchangeable, controllable commodities.

One weakness in that process, is that it does not take into account the social and culture variables that would have direct impact on the project. Whilst the number of project managers with certifications in methodologies such as Project Management Professional (PMP) or Projects IN Controlled Environments 2 (PRINCE2) are increasing annually as a result of demand in the job marketplace (Levinson 2010), the rate of project failure is not decreasing.

Project management and software development methodologies have been used in projects, small and large for years. They have been effective to some extent, but with the complexity and ever changing landscape of information technology and organisation structures, there seem to be gaps that are not addressed by such methodologies. As current methodologies do not address the human factors in project management, the focus of this study is on the human factors that impact project objectives, proposing solutions for how to address such shortcomings.

While these methodologies may have worked for some organisations in the past and may still work in some circumstances, for many companies these methodologies only added cost and complexity while providing a false sense of security that management was 'doing something' by exhaustively planning, measuring, and controlling. Huge costs were sunk in premature planning, without the rapid iterative development and continuous feedback from customers that the industry has come to realise are pre-requisites for success today.

A number of concepts have been proposed in the literature, specifically in the area of project critical success factors such as management commitment (Chow and Cao 2008), factors such technology, economy and client found to be critical (Belassi and Tukul 1996), corporate culture (Yeo 2002), realistic scheduling (Nasir and Sahibuddin 2011), effective planning and communication (Shehu and Akintoye 2009), and project control and management (Smuts et al. 2010). Taylor and Woelfer (2011) stated that while IT projects continue to have a poor reputation for successful outcomes, there is increasing evidence that the project manager's skills can be critical for effective project team performance.

Verner and Abdullah (2011) stated that successful software development is concerned with not only technical solutions but also organisational issues, project management and human behaviour. Buschmann (2010) discussed the issue of technology addiction, in

which technology is used as an end and not a means to deliver value to the organisation. Conboy (2010) highlighted that the majority of information system development projects run drastically over-budget and there is no reason to suggest that this trend is improving. Despite the fact that overspending is such a concern, little research has focused specifically on how budgeting or other general management accounting techniques are being used in information systems development.

### **1.3 The Purpose of the Study**

There is significant literature on Critical Success Factors (CSF) which details the optimal conditions for projects to succeed. However, while the literature does provide the conditions, it does not also identify the different paths that can be followed in seeking alternative solutions when dealing with challenging projects.

This dissertation examines and presents the concept of 'Intervention into Information Technology Projects' at the risk of failure or being challenged to deliver their objectives. The basic design of project management and software development methodologies assumes optimal conditions of operation and does not provide alternatives for dealing with projects that fail to deliver. However, project managers and senior managers are increasingly faced with complex projects and circumstances that impede their projects in moving forward, and with methodologies not designed to deal with such complexity. These challenges are addressed by answering the following research questions

1. What are the underlying factors in IT development projects at risk of failure?
2. How can management intervene in a holistic and structured way to address these factors and mitigate the risk of failure?

A detailed description of the research design is presented in Chapter 3

### **1.4 Dissertation Structure**

The document is structured as follows.

**Chapter 2** presents a review of related literature, starting with quality as the central theme since it plays a critical role in project outcomes, followed by software development and project management methodologies, their history and characteristics. The chapter also

discusses success factors, project failure and examples of these, as well as systems theory and its use in project management.

**Chapter 3** presents the research design. The chapter includes a justification of the chosen research method and discussion of the case study design, case study preparation, data collection, and data analysis. The chapter also introduces the case studies examined as part of the research.

**Chapter 4** presents the four case descriptions that were undertaken as part of the research. For each case, the project is initially described including company structure, background, and the motivation for the project, followed by the project issues and problem definition based on the analysis of the case study.

**Chapter 5** presents the new framework that embodies the proposed framework to address the issues identified in the case studies undertaken as part of this research. The chapter also includes the theoretical background for the intervention framework, and how the framework can be applied in practice, as well discussing the results and analysis from the survey as part of the framework evaluation.

Finally, **Chapter 6** discusses the study and its findings. It details the study's contributions; its limitations, implications for research and practice, and identifies opportunities for future research and makes concluding comments.

With mere good intentions, hell is proverbially paved

William James (1842–1910)

Trying is the first step to failure

Homer Simpson



## 2 Literature Review

### 2.1 The Story of Quality

In his pivotal article Nicholas Carr (2003) argues that Information Technology (IT) doesn't matter anymore as a strategic tool in building competitive edge in the market place. With IT power and ubiquity having grown to an unprecedented scale, Carr argues that IT strategic importance has diminished and is now viewed as a resource that has become essential to competition but inconsequential to the organisation strategy.

Carr (2003) highlighted that the arrival of the internet has accelerated the commoditisation of IT by providing a perfect delivery channel for generic applications, in which companies will consume over the internet and technology vendors will act as IT utilities.

Carr (2003, 42) stated that "resources become essential to competition but inconsequential to strategy, the risks it creates become more important than the advantages it provides". Today, an IT fault can reduce a company's ability to make its products, deliver its services, and connect with its customer, not to mention reputation damage. Yet, few companies have done a thorough job of identifying and tempering their vulnerabilities, regardless of all the safeguards that companies can employ (e.g. service level agreements, compensation claims). Worrying about what might go wrong is not the most glamorous job in the IT industry compared to promoting future growth; however, it seems more essential than ever. Where companies may not have IT as their core business, without IT they cannot perform their core business. While Carr argued against the importance of IT as a strategic tool they are many cases where IT does play a strategic role, for example a stock exchange in South East Asia recently announced the development of the world's fastest trading platform as part of a US\$250 million strategy to become a global hub for stock and commodities trading in Asia (Norell 2010).

Quality is one of the key attributes of project success. Everyone demands quality and promises quality in project implementation. However, quality is the first element to be removed from the schedule when faced with time, resources or scope pressures.

Quality means different things for different stakeholders in any project; customers know it when they see it, and suppliers promise that their products embody it. However, both

views lack clear definition of what quality is which leads to confusion and frustration when trying to determine how to deliver it in an IT project.

Given the importance of quality to IT project outcomes, many thought the quality problem was solved a long time ago. It has not been, and projects continue to be plagued by imprecise quality goals during the phases of the project as well as during the final product transit from project to production.

### **2.1.1 Definition of Quality**

Definitions of quality already exist. Joseph M. Juran in Juran's Quality Handbook, states that quality has two meanings that are critically important to its management. Quality means "features of products which meet customer needs and thereby provide customer satisfaction"(Juran and Godfrey 1999, 20). Quality improvement usually costs more. Quality also means "freedom from deficiencies" (Juran and Godfrey 1999, 20).

Deficiencies are errors that require further rework or result in failures. Such failures may result in refunds, and customer dissatisfaction. Quality improvement related to deficiencies usually costs less if dealt with early, Juran's view of quality considers products, defects, and customers (Rose 2005, 41).

The Project Management Institute (2008, 180) defines quality as "the degree to which a set of inherent characteristics fulfil requirements". This definition is taken directly from ISO 9000:2000, published by the International Organization for Standardization. The ISO 9000-series standards are a group of international consensus standards that address quality management. ISO 9000:2000 is a brief introductory standard that covers fundamentals and vocabulary (ISO 2010). The ISO definition considered the most complete because it is very broad. The set of inherent characteristics may be of a product, process, or system. The requirements may be those of customers or stakeholders, the latter being an important group that is ignored at great peril to the success of the project.

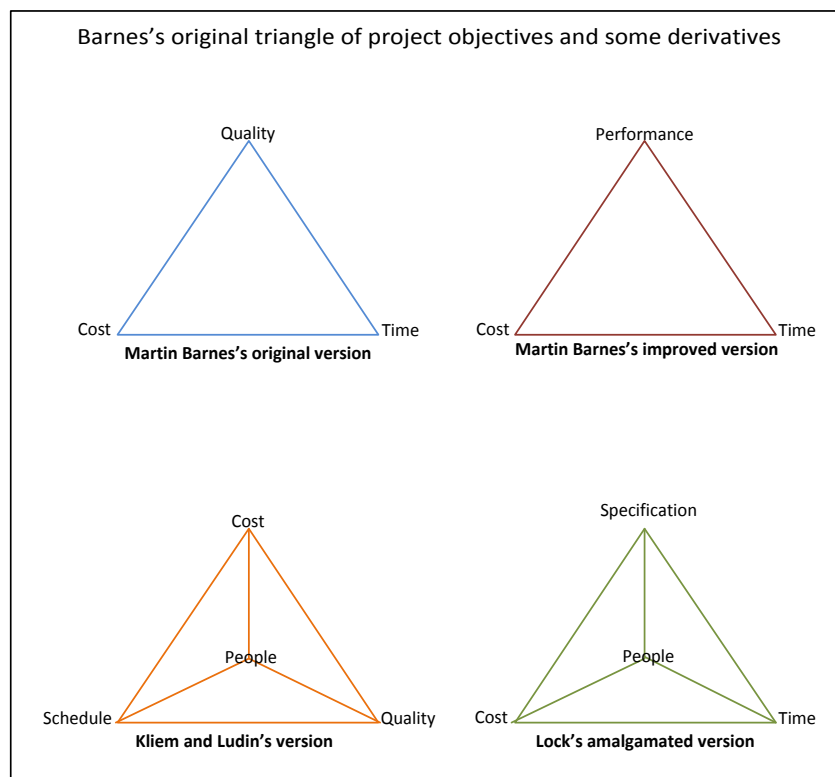
Rose (2005, 6) pointed out that one important aspect of quality does not originate from any of these definitions, instead to states that "quality is 'counter-entropic'; it is not the natural order of things. Entropy, from the Second Law of Thermodynamics, says that things naturally move from a state of organisation to a state of disorganisation".

Quality doesn't happen in a vacuum; it is the result of hard work that begins with planning the project, including understanding all the elements that contribute to building

quality from day one in all phases of the project, including closure. To achieve quality in an IT project requires management of the quality, but above all commitments, understanding and direction from upper management to incorporate quality, rather being seen as an afterthought.

Projects success most widely used definition that is completed on time, within budget (Procaccino et al. 2005). In the mid 1980s Dr Martin Barnes introduced the first version of his triangle of objectives (shown in the top left-hand quadrant of Figure 1). The purpose of this triangle was to illustrate that the three primary objectives of cost, time and quality are interrelated. Kliem and Ludien set out a modified triangle of objectives with people shown at its centre. Lock (2007, 21) was not content with the word quality and introduced specifications instead of quality.

Managers responsible for IT projects try to balance the three elements that make the golden triangle while trying to meet the project objectives and satisfy stakeholders. Quality is the fourth element that is not part of that golden triangle, but it is “closely associated with scope because scope is based on customer requirements and quality is closely associated with customer requirements” (Rose 2005, 6).



### 2.1.1.1 W. Edwards Deming

Deming is one of the best known quality pioneers. Deming developed a list of fourteen goals which he called 'fourteen points for management' (Table 1), and he advocated that the fourteen points to be taken as whole; piecemeal or partial adoption will not work. He also emphasised that no individual point is more important than another.

**Table 1: Deming's Fourteen Points for Management (Deming 1989, 22-86)**

Deming's Fourteen Points for Management (Deming 1989, 22-86)(Deming 1989, 22-86)(Deming 1989, 22-86)(Deming 1989, 22-86)(Deming 1989, 22-86)(Deming 1989, 22-86)(Deming 1989, 22-86)(Deming 1989, 22-86)(Deming 1989, 22-86)(Deming 1989, 22-86)(Deming 1989, 22-86)(Deming 1989, 22-86)(Deming 1989, 22-86)(Deming 1989, 22-86)	
1	Create constancy of purpose for improvement of product and service.
2	Adopt the new philosophy.
3	Cease dependence on mass inspection.
4	End the practice of awarding business on the basis of price tag alone.
5	Improve constantly and forever the system of production and service.
6	Institute training.
7	Adopt and institute leadership.
8	Drive out fear.
9	Break down barriers between staff areas.
10	Eliminate slogans, exhortations, and targets for the work force.
11	Eliminate numerical quotas for the work force; eliminate numerical goals for people in management.
12	Remove barriers that rob people of pride and workmanship.
13	Encourage education and self-improvement for everyone.
14	Take action to accomplish the transformation.

### 2.1.1.2 Joseph M. Juran

Juran's approach to quality focused on strategic and planning issues. He believed that poor quality results from inadequate or ineffective planning, so he proposed the Juran Trilogy, a three step approach to quality that includes quality planning, quality control, and quality improvement (Table 2).

**Table 2: The Three Universal Processes of Managing for Quality (Juran and Godfrey 1999, 2.6)**

Quality Planning	Quality Control	Quality Improvement
Establish quality goals	Evaluate actual performance	Prove the need
Identify who the customers are	Compare actual performance with quality goals	Establish the infrastructure
Determine the needs of the customers	Act on the difference	Identify the improvement projects
Develop product features that respond to customers' needs		Establish project teams
Develop processes able to produce the product features		Provide the teams with resources, training and motivation to: diagnose the causes Stimulate remedies
Establish process controls; transfer the plans to the operating forces		Establish controls to hold gains

Juran's view of quality was based on two aspects: product features and freedom from defects, which are commonly used as metrics in IT projects. According to Juran (1999, 37.25) "quality improvement depends on two different activities: control and breakthrough. Control ensures that processes are performing consistently, free of assignable cause variation. Breakthrough occurs after a process has been studied and some major improvement has been designed and implemented". He suggests that these activities are not separate and sequential; they can and should occur simultaneously (Rose 2005).

### 2.1.2 Quality Paradigms

Quality has evolved over the years and been captured in a number of formalised frameworks. Many of the frameworks were designed for a specific industry's quality requirements and then extended to the IT industry with a varied level of success when implemented in IT related projects.

#### 2.1.2.1 Six Sigma

This approach originated in the semiconductor industry in the 1980s. The name comes from the Greek letter sigma ( $\sigma$ ), which is used in statistics and quality as a symbol for standard deviation. From basic statistics, the area under a standard normal curve (a 'bell-shaped' curve) is encompassed by three standard deviations above and below the mean, accounting for 99.73% of the total area under the curve. Technically, six standard deviations above and below the mean encompasses 99.999998% of the standard normal curve, or two defects per billion. Motorola later modified the percentage and established the target as 99.99966% (Taghizadegan 2006).

The Six Sigma approach comprises two basic elements: management and methods. The application of the approach starts with a management initiative that requires everyone in their organisation to contribute to the effort to achieve significant improvement and not incremental improvements. Success depends on selecting the right projects, those that support the strategic goals of the organisation and not the most convenient, troubled or the management's favourite (Rose 2005).

Another requirement for successful implantation of Six Sigma is having effective project management and comprehensive reviews. It also requires a stable long term viewpoint from management as well as stable staffing with low turnover.

Six Sigma methods and tools arise from common quality practice. The Six Sigma approach begins with process thinking that considers inputs, outputs, and both controlled and uncontrolled variables. Variation is a foundation of the approach, with the goal being to reduce variation around the mean and to move the mean closer to the target value if necessary. Six Sigma depends on data-based decisions, so data, facts, and figures play a key role. Standard quality tools and statistical tools are employed throughout implementation. Because statistics are so important, user-friendly statistical software has been developed that is specifically oriented toward Six Sigma application. The 'vital few' variables are the focus of attention, not the whole range of possible variables.

These tools are all integrated into a standard methodology designated by the acronym DMAIC, for define, measure, analyse, improve, and control (Yang and El-Haik 2009, 34):

- **Define** customers and requirements;
- **Measure** things critical to quality;
- **Analyse** baseline, opportunities, objectives, and root causes;

- **Improve** the process;
- **Control** the process.

#### 2.1.2.2 ISO 9000

The International Organization for Standardization (ISO) is a global body headquartered in Geneva, Switzerland, that develops consensus standards for worldwide use. The Organization's short title ISO is not a fractured acronym, but rather an adaptation of the Greek word *isos*, which translates to English as 'equal'. The American National Standards Institute (ANSI) is the U.S. member of ISO. The American Society for Quality (ASQ) is a member of ANSI and is responsible for quality management standards. It publishes standards in the ANSI/ISO/ASQ-Q9000 series that are the U.S. equivalent of standards published by ISO.

The ISO 9000-series of standards address quality management systems. The series includes three standards (ISO 2010):

1. ISO 9000, Quality management systems — Fundamentals and vocabulary
2. ISO 9001, Quality management systems — Requirements
3. ISO 9004, Quality management systems — Managing for the sustained success of an organisation – a quality management approach.

ISO 9001 is a specification standard. If an organisation wishes to become certified or registered the terms mean the same thing, only the conventions of use differ and the organisation would have to conform to the requirements of ISO 9001. ISO 9004 is a guidance standard. It provides additional, useful information about quality management. Neither ISO 9001 nor ISO 9004 are performance standards. They do not address quality itself, only the management processes necessary to achieve quality. Various editions of the ISO standards include dates in the reference number.

ISO 9001 (2010) is a brief document. It contains many prescriptive paragraphs that indicate what an organisation 'shall' do. Conformance requires extensive documentation, including:

- **Quality policy** — A statement from top management;
- **Quality manual** — A document that addresses each clause in ISO 9001. Specific procedures may be part of the manual or referenced in the manual;

- **Quality objectives** — Goals assigned to organisational elements;
- **Quality procedures** — Step-by-step actions for each ISO 9001 requirement or any process that affects quality;
- **Forms, records, documentation** — Proof of performance.

### 2.1.3 Cost of Quality

The relationship between quality and cost is a very complex one; the term quality may refer only to the final product/service quality, not the whole quality of the organisation or process behind the final product or service. This relationship is influenced by the quality strategy adopted by a particular organisation. If an organisation adopted downstream quality, which is also known customer quality, in which defects is noticed by customers (e.g. noise, vibration...etc), then cost of quality could be very high. If an organisation adopted a strategy “emphasising upstream improvement and problem prevention, then improving quality could actually reduce the life-cycle cost because there will be less rework, less recall, and therefore, less product development cost” (Yang and El-Haik 2009, 216).

If quality is used to define the whole quality of an organisation, then the higher whole quality of the organisation will lead to reduction in cost. For example Six Sigma is built on a foundation that includes the following principles (Tayntor 2003, 5):

1. Prevent defects;
2. Reduce variation;
3. Focus on the customer;
4. Make decisions based on facts;
5. Encourage teamwork.

Because total quality means higher performance benchmarks of all aspects of a business, it also means higher performance of an organisation supporting functions (e.g. Finance, Human Resources), which would lead to waste reduction and improved production. As a consequence of total quality, organisations can reduce business operation cost, including production and improve profit margins.

The Defence Materiel Organisation (DMO) managing Australia’s first air warfare destroyer project reported a critical quality issue in which the keel of the destroyer was



manufactured to the wrong size (Lazzaro 2010). While the ship was based on a Spanish design and had been built five times before being adopted for the Australian navy, the DMO has implemented a technique which assesses the quality of projects as they progress from concept to in-service (Gershon 2008). That did not prevent serious quality issues that would seriously impact the project schedule and overall budget.

#### **2.1.4 Quality Drivers**

Boehm (1981) and Clark (1997) identified numerous drivers of software quality. Product complexity and human capabilities have been identified as the most critical factors affecting software cost and quality. Human capabilities included knowledge of the problem domain, modern programming practices, and software tools. Other important factors include scheduling, product reliability needs, team, and technology stability.

Nikora (1998) research cited by Kandt (2006) points to software complexity, size and viability as the primary drivers affecting software quality.

#### **2.1.5 Quality in Software**

Though more than fifty years of “software development has come and gone, software quality today is no better than decades ago and is worse in some cases” (Gorla and Lin 2010, 602). Parnas and Lawford (2003, 647) highlighted that “many major products are known to have thousands of bugs. It is not for lack of trying; all major software developers have a software quality assurance effort and attempt to remove bugs before release”.

Boehm (2007, citing Hirsch 1972) explained what went wrong with the World Wide Military Command and Control system which proved so unreliable that 95 per cent of the code had to be rewritten to meet operational needs. The Federal Aviation Administration’s Air Traffic Control Centre software with a budget of US\$1.8 million and a 17 month schedule, took five years to complete and the budget went to US\$19 million. A few years later, the direct cost to maintain the software was estimated to be more than US\$100 million.

The journal, *Software Engineering Notes*, publishes a list of software failures in every issue, which demonstrate that software quality issues are widespread and the problem remains unsolved to date. Kandt (2006) citing Robert Floyd in his 1978 Turing Award acceptance speech described the situation as ‘software depression’. Thirty years later, the

situation does not seem to be getting better, but is worsening, with greater dependency on software to manage our businesses, government and houses. We are far more dependent on software than ever.

Gopal, Mukhopadhyay, and Krishnan (2005, 679) stated that “losses due to inefficient development practices lead to inadequate quality that cost the US industry approximately US\$60 billion per year”. It should be noted that a software product is not only software code, but it includes user interface, which users interact with; software quality includes both functional and non-functional aspects of the software, such as usability, reliability and maintainability. Most software engineering research emphasises technical rather behavioural aspects of software projects (Gorla and Lin 2010).

A recent incident, in which an Australian airline check-in system developed and hosted by what Carr (2003) called IT utilities’ providers, faced meltdown. This resulted in more than 100 cancelled flights, affecting some 100,000 passengers (Foo 2010). The two-year project to introduce the new check-in system was estimated to cost the airline AUD\$10 million to roll out and it suffered its first operational problem on the same day it was rolled out into production. According to the airline’s own website the new system intended to make travelling with the airline a fast, efficient and rewarding experience (Foo 2010).

The airline estimated the cost of its check-in system meltdown in late September 2010 as being between AUD\$15 million to AUD\$20 million (Creedy 2010), which is nearly double the cost of the actual system implementation. Constructing the system took the airline two years and the meltdown lasted only two days; however, the cost to the airline revenues exceeded the cost of the system implementation, without taking into account the cost to the airline’s reputation due to the system meltdown.

When developing software, it is essential to focus on both product and process qualities. Product quality reflects the essential character, features and properties of the artefacts and is a reflection of how they will support stakeholders’ needs. Process quality is concerned with how the product is produced. When software is developed, the final product will reflect the level of adoption of both qualities within the organisation behind the final product.

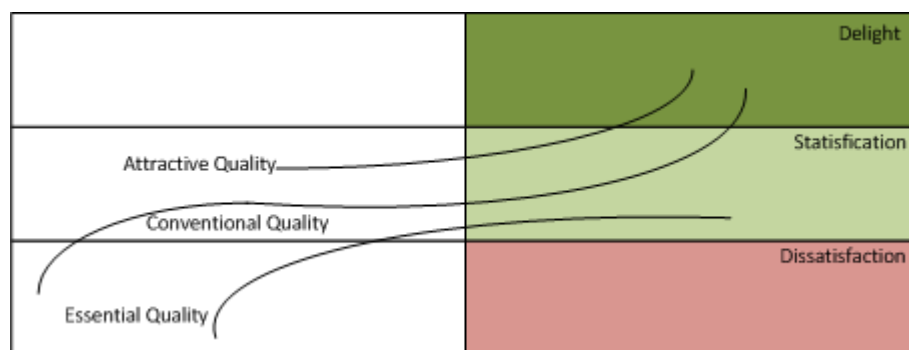
Kandt (2006, 3) has listed three types of qualities that are important when developing software:

**“Conventional Quality:** results in stakeholder satisfaction when it is present in a product and dissatisfaction in its absence.

**Essential Quality:** reflects the attributes of an artefact necessary to achieve a minimum level of customer satisfaction.

**Attractive Quality:** represents a product characteristic that is not expected to be present in a product; when it is present the product’s customers are delighted”.

To classify product or process quality as conventional, essential or attractive, it is important to consider both positive and negative consequences of that classification as highlighted in Figure 2.



**Figure 2: The Three Types of Quality (Kandt 2006, 4)**

Quality according to ISO 9000 is defined as “the totality of characteristics of an entity that bear on its ability to satisfy stated or implied needs”(ISO 9000 2010, 1). By employing the term ‘satisfaction’, ISO/IEC 9126 implies ‘the capability of the software to satisfy users in a specified context of use’. ISO/IEC 9126 Software Engineering – Product Quality Standard assesses a system’s internal and external quality, as well as quality in use (Kanellopoulos et al. 2010, 18).

Software quality has also been defined in terms of internal and external quality. Internal quality refers to how the software was developed, while external quality refers to how the software will function in its environment.

ISO/IED 9126 internal quality, consists of six characteristics (ISO/IEC 9126 2010, 1) :

1. **“Functionality:** concerned with what the software does to fulfill user needs;
2. **Reliability:** evaluating software’s capability to maintain a specified level of performance;
3. **Usability:** assessing how understandable and usable the software is;

4. **Efficiency:** evaluating the capability of the software to exhibit the required performance with regards to the resources needed;
5. **Maintainability:** concerned with the software's capability to be modified;
6. **Portability:** measuring the software's capability to be transferred across environments".

It is also worth remembering that the software quality movement is based on the premise that a high quality process is required for high quality products (Voas and Wilbanks 2008, 12).

There are other qualities in addition to the qualities identified by ISO/IEC 9126 that would include:

- **Availability:** the readiness of a software system for immediate use at any time. Hence, a system can be highly reliable yet still be rarely available;
- **Extensibility:** the extent to which software can be expanded or enhanced. In the real world, user needs change, technology changes, personnel change, and funding changes. Consequently, to develop quality systems on time and within budget that satisfy and delight customers requires that software engineers pre-plan products for evolution;
- **Modularity:** the extent to which one plans a software system in terms of a collection of standardised units for use together. Modular systems decompose into smaller components, each solving a fragment of a larger problem;
- **Simplicity:** the extent to which a software system contains only essential complexity. Thus, software systems should only include those features that it needs to achieve its purpose;
- **Testability:** the extent to which software facilitates the verification of its operation;
- **Understandability:** the extent to which people can comprehend the behaviour of a software system, which generally results in the development of more reliable software systems;
- **Accuracy:** the extent to which the preciseness of program output satisfies its intended use;

- **Completeness:** the extent to which all parts of a software system are fully developed;
- **Robustness:** the extent to which a software system can continue to operate despite anomalies and perform as intended;
- **Reusability:** a measure of the ease with which a software artefact can be used by a software project other than the one for which it was originally intended;
- **Effectiveness:** the extent to which one can produce a product that is ready for service. Thus, effective products meet the needs of their users and provide a quality of service that pleases them;
- **Predictability:** the extent to which one can declare something in advance based on observation, experience, or reason.

## 2.2 Security Problems

The 2008 Computer Security Institute/Federal Bureau of Investigation report on computer security highlighted the high number of computer and information security breaches and the high cost associated with it. The 2008 survey data based on data from 522 computer security practitioners and senior executives from U.S. corporations, government agencies, financial institutions, medical institutions and universities (Richardson 2008, 2).

A plethora of computer security incidents caused an average loss per respondent of \$US288,618. The survey also reported the vulnerability and attack trends within a 12-month time period, including:

- 59% experienced an attack involving a virus;
- 29% of organizations reported unauthorised use of computer systems;
- 44% reported insider abuse.

Software related quality problems do not get much media attention, however, when failure occurs in software systems that are used large number of (e.g. internet banking failure) media and public take notice. The problems are especially noticed when the processes are watched carefully by the news media. For example, during the 2008 election process in the USA, when media attention was focused on every election-related event, it

was inevitable that problems in software that support election processes were noticed (Bieman 2008, 485).

A significant number of security problems was reported, including the software vendor storing files on insecure internet sites, as well using easy to guess password. Code reviews of election software produced by three vendors revealed serious security risks caused by inadequate software designs (Bieman 2008, 486).

The reported problems that have occurred during actual elections do not appear to be caused by malicious behaviour (Bieman 2008). Most of the reported problems originated from poor software development practices, and either lack or limited software quality assurance.

Futcher and Solms (2011) highlighted that software developers and users need to be confident that software application developed will be secure and can be trusted when deployed. Peeters and Dyson (2007) pointed out the dilemma businesses face when making a cost-effective investment in making their software more secure.

Building secure applications is a significant challenge in application security. Unfortunately, application security initiatives are usually the domain of security organisations that do not understand software development or that cannot influence the software engineering practices of their software development groups. Due to this chasm, it is very difficult to move application security development from being reactive to being proactive and work to mitigate vulnerabilities during the entire software development process (Payne 2010).

Other factors, such as the culture within the development team, can also affect the security of the developed solutions. Culture in security systems has been found to be multidimensional as well, including security governance, control, coordination, sound security processes (Ruighaver, Maynard, and Chang 2007), top management support (Solms and Solms 2004), employee participation and training (Kraemer and Carayon 2005).

Kajava et al. (2006, 1519) pointed out that for “senior executives, information security is a basic requirement for business success”. However, senior management understanding of security issues is superficial and could lead them to making decisions that not entirely to the best interest of the organisation.

The relationship between human and organisational factors in computer security can also have a crucial influence on security (Werlinger, Hawkey, and Beznosov 2009, 17). Werlinger et al. produced an “integrated framework of human, organisational, and technological challenges associated with security management and emphasised the relationship among the various factors in the information system”. They found that in order to address many of the security problems, the human, organisational and technological factors must be addressed as well.

This insight expands on the conclusion reached by Tarimo, Bakari, et al. (2006), who states that the “human dimension is a weak link in the ICT security chain”. Since security involves both technical and non-technical elements, addressing, addressing the human dimension would improve security overall.

Contemporary software applications frequently contain defects, some of which leave systems vulnerable to cyber-attacks. Although rigid quality development processes can reduce vulnerabilities, these processes alone are not sufficient for operational security; hence, we are reminded on a daily basis of ever-increasing high profile cyber-attacks. Software development processes must stipulate measure to address security-related risks. This ensures software systems maintain effective performance while reducing the risks to the organisation they support. Mwakalinga, Kowalski, and Yngstrom (2009, 1) sum up the security problem aptly: “Information security is not just technology and communication protocols and so we consider other factors like environments and values of users”.

## **2.3 Information Technology Projects**

Projects and project management have been with us for centuries in different forms or shapes: for instance, the pyramids, the Great Wall of China, the thousands of bridges all over the world old and new, and aeroplanes. The internet started as a research project to explore and articulate principles of communications between physically separate systems. One of the longest running projects known is connecting the Danube and Rhine basins by canal; it was started in 793 by the Emperor Charlemagne and was completed on 25 September 1992 (Rich 1991) taking over 1200 years to be completed.

Projects are a natural occurrence to any business that grows and expands its products, knowledge, or even its physical representation. From as small as adding a new room to the office building to creating a worldwide campaign for the next great product, projects

exists in many forms within the walls of an organisation. While IT projects becoming natural part of business, project management is not (Lawson 2008). Bjarne Stroustrup, the man behind the C++ programming language, in a recent interview coinciding with the 25<sup>th</sup> anniversary of the language, highlighted the fact that people do not appreciate how much they depend on software: “given the complexity of modern society and modern transporting systems, it is fair to say that most people would simply starve without software. We would also be without electricity, heat and telephones” (Calore 2010, 2). In early 2010 the Toyota Motor Company issued a recall of its Prius hybrid vehicles, due to a software glitch that affected the braking system control (Valdes-Dapena and Lah 2010). Projects fall within a specific business context within an organisation. A project may be stand-alone serving a specific need, or it may be a sequence of related projects that form a larger programme of work with the potential to transform the business.

Projects by nature are temporary structures, created to achieve a specific organisation benefit or objective. When the work has been completed, the project is disbanded (Turner and Muller 2003). In the modern era of project management the emphasis has shifted from tools and techniques to the execution of the project to increasing focus placed on the ‘front end’ of the project. Barnes and Wearne (1993, 137), stated that:

“The evolution of techniques of project management has moved progressively from concentration upon the problems apparent at the tail end towards the front end – from downstream to upstream. The emphasis for project management now is [to] start with attention to a project's needs and risks as a whole so as to anticipate the potential problems and shrink the risks.”

Information Technology has grown so rapidly and the number of projects associated with it has exploded, with organisations and individuals relying on IT to achieve their goals. In order to explore IT projects, we need to understand why projects exist and how they are managed and constructed, but more importantly, what makes them succeed or fail.

### **2.3.1 What is an Organisation**

In order to fully understand the nature and role of projects undertaken by organisations it is essential to define the organisation and its characteristics, and what makes an organisation change.



An organisation can mean different things for different people depending on their perspective. Internally, an organisation can be viewed as a collection of individuals whose activities are coordinated. Externally, organisations exist within a large environment from which they receive inputs and create outputs to be consumed by the external world. Organisations come to existence with the aim to fulfill society's needs, serving as intervening elements between what societies desire and the satisfaction of those desires.

It is characteristic of organisations to produce a product that is desired and consumed by some portion of the society beyond the organisation. That product may be tangible, such as a car or golf ball, or it can be a service, such as financial services, or it may be less tangible, such as an insurance commission which regulates the insurance industry.

A reasonable definition of an organisation may be "a collection of individuals whose activities are coordinated so as to produce objects and services that society or portions of it desire and could not otherwise easily obtain" (Lowenthal 2002, 5).

### **2.3.2 Organisations as Machines**

Organisations as machines reflects upon the idea that an organisation functions like a machine, when all parts that make the machines organised, constructed, connected and operated correctly, it will continue functioning until one of those components fail. Green (2007, 16) saw that as the "metaphor for a simple project management approach to change where everything not only can be put onto a Gantt chart but everything and everyone will perform as if it really were a piece of machinery". Morgan (2006) agreed with Green and stressed that organisation as a machine metaphor has its place because many products and services rely on clear, predictable, reliable and compliant processes

### **2.3.3 Organisations as Political Systems**

This metaphor suggests that everyone who inhabits an organisational space is in the midst not only of a human system but one where there are competing forces and pulls on scarce resources and where different players have different degrees of power. It is the awareness and management of these forces and these players that allow work to be achieved. There is an understanding of who is an enabler and who is a disabler; who stands to gain and who stands to lose; who is supporting you and who might be against you. The following are all factors that need to be considered when one wants to effect

change and enter this reality “organisational goals, structure, technology, job design, leadership style, and other seemingly formal aspects of organisational functioning have a political dimension as well as the more obvious political power plays and conflicts” (Morgan 2006, 203).

### **2.3.4 Organisations as Organisms**

Organisations as organism’s metaphor suggest that organisations are not single entities, but has number of sub-systems interacting with one another and with the external environment. It is an open-systems approach as defined by Bertalanffy (1969). The internal sub-systems of the system such as human, management, technology would need to interact, communicate and respond to changes accordingly. Morgan (2006, 65) stressed that organisations are open systems and are best understood as ongoing processes rather than as collections of parts.

### **2.3.5 Organisations as Flux and Transformation**

Entering into the metaphor of flux and transformation can be a disconcerting experience. We are moving into a world where we need to review our understanding of what an organisation actually is. Rather than a machine or a social system of power bases, or an organism that interacts symbiotically with the environment, it is a place that has form and movement but events which cannot be predicted with any degree of certainty. There is a dynamism that can lead to equilibrium or disequilibrium depending on the factors or ‘attractors’ at play: organisations are described by sub-systems of interaction that are both in order and also chaotic. Because of such complexity, disturbances could produce unexplained events that would impact the whole system, coherent order always emerges out of the randomness and apparent chaos (Morgan 2006).

### **2.3.6 Factors that Influence Organisations**

There are many factors that may affect originations. They can be divided into two main categories: internal or external factors. Internal factors that may affect organisations may include a product range, centralisation or decentralisation of operations, an acquisition or other businesses. External factors may include increased competition, government regulation, and changing economic conditions such as recession.

Internal factors that may influence the organisation can be grouped into either downward pressures originating within management, or upward pressures arising from the needs and the demands of members of the organisation. Internal factors of organisational change may be generated at any level, and they do present a paradox, since the responsibility for initiating change normally rests with management. However, change may conflict with managerial prerogatives.

Let me give you an example from my own experience: An Australian federal agency in 2007 initiated a management decision to dismantle their internal quality assurance department to reduce the cost of software development, and instead have their development teams take the responsibility for both development and quality assurance. Five years on, the organisation is struggling with the consequence of that decision. However, the situation is unlikely to change in the near term, since the senior executive who made the decision remains in his position.

External factors that influence the organisation centre on the organisation's role in society. External factors tend to be more intense and visible than internal factors and would receive immediate management attention. External factors can be divided into two general categories: government and end users.

Government pressures are steady or at least predictable: they can relate to increased taxes or changes to certain regulations that directly impact the organisation. End users or consumers may be a greater source of uncertainty to the organisation. For example, climate change did force car manufacturers to adopt greener cars in response to increased consumer demands, as well as greater scrutiny of cars with high fuel consumption.

It is worth noting that internal or external factors that influence the organisations could be the focus of a new project within the organisations. Projects affect organisations and may also be affected by the organisation's internal and external factors.

#### **2.3.6.1 Information Technology Role in Business Transformation**

Business managers naturally focus on the costs and risks of information technology that impact the organisation's bottom line. The 1990s witnessed phenomenal investments in IT; companies raced to organise their processes to be integrated in Enterprise Resource Planning (ERP) systems, and readying software for the year 2000 bug. Many organisations

invested in the 'new economy' and the letter e preceded everything (e.g. e-business, e-commerce).

All of that came to an end with the dot-com boom in late 2000 and organisations started to realise that not all the benefits promised by the IT industry are realisable or deliverable. The cost cutting programs of recent years have shown that measures such as consolidation, harmonization, and outsourcing can significantly reduce IT expenditure without compromising the quality of service delivered by IT.

It seems that the decisive factor is not the absolute amount of IT expenditure in an organisation or the proportion of revenues, but the alignment of each individual investment and business solution with the overarching strategy. In short, the business model must dictate the direction and amount of investment (Kagermann, Österle, and Jordan 2011). Are investments in new IT business concepts really a source of competitive advantage? In many cases, the answer is no, especially if competitors adopt the same solutions given that many of the systems offered are now commodities and some are offered as open-source. But a company that does not stay current can fall behind. The company that implements a new solution first can set itself apart from competitors until they catch up by implementing the same solution or a better one.

Intelligent business that must adapt to ever growing competition is what distinguishes organisations in 2010 from the enterprises of the 1970s (Kagermann, Österle, and Jordan 2011). Competition, globalisation, deregulation, global logistics, and new materials and production procedures. But the key triggers for most new business concepts centre on information technology. New technologies for search and data exploration as well as enterprise social networking can find either answers, or people with answers.

New technologies and management practices have forced pragmatism to be the byword of the entire industry. Business managers are not concerned with IT per se, but they are concerned with new business concepts based on IT. Unless managers understand what a new business concept can bring to customers and their own company, they cannot make sound investment decisions. The answer to the market's challenges is to be found not in IT but in the business model that uses the IT.

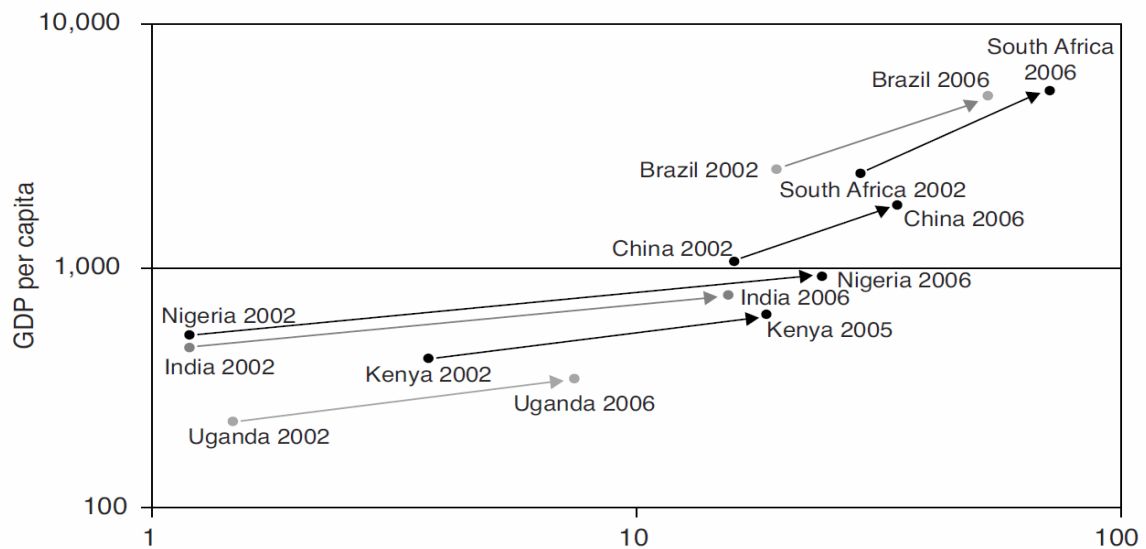
#### **2.3.6.2 Understanding Change**

Changes can take place occasionally and irregularly; they might occur in respect to some activity in a few locations while leaving other locations untouched for long periods. Change may affect a few people in many places or a large number in one place, but rarely everyone everywhere. Many changes are due to the rapid application of new global innovation in the area of telecommunications. In his book about the diffusion of innovations, Rogers (2003, 1) stated that “getting a new idea adopted, even when it has obvious advantages, is often very difficult and could require lengthy periods to understand the change”. There is hence a need to understand the different types of change: structural and cyclical.

### **2.3.6.3 Structural Change**

Structural change is a fundamental transformation of an activity or institution from a previous state. Following structural change, the organisation is in a new state which is considerably different and the changes made are irreversible, requiring permanent adjustment. In some cases that type of change is called disruptive change, since it alters the way people perform the same activity.

In the 6<sup>th</sup> May 1986 edition of The Guardian newspaper, it was predicted that by the year 2000 small pocket-phones ‘will be as common as Walkmans’ and that people will need to develop a whole new social code (Meek 2002) to utilise them in a very changing world. By 2009 there were more than 3.4 billion mobile phones worldwide, making mobile phones more common than personal computers (Jackson 2009). Mobile phones have had significant impact on our lives and the way that we perform everyday tasks, many apparent, while others we are yet to recognise. In the case of the mobile phone a structural change is irreversible; the thing that changes undergoes permanent transformation and attains a new state. There may be stability in the new state, or there may be a continuing evolution to yet another new state. But, there is no going back to the previous state. The price/performance ratio of technology for mobile communications in developing countries (Figure 3), is improving at a rapid pace, and contributing to national economic competitiveness across the globe and it is unlikely to go back to the state in which only developed countries have access to such technologies.



**Figure 3: Mobile Teledensity : Subscriptions Per 100 Head of Population in Some Developing Countries (Kagermann, Österle, and Jordan 2011)**

#### 2.3.6.4 Cyclical Change

Cyclical change is a temporary change of something from a level or state to which it is likely to return later. Over time, cyclical change tends to follow a discernible fluctuating pattern by returning regularly to a prior state. During recession, factories shed their inventories and tend to become more conservative with their investments, while in boom time they will be increasing their production or adding more staff to their payroll. Cyclical changes usually do not cause any irreversible alterations in the structure of the institution or activities in which they are occurring.

#### 2.3.7 What is a Project

A project can be defined as:

An endeavour in which human, material and financial resources are organised in a novel way, to undertake a unique scope of work, of given specification, within constraints of cost and time, so as to achieve beneficial change defined by quantitative and qualitative objectives (Turner 2009b, 2).

That definition appeared in the first edition of Turner's book, *The Handbook of Project-Based Management*. In the third edition, Turner adopted a less prescriptive definition which focused on the key features of project: "A project is a temporary organization to which resources are assigned to do work to deliver beneficial change" (Turner 2009b, 14).

Other definitions of project include:

- PRINCE2 defined projects as “A management environment that is created for the purpose of delivering one or more business products according to a specified Business Case” (Commerce 2002, 7);
- The British Government’s definition of a project is “A temporary organisation that is needed to produce a unique and predefined outcome or result at a prespecified time using predetermined resources” (Commerce 2005, 3);
- The Project Management Book of Knowledge (PMBok) definition of a project is “A temporary endeavour undertaken to create a unique product, service or result” (Project Management Institute 2008, 5).

For the purpose of this research Turner’s (2009), definition of projects will be adopted. A project is undertaken to deliver beneficial change, and thus has three essential features (Turner and Muller 2003, 1):

1. It is unique: no project before or after will be exactly the same;
2. It is undertaken using novel processes: no project before or after will use exactly the same approach;
3. It is transient: it has a beginning and an end.

These features create three pressures (Turner and Muller 2003, 1):

1. Projects are subject to uncertainty: we cannot be certain that our plans will deliver the required project outcomes or desired beneficial change;
2. They create a need for integration of the resources to do the project, between different parts of the project, and of the project into the business;
3. They are undertaken subject to the urgency of delivering the desired outcomes within the desired timescales.

The work of the project has three features: it is unique, novel, and transient (Table 3). The project has a transient existence and is disbanded when the work to deliver the new asset is finished. Thus we expect the work to be transient.

**Table 3: Features of a Project (Turner 2009b, 25)**

Aim	Features	Pressures	Processes
To deliver	Unique	Uncertainty	Flexible

Beneficial	Novel	Integration	Goal Oriented
Change	Transient	Transience	Staged

### 2.3.7.1 Projects as a Production Function

A classical definition of the project puts emphasis on the role played by a production function. Hart (1989, 1757-1774) points out that “viewing the firm as a nexus of contracts is helpful in drawing attention to the fact that contractual relations with employees, suppliers, customers, creditors and others are essential aspects of the firm”. He also emphasises that the ‘the firm is not an individual’ and the firm behaviour draws similarities to the market. Earliest definitions of the project, referred to it as ‘an endeavour’ a reference that is very close to how organisations are defined: a “social arrangement which pursues collective goals, controls its own performance, and has a boundary separating it from its environment” (Gruppe 2010, 3). Whilst projects may be a temporary endeavour in pursuit of specific goals or objectives, organisations tend to have longer life.

Turner and Muller (2003, 2) referred to the project as a “collection of plans, presided over by a manager, who buys and sells the project’s inputs and outputs on the open market, and tries to maximise the benefit to the owner”. That view of the project taking the net value, and discounting the risks associated with the undertaking, is popular because (Turner and Muller 2003, 3):

- It lends itself to easy mathematical formulation (critical path analysis, earned value analysis, etc.);
- It is useful for examining how the project plan responds to risks; and
- It is useful for analysing the interaction between the project and other projects and routine operations.

However, this perspective of the project definition suffers from some weaknesses, as it does not explain :

- The social aspect of the project and how relationships can impact the project;
- Efficiency in running one project or multiple projects.

### 2.3.7.2 Project as a Temporary Organisation



Cleland and Kerzner (1985, 199) define a project as “A combination of human and non-human resources pulled together into a temporary organization to achieve a specified purpose”. The definition put emphasis on the unique character of the project:

- as a temporary organisation;
- as a production function; and
- an agency for assigning resources.

The definition implies that the endeavour created is unique, novel and transient. As a temporary organisation, the project also can be presented as an organisation established by the parent organisation to complete set of predefined objectives. Thus, a project has “much in common with an agency in a political bureaucracy” (Moe 1995, 116).

Projects will have supporters in the parent organisation who will try to create structures and supports to ensure success, while its opponents will attempt to undermine it by introducing all sorts of obstacles to derail it. The parent organisation will need to appoint an agent to act on their behalf, as well as creating the structures, information channels, monitoring processes and guidance for the agent to ensure the project remains aligned to the parent organisation objectives.

Viewing the project as a temporary organisation introduces many of the elements of project management, including (Turner and Muller 2003, 3):

- The conflict of interest between the various stakeholders;
- The role of the manager (agent), and of the broker and steward.

There is a need to establish governance to monitor project delivery, to ensure it will deliver upon its promise. However, it still does not tell us whether it is efficient, whether two projects should be managed as one, or how many projects can be run simultaneously within the organisation.

### **2.3.7.3 Project as an Agency for Change**

The definition of a project by Andersen et al. (2004) emphasise that projects deliver change. Organisations adopt projects as a tool for change within their organisations; they may be used to make it efficient, and more competitive. They create the temporary organisation to deliver a coherent set of change objectives, because projects are better

suited for managing change than the functional organisation. Turner and Muller (2003, 4) suggested that there are several reasons for this:

- Organisations have a high dislike to change; projects provide them with a mechanism to overcome that inertia, by having a temporary structure within the organisation that can build momentum and be used as example for change.
- Projects, being temporary small organisations within the parent organisations, are more flexible and better suited to respond to the ever-changing environment surrounding them.
- The functional organisation is designed for the management of the routine, and so is not suited for managing change

This view of the project as an agency for change used to define the boundaries of a project. It is defined by a coherent set of change objectives (Thiry 2009, 49).

#### **2.3.7.4 The Project as an Agency for Risk Management**

Most project definitions do not mention risk when referring to the project. Risk is a feature of projects; uncertainty is a by-product of the nature of the project as a risky undertaking because it is a unique. It is a onetime task that does not allow for all the details to be known prior to commencing the undertaking.

Analysis can be done before starting a project, but it rarely reveals all the necessary steps required to proceed and achieve the desired results. It is also important to emphasise that even an experienced agent will not be familiar with the new undertaking, even if they have performed similar projects in the past, as a result of the unique nature of each project, and because the project is performed within a different organisation, with different people and in a different environment.

The activities may consequently be totally different, even if they are aiming to achieve similar results. The combination of risk and uncertainty creates varied levels of risk to the project, and may result in different outcomes.

#### **2.3.7.5 The Project as an Agency for Resource Utilisation**

Projects play an important role in utilising existing or new resources in order to complete the endeavour or assigned tasks. Turner and Muller (2003) says the project is a focus for

assigning resources from across the firm. Carroll (1995) emphasises that organisational success is dependent on the organisation's ability to attract resources and ensure they suit the assigned tasks in order to deliver to the organisation the desired outcomes. Projects, being temporary organisations, need to acquire their resources and negotiate for new resources when required during the project.

However, given the project is an agency for change risk management within organisations, projects are also perceived as an effective way of assigning resources to change the organisation.

Carroll (1995) also says that the only measure of an organisation's efficiency is its longevity. That will not be valid when referring to projects, as they are temporary structures within organisations. Another issue faced by organisations, is attracting resources to be part of a temporary project.

The role of the project as an agency for resource allocation implies something about the structure of the project which can be in conflict with the parent organisation, such as when one resource is responsible for several unrelated sets of changes under the direction of the project and the parent organisation, that could lead to ineffective and inefficient utilisation of resources. In December 2003, the Project Management Institute published the Organisational Project Management Maturity Model (OPM3) which attempted to provide guidelines for the optimization of processes at the interface between permanent and temporary organisations (Schlichter 2001).

Turner and Muller (2003, 4) highlighted that research on organisational support showed the extension of project requirements beyond the project team and into the functional organisation is lacking, and mechanisms for sharing and resolving resource issues are seldom in place.

#### **2.3.7.6 Project Management Methodologies**

A "methodology is an explicit way of structuring one's thinking and actions. Methodologies contain model(s) and reflect particular perspectives of 'reality' based on a set of philosophical paradigms. A methodology should tell us what steps to take, in what order and how to perform those steps but, most importantly, the reasons 'why' those steps should be taken, in that particular order" (Jayaratna 1994, 242). Richman (2002, 203) defined project management methodology as "a set of principles, methods, and

techniques that people use to effectively plan and control project work. It establishes a sound basis for effective planning, scheduling, resourcing, decision-making, controlling, and replanning” Projects as collective effort are focused on creating deliverables (tangible items that shows progress of the project). Deliverables demonstrate to stakeholders the work efforts of the project team. Central to that idea of creating deliverables is defining the work that needs to be completed to produce the deliverables. Project management tools like PERT and CPM, Work Breakdown Structure (WBS) and Earned Value become synonymous with projects (Stretton 2007), assisting project managers to schedule defined tasks, and resources to meet schedule.

Project management principles and techniques help complete projects on time and within budget, achieving all predefined outcomes. At the same time, they could be used to improve the organisation productivity, effectiveness and quality. Project management methods main objectives is to optimise project time, cost, quality and scope.

Kerzner (2010, 7) identified six driving forces that lead executives to recognise the need for project management:

- Capital projects;
- Customer expectations;
- Competitiveness;
- Executive understanding;
- New project development;
- Efficiency and effectiveness.

Advocates of project management methodologies point to the high rate of IT project failure which stood in 2009 at 24% of all projects reported in the Standish Group CHAOS summary report (Standish 2009). Pointing out that without a standardised methodology for managing projects, stakeholders will have different views about how things should be organised and managed during the project lifecycle. Moreover, staff involved in the project will not be clear about roles and responsibilities, or reporting hierarchy, there will be confusion around the project. The PRINCE2 manual stated that: “Without a project management method, projects are rarely completed on time and within acceptable cost – and this especially true of larger projects” (Commerce 2005, 2).

To achieve the desired results of successful projects, project management methodologies will need to have a set of principles to facilitate achieving the desired results (Commerce 2005, 2):

- A project is a finite process with a definite start and end;
- Projects always need to be managed in order to be successful;
- For genuine commitment to the project, all parties must be clear about why the project is needed, what it is intended to achieve, how the outcome is to be achieved and what their responsibilities are in that achievement.

The PRINCE2 manual states that the methodology is designed to be used on any type of project in any environment, as it contains a complete set of concepts, processes and tools that are required to properly run and manage projects. Comparing that to the actual requirements in the marketplace reveals a different story. Monitoring the most popular employment website in Australia by the number of users ([www.seek.com.au](http://www.seek.com.au)) and selecting Information Technology job and the specific subcategory of Project and Program management between 18<sup>th</sup> and 22<sup>nd</sup> of October 2010 paints a different picture of the marketplace, in which specific domain knowledge is required. For example the finance sector distinguishes between general banking systems, wealth management systems, compliance and auditing, and insurance. Moreover even within the same sector different skills/knowledge is required; work in wealth management systems, requires specific knowledge in the area of private banking, credit cards, superannuation and so on. It is worth noting that most of the advertised jobs require applicants to be either Project Management Body of Knowledge (PMBOK) or PRINCE2 certified.

The Gershon report published by the Australian government in 2008 (Gershon 2008, 16) reveals that “most Commonwealth of Australia agencies use some form of project management methodology to manage their Information and Communication Technology (ICT) projects. Twenty-two agencies (59%) use the PRINCE2 methodology as the basis of their project management methodology, with a further two agencies planning to introduce PRINCE2 in the near future”. Additionally, five agencies use PMBOK as their project management methodology, while another two agencies planning to adopt PMBOK in the near future.

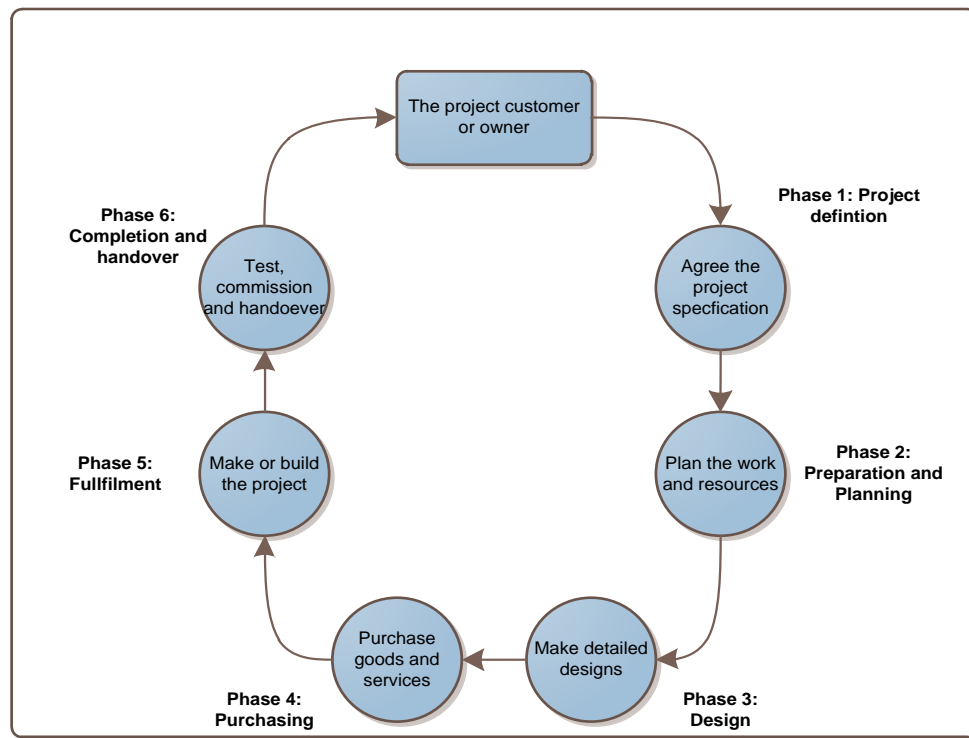
#### **2.3.7.7 Benefits of a Project Management Method**

Organisations private and public are seeing advantages in adopting the project approach in tackling business challenges and delivery platform for changes onto the organisation. They are also “increasingly aware of the benefits that can accrue through a single, common, structured approach to project management, as is provided through PRINCE2” (Bentley 2002, 4).

The PRINCE2 manual lists the following as the benefits of using PRINCE2 in managing projects (Commerce 2005, 2):

1. A method that is repeatable;
2. A method that is teachable;
3. Building on experience;
4. Ensuring that everyone knows what to expect, where, how and when;
5. Early warning of problems;
6. Being proactive, not reactive, but able to accommodate sudden, unexpected events.

Projects may exist in their own right, may have relationships with other projects or may be part of a larger programme of work. Projects have a lifecycle (Figure 4), which is the sequence in which different activities will take place to achieve predefined outcomes. Figure 4 illustrates how project start as an idea, which will take shape and go through lifecycle to produce systems which can be used to end users.



**Figure 4: Project Life Cycle (Lock 2007)**

#### 2.3.7.8 PRINCE2

PRINCE2 is a structured method for effective project management. The Office of Government Commerce in the United Kingdom is responsible for the continual development of the method. PRINCE2 was launched in 1996 in response to user requirements for improved guidance on project management on all projects, not just information systems. PRINCE2 is based on the experiences of scores of projects, project managers and project teams, who have contributed, some from their mistakes or omissions, others from their successes (Commerce 2005).

PRINCE2 is a de facto standard used extensively by the UK government and is widely recognised and used in the private sector, both in the UK and internationally. PRINCE2 is designed to be used on any type of project in any environment (Commerce 2005). The methodology offers a set of processes that provide a controlled start, controlled progress and a controlled close to any project. The processes explain what should happen, when it should be done and by which role and provides the minimum requirement for a properly run and managed project.

Key to PRINCE2 that it firmly distinguishes the management of the development process from the techniques involved in the development process itself (Figure 5). There are two key principles of PRINCE2:

1. A project should be driven by its business case
2. PRINCE2 is product based



**Figure 5: PRINCE2 Processes and Components (Commerce 2005, 11)**

#### 2.3.7.9 Project Management Book of Knowledge (PMBOK)

In 1969, five volunteers founded the Project Management Institute (PMI) to set standards for project management, conduct research in improving the way projects are managed, and to provide the growing number of project managers with the opportunity to exchange knowledge and educate themselves in the disciplines of project management. Since then, PMI has been recognized by the American National Standards Institute (ANSI) as an accredited standards developer. One particular standard is the Guide to the Project Management Book of Knowledge. The standard began in 1987 as an attempt to standardize the information and practices of project management that have been generally accepted by the community of project managers (Conchúir 2010, 9).

The PMBOK Guide segments project management into 44 processes that fall into five basic process groups and nine areas of knowledge. The PMBOK is comprehensive and provides a general guide to managing most projects and is flexible enough to be adapted by specialised projects in construction or government which encourage development of standards specific to those industries. The approach used by PMBOK is compatible with ISO 9000 and the Software Engineering Institute's Capability Maturity Model Integration



(CMMI). The five processes groupings (Initiating Process Group, Planning Process Group, Executing Process Group, Monitoring and Controlling Process Group, Closing Process Group) found within the PMBOK overlap and interact throughout the life of a project (Conchúir 2010).

### **2.3.8 Software Development Methodologies**

Software development of software is viewed as a life cycle; project management carries out software development according to timely linked phases. The classic example of the former approach in information and communication technology is the waterfall model originally developed by Royce (1970). The name comes from how phases linked to one another, which is associated with waterfall. In the waterfall model, there is distinction problem-area-specific and implementation-specific activities, which is conveyed by the explicit separation between the analysis and design phases. To this day, the waterfall model is widely used in software development, and improved. The model now has validation steps and feedback loops between the various phases, to improve the development and quality assurance of the final product.

Evolutionary prototyping, in which the prototype is developed in steps or iterations until the final product is completed. Boehm (1986) achieved the linking of two development methodologies via his spiral model. Here, the analysis, design, implementation, and testing phases are embedded within an iterative framework, making an improved prototype available after each phase.

The Institute of Electrical Electronics Engineers (IEEE) standard glossary of software engineering terms defines process as a “sequence of steps performed for a given purpose” (IEEE Computer Society 1990, 57). The purpose of IT projects is to develop high quality software to satisfy the needs of the end users or clients. A development process or methodology will be used to achieve this purpose.

The development process for a project plays a key role in deciding the outcomes. In theory, following a process, the desired end goal of delivering software can be achieved and failure may be avoided. Projects differ in that they must achieve those desired outcomes within the boundaries of the golden triangle (time, cost and scope) as described in Figure 1. As a consequence, the importance of development methodologies in projects

increases to satisfy the goals of the project to deliver high quality software within time, cost and scope.

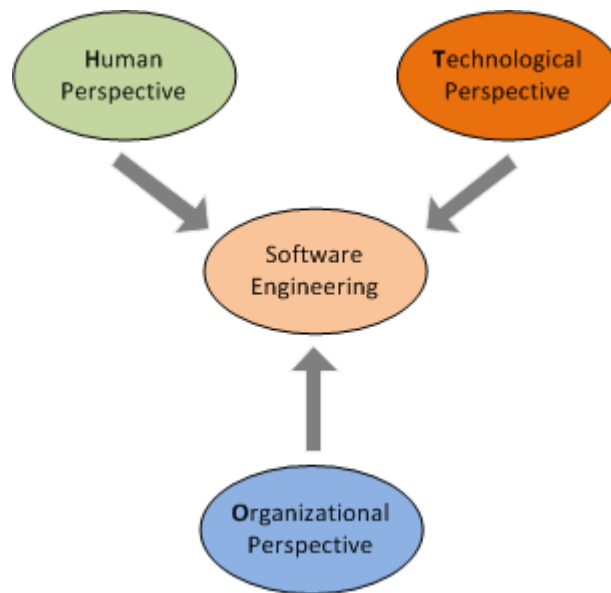
It is fundamental to separate the process definition and specification from the process itself. A process is a “dynamic entity which captures the actions performed, whereas a process specification is a description of a process which presumably can be followed in some project to achieve the goal for which the process is designed” (Jalote 2008, 11).

In projects, a process is often specified at a high level or sequence of stages (e.g. Plan, Design, Develop, and Implement). The sequence of steps for a stage is the process for the stage, and is often referred to as a sub-process of the process.

Software development methodologies have the goal of producing high quality products. Therefore they focus on activities directly related to the production of that software. Software development methodologies define the tasks the project will perform and the order in which they should be performed; in this case, development methodologies could put some restrictions on projects and how the project outcomes can be achieved.

Jalote (2008, 13) defined the main premise underlying why projects should adopt development methodologies, “in the situation for which the model is applicable, using the process model as the project’s process will lead to low cost, high quality, reduced cycle time’, which will contribute to the success of the project”.

Due to the critical nature of the software development process, various methodologies have been proposed and adopted in IT projects. Software engineering comprises mathematics, computer science and specific domain knowledge (e.g. finance, accounting, transportation). A software development method should not only address the technological aspect, but also the work environment and the professional framework where the methodology will be adopted. Hazzan and Dubinsky (2008, 4) identified human, organisational and technological perspectives (Figure 6) that would need to be considered when engineering the software.



**Figure 6: The HOT Analysis Framework for Software Engineering (Hazzan and Dubinsky 2008, 4)**

The **Human** perspective includes cognitive and social aspects, and refers to learning and interpersonal processes.

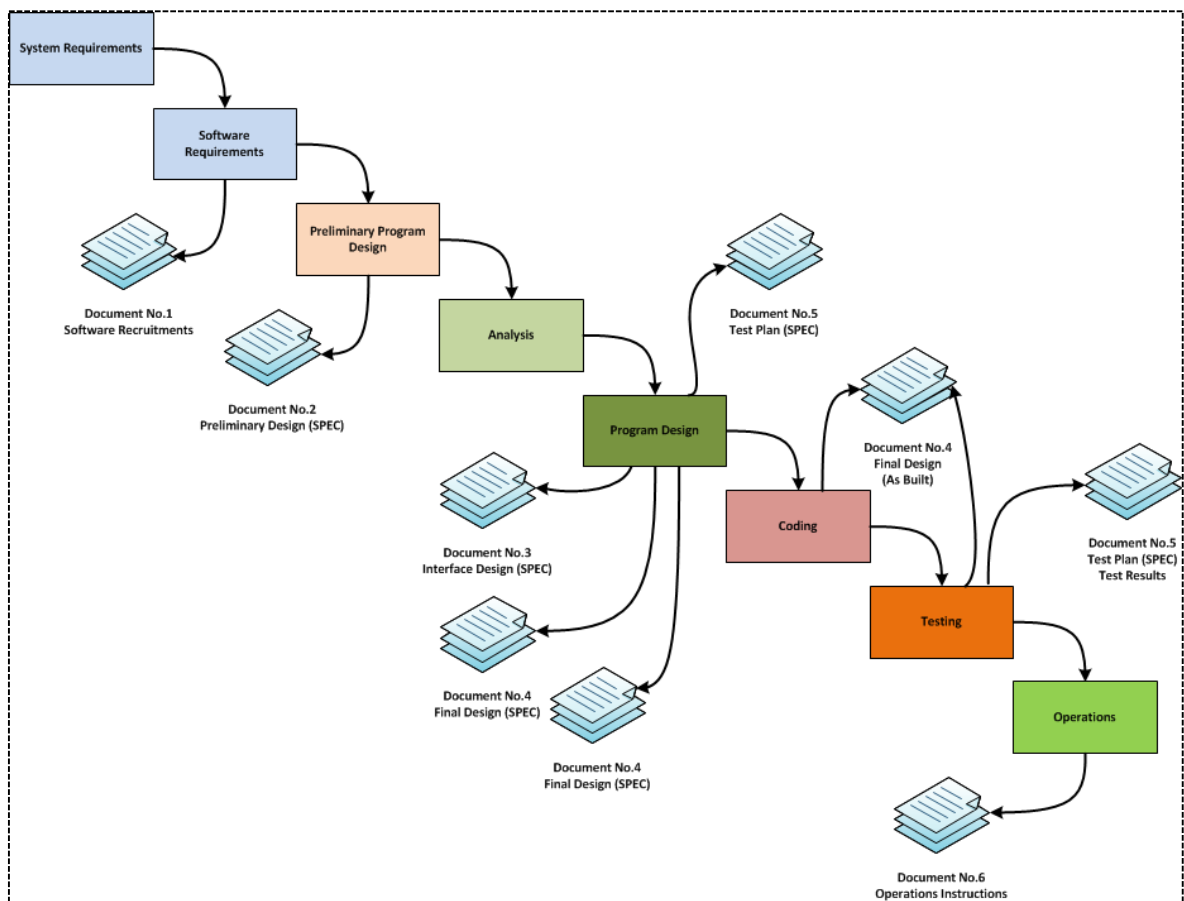
The **Organisational** perspective includes managerial and cultural aspects, and refers to the workspace and issues that extend beyond the team;

The **Technological** perspective includes practical and technical aspects, and refers to the how-to and code-related issues.

The following section will discuss some of the major development methodologies and highlight their strength and weakness and their importance to achieving project goals.

#### **2.3.8.1 Waterfall Model**

Royce (1970) laid the ground for the waterfall model to take hold in the software engineering industry and his paper was cited by numerous researchers as if validating the Waterfall model. In the 1980's the United States Department of Defence officially adopted the Waterfall model as their preferred development methodology and published DOD-STD-2167. The Waterfall model (Figure 7) is simple and the model and states that the phases of development are organised in a linear order.



**Figure 7: The Waterfall Model Proposed by Royce (1970, 333)**

The basic idea behind the phases is the separation of issues, with each phase dealing with a distinct and separate set of issues. Adopting the Waterfall model allowed an organisation to deal with large complex projects by breaking them into small tasks which in theory improved the capability of engineers and managers to deal with such complexity.

Sequential ordering of activities in the waterfall model has advantages. It is used to identify the end of one phase and the beginning of the next; some control mechanism has to be employed at the end of each phase. This is usually done by employing verification and validation (testing) to ensure that the output of a phase is consistent with the input and it is consistent with the overall project requirements. The benefit of having controls at every phase, is being able to show the tangible outcomes completed at the end of phase. It can also document the requirements phase or working software module as output of the coding phase.

The Waterfall model puts emphasis on having a reasonable set of documents that is required to be produced in each project:

1. Requirement document;
2. Project plan;
3. Design documents (architecture, business requirements, functional requirements);
4. Test Strategy, test plan and test report;
5. Software manuals (e.g. user, installation).

The main advantage of deploying the Waterfall model is its simplicity. Conceptually it is straightforward and divides the large task of building a software system into a series of clearly defined phases, each phase having a certain set of outputs that must be verified against the overall requirements. Waterfall is easier to manage contractually, as each phase is completed and its work product delivered, and a contracted payment is made by the customer to the development organisation.

However, the Waterfall model is not without limitations.

1. It assumes that the requirements of a system can be frozen before the design begins. This can be difficult in many instances where the concept of the application will mature and either gain or lose features over a period of time. Hence, having unchanging requirements is unrealistic for IT projects.
2. Large projects might take a few years to complete; freezing the requirements requires choosing the hardware. When that happens early in the process, the software and hardware of the project can be rendered as out-dated and inappropriate by the conclusion of the project.
3. It follows the 'big bang' approach in which the entire software is delivered at one stage. That comes with big risks, as the user will not know what they are getting until the very end. Furthermore, any budget run-out can cause the project to be stopped with nothing to show the end user.
4. It encourages recruitment hangover, since all requirements must be specified at the start and nothing else can be added later. Software stakeholders attempt to add features which may not be actually needed to protect their interests.

5. The methodology is heavy on the documentation side and requires formal documents to be produced at the end of each phase before moving to the following phase.

The Waterfall model has been widely used as a software development methodology, since it is well suited for projects where the requirements and project objectives are well understood in advance. The Waterfall model will work and could be the most efficient development methodology.

#### **2.3.8.2 Iterative Development**

The iterative development methodology arose as a counter to some of the limitations of the Waterfall model. Earlier development of iterative models focused on a risk management variant of the Waterfall model (Boehm 1986). The spiral model proposed by Boehm presented a risk-driven approach to the risk management process rather than specification driven or prototype driven approaches, and it did attempt to incorporate many of the waterfall and prototyping models.

Boehm (1986, 23) in his introduction to the spiral model listed some of the challenges faced by waterfall projects and why alternative model development was needed.

1. The waterfall model does not adequately address concerns of developing program families and organising software to accommodate change.
2. The waterfall model assumes a relatively uniform progression of elaboration steps.
3. The waterfall model does not accommodate the sort of evolutionary development made possible by rapid prototyping capabilities and fourth generation languages.
4. The waterfall model does not address the possible future modes of software development associated with automatic programming capabilities, program transformation capabilities, and knowledge based software assistant capabilities.

The spiral model illustrated in (Figure 8) has four main phases (Planning, Evaluation, Risk Analysis and Engineering). The phases iteratively follow each other providing feedback loop which was missing in the Waterfall model.

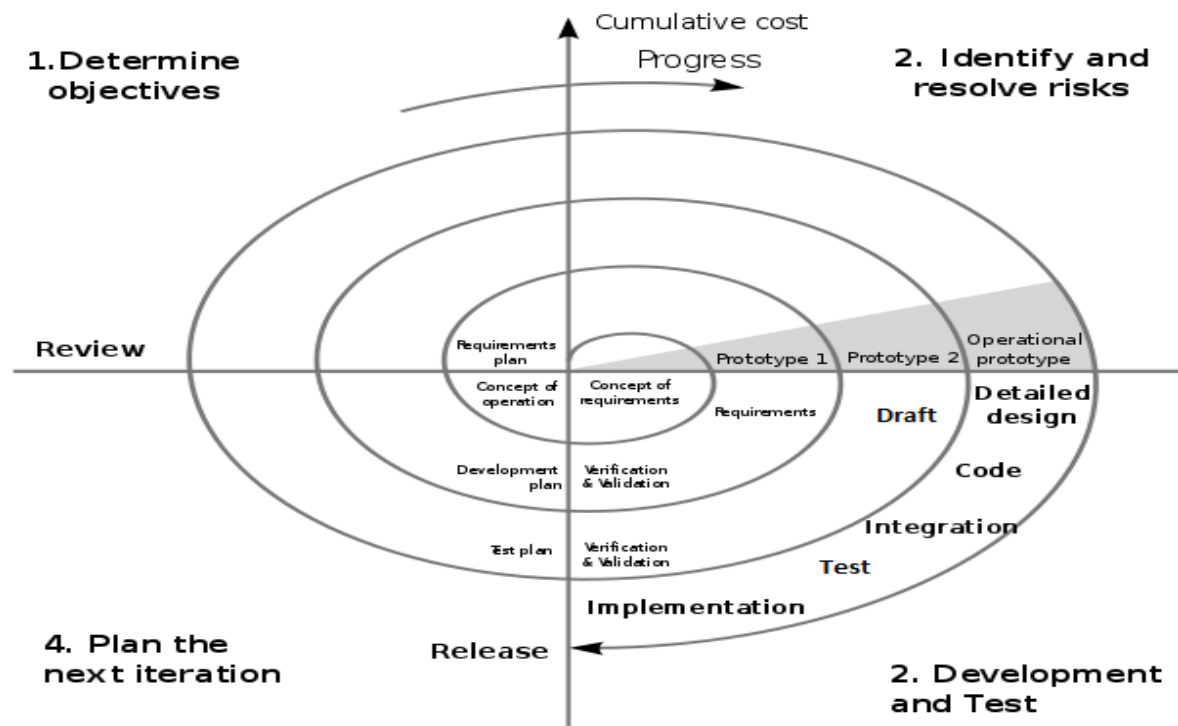


Figure 8: The Spiral Model (Boehm 1986, 25)

The basic concept behind the iterative model is that software should be developed in increments (phases), each will build on the previous until having complete system.

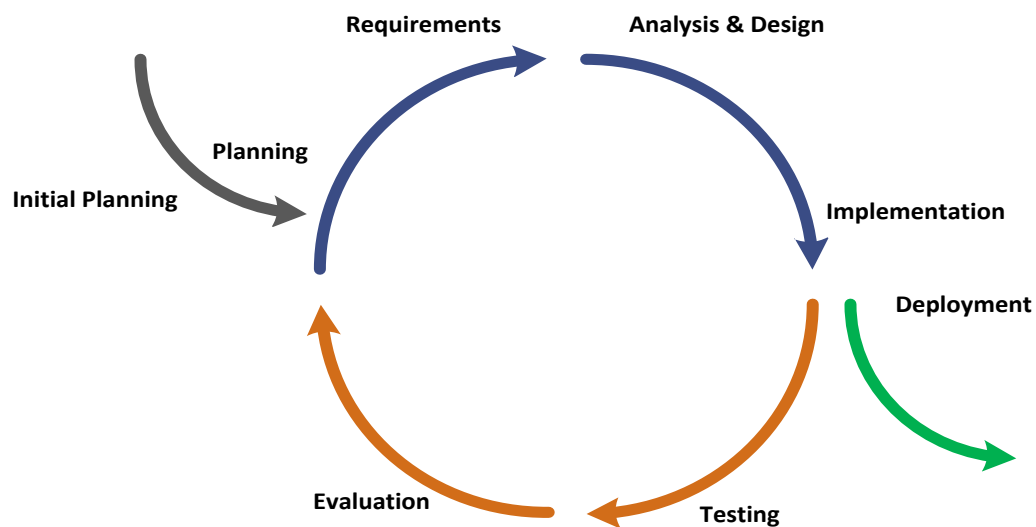


Figure 9: The Iterative Model (Jalote 2008)

Figure 9 is an example of the model. In the first step of this model, a simple initial implementation is completed for a subset of the overall requirements (framework), which will be the foundation of the software and form the basis on which the remaining functions will be developed. A priority list will be developed and all system functions will be recorded there, and each increment will address a subset of this list until none are left.

The iterative model assumes that the design of the system will generally occur in the initial increments, and in later increments the design would have stabilised and there is less chance of redesign being required.

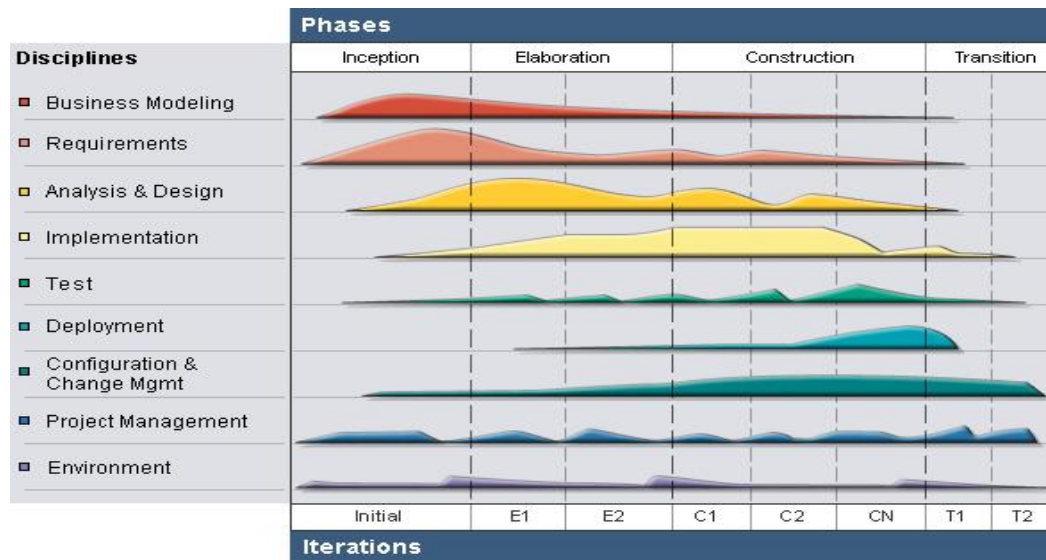
There are clear benefits of the iterative development methodology, specifically in allowing requirements to be changed and the ability to show progress to project stakeholders. There are some increased costs associated with adopting the iterative development. For example, when changes are required toward the end of the project that would require significant redesign or major overhaul of early functions, risks would be added to the overall project.

Another approach for using the iterative development methodology is to have complete requirements and architecture design as per the waterfall model and develop the software iteratively. That approach implies having an iteration to deliver the requirements and architecture plans, and further iteration to deliver the software in increments. Each iteration will end up with a concrete sets of deliverables that can be the base for the next iteration providing clear value to the end user. More importantly highly complex areas of the software could be developed earlier and allow for end user input as well.

One of the main advantages of the iterative models is that system user's can early access to the system during its development, and provide feedback that would aid the development team to address any shortcomings. The value to the software customer is that software is delivered iteratively so it does not have the all-or-nothing risk of the waterfall model. It is also worth noting that the process allows feedback from previous iterations to be incorporated in the following iterations.

In recent years, the iterative approach has been popularised with the release of IBM Rational Unified Process (RUP), using the Unified Modelling Language (UML). RUP uses the term cycles instead of iteration and emphasises that each cycle is treated as separate project that will be divided into cycles and each cycle will be broken into four phases (Inception, Elaboration, Construction and Transition) as illustrated in Figure 10:





**Figure 10: The Rational Unified Process (Kruchten 2000, 40)**

Each phase has a well-defined milestone in the project with clearly defined outputs. Phases may have one or many iterations to be able to deliver expected outcomes. Some phases will have more iterations than others, and the construction phase is expected to be the longest and would have more iterations than other phases.

The approach fits well with the current business climate in which users want to see a return on their investment delivered as early as possible and not committing significant budget for software to be delivered in few years' time. The feedback and ability to change requirements to adopt to increasing competition in the marketplace allows the business to have the basic requirements and then add to them to adjust to the change, instead of freezing the requirements for the entire project.

The iterative approach adopts elements of systems theory by allowing feedback to improve the input required for the following iteration and thus improving the outputs.

### 2.3.8.3 Agile

Agile development methodologies evolved in the 1990s as an attempt to reduce documentation and streamline line processes that were established by popular methodologies such as waterfall or iterative methodologies. Agile methodologies have some common principles that can be applied to all 'Agile' style methodologies and listed in the Agile Manifesto (Fowler and Highsmith 2001, 2-4):

- Working software is the key measure of progress in a project;

- For progress in a project, therefore, software should be developed and delivered rapidly in small increments;
- Even late changes in the requirements should be entertained (small-increment model of development helps in accommodating them);
- Face-to-face communication is preferred over documentation;
- Continuous feedback and involvement of the customer is necessary for the development of good quality software;
- Simple design which evolves and improves with time is a better approach than doing an elaborate design up-front for handling all possible scenarios;
- The delivery dates are decided by an empowered team or talented individuals and are not dictated.

Agile methodologies are predicated on the basis that changes are inevitable and rather than treating changes as undesirable, software development should embrace and encourage change to produce applications that satisfy the needs of the stakeholders. That can be achieved by lightweight development methodologies that are able to respond quickly to change.

Extreme Programming (XP), Dynamic Systems Development Method (DSDM), Feature Driven Development (FDD) and Scrum agile methodologies have roots which predate the Agile Manifesto. The Manifesto came to life when a group of 17 of the leading proponents of lightweight development methodologies met in 2001 to find common ground that would unite all those lightweight methodologies, and the Agile Manifesto was born. Fowler and Highsmith (2001, 2) brilliantly state the core values that form the bedrock for all Agile methodologies:

“We are uncovering ways of developing software by doing it and helping others do it. Through this work we have come to value:

- Individuals and interactions over processes and tools;
- Working software over comprehensive documentation;
- Customer collaboration over contract negotiation;
- Responding to change-over following a plan.”

The Manifesto highlighted the importance of the plans, but also emphasised that they should not be rigid, unchanging plans, with a focus on the ability to respond to changes being more critical to the success of most software development projects.

Agile methodologies put emphasis on prioritising recruitments according to the MoSCoW rules (A Guide to the Business Analysis Body of Knowledge Version 2.0 2009, 102):

- **M** – Must-have requirements;
- **S** – Should have if at all possible;
- **C** – Could have, but not critical;
- **W** – Won't have this time, but potential later.

Agile methodologies borrowed heavily from the lean principles that have been applied in manufacturing for the last 60 years and made popular by the Toyota Production System and Just-in-Time manufacturing.

Lean is a mindset, a way of thinking about how to deliver value to the customer more quickly by finding and eliminating waste. Shigeo Shingo, who co-developed the Toyota Production System with Taiichi Ohno, identified seven kinds of waste (Liker and Meier 2006, 35,36):

- **Defects:** this is perhaps the most obvious type of waste. Lean focus on preventing defects instead of the traditional 'find and fix' mentality;
- **Overproduction:** producing more than is needed, or producing it before it is needed. It is often visible as the storage of materials;
- **Transportation:** the unnecessary movement of parts between processes. When you move material and parts between factories, work cells, desks or machines, no value is created;
- **Waiting:** people or parts waiting for the next production step;
- **Inventory:** all material, work-in-progress, and finished products that are not being processed. Inventory beyond the bare minimum consumes productive floor space and delays the identification of the problem;
- **Motion:** people or equipment moving or walking more than needed to perform the processing;

- **Processing:** over-processing beyond the standard required by the customer. This adds additional cost without adding additional value.

Many of the concepts described by Taiichi Ohno can be traced to elements in Agile methods. Concepts like Timeboxing introduced by the Agile movement with the aim to limit the time during which a task is accomplished could be related to lean concepts described above. Opponents of Agile point out that lightweight methodologies are inferior to traditional methodologies such as waterfall or iterative. However, Morgan (2008) indicated that in analysis he performed on the adoption of Agile in one organisation, he came to the conclusion that agile suffers from some weakness, most notably lower productivity and no significant improvement in the structural quality of the code when compared to software applications developed using traditional methods (e.g. Waterfall).

Others like Stanbridge, Ryan-Brown, and McBride (2009) pointed out that moving to Agile doesn't automatically lead to improvements in quality. The typical problem of communication is identified as an issue that affects projects implemented using Agile (Read and Properjohn 2008). Royce (2009) pointed that adopting Agile requires the same level of discipline as any other methodology.

Adoption of Agile varies from one organisation to another. An electricity utility company went with developing one of their applications and announced that they were using agile methodology as part of transformation program. The development team developed the code and did not produce any of the basic documentation required by Agile methodologies such as user stories and instead requested that the quality assurance team document the application while testing the application. The management agreed with that approach as it presented a significant reduction in the cost of producing the application. However, the consequence of that decision was only felt once the users started to perform testing on the application and found that many of the features agreed were never communicated to the development team, and no defects were raised by the testing team since they wrote the specification while testing the application.

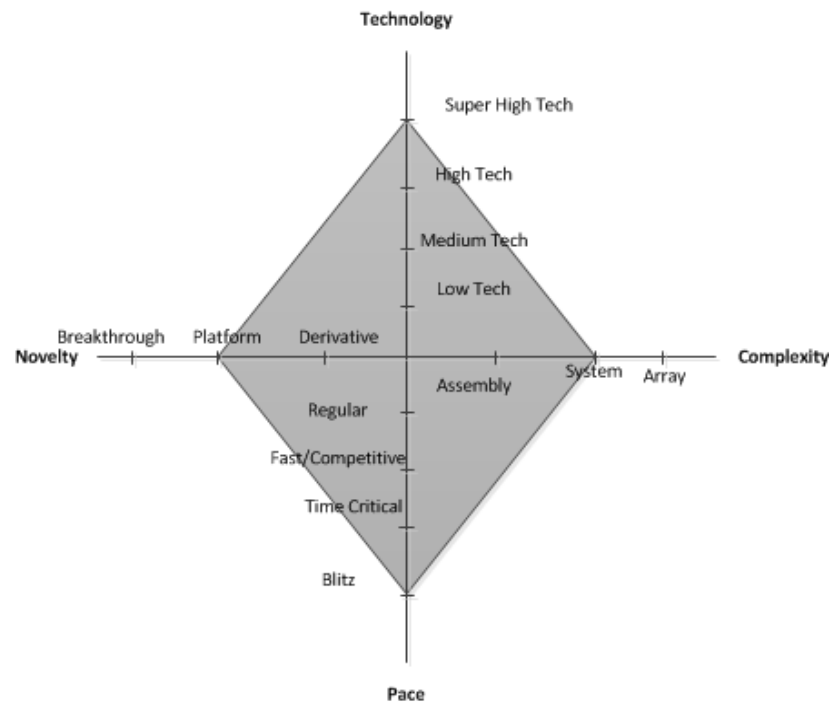
### **2.3.9 Implications for Management**

It is often-overstated that in the pursuit of ever newer and better management concepts to address existing challenges, organisations companies are confronted with number of

recommendations which could be conflicting. Methodologies such as iterative, agile, and six sigma, total quality management, and/or reengineering were often regarded as a cure-all for organisations project's problems. Leader or top managers who do not embrace such concepts could end up needing to justify their decision and had to address resistance within their organisations. Within these developments, which are often strongly influenced by various trends depending on the type of the challenge, it is becoming increasingly difficult to distinguish truly influential ideas from quick fixes.

For a very long time, change has mainly been applied to the functional hierarchy, which has been the dominant organisation model. In order to achieve change, the change agent has to identify core processes that cover the entire enterprise, but also external partners and customers. The process or methodology is not the focal point, but how the end product is produced with the support of partners, suppliers and, possibly, customers. However, even when firms have organisations that may be perceived to have the correct processes or methodologies, the process is a subset of (say) a system. Thus, the 'system' is required to design the 'process'. Information and communication technology plays a critical role in this process.

Selecting the right methodology for the projects undertaken by organisations can be a daunting task. Some organisations would have the methodology adopted organisation wide, while others may allow their internal departments to use elements of the methodology that would suit them (Shenhar and Dvir 2007), such as diamond topology which is based on four dimensions, Novelty, Technology, Complexity and Pace (NTCP) (see Figure 11). This topology assesses the product, the task, and the environment and suggests what may be the optimal project management style that would fit the project type.



**Figure 11: NTCP Framework (Sauser, Reilly and Shankar 2009)**

Projects becoming more complex and their objectives in many cases start with the big statements, like building the fastest e-commerce platform. Such ambiguous objectives, which are difficult to measure, tend to increase the uncertainty of whether a project will meet its stated goals.

Pich, Loch, and Meyer (2002, 1020) developed a time-dependent model for determining strategies based on coping with uncertainty in terms of information adequacy. They highlighted that in complex projects, tasks are interdependent and are coordinated in parallel; therefore, engineers cannot afford to wait for complete information, and they will often continue with such effort during the project lifecycle using preliminary and ambiguous information. Such a conclusion contradicts the traditional project management methodologies, which assumes the projects will have adequate information available to all levels of the project.

Hanif and Limbachiya (2010) suggested a six step framework based on the Deming cycle, where the basic element of the framework is an understanding of the project key drivers that are influencing the project or will influence the project in the future. Using the framework to select right project management methodology could assist in addressing project issues earlier in the process.

### **2.3.10      The Role of Project Manager**

While projects are as old as civilisation it was not until the early 1950s that the language of modern project management was invented. The term 'project management' was coined, and then the modern discipline was begun by the US military in 1953 (Morris 2009). The rise in the late 19th century of new industries such as power generation, telecommunication, rail and oil brought management scientists like Gantt and Ademiaki developing scheduling techniques around 1917 and 1931 respectively (Morris 2009). The cold war in the 1950s prompted the US Air Force, Navy and Army to look seriously at how to accelerate the development of their defence programs. It was 1954 when General Bernard Schriever promoted the parallel planning of all systems elements for the Atlas InterContinental Ballistic Missile (Neufeld 2005), and as a result of that program systems testing, tracking and configuration management techniques were developed to cater for the new paradigm.

Tools like PERT and CPM, Work Breakdown Structure (WBS) and Earned Value became synonymous with Projects (Stretton 2007, 10). In 1959 the Harvard Business Review published an article by Gaddis (1959) on the new role "the project manager", which was later made famous with NASA landing men on the moon; since then, the role of project manager has become associated with projects in all disciplines (Morris 1994).

Project managers have a unique responsibility inside the organisation. They are responsible for changing or reforming the business, in whatever way mandated by the upper management. The size of the company plays a significant role in the number of management layers that separate the visionaries of change at the executive level and how that is communicated to project managers who are responsible for carrying out that change.

Project managers work mostly within middle management to obtain the resources necessary to execute the project, and typically they are responsible for building teams to successfully implement the vision of change. The knowledge, skills, and passion of the project team are ultimately just as important as the project manager and applying the discipline of project management. Because of this, it is very important to carefully consider the makeup of the project team and ensure that the right people are assigned to the project. In addition to the core project team, there are typically other individuals who

will provide their knowledge and skills as resources to the project as part of the operational side of the organisation.

### 2.3.10.1 The Role of Project Manager

While project management is critical to the success of information technology project, littler research has investigated the skills required for an IT project managers. While there are existing project management methodologies that create training and certification programs, these offerings address generic project management skills. For example, project managers are responsible for managing the budget of their projects, which does require significant accounting knowledge, which is not addressed by any of the project management methodologies. Napier, Keil, and Tan (2009, 256) found that “IT projects have higher levels of uncertainty than projects from construction, utilities, pharmaceutical, or manufacturing industries”. Napier, Keil and Tan (2009) researched the specific skills needed for IT project managers and the results of their research are summarised in Table 4.

**Table 4: Project Manager Skills (Napier, Keil, and Tan 2009, 266)**

Skill	Definition
<b>Planning and control</b>	skill which involves planning, monitoring and controlling project tasks to ensure that the project is completed on time and within the budget.
<b>General management skill</b>	encompasses business and interpersonal skills required to appropriately manage themselves and others.
<b>Leadership skills</b>	relate to the ability to form and communicate a message about the future direction of the project in a way that garners enthusiasm and commitment from others.
<b>Communication skills</b>	relate to the ability of the project manager to effectively speak, write and listen to secure resources, enhance coordination, and ensure that work is completed.
<b>Team development skills</b>	required to create a productive team environment for those working on the project while demonstrating concern for their personal and professional growth.



<b>Client management abilities</b>	to successfully relate to clients during all phases of the project.
<b>System development skills</b>	that require the project manager to understand and manage the technical aspects of developing complex, technical systems while controlling for quality.
<b>Problem solving</b>	is a necessary skill for project managers to address problems efficiently and effectively.
<b>Personal integrity</b>	in which the project manager acts in a manner consistent with high ethical standards as opposed to self-interest.

Projects are characterised by change and naturally they promote change within their environment. Vartiainen et al. (2011) studied the impact of managerial turnover on software project performance. The results indicated that managerial turnover may lead to an apparent shift in the cost/schedule trade-off choices, which has effects on staff allocations and the project performance in terms of cost and schedule.

Parker and Skitmore (2005, 14) studied project management turnover and found that its causes were related to “career and personal development and dissatisfaction with the organisational culture and the project management role. Their study reveals most of the turnover occurs during the execution phase, and tends to have a negative impact on the performance of the project team”.

Sauer and Reich (2009, 185) identified nine quality principles that distinguish project managers and referred to it as the new mindset. The principles are:

1. Focus on ultimate value.
2. Deep personal identification with project goals.
3. Investment in trust.
4. Devolved, collective responsibility.
5. Willingness to continually adapt.
6. People development.
7. Learning orientation.
8. Creativity and innovation.

9. Proactive view.

### **2.3.11 Emotional Intelligence**

Most employers today are expected to demonstrate and excel in many 'softer' skills such as teamwork and group development (Rothwell 2010). Companies are now more keen to tap into those soft skills obtained during study and periods of work experience, rather than just degree-specific knowledge (Raybould and Sheedy 2006).

Managing projects requires the ability to balance between competing demands made by various project stakeholders: the project manager's ability to simplify complex technical concepts, interpersonal skills, and more importantly ability to understand situations and people and then to dynamically utilise the appropriate leadership behaviours (Pant and Baroudi 2008).

El-Sabaa (2001) added that the human skills of project managers have the greatest influence on project management practices, and technical skills the least. From here (Turner 2009a, 3) presented a definition for projects that takes into account the human factor:

"Project is an endeavour in which human, financial and material resources are organised in a novel way to undertake a unique scope of work, of given specification, within constraints of cost and time, as to achieve beneficial change defined by quantitative and qualitative objectives".

The Project Management Book of Knowledge (PMBOK) is more concerned with the hard skills required in project management, skills such as Project Human Resources Management and Project Communication Management are seen as secondary to technical skills Pant and Baroudi (2008). Such deficiency in project management methodologies does not appear to be limited to the PMBOK, but includes PRINCE2 and similar methodologies.

Project managers may choose to ignore soft skills while managing their projects. Halstead (1999) highlights that whilst a project manager must focus on the task, real success comes from knowing how to get things done through others. Whilst some may see managing the human issues within a project, as a soft option, it is neither soft, nor an option, if a project manager wants the project to succeed.

Huy's (1999) paper titled 'Emotional Capability, Emotional Intelligence, and Radical Change' presented a model which is grounded in a social interactional perspective, where it assumes that human beings can effect radical change in organisations. The model addresses emotional issues that are engendered by change at the organisational level and not the one produced by group conflicts.

Emotional Intelligence has been defined as "the ability to perceive and express emotion, assimilate emotion in thought, understand and reason with emotion, and regulate emotion in the self and others" (Mayer, Salovey, and Caruso 2000, 396).

Emotional intelligence can also be used to facilitate change and social adaption at the individual level, and how attributes such as 'emotional capability' can facilitate radical change at the organisational level (Goleman 1995).

### **2.3.12 Motivations for Projects**

Projects are always focused on delivering specific products or services that meet specified objectives or outcomes. It may be building a bridge, skyscraper, sending men to the moon or writing or modifying existing software applications. The motivation for a new project can vary, but it is more likely to fall into one the following categories (Graham 1989, 134):

1. Financial: In the form of additional profit or reducing cost or making the organisation more efficient.
2. Strategic: By providing a platform that would move the organisation toward achieving its strategic aims, in the form of building new products into new markets.
3. Legislative: By fulfilling some mandated requirements prescribed by government bodies, such as Anti-Money Laundering in the wake of 11<sup>th</sup> of September events required all financial institutions to install systems known as Know Your Customer.
4. Political: By fulfilling promises made by politicians during election campaigns.

For the first three categories a Business Case will be required and can be reviewed during the project progress against any revised expectations for achieving the defined benefits. In

some projects, there are opportunities to discover new benefits that may even enhance the final outcome of the project or the product or services produced by the project.

A project will have stakeholders with an interest in the project and its product that may include:

1. **Customers:** Anyone who is affected by the product or by the process used to produce the product; customers may be external or internal.
2. **User(s):** Who will use or operate the final product; the customer and user may be the same group of people.
3. **Suppliers:** Who are providing specialist resources and/or skills to the project or are providing goods and services.
4. **Sub-Contractors:** Who provide products or services to the supplier.

The PRINCE2 customer/supplier environment assumes that there will be a customer who will specify the desired product, make use of the final product, as well as pay for the project suppliers who will provide resources and skills to create that product.

Regardless of the project team composition, it is assumed that the customer should always participate throughout the project in the creation and verification of products. Projects by nature will have a great deal of change and the future is always less predictable compared to other business-as-usual activities. Projects large and small will have to deal with the uncertainty by managing risks.

The fourth type of motivation is the political motivation, which fundamentally differs from the other types of project motivations, since it does not have some of the elements that characterise the typical project. During the 2010 Australian federal election, then candidate now Prime Minister Julia Gillard announced the 'Cash for Clunkers' program with the objective to help move older cars off the road with 1 January 2011 announced as the go-live date (Owens and Kelly 2010).

The federal election did not produce a clear cut winner. Following the formation of the new government, the department responsible for the project engaged another federal agency to deliver the IT component of the project. It was not until early October 2010 that the initial business requirements were made available for technical and financial assessment. Initial assessment estimated the need for 6 months to deliver an operational IT system that could cater for the 200,000 estimated customers of the system. More

estimates were requested with varied delivery options, but the delivery date remained 1 January 2011.

The department responsible for the project delivery submitted the list of delivery options shown in Table 5; all the options require an IT component in the form of a payment system, audit and fraud protection mechanism to ensure funds are awarded to merited recipients.

**Table 5: Cash for Clunkers Proposed Implementation Options (EL Desouki, H, personal communication, 22 October 2010)**

Option	Description
1	Paper based model
2	Face to Face model
3	Phone model
4	Including scanned eligibility documents model
5	Limited requests for eligibility documents model
6	Combination of paper and phone based models
7	Combination of paper and scanned eligibility document
8	Combination of paper and limited eligibility documents model
9	Combination of paper, phone and eligibility document model

The government later decided to delay the scheme to start at 1 July 2011 instead of the original date as announced, so as to consult more with the industry and ensure that the project was viable and would benefit the community (Davis 2010).

On the same day the leader of the opposition called the government to scrap the project altogether as it was expected to not deliver any benefits to the community (Roxas 2010).

## 2.4 Critical Success Factors for Projects

Australia doesn't have exact figures of the value of the annual IT spend in 2010, but the Australian Bureau of Statistics ("Government Technology, Australia, 2002-03" 2004) estimated the total IT expenses for hardware, software and telecommunication in 2002-03 as AUD\$5,059 million. Total capital expenditure on ICT by all levels of government was

AUD\$2,333 million during 2002-03. The majority of capital expenditure on ICT was by the federal government level estimated to be around 47% of the total expenditure. The Australian Bureau of Statistics published the Information and Communication Technology industries survey in respect of 2006-07 which showed 299,805.000 Australians employed in IT, with 128,171.000 involved in Computer system design and related services generating AUD\$24,459.3 million Gross Domestic Product (GDP) ("8126.0 - Information and Communication Technology, Australia, 2006-07" 2008).

The UK government ICT strategy published in 2010 stated that IT employs about 1 in 20 people in the UK with 35,000 IT professionals in the public sector. The UK government is the largest consumer and the largest employer of IT professionals in the UK. The public sector spends approximately £16 billion per year on technology, which accounts for 4.6% of overall public sector expenditure("UK Government ICT Strategy: Public Sector Transformation" 2010)

#### **2.4.1.1 Project Failures as Global Phenomena**

Software projects are complex undertaking and in many cases their final outcome is far from definite. This has been examined, and studied in the available literature. Most frequently a project is considered a failure if it fails to meet its targeted cost, time or scope (Robertson and Williams 2006, 56), some also include the lack of benefits to the organisations to this list. As a result, the track record of the software engineering industry is rather disappointing (Fitsilis, Kameas, and Anthopoulos 2011, 149). This implies, at least, that software projects are complex undertakings and they would be prone to failure. Information Technology failure remains an important, unsolved problem. Sauer, Southon, and Dampney (1997) noted that failures have been persistent and the failure rates have not declined over the last decade. Failure is also pervasive and does happen in organisations with a relatively successful track record implementing IT projects. Moreover, failure can be pernicious, in which costs can be severely damaging to organisations and their ability to respond to market forces and intensified competition. The issue has been researched intensively over a long time and many of the common causes have been identified. However, failures have persisted either because of incompetence or because of widespread disregard for research findings and industry experiences. Another possibility is that IT project managers are unable to manage the most common causes of failure (Sauer, Southon, and Dampney 1997).

IS failure comes in many forms, including correspondence failure (failure to meet requirements); process failure (budget and time overruns); interaction failure (end users not using the system) (Lyytinen and Hirschheim 1987); and escalation (unnecessarily) as noted by Keil et al. (1994).

While Carr (2003) argued that IT doesn't matter anymore as a strategic tool in building competitive edge in the market place, governments and organisations have never stopped embracing IT solutions, and they keep failing. In a survey published in Europe in which European IT managers expressed the belief that "software products and systems are released before they've been properly tested, 68% of IT heads think too many products and systems are launched without sufficient testing, and 89% of respondents said they had problem-ridden systems 48 hours after going live as highlighted by survey commissioned by IT services company Logica" (CMG 2005, 1). The surprise is that many "IT managers are accepting responsibility without a suitable level of business support" (CMG 2005, 1). Other results from the research show that half of Europe's organisations show that new software deployments are late, while over half said that 'regulatory compliance' has a major impact on how testing and quality assurance activities are undertaken.

Brown and Jones (1998b) stated that episodes of failure provide an interesting arena for the observation of alternative inter-operation of organisational events. They also suggested that project stakeholders tend to blame failure to external factors outside of their control.

Despite a belief that project management techniques have matured, the rate of failure of projects has never been higher (Cooke-Davies and Arzymanow 2003, 471). There is various evidence, surveys and research on project failure, all pointing out that failure is not uncommon. Robertson and Williams (2006, 56) research showed that projects "overrun are more common than projects which complete within the original time scales, with over-run likely to be between 40% and 200%, and fewer than half of the projects examined in one survey met cost and schedule targets; and that only one of the World Bank projects met their aims, with typical delays of 50% over-run". Keil and Robey (1999) reported a survey that found that half of all information systems projects in the United States in 1995 failed, costing a total of US\$140 billion.

Simon and Webster (2011, 8) identified four types of failure:

- **The Unmitigated Disaster** - The most shocking failure occurs when an organisation invest millions of dollars to implement systems and continue to miss deadlines.
- **The Big Failure** - These types of failures are less catastrophic but happen more frequently. When a project budget initially estimated at \$1M for one year, but end up spending \$3M over 3 years and end up with less functionality with the original scope.
- **The Mild Failure** - In comparison to the previous categories of failures, these are 'mostly successful' projects which face small budget overruns, are slightly late, or fail to implement all functionality as originally agreed upon.
- **The Forthcoming Failure** - System failure is not immediately apparent. At first, this may seem to be confusing. If project has met its budget and schedule, how can it consider the system a failure? It may come later when the system is fully operational but return of investment could not be materialised.

Project failure is common and it is happening in private and public organisations such as state or federal government agencies.

#### **2.4.1.2 Project Failures in the Public Sector**

A report published by the United States Government Accountability Office (GAO) stated that more than 400 U.S. government agency IT projects worth an estimated US\$25 billion are suffering from poor planning and are underperforming (Powner 2008). Since 1994 Congress has required federal agencies to keep costs, delivery dates and performance goals of major IT acquisitions within 90% of the originally proposed plan: "With risky investments such as IT is important to increase collaboration and visibility, not hinder it. So far, this hasn't been the case" (Mark 2008, 1).

The report also pointed out that some agencies are 're-baselining' to cover cost overruns or to keep schedule delays from Congress. Almost 50% of all federal IT investments are re-baselined with the Department of Agriculture and the Department of Veteran Affairs having re-baselined more than five times on a single investment.



Although agencies are responsible for the excessive rebaselining, there is one thing in common between all these investments. Every baseline and rebaseline was approved by the agency overseeing the projects. Powner (2008, 9) stated that "Someone, somewhere is not fulfilling their responsibility to ensure that taxpayer money dollars are spent only on those investments that are well thought out and truly necessary".

In their book, *Plundering the Public Sector*, Craig and Brooks (2006) highlighted waste associated with government IT programmes. More than US\$70 billion has been spent on large-scale IT led change that has resulted in administrative chaos and inefficient services, with many IT led initiatives having been quietly buried to avoid admitting failure by senior management.

The Australian Taxation Office (ATO) is a federal agency that embarked on a AUD\$750 million technology overhaul designed to update the systems used to process the nation's tax information, and has been delayed for years. The latest delays come after the ATO completed a major review of the project, which delayed the previous completion date for one core system to July 2010 and also disposed of the project's original title, the 'Change Program'.

The project was first announced in 2003 and originally scheduled for completion in December 2007 at a budget of about AUD\$350 million. In 2005, the cost blew out to almost AUD\$700 million and the final delivery date was pushed out by two years to update superannuation taxation systems in line with new legislation. When the new system is delivered, 'if at all', this would be radically different from what was originally scoped by the ATO and promised by the contractor (Sharma 2009).

In a report published by the Inspector-General of Taxation (Moran 2011) the project is reported to suffer AUD\$300 million over its original budget, the program included a lengthy technology upgrade, but suffered from a set of problems with new systems which have caused delays in taxpayers receiving refunds as well as errors and complaints.

The Queensland Government is currently seeking almost AUD\$100 million in compensation for a failed e-health project, following the government's scrapping of a AUD\$30 million hospital contract with an external contractor. The contractor described Queensland Health department as unreasonable and unconscionable (Parnell 2008). The department in return stated that the contractor misrepresented itself and its product. The

government “estimates it would cost AUD\$132 million to have a similar system installed now, not to mention the cost of keeping other systems going in the meantime, well beyond the AUD\$33.81 million involved in the original deal” (Parnell 2008, 1).

The Queensland Health department also suffered setbacks with their payroll system with “tens of thousands of staff being underpaid, overpaid, or not paid at all following the introduction of the new system” (70 IT Problems in QLD Payroll Debacle 2010, 1).

They have identified at least 70 key problems relating to software defects and configuration errors including poor business rules and processes, which made the job of people running the system more difficult. While many of the errors had already been identified, new errors were arising on a daily basis, and there were new ones raised today which no one had previously known existed which has put the department under significant stress.

A New South Wales IT project that commenced eight years ago will cost NSW taxpayers an extra AUD\$23 million due to chronic communication breakdowns. The project, originally planned to be completed in 2005, in 2009 had not even passed the halfway mark and is set to deliver AUD\$50 million less in savings (Foo 2009). In a report published by the NSW Auditor General there was a lack of project governance and ownership identified as the fundamental issues behind the problems, with the project now forecast for full implementation by 2014.

In 2001, the NSW government licensing project commissioned the standardisation and simplification of the licensing processes of all agencies. The project original cost estimates came to AUD\$63 million and were estimated to provide a net benefit of AUD\$69 million. However, that price tag is expected to swell to AUD\$86 million over 12 years, delivering a net benefit of only AUD\$19 million. The Office of Information Technology in the Department of IT and Management was originally responsible for the project, which was doomed from the start, according to the Auditor general report.

The 2001 business case did not clearly identify which agencies were to be included. Apparently, the original intention of government was that ‘in scope’ agencies would adopt the system. However, this was not effectively communicated to the ‘in scope’ agencies. A number of agencies believed they had the right not to be part of the project. Others showed reluctance to implement the systems developed. Managers responsible for

licensing projects in most agencies that were interviewed for the Auditor General report, advising that they believed they had a choice of whether to adopt it or not.

The department responsible for the project admitted that the original scope of the project was too ambitious and could not be delivered according to the original baselined schedule, and underestimated the scope of the reform processes associated with the project (Foo 2009).

Another project designed to streamline Victoria's criminal justice system is running nine years late and could cost four times its original budget. A report published by the Victoria Auditor General says the Criminal Justice Enhancement Program, due to be completed in November 2000, is still not fully operational, with the original AUD\$14 million budget for the program having blown out to possibly AUD\$54 million. One component of the project designed to streamline the distribution of documents and help parties communicate before they enter a courtroom, is not yet operating, while another core component of the project will need to be replaced in the near future, to cost AUD\$45 million, to keep up with the new Integrated Courts Management System (AAP 2008a).

The project was first approved in 1998, and the Auditor General report pointed out to the earlier failure to properly fund the project. As well, problems were identified with contractor performance management and lack of firm commitment from the involved agencies. The report follows similar findings by the Auditor General that a AUD\$320 million IT program to modernize Victoria's health systems was running late and over budget with no reliable measure to ever know its full cost.

The South Australian government recently scrapped a maintenance works IT project, ending a five-year project which had suffered from repeated cost blowouts, and delays. The project, commissioned by SA's Department of Families and Communities in September 2003, was originally budgeted at AUD\$2 million but increased to AUD\$4 million.

The department froze the project in mid-2007 when an additional AUD\$1 million was requested for the project. Subsequently, auditors were called in to evaluate whether any components of the project could be salvaged, but the auditor recommended the records management system be scrapped altogether and that the department start again (Sharma 2008).

On 7 July 2011 the Western Australian government decided to decommission the Office of Shared Services project, with the project costing AUD\$440 million dollars which is five times its original AUD\$82 million planned cost (Trenwith 2011). The project was commenced in 2003 and envisaged to be completed in 2005, and planned to have eighty out of one hundred fifty government agencies onto one payroll, human resources, finance and procurement integrated system. The original business cases estimated a saving of AUD\$54 million per year, following the initial cost of AUD\$82 million.

A report published by the Western Australia Economic Regulation Authority in July 2011 stated that agencies using the system were financially worse off under the new system and that all anticipated efficiency savings have not been achieved. Furthermore, any savings or benefits written into the budget on the basis of the 2003 business case or subsequent revisions, are financial transactions that are based on the efficiencies envisaged rather than actual efficiency savings (Rowe 2011).

Rowe (2011, xiii) stated that the “original 2003 business case was flawed, with the proposed business benefits being optimistic, with the true cost of the project underestimated and the proposed roll-out schedule was unrealistic”. When joined with decisions made regarding customising off the shelf software systems during the initial stages of the project, this caused the project problems that have influenced the project outcomes to date.

Another issue highlighted in the report is the lack of trust between the agencies and the authority responsible for the delivery of the project, largely caused by the centrally-driven mandatory implementation schedule and lack of a meaningful services level agreement. This lack of trust makes implementation of a difficult project, even more difficult or near impossible. With many agencies rolling-out the applications, facing disruption to their business, the causes were attributed to:

1. The lack of staff training, especially in regional areas;
2. Systems issues, including the lack of interfaces between agency core systems and the system provider;
3. The inability to anticipate and resolve unique and complex operational issues. These issues often required workarounds and reengineering of procedures/processes;

4. The inability to test the data, structures and systems prior to rolling-out meant that errors were detected and resolved in a 'live' environment;
5. The inability of agencies to quickly adjust to business process changes needed in the new environment; and
6. Agencies, and the agency responsible for the project, not providing sufficient and stable resourcing to the project team.

The recommendation of the report was to decommission the authority responsible for delivering the system and allowing each agency to have their systems. The report estimated the cost of decommissioning and establishing new systems in the respective agencies of around AUD\$400 million which brings the total cost of the project to AUD\$1 billion paid by the taxpayers and with no return on such a wasted investment.

#### **2.4.1.3 Project Failures in the Private Sector**

A recent report published by the Securities and Exchange Commission and the Commodity Future Trading Commission of the United States, as a result of a 6 month investigation, outlined how a trading system caused what is known as a 'flash crash' and shaved around US\$25 billion off stock values in just 20 minutes and sent the global stock market into a spiralling downturn. The problem was caused by a logic problem in the high-frequency trading system began to quickly buy and then resell contracts automatically, generating a 'hot-potato' volume effect as the same positions were passed rapidly back and forth (Lauricella, Scannell, and Strasburg 2010, 1). The problem started with Accenture shares that were selling for US\$40 on 6 May 2010 when the stock suddenly seized up. For 22 seconds there were no recorded trades. Then came a transaction below US\$10. In the next eight seconds, the Accenture share price changing more than 80 times before flat-lining at one penny. Then just as abruptly the share price rebounded to US\$40 and stayed there.

At one point, the high-frequency trading system traded more than 27,000 contracts in just 14 seconds. The "algorithm responded to the high volume by picking up the pace of its selling, even though stocks were spiralling lower" (Lauricella, Scannell, and Strasburg 2010, 2), with the cost of the bug yet to be fully calculated. In early 2011 the Securities and Exchange Commission fined a French insurer US\$242 million to settle fraud accusations, as it hid from clients for nearly a year a serious software glitch in a quantitative

investment model similar to the one cause the flash crash (Eaglesham and Strasburg 2011).

Toyota, the largest auto-maker in the world and the champion of the Toyota Production System (TPS), recently announced that their vehicle crash data recording devices are prone to a software bug that could inaccurately record a vehicle's speed at the time of an accident. The investigation of that bug came to light when an accident occurred in 2007 for a pickup truck that recorded a speed of 170 miles per hour, a figure physically impossible for the truck to achieve without heavy engine modification, which was not the case for the vehicle involved in the accident (Ganz 2010).

While a software bug caused National Australia Bank (NAB) customers to wait a few days for their pay to be transferred to their accounts due to an error in the bank's electronic transactions system, the bug affected both retail and business customers and forced the bank manager to apologise for the pain caused by the anomaly (AAP 2008b).

In late 2010 a similar problem affected millions of NAB customers but on a wider scale, in which transactions originating from other banks to the NAB were also impacted by an error in which customers were unable to access their accounts or receive their pay. In consequence, the bank was forced to open 120 branches across the nation to give customers access to their money (AAP 2010). It took the bank over one week to identify the problem and provide a solution. The bank has lost details of thousands of transactions many of which may not be recovered. As a consequence retailers are preparing a class action against NAB over the error during the crucial Christmas shopping sales, and the bank has received 6,500 compensation claims from customers demanding refunds of bank fees, interest and late payment charges.

Dr Patrick McConnell, a Visiting Fellow at Macquarie University Applied Finance Centre, Sydney, published an article comparing the lack of response from the Australian Banking regulator in comparison to its counterpart in Singapore in relation to IT banking systems' failure (McConnell 2010). Singapore's biggest bank suffered a failure in July 2010 from 7 hours outage, and 970,000 customers could not access their banking services in the branches, ATMs, Internet or mobile banking. The regulator ordered the bank to increase its reserve for operational risk to SGD\$180 million, as well as ordering the bank to undertake a review of its outsourcing arrangements and to "redesign its online and

branch banking systems platform to reduce concentration risk and allow greater flexibility and resiliency in operation and recovery capability”(McConnell 2010, 1).

More than 90,000 clients of the Western Australia energy retailer, Synergy, were affected by problems with its new billing system, which caused the company to lose A\$750,000 in lost revenues (Sonti 2010). The problem has seen many customers either not receive a bill, or receive late payment warnings when no bill was sent, or when customers do get a bill, find it is for the wrong amount. The problems have been around since Synergy recently implemented an AUD\$38.4 million billing system. The WA Energy Minister added that the company has been spending AUD\$165,000 a month trying to fix the problem without success to date.

A fatal Spanair crash which killed 154 people in 2008 could have been caused by Malware. A report published by independent crash investigator pointed to the fact that “the airline's central computer which registered technical problems on planes was infected by Trojans at the time of the fatal crash and this resulted in a failure to raise an alarm over multiple problems with the plane” (Leyden 2010, 1).

The information systems technology industry has recently been shocked by the discovery of the most sophisticated malicious software program. Security experts say “Stuxnet attacked the software in specialised industrial control equipment made by Siemens by exploiting a previously unknown hole in the Windows operating system” (Richmond 2010, 2).

#### **2.4.1.4 What is Success?**

In one project in which the deadline had to be met due to commitments made to stakeholders outside the organisation, the software development team extended their code delivery date to the quality assurance team by three weeks. In a project meeting, the development team manager stated that his team deliveries were on target to meet the new unannounced software delivery date. The Quality Assurance manager raised a concern since the three weeks added by the development team to their schedule, simply came from her schedule which was already stretched. It meant that any critical defects found by QA in the final week wouldn't make it into the final code. The development manager disputed that his team was behind schedule and stated that the final go-live date was not impacted.

The scenario presented an issue which had delivery implications and required resolution. To the organisation tracking the project activities against time, scope and budget, it would look from the outside as a success, since the project would end up meeting the deadline. However, the project actually suffered from three weeks of delays and staff ended up working on weekends, which is normally not recorded on project schedules. The budget may not have been impacted, but with the development team taking three weeks longer to deliver their work output, the Quality Assurance team had to wait for the code and had less elapsed time to perform their tasks, with the potential to compromise the final project deliverables. Scope seems to be the element which was not impacted in that scenario, but with pressure building on the schedule, some features had to come out of the project.

For the organisation as a whole, the project was delivered and was considered a success by the management team. According to Gershon's (2008) study of 193 projects in federal government agencies, 48% of projects were delivered over budget, and 57% over time (Table 6).

**Table 6: Performance of 193 Completed Projects (Gershon 2008, 18)**

<b>Cost</b>	<b>Time</b>	<b>Benefits Achievement</b>
23% (45) were delivered over budget	33% (64) were delivered over time	44% (86) reported achievement of benefits but did not provide evidence of measurement
39% (74) were delivered under budget	2% (3) were delivered before time	Only 5% (10) reported actual measurement of benefits and compared anticipated benefits with actual benefits realised
13% (25) had no variance between estimated cost and actual cost	41% (80) had no variance between estimated time and actual time to delivery	45% (86) reported outcomes that were not measurable
25% (49) were silent on the question	24% (46) were silent on the question	6% (11) were silent on the question

The same report studied thirty four of the 193 projects with expenditure of more than AUD\$5 million and found that 62% of the projects were over budget and time, many of



the projects failed to show how they measured the benefits of the project to the organisation (Table 7).

**Table 7: Performance of Projects over AUD\$5 million (Gershon 2008, 18)**

Cost	Time	Benefits Achievement
12% (4) were delivered over budget	12% (4) were delivered over time	36% (12) reported achievement of benefits but did not provide evidence of measurement
29% (10) were delivered under budget	No projects were delivered under time	11% (4) reported actual measurement of benefits and compared anticipated benefits with actual benefits realised
9% (3) had no variance between estimated cost and actual cost	38% (13) had no variance between estimated time and actual time to delivery	38% (13) reported achieving actual outcomes that were not measurable
50% (17) were silent on the question	50% (17) were silent on the question	15% (5) were silent on the question

Charette (2005) collated an extensive list of IT projects that have failed and the cost of failure. While the failure of IT projects is not new, the consequent cost of project failure tends to be expensive, as demonstrated in Table 7.

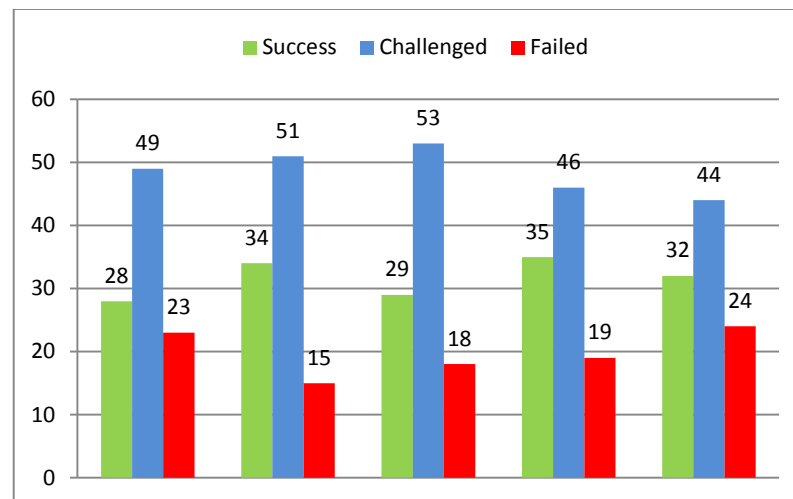
**Table 8: Cost of IT Projects Failure(Charette 2005, 7)**

Year	Company	Outcome (costs in US\$)
2005	Hudson Bay Co. (Canada)	Problems with inventory system contributing to a \$33.3 million Loss
2004-2005	UK Inland Revenue	Software errors contributing to \$3.45 billion tax credit payment
2004	Avis Europe (UK)	Enterprise Resource Planning (ERP) system cancelled after \$54 million is spent
2004	Ford Motor Co.	Purchase system abandoned after deployment, costing approximately \$400 million
2004	J Sainsbury (UK)	Supply chain management system abandoned after deployment, costing \$527

2004	Hewlett-Packard Co.	Problems with ERP system contributing to \$160 million loss
2003-2004	AT&T Wireless	Customer relations management (CRM) upgrade, problems leading to revenue loss of \$100 million
2002	McDonald's Corp.	The Innovate information purchasing system cancelled after \$170 million is spent
2002	Sydney Water Corp (Australia)	Billing system cancelled after \$33.2 million is spent
2002	CIGNA Corp	Problems with CRM system contribute to \$445 million loss
2001	Nike Inc.	Problems with supply chain management system contribute to \$100 million loss
2001	Kmart	Supply chain management system cancelled after \$130 million is spent
2000	Washington, D.C	City payroll system abandoned after deployment, costing \$25 million
1999	United Way	Administrative processing system cancelled after \$12 million is spent
1999	State of Mississippi	Tax system cancelled after \$11.2 is spent; state receives \$186 million damage
1999	Hershey Foods	Problems with ERP system contribute to \$151 million loss
1998	Snap-on Inc.	Problems with order entry system contribute to revenue loss of \$50 million
1997	U.S. Internal Revenue Services	Tax modernisation effort cancelled after \$4 billion is spent
1997	State of Washington	Department of Motor Vehicle system cancelled after \$40 million is spent
1997	Oxford Health Plans Inc.	Billing and claims system problems contribute to quarterly loss, stock plummets, leading to \$3.4 billion loss in corporate value
1996	Arianespace (France)	Software specification and design errors causes \$350 million Ariane 5 rocket to explode
1995	Toronto Stock Exchange (Canada)	Electronic trading system cancelled after \$25.4 million is spent
1994	U.S. Federal Aviation Administration	Advanced Automation System cancelled after \$2.6 billion is spent
1994	State of California	DMV system cancelled after \$44 million is spent
1994	Chemical Bank	Software error causes a total of \$15 million to be deducted from 100,000 customer accounts
1993	London Stock Exchange (UK)	Taurus stock settlement system cancelled after \$600 million is spent
1993	Allstate Insurance Co.	Office automation system abandoned after deployment, costing \$130 million
1993	Greyhound Lines Inc.	Bus reservation system crashes reportedly upon introduction, contributing to revenue loss of \$61

		million
1992	Budget Rent-A-Car, Hilton Hotels, Marriot International and American Airlines	Travel reservation system cancelled after \$165 is spent

The Standish Group Chaos report is one of the most widely cited when it comes to IT project failure. The 2009 report (Standish 2009, 1) results illustrated in Figure 12 show a marked decrease in project success rates, with 32% of all projects succeeding – that is, delivered on time, on budget, with required features and function – 44% were challenged – being delivered late, over budget, and/or with less than the required features and functions – and 24% failed – being cancelled prior to completion or delivered and never used. These numbers represent a decrease in the success rates from the previous study, as well as a significant increase in the number of failures.



**Figure 12: Standish Report 2000 to 2008: Project Resolution (Standish 2009, 1)**

The report also highlighted that size does matter in determining the rate of project success, with 61% of successful projects costing less than US\$750,000 in staffing, and 19% of projects from US\$750,000 to \$3 million were successful. Therefore, 80% of successful projects have staffing costs under \$3 million. Projects costing less than US\$750,000 in staffing have a 71% chance they will be successful, while projects costing between US\$750,000 and US\$3 million have a 38% chance of being successful. Projects over US\$10 million only have a 2% chance of coming in on-time and on-budget, and represent a statistical zero in the success column. Xiangnan, Hong, and Weijie (2010) in their study

of small and medium sized projects in China estimated that success of IT projects remained below 30%.

Myers (1995) suggested that success can be achieved when an information system is perceived to be successful by stakeholders. This appears practical; however, perceptions is subjective and it is influenced by expectations. Thomas and Fernández (2008, 733-742) explain “that optimistic expectations regarding time, budget or quality can be regarded as normal human psychological behaviour under conditions of uncertainty”.

Humans have a tendency to be optimistic which could lead to under-estimating challenges and to over-estimating their own capabilities. Project stakeholders could perceive projects that have failed or partially failed, as successes. Looking at the earlier scenario in which development was extended by three weeks, while quality assurance was reduced by three weeks, the project according to the organisation and the external stakeholder, was considered a success. However, internal stakeholders, especially project staff, viewed the project as a failure, since it meant that part of the project staffing had to work extended hours including weekends to meet the revised schedule, and some features were omitted from the deliverables.

How project sponsors view the project is critical to the survival of the organisation. Project success may be perceived regardless of the actual performance of the systems developed. The definition of success determine whether an information system succeed to some degree but fail otherwise. For example, failure can take place, even with the system technical performance exceed its requirements, but suffer from lack negative user perception. Information technology projects could still be counted as successful, despite being over time and budget, when they deliver end user stratification.

Recently Eveleens and Verhoef (2010) published a paper in the Institute of Electrical and Electronics Engineers (IEEE) journal challenging the numbers stated by the Standish report. The major problems in the Standish report seems to be about the way the data relating to Successful and Challenged projects is gathered. According to Eveleens and Verhoef, these Standish figures are: “misleading, one-sided, pervert the estimation practice, and result in meaningless figures” (Eveleens and Verhoef 2010, 30).

Eveleens and Verhoef argued that the problem seems to arise from the way the successful and challenged projects being defined. The definition seems to have loopholes which

meant that many project would not be included in the Standish report, leading to misleading results.

#### 2.4.1.5 Project Success Factors

Empirical studies of project success factors are mostly limited to describing the demographics of project management tasks such as project planning, reporting, risk management, scheduling, and budget (Raymond and Bergeron 2008). In a survey conducted by Chow and Cao (2008) to compile project success factors in agile software projects, they performed reliability analysis and factor analysis on those factors and consolidated them into five different categories as illustrated in Table 9.

**Table 9: Success Factors in Agile Projects (Chow and Cao 2008, 963)**

Dimension	Factor
<b>Organisational</b>	Strong executive support
	Committed sponsor or manager
	Cooperative organizational culture instead of hierarchal
	Oral culture placing high value on face-to-face communication
	Organisations where agile methodology is universally accepted
	Collocation of the whole team
	Facility with proper agile-style work environment
	Reward system appropriate for agile
<b>People</b>	Team members with high competence and expertise
	Team members with great motivation
	Managers knowledgeable in agile process
	Managers who have light-touch or adaptive management style
	Coherent, self-organising teamwork
	Good customer relationship
<b>Process</b>	Following agile-oriented requirement management process

	<p>Following agile-oriented project management process</p> <p>Following agile-oriented configuration management process</p> <p>Strong communication focus with daily face-to-face meetings</p> <p>Honouring regular working schedule – no overtime</p> <p>Strong customer commitment and presence</p> <p>Customer having full authority</p>
<b>Technical</b>	<p>Well-defined coding standards up front</p> <p>Pursuing simple design</p> <p>Rigorous refactoring activities</p> <p>Right amount of documentation</p> <p>Regular delivery of software</p> <p>Delivering most important features first</p> <p>Correct integration testing</p> <p>Appropriate technical training to team</p>
<b>Project</b>	<p>Project nature being non-life-critical</p> <p>Project type being of variable scope with emergent requirement</p> <p>Projects with dynamic, accelerated schedule</p> <p>Projects with small team</p> <p>Projects with no multiple independent teams</p> <p>Projects with up-front cost evaluation done</p> <p>Projects with up-front risk analysis done</p>

Raz, Barnes, and Dvir (2003, 14) described four dimensions of project success:

- Project efficiency (meeting schedule and budget goals, or ‘meeting design goals’);

- Impact on consumer (meeting functional performance and technical specifications, fulfilling customer needs, solving a customer's problem, customer using the product, customer stratification);
- Business success (commercial success and creating a new market share);
- Preparing for the future (creating a new market, product line, or technology).

Similarly, every practice that is not good is a bad practice. Bad practice is the main source of bad project results more than lack of money, time, and people as suggested by Viskovic, Varga, and Curko (2008, 306).

- “Bad practices in the management domain;
  - Conducting projects without clear project goals;
  - Incompetence of seeing the whole project portfolio – Not having the big picture;
  - Missing true management support;
- Bad practices in the communication domain;
  - Not understanding the importance of communication to end users;
  - Paying outside consultants instead of own people;
  - Not retaining knowledge acquired on the project;
  - Not learning from mistakes;
  - Allowing the project documentation to become out of date;
- Bad practices in the methodological domain;
  - Believing in the existing business process documentation;
  - Not working methodologically – ignoring good practice”.

Lyytinen and Hirschheim (1987) defined four major notions or categories of IS failure as follows:

1. **Correspondence failure:** It happens when the system requirements are not achieved.

2. **Process failure:** A process failure takes place when an information system project could not be completed within budget and/or schedule.
3. **Interaction failure:** The level of end user usage of the developed information system.
4. **Expectation failure:** Expectation failure refers to the gap between actual and desired outcomes of the system by various project stakeholders.

Flowers (1996, 100) defines an information systems as a failure if one of the following criteria is met:

- “When the system as a whole does not operate as expected;
- If, on implementation, it does not perform as originally intended or if it is so user-hostile that it is rejected by users and underutilised;
- The cost of the development exceeds any benefits the system may bring throughout its useful life.
- Due to problems with the complexity of the system, or the management of the project, the information system development is abandoned before it is completed”.

A paper published by Ivory and Alderman (2005, 5) suggests that “failures occur as a consequence of multiple interactions (linear, and nonlinear), internal contradictions, and geographically dispersed and ‘multi-node’ (i.e., multiple sites of control and influence) nature of projects”. However, they noted that such complex systems could be enhanced through ongoing-targeted interventions. They stated that after studying such approaches in complex projects, it can be useful in altering the project outcomes.

Sauer, Southon, and Dampney (1997) proposes that systems should be considered as a failure if there is a development or operation termination. Sauer, Reilly, and Shenhar (2009, 666) discussed the NASA Mars Climate Orbiter Project, using the contingency theory to “understand project failure due to managerial reasons by utilising different contingency theory frameworks for a retrospective look at unsuccessful projects and perhaps more importantly, the potential prevention of future failures”.



While the criteria posited by Flowers (1996) are clear, when some of the criteria are applied, they could lead to a conflicting evaluation. One government organisation developed a software application that has been in production since 1989. The project originally took three years to build and when it was delivered it could be considered a failure due to budget and time overruns.

But the software has now been in production for 21 years and management has no solid plans to replace it. More critically, the staff who took part in the original development and continue to support the system, will start retiring in the coming years. While the system following its introduction could be considered a failure according to Flowers' (1996) evaluation criteria, applying the same criteria now would indicate different outcomes. While time could alter the evaluation results, not all projects remain in production for as long. With the cost of replacing the existing system being high and the system considered critical to healthcare service delivery nationwide, it is hard to see the system other than a success.

When the NASA Mars Climate Orbiter (MCO) was lost in space, the project was declared a failure by the press. The initial investigation pointed to that failure being due to technical issues. However, upon considering a root cause analysis of the failure, it became clear that the failure was not technical, but was rooted in management's failure to select the right approach to that project according to Sauser, Reilly, and Shenhar (2009, 665). MCO management could have prevented this failure by better understating and assessment of the risk and complexity associated with the program upfront.

Project success means more than just meeting schedule and budget. It also involves delivering business results or readying organisation for the future. For a long time researchers have tried to identify reasons for project success and failure, and one of the most common approaches is the search for critical success factors (Sauser, Reilly, and Shenhar 2009, 666).

Projects can be declared successful when benchmarked against their overall objectives, while project management practices success is benchmarked by the golden triangle (time, cost and quality). Benchmarking project management success is much easier and normally takes place during the project closure phase, in comparison project success criteria is harder to assess during the life of the project.

The issue with defining success are because that many projects are started without having clear definition of what is success and what is not (Thomas and Fernández 2008, 733).

Jugdev and Moller (2006) suggested the need to define success amongst projects key stakeholder, before commencing the project, as well having multiple reviews during the project life. However, this does not always occur, due to the varied nature and motivation of projects.

Busby and Zhang (2008, 86) suggested that project risk analysis typically focused on the analysis of external threats to the project. In their paper titled "The Pathogen Construct in Risk Analysis", they argued, "that internal decisions and structure are more fundamental, because they determine which external events pose a risk to the project"

Project management methodologies call for a post-mortem to take place after each project. However, formal post-mortems are often not conducted because of political agendas (Smithson and Hirschheim 1998). The general perception of evaluating failure is often associated with embarrassment for managers, rather than been seen as an opportunity to learn. Such negative association, regardless of the outcome of post-mortem exercise, make it harder for manager to undertake them.

Sauser, Reilly, and Shenhar (2009, 677) pointed out that "project management research is still in its early stages. While much research has been devoted to critical success factors, not many studies have focused on finding alternative frameworks that allows us to understand why projects fail and what can be done about it"

The contingency theory used to analyse the failure of MCO provided new perspective and a deeper understanding of project failure, but more crucially, it established the ground for different direction when researching project success and failure.

Sauser, Reilly, and Shenhar (2009) stated that at this stage current project management practices have not adopted well accepted and standardised approach to identify project uniqueness at project initiation and to select the most adequate management approach. Taken into account that no project is undertaken in isolation and organisations are typically engaged in more than one project at a time, that in turn raises a question about whether the existing project management methodologies can be adopted out of the box or will need customisation to suit the organisation's needs. If that is the case, and each

organisation opted to have their own project management methodology, the value and benefits of having a globally accepted standard becomes uncertain.

El Emam and Koru (2008) studied project failure and they started by providing a summary of the Standish report and studied companies in various sectors. Their results were similar to the Standish report as shown in Tables 9-11.

**Table 10: A Summary of Evidence of Software Project Cancellation Rates (El Emam and Koru 2008, 85)**

Study, Year, and Location	Cancellation/Abandonment Rate (%)
Standish Group, 1994, US	31
Standish Group, 1996, US	40
Standish Group, 1998, US	28
Jones, 1998, US (Systems Projects)	14
Jones, 1998, US (Military Projects)	19
Jones, 1998, US (Other Projects)	>24
Standish Group, 2000, US	23
Standish Group, 2002, US	15
Computer Weekly, 2003, UK	9
UJ, 2003, South Africa	22
Standish Group, 2004, US	18
Standish Group, 2006, US	19
Standish Group, 2008, US	24

**Table 11: Distribution of Companies where the Projects were Performed (El Emam and Koru 2008, 86)**

Year	Domain	Percentage
2005	Financial Services	22
	Computer Consulting and Systems Integration	21

	Computer Software Publisher	12.5
	Government	9
	Telecommunications	5
	Outsourcing/Web Services	5
2007	Computer Consulting and Systems Integration	19
	Financial Services	18
	Computer Software Publisher	12
	Government	6
	Medical and Health Services	4.5
	Colleges and Universities	4.5

**Table 12: Reasons for Project Cancellation with Percentages and 95% Confidence Intervals for the 2007 Respondents (El Emam and Koru 2008, 88)**

Reasons for Cancellation	Percentage of Respondents (95% confidence Interval)
Senior Management not sufficiently involved	33 (13,59)
Too many requirements and scope changes	33 (13,59)
Lack of necessary management skills	28 (10,54)
Over budget	28 (10,54)
Lack of necessary technical skills	22 (6,48)
No more need for the system to be developed	22 (6,48)
Over Schedule	17 (4,41)
Technology too new: didn't work as expected	17 (4,41)
Insufficient staff	11 (1,35)
Critical quality problems with software	11 (1,35)

End user not sufficiently involved	6 (0,27)
------------------------------------	----------

A cancelled software project is usually an unwanted situation that means loss of limited economic resources, and embarrassment to senior management. Fundamental to project management methodologies is the conduct of a post-mortem to understand what went wrong during the project. If the post-mortem is not conducted, there is unlikely to be an understanding of why projects fail. Analysis of cancelled projects enables organisations to modify and improve the project management methodologies and software development process and to identify critical decision points before and during the project execution (Ahonen and Savolainen 2010).

Procaccino et al. (2005) assert that there is a general agreement about the necessity for post-mortems, but still they are quite rarely performed. One reason, could be that learning from bad experience is not easy. Moreover, “concern about frank analysis, especially of failure, creates a natural disincentive within the organisation to conduct a post-mortem; it also creates apprehension in the individual preparing to take part in post-mortems that are held” as outlined by (Collier, DeMarco, and Fearey 1996).

Seddon (2008) cites Norman Dixon, a psychologist and author of the “On the psychology of military incompetence”, in outlining Dixons’ thesis that military organisations knock the attributes of leadership out of people as they progress through the hierarchy, so that by the time they reach the top they are no longer fitted to leadership. Seddon uses Dixon to draw a parallel with the public sector, alleging that public servants betray a “fundamental conservatism’, a ‘tendency to reject or ignore information which is unpalatable’ and ‘an obstinate persistence in a given task despite strong contradictory evidence” (Seddon 2008, 119).

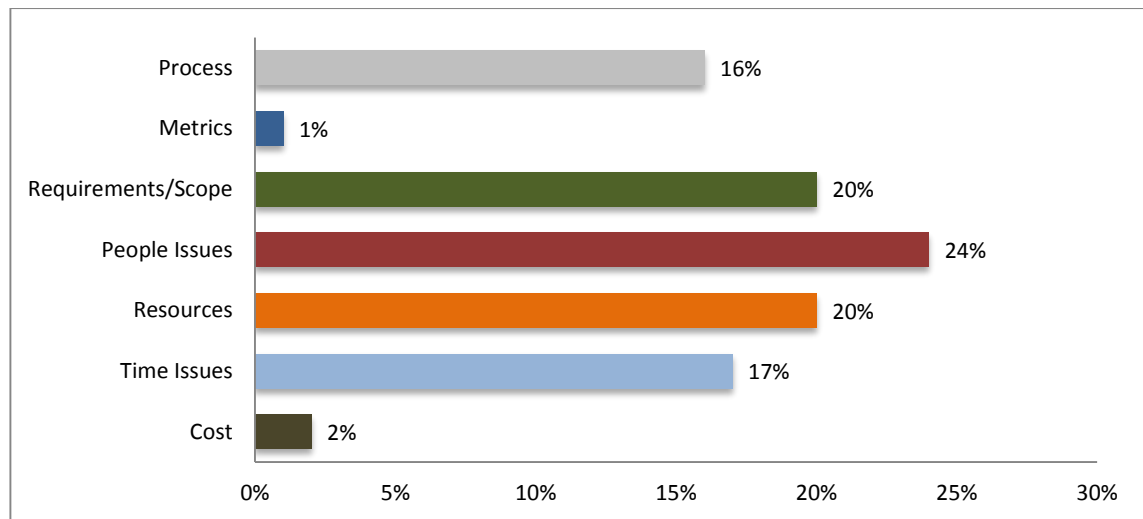
Rodriguez-Repiso, Setchi, and Salmeron (2007, 583) identified some of the significant difficulties faced by projects:

- “IT projects are often poorly defined, codes of practice are frequently ignored, and in some cases not many lessons are learned from past experience.
- Market pressures demand delivery in the shortest time frame even if it may result in a lower quality product.

- The rapid pace of technological progress in IT hinders the expertise in a particular technique and creates a culture where the use of tools not completely tested, is acceptable and commonplace.
- The tendency to write new software code to perform well-established functions decreases reliability.
- IT projects involve numerous iterations and continuous interaction between everyone involved in design and implementation. Their work is highly interdependent which necessitates efficient communication within the project team.
- IT projects contain a greater degree of novelty than other engineering projects. In particular, IT projects related to product innovation development are extremely complex, risky and expensive endeavour”.

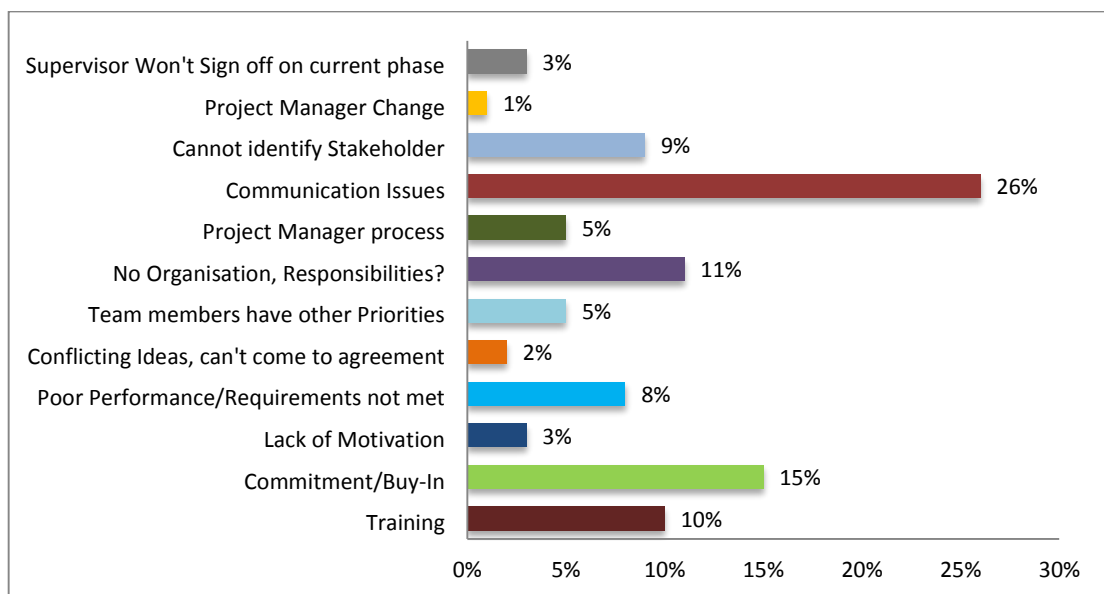
Busch (2008) argues that regardless of a long history and constant publicity of project failures in public and private organisations we are still unable to increase the rate of project success, despite being able to analyse and document the reasons behind failure.

Busch (2008) research illustrated the results of the project problem categorisation. Of the seven categories of project problems, five stood out as the most predominant and accounted for 97% of the project problems (Figure 13). People issues came first, followed closely by resources and requirements/scope issues. The Cost and Metric issues are very low in comparison with the first five categories, while project cost is recognised as important, is not recognised in Busch’s research as being nearly as important as product quality or project delivery date.



**Figure 13: Major Categories of Project Problems (Busch 2008, 1411)**

When looking at details of the people issue, recognised in the Busch research as the major category of project problems, as detailed in Figure 14, the most prominent is the communication problem, which is recognised by other researchers as fundamental to project failures.



**Figure 14: People Issue Problems (Busch 2008, 1415)**

#### 2.4.1.6 Classification of critical success factors

Belassi and Tukel (1996, 142) distilled “seven different lists of critical factors from the literature. Most of the lists are theoretically based, rather than empirically proven”. Most, of these lists include factors related to the project manager and the organisation to which the project belongs, and many ignore other elements, such as the formation of the project

team and external factors that influence project performance as illustrated in Table 13. For a long time, the literature has focused on project scheduling issues, assuming that having efficient scheduling techniques, would address project issues and lead to successful completion of projects. However, there are internal and external factors outside management control which have influence over the project outcomes. In the literature, these factors are referred to as critical success/failure factors.



**Table 13: Seven Lists of Critical Success Factors Developed in the Literature (Belassi and Tukel 1996, 143)**

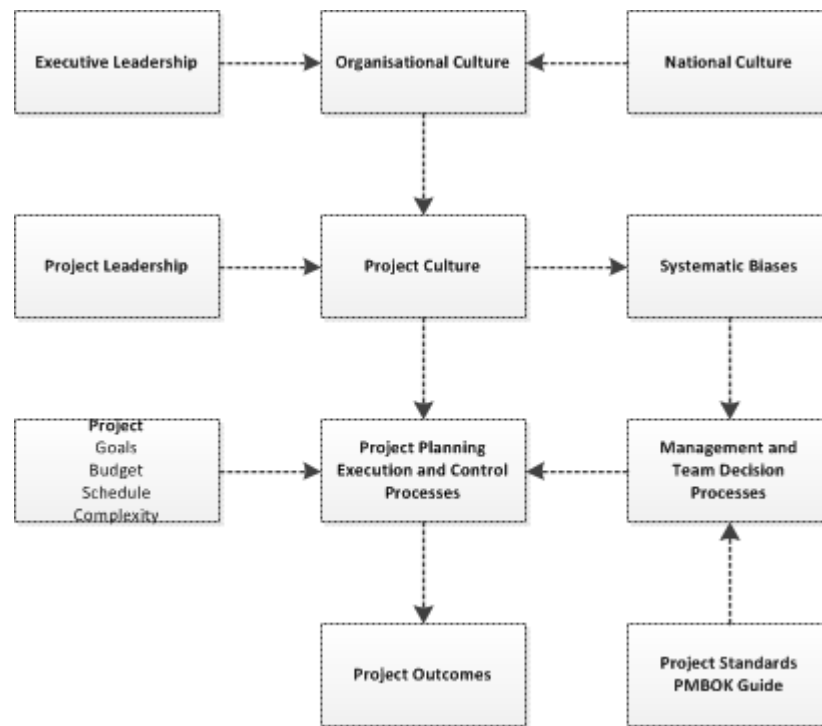
Martin (1976)	Locke (1984)	Cleland and King (1983)	Sayles and Chandler (1971)	Baker, Murphy and Fisher (1983)	Pinto and Slevin (1989)	Morris and Hough (1987)
Define Goals	Make Project commitment known	Project summary	Project manager’s competence	Clear goals	Top management support	Project objectives
Select project organisational philosophy	Project authority from the top	Operational concept	Scheduling	Goal commitment on project team	Client consultation	Technical uncertainty innovation
General management support	Appoint competent project manager	Top management support	Control systems and responsibilities	On-site project manager	Personnel recruitment	Politics
Organise and delegate authority	Set up communication and procedures	Financial support	Monitory and feedback	Adequate funding to completion	Client acceptance	Community involvement
Selection project team	Setup control mechanises (schedule, etc.)	Logistic requirements	Continuing involvement in the project	Adequate project team capability	Client acceptance	Schedule duration urgency
Allocation sufficient resources	Progress meetings	Facility support		Accurate initial cost estimates	Monitoring and feedback	Financial control legal problems
Provide for control and information mechanisms		Market intelligence (who is the client)		Planning and control techniques	Communication	Implement problems
Require planning and review		Project schedule		Minimum start-up difficulties	Troubleshooting	
		Executive development and training		Planning and control techniques	Characteristics of project team leader	
		Manpower and organisation		Task vs. social orientation	Power and politics	
		Acquisition		Absence of bureaucracy	Environment events Urgency	
		Information and communication channels				
		Project review				

There can be difficulty in deciding whether a project is a success or failure. However, there is no single measure that can be used to measure project success, because different stakeholders perceive success or failure differently. A project, which can be considered success by the client, could be considered failure by senior management (e.g. over budget) if the project outcomes do not meet top management requirements, even though it met the end user desired outcomes.

Poon and Wagner (2001, 396) highlighted that “the quality of the staff that support an IT system for senior executives is important”. They also emphasised “that project managers should have technical as well as business knowledge, and the ability to communicate with senior management”, while project support staff need to be experienced and able to communicate with senior management and be able to utilise the technologies for the planned system.

Procaccino et al. (2005, 194) suggest that the “practitioner’s perception of project success, in contrast to that of their management and the organisation as a whole, tends to take a more micro-level project view, as their activities focus on design and construction”. Information technology practitioners generally see success in meeting customer requirements.

Shore (2008, 5) pointed to the fact that “failures occur despite the fact that the process of planning, executing, and controlling projects has been significantly improved”. In this context, Shore (2008) introduced a concept related to the interaction of culture, leadership, project management, and behavioural factors and their relation to project outcomes (see Figure 15).



**Figure 15: Influence of Cultural, Leadership, Project, Management, and Behavioural Factors on Project Outcome ("Handbook of Qualitative Research" 2005; Shore 2008)**

Research in project failure provides us with some insight into the organisational and project culture of failed projects, suggesting systematic biases such as:

1. Selective perception, which happens when an issue viewed from limited perspective;
2. Insular nature of the departments within organisations, which creates a culture that limits communication amongst those departments that results in many changes promoted by the organisation top management, that remain unimplemented;
3. Illusion of control by senior managements occurs when they envision central organisations with control over its departments, but suffer when those departments remain in control of their procedures and ignore appropriate policies;
4. Management tend to focus on project metrics such as schedule and budget, which creates availability bias in which departments tend to focus on their own tasks and assume they are under control, but ignore the overall progress of the project.

The types of bias described above are overlaid on the competing value modes, in which failed projects appear to be related to organisational and project cultures characterised by an internal focus on stability. This suggests that those organisations are protecting their own structure and management processes, as well as those organisations resisting change and dismissing external threats as they tend to focus on internal threats and politics.

Organisations do not initiate lawsuits over botched IT projects every day. Lamentably, however, system failures are common. Statistics, government, and media reports indicate a trend where increasing numbers of IT Projects do not do what they were supposed to do within budget and within the expected timeline. The processes used for implementing enterprise information technology have been in place for many decades and can be hardly called recent. If it were, that could be used as a reason for why we have a high failure rate. To the contrary, the rate of failure has increased with the wider adoption of information technology and few of those projects have met their original goals and promises. More critically, information technology projects that are completed and make it to the end user frequently add little value or fail to enhance the overall productivity, resulting in many staff reverting to old habits, processes, and systems.

Project managers and project team members are likely to be involved in many failed projects. Experience and lessons learned theoretically should be used by senior executives, project managers, and team members to ensure success in the next venture. However, similar results appear to be consistent over multiple projects and failure is simply repeated again and again.

It is not clear whether people, processes, or the technology should be blamed for these failures. Information technology has leapt forward in the last two decades and rapidly became accessible by significant proportion of humanity, yet the problems associated with implementing such technologies changed little. Moreover, the processes and methodologies that accompanied the explosive growth remained unchanged, or at best unable to deal with the complex environments where such technologies are adopted. For example, twenty years ago, stock exchanges buying orders were fulfilled manually or using primitive computer systems; nowadays, we have split-second trading where systems buy and sell stocks multiple times within few seconds. Such advances in technology were not complemented by similar advances in processes to implement those

systems; moreover, human-related issues remain at the core of why information technology project fails.

Royer (2003) highlighted the cases of RCA's SelectaVision videodisc recorder. This project involved investment of US\$580 million and commitment of company resources for 14 years, yet resulted in absolute failure. Private and public organisations make similar mistakes all the time. But the main question remains, why? Why companies pursue failed project regardless of all signs. Royer (2003, 50) stated that "a fervent belief in the inevitability of a project's ultimate success can, surprisingly, be the root of trouble in the project and eventual project failure".

## **2.5 Projects as Systems**

Human life is frequently described as becoming more and more complex, and rightly so. It seems that the terms "complex" or "complexity" appear everywhere. In some part, this is because life really is complex! But this conclusion is also driven by the fact that over the last few decades, we have learned more about the nature of complexity and the role that complexity plays in our lives. Complexity is a feature of all living and natural systems (Paradice 2010).

Complex systems have long a crucial component of the systems approach to management. Von Bertalanffy (1972, 420) reports that "modern technology and society have become so complex that traditional branches of technology are no longer sufficient; approaches of a holistic or systems, or generalist and interdisciplinary, nature became necessary". The domains of software engineering (Glass 1998) and systems engineering (Bar-Yam 2003) have also been concerned with the engineering complexity of complex systems (Shenhar and Bonen 1997).

The emergent properties from a system cannot be attributed to the individual actions performed from parts. Rather the interactions among people, machines, applications, procedures, data, policies, and the organizational setting and organizational environment are responsible for their coproduction.

Simon (1996, 183) writes: "Roughly, by a complex system I mean one made up of a large number of parts that have many interactions". This simple definition can be readily applied to organisations and their information systems. Thus, an organisation is a

complex system if it has many units (departments, for example) and there are many interactions among units. A complex information system is one that has many elements (programs, modules, objects, relationships, attributes, databases, etc.) that interact in many ways (Courtney et al. 2010, 44).

A complex society is a state of society in its evolution that sociologists label 'take-off'. It exhibits the following characteristics (Jaafari 2003, 47):

**"Open Systems:** A complex society is made up of a complex web of interacting open systems that are subject to instability and in the throes of constant change;

**Chaos:** The complex society is affected by uncertainties that are beyond long term contemplation and thus defy the classical management approach of orderly planning and control;

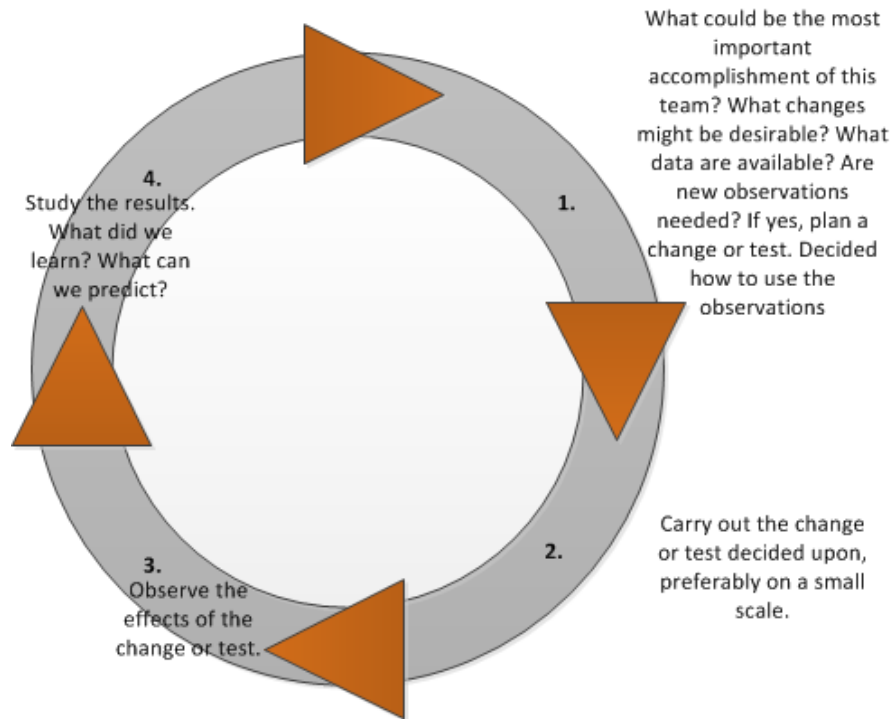
**Self-organisation:** In a complex society the tendency is for self-organisation to take place following an autocatalytic process leading to autonomous organic (self-steering) organisation units, based on insights and the competence of the actors as well as synergy, flexibility, and teamwork;

**Interdependence:** the growth of interdependence makes it increasingly difficult, if not impossible, to make any predictions on the basis of previous experience."

System thinking is concerning of seeing the big picture. System thinking emphasises understanding relationships rather than seeing things in isolation. Systems thinking is necessary for successful product development and for successful process improvement. W. Edwards Deming argued that organisations should be managed as systems, not functional hierarchies. Deming (1989) also pointed out that "A system must have an aim. Without an aim, there is no system", comparing systems to projects that are defined as: "A temporary organisation that is needed to produce a unique and pre-defined outcome or result at a pre-specified time using pre-determined resources", revealing significant similarity, in which both projects and systems share the need to achieve outcomes in order to gain their definition.

Deming's work was based on work done by Walter Shewhart in 1939 (Kasse 2008). The Shewhart cycle (Figure 16) is useful as a procedure to follow improvements at any stage and as a procedure for finding a special cause detected by a statistical signal. Deming

modified such work while working with the Japanese in 1950s and the concepts became known as the Deming cycle, and much of that work was used in building the Capability Maturity Model Integration (CMMI), as it used the same building block of plan-do-check-act.



**Figure 16: The Shewhart Cycle (Shewhart and Deming 1939)**

However, it seems to be the norm today for organisations and their environments to be in a state of constant change. Organisations must adapt to environmental changes in order to survive, not to mention thrive. The same can be said for information systems in organisations. Organisations may even rely upon their information systems in order to understand, analyse, and adapt to such changes. Hence, organisations and information systems are both forms of complex adaptive systems.

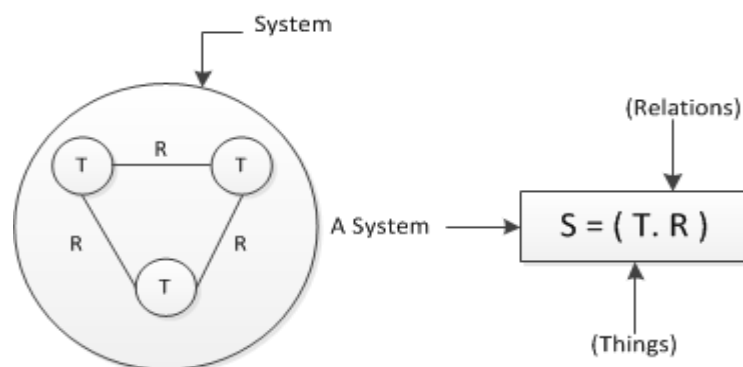
There is no question that information systems in organisations, as they have been defined, are complex. The very basis of information systems, the underlying technologies, programs, machine language, and so forth, are inherently ways of dealing with complexities of calculation and the complexity of the use contexts, in this case, the organisation. What has not been included in the description of information systems as “systems” are several key notions from complex adaptive systems and current compute models that directly or indirectly reflect complex systems modelling (Courtney et al. 2010).

At this point in history, the organisation and its computerised information systems are inextricably connected. There is no turning back, as there may have been as late as the 1970s when reliance on paper-based systems was still a viable option (Courtney et al. 2010, 47).

The need to view projects as systems is not limited to information systems projects. In an interview with Danish architect Jan Gehl on the BBC One Plant program (Wander 2011) Gehl raised the concern that city planners are failing the people they are supposed to be helping. Gehl pointed out that most cities have a transportation department which is responsible to ensure city roads are adequate for cars, buses and all types of transportation. On the contrary, cities do not have departments to ensure services provided to the city residences are adequate and actually enhance their life (the example given is the traffic signals that are designed to ensure fast and easy passage to cars, whilst pedestrians have to wait and run to cross the road when the signal is green). Part of that problem Gehl attributed to the over specialisation in city planning (traffic, building, architecture etc.) without attempting to see the city as whole, or in other words, as system.

A system definition by Hitchins (1992, 56) considered both pragmatic and scientific is the following: "A System is a collection of interrelated entities such that both the collection and the interrelationships together reduce local entropy".

In other words a system is an organised whole in which parts are related together, which generates emergent properties and has some purpose. An often applied mathematical definition of the word system comes from Klir (1991). His formula is however extremely general and has therefore both weaknesses and strengths. In the formula (Figure 17), T stands for a set having arbitrary elements, but it may also represent a power set. R stands for every relationship that may be defined in the set with its special characteristics.





**Figure 17: Formula Defining a System**

Skyttner (2001, 120) pointed that living systems can be classified into eight very real and concrete hierarchical levels. Each new level is considered as being higher than the one it precede and encompass all lower levels. The vital system components of one level are systems in their own right on the level below. In other words, the larger and higher levels with their component lower level sub-systems constitute a suprasystem.

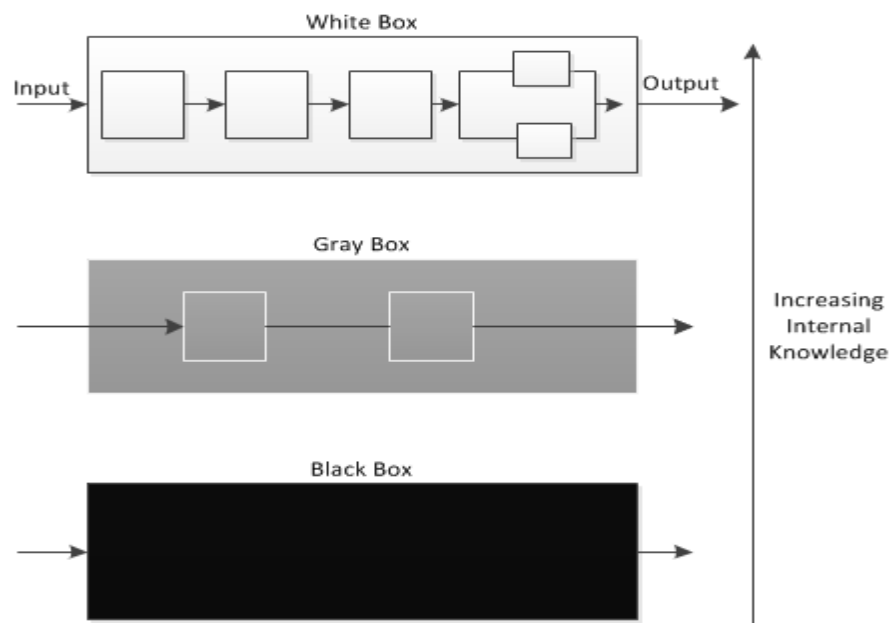
Kenneth Boulding, one of the early pioneers and advocate of Systems Theory (Boulding 1956, 200), suggested possible arrangements of 'levels' of systems which included:

1. "The first level is that of the static structure. It might be called the level of frameworks.
2. The second level of systematic analysis is that of the simple dynamic system with predetermined, necessary motions.
3. The third level is that of the control mechanism or cybernetic system, which might be nicknamed the level of the thermostat. This differs from the simple stable equilibrium system mainly in the fact that the transmission and interpretation of information is an essential part of the system.
4. The fourth level is that of the 'open system', or self-maintaining structure. This is the level at which life begins to differentiate itself from not-life: it might be called the level of the cell.
5. The fifth level might be called the genetic-societal level; it is typified by the plant, and it dominates the empirical world of the botanist.
6. The sixth level as we move upward from the plant world towards the animal kingdom we gradually pass over into a new level, the 'animal' level, characterised by increased mobility, teleological behaviour, and self-awareness.
7. The 'human' level that is of the individual human being considered as a system. In addition to all, or nearly all, of the characteristics of animal systems man possesses self-consciousness, which is something different from mere awareness".

Systems are usually classified as concrete, conceptual, abstract or unperceivable. The most common is the physical system which exists in the physical reality of space and time and

is defined as consisting of at least two units or objects. Kenneth Boulding wrote “A system is a big black box of which we can't unlock the locks and all we can find out about is what goes in and what comes out” (Klir and Elias 2003, 58).

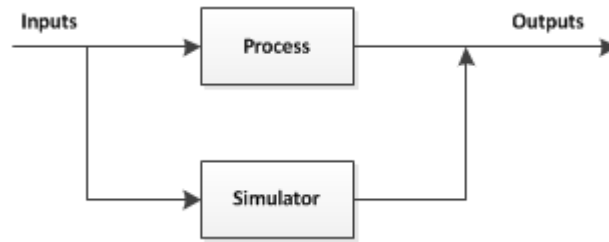
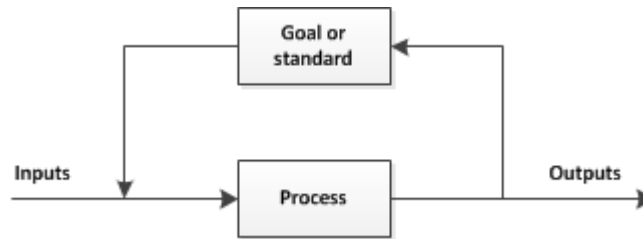
In Figure 18 a black box approach can therefore be the effective use of a machine by adjusting its input for maximum output. A grey box offers partial knowledge of selected internal processes. The white box represents a wholly transparent view, giving full information about internal processes. This command of total information is seldom possible or even desirable.



**Figure 18: Degrees of Internal Understanding (Skyttner 2001, 73)**

In an earlier section of this chapter while discussing project management methodologies, nearly all methodologies called for a post-mortem to take place after each project to assist management and organisations in general to learn from the issues faced by such projects. Open loop systems boundaries can be crossed and might experience uncontrolled inputs and outputs (Figure 19). For systems to adapt to the ever-changing environment, feedback is seen as the main mechanism which allow systems to compensate for changes. Such feedback loops allow systems to maintain certain variables constant, or regulates the types and amounts of particular components (Figure 21). It is often defined as the “transmission of a signal from a later to an earlier stage” (Skyttner 2005, 75). Information concerning the result of own actions is thus delivered as a part of information for continuous action.



**Figure 19: Open Loop System****Figure 20: Feedforward Loop****Figure 21: Feedback Loop**

The feedback serves as a control mechanism as it is based on the actual performance of the system rather than its theoretical performance. Feedback is a key concept in cybernetics, and if the negative feedback of a system disappears, the stable state of the system vanishes and gradually its boundaries disappear, and after a while it will vanish. A living system is a complex, adaptive, open, negentropic system and can thus be characterised as purposive. It maintains within its boundary a less probable thermodynamic energy process by interaction with its environment (Skyttner 2001).

This process is called metabolism and it provide energy to all basic activities in the system, such as reproduction, production and repair. The metabolism or processing of information is of equal importance, making possible regulation and adjustment of both internal stress and external strain.

For systems to maintain constancy over time, living systems must be able to self-maintain and self-repair. Skyttner (2005, 120) pointed out that such abilities take place according to the following points:

- “Information processing;
- Energy processing;
- Material processing;
- Synthesis of parts by combining materials;

- Rearrangement and connection of disarranged parts;
- Energy storing for fuel reserves and necessary structure;
- Removal of worn parts”.

As it is well documented, all systems exhibit variation. When certain targets are set for a project, to avoid failing their targets, workers and managers learn to focus their ingenuity on survival rather than improving processes. Management focus their attention on the variations in targets/benchmarks treating them as different when they are, in fact, just as probable. This means they inadvertently increase the variation in the system, and so managers can survive even if the actual outcome of the project differs from the intended outcomes. Deming (1989, 315) called this phenomenon ‘tampering’ and described it as ‘costly confusion’ “Confusion between common causes and special causes leads to frustration for everyone, and leads to greater variability and to higher cost, contrary to what is needed”.

Stafford Beer's focus (Ramage and Shipp 2009, 191) was on the improvement of organisational performance. He also introduced three indices for levels of achievement which are defined in the following way:

1. **“Actuality:** The current achievement using existing resources and constraints;
2. **Capability:** The possible achievement with existing resources and within existing constraints;
3. **Potentiality:** What could be achieved by developing resources and removing constraints”.

If these indices are related to each other in the way presented below, the concepts of productivity, latency and performance are created.

Checkland (1999, 175) claims that “there are systems which could not be other than they are, given a universe whose patterns and laws are not erratic”, their origin is the origin of the universe and the processes of evolution. Within the natural systems there exists an obvious hierarchy from atoms to molecules. The most fundamental on this level is the social system, represented by family or tribe. Typically, there is the basic need for the members to form a mutual support within the frame of a community. In a sense, with their central structure, social systems belong to both natural and human activity systems.

Organisations and their services are products of their society. They have to keep innovating to survive and build unique identity that distinguishes them from their competitors. A characteristic of this social environment includes the following:

- Changes in today's society taking place with increasing speed;
- Science and technology developing rapidly. Social adjustment and behaviour do not keep pace;
- The complexity of every system is growing rapidly;
- Environment as a whole is becoming unstable;
- Society is increasingly materialistic and acquisitive;
- Contrasts between poor and rich, employed and unemployed and between different ethnic and religious groups, increase all the time;
- Confrontation and violence of different kinds is becoming pervasive;
- Confusion and uncertainty is part of everyday life;
- The society as a whole is transformed toward global civilisation;
- Information and its manifestation like money is instantly mobile around the globe.

Skyttner (2001, 49) summed up and summarised the main features of the system theory as illustrated in Table 14.

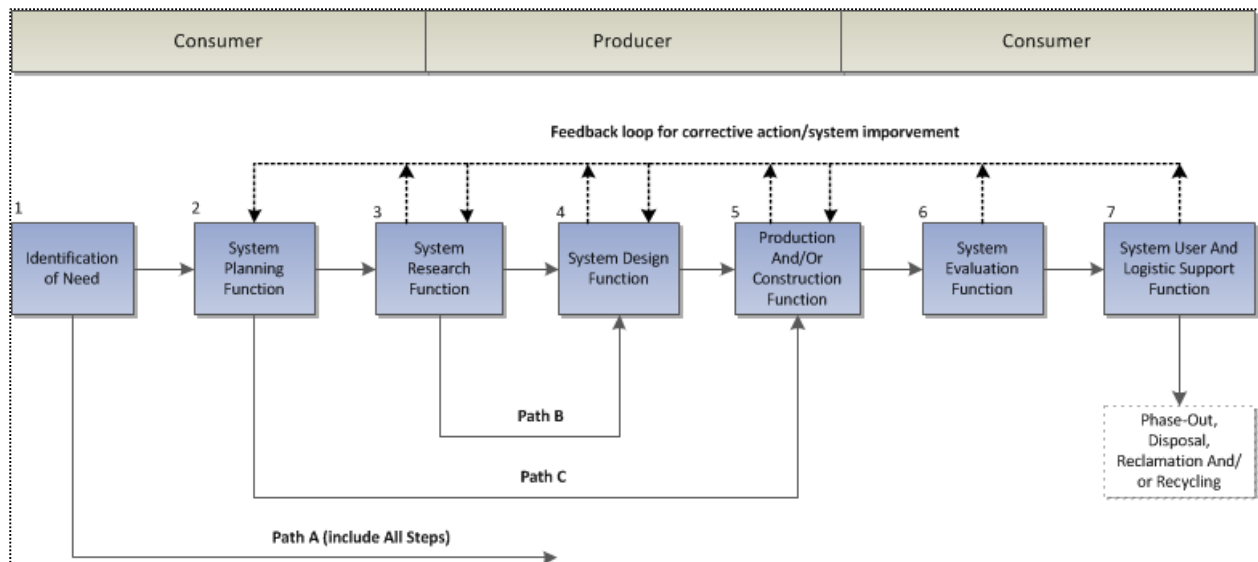
**Table 14: General System Theory Properties Skyttner (2001, 49)**

Property	Description
Interrelationship and interdependence	of objects and their attributes: Unrelated and independent elements can never constitute a system.
Holism	Holistic properties not possible to detect by analysis should be possible to define in the system.
Goal seeking	Systemic interaction must result in some goal or final state being reached or some equilibrium point being approached.
Transformation process	All systems, if they are to attain their goal, must transform inputs into outputs. In living systems this transformation is mainly of a cyclical nature.
Inputs and outputs	In a closed system the inputs are determined once and for

	all; in an open system additional inputs are admitted from its environment.
Entropy	This is the amount of disorder or randomness present in any system. All non-living systems tend toward disorder; left alone they will eventually lose all motion and degenerate into an inert mass.
Regulation	The interrelated objects constituting the system must be regulated in some fashion so that the system's goals can be realised.
Hierarchy	Systems are generally complex wholes made up of smaller sub-systems. This nesting of systems within other systems is what is implied by hierarchy.
Differentiation	In complex systems, specialised units perform specialised functions. This is a characteristic of all complex systems and may also be called specialisation or division of labour.
Equifinality and multifinality	Open systems have equally valid alternative ways of attaining the same objectives from different initial conditions (convergence), or from a given initial state, obtain different, and mutually exclusive, objectives (divergence).

Skyttner (2001, 87) defined the homeokinetic plateau as a quite natural part of what can be called a system life cycle. In living systems this consists of birth, evolution, deterioration, and death. In non-living systems, such as more advanced artefacts, the system life cycle can be divided into the following phases (Figure 22):

- "Identification of needs;
- System planning;
- System research;
- System design;
- System construction;
- System evaluation;
- System use;
- System phase-out".



**Figure 22: System Life Cycle of Advanced Artefacts (Skyttner 2001, 87)**

Whilst projects and systems share many characteristics (life cycle, objectives and feedback), systems tend to be superior in correcting themselves and adjusting their input and processes to cater for unexpected changes. Nations can be viewed as systems; once they are established they build mechanisms to keep improving their ability to serve their citizens (elections, parliament, citizen's assembly, and pooling) in which politicians tweak/alter the politics to ensure citizens' demands or questions are catered for and ensure the nation will survive. Whilst project lifecycles advocate the need for post-mortem review to ensure lessons learnt from challenged projects are passed to management and to the organisations as a whole, the failure rate remains high, particularly in the case of IT projects. Some of those issues that face projects from a system perspective will be discussed in the following section.

Project organisation has been very popular in both private and government organisations as a deliverer of new advantages (Skyttner 2001). Among these the most important are:

- Freedom to act in a better way;
- More solid and well thought out solutions;
- Instructive and inspiring for participators;
- Creates a new pattern of cooperation;
- Influences organisational development;
- More easy to implement solutions.

### 2.5.1 Project Management Systems Issues

Wallace, Keil, and Rai (2004, 305) suggest that “Social Sub-system Risk increases Technical Sub-system Risk, as determined by requirements and technical complexity”. Projects with fluid organisational structure or with substantial resistance increases Social Sub-system Risk which, which, in turn, increases Technical Sub-system Risk. Project management processes such as planning and governance could be used to reduce projects Technical Sub-system Risk.

There are few problems that can be associated with Project Management when viewed as systems.

- 1. Designs for service are based on opinion, not knowledge**

The rapid adoption of project management methodologies in organisations has witnessed the birth of ‘specifiers’ – people who determine the design the features of the systems which should be delivered to the end user. There is now a role called Business Analyst that can be found in many organisations, but it suffers from a lack of definite boundaries or purpose relative to the overall project.

- 2. Targets do not represent the reality of service from the customer’s point of view**

As part of the specification, specifiers decide performance and characteristics of the system. While some of these performance indicators may be valid on a construction site (productivity measure by the number bricks laid per day) they would prove difficult if not impossible to apply to an intellectual field like IT. More disturbing is that some of these measures would be hard to use from a customer point of view, which sees the end product as a tool that would assist in achieving certain tasks.

- 3. Targets drive people to use their ingenuity to meet the target, not improve performance**

Target believers believe the ‘cheating’ phenomenon to be occasional and rare. The reality is that it is ubiquitous and systemic. Taking a systems’ angle, it becomes easy to see that the use of any arbitrary measure as a management device could lead to worse performance. In the project management world in which the golden triangle remains the benchmark of measurement, it is hard to see how projects actually performed in organisations without being an insider, and not just an auditor who will verify a set of documents provided to you by the project team and without



taking into account the culture, work environments, and work practices within the project.

**4. Plausible ideas are publicised without any evidence as to their efficacy**

Organisations tend to adopt methodologies as a way to justify certain management decisions and could unquestioningly adhere to plausible ideas about certain management techniques or methodology, without sufficient scrutiny and in depth studies as to whether the adaption of such techniques would actually aid the overall performance of the organisation. Management often adopt project management methodologies when faced with failure. A recent project failure in one federal agency resulted in a management decision to put 60% of the agency employees through 2 days project management training in the name of risk mitigation.

**5. Management seeks questionable evidence to support their point of view**

Many projects lack robust evaluation; new pilot projects rapidly become 'programmes' which faithfully reproduce the design faults across the whole organisation. Management tend to promote pilot projects as their babies which are destined to succeed, implying that there is a political requirement to report success, regardless of what actually could be the actual outcome of the project. In this insidious way, part of the compliance is providing the regime with evidence, however flimsy, to support what it is doing. (For example, sacking the QA department and asking developers to conduct QA, saved money for the organisation in theory, and did not impact critical production systems).

**6. It is the system – the way work is designed and managed that governs performance**

Only by changing thinking can we start to learn how to manage the organisation as a system and achieve a level of performance that could deliver profoundly better project management practices and better outcomes.

Deming pointed out that the present system of management is something that needs reinventing: the systems approach represents a fundamentally different and more effective way to design and manage projects. Organisations, private and public, are getting into the habit of classifying everything as projects. In some instances, they have projects to scope the actual project. Is it because projects provide management with the illusion of control? To the contrary, many of what are classified as projects

can be merely classified as tasks or work packages that can be achieved without the overhead of projects.

**7. Taking a systems approach could result in performance improvements that would have been considered utterly unachievable if set as a target**

Taking the systems approach in managing projects means rejecting much of what is taken for granted when using methodologies arguably designed to achieve a specified set of benchmarks (time, schedule, scope). It is the strength of the results that could provide a platform for arguing for change. Deming (2000, xv) also highlighted the fact that many “people imagine that the present style of management has always existed, and is a fixture. Actually, it is a modern invention – a prison created by the way in which people interact”.

**8. Project scoping limits the ability for the project to deliver outcomes**

One of the defining properties of systems is Holism which means “all, whole, entire, total” which Skyttner (2001, 46) refers to “systems that cannot be determined or explained by their component parts alone”. Project management methodologies put emphasis on defining the scope which represents the total aggregation of deliverables produced by a project, and it is one element of the golden triangle which is used to manage projects. To the contrary, scope puts restrictions on a project’s ability to deliver desired outcomes, since it restricts the project stakeholder to view overall benefits to the organisations, and could lead to the making of decisions within projects that could have wider implications for the organisation, since the focus is the project.

**9. Project budgeting limitation**

The project budget plays a pivotal role in ensuring that projects can deliver their outcomes. However, project budgets in the public sector are managed differently. In many organisations, projects must submit monthly budgets and in case the project doesn’t spend it, project managers must submit a report to justify the reasons behind that underspend. The approach can be viewed as a tool for accountability and would assist in providing better estimates for future project. To avoid questioning and the paperwork associated with that approach, project managers may opt instead on spending the budgeting instead. Viewing that approach through a systems lens, reveals a different perspective and a deficiency in project management methodologies. Instead of viewing the saving as a measure of effective

project management and ability to utilise resources in a more efficient manner, project management methodologies discourage that and don't promote feedback, which is critical to maximising the efficiency of any system.

While trying to take a systems view of the organisations and projects within, it becomes clear that traditional command-and-control thinking in management suffers from some fundamental problems. Some of the most important ones are summarised below:

**1. Treating all demand as though it is 'work'**

When project managers assume that all work or customer demands associated with the project as 'value work'. In reality many of such requests could be classified as failure demand. Many projects attempt to have a comprehensive set of requirements upfront assuming that would cater for most customer demands, ignoring the fact that customers will ask for everything fearing that many of their late requests may not be fulfilled by management, thus they would submit requests for features that may never be used.

**2. Failure demand – a lever for improvement**

Call centres established in the UK reveal that many of them were established in response to failure demand (Seddon 2008) as they were mandated by ministers assuming that access was synonymous with service. The same phenomenon can be related to how governments rush to establish IT projects in response to policy change, without measuring the effectiveness of such projects. In their response to the failed Home Insulation Program, the Commonwealth of Australia Department of Environment admitted their lack of project management expertise in the area of planning, risk assessment, communication, reporting, quality management, documentation, leadership and supervision, but more importantly the lack of qualified personnel. The failed project ended up costing taxpayers around A\$1.45 billion and resulted in the death of four installers between October 2009 and February 2010 (McPhee 2010). The project was part of an overall federal government initiative to lessen the impact of the global financial crisis, since senior management focused on activities and not on the purpose and led others to believe that they had adequate measures in place to handle the demand either by making under-staffed departments handle more demand which they didn't plan for, and focused instead

on meeting unrealistic ministerial delivery dates that went unquestioned and lacked proper risk assessment.

To think about flow in systems terms is to think from the outside in and then work back from the end customer. It is only by understanding demand, that organisations can evaluate flow, which will define how the system or services will be provided. Managing flow and demand would allow organisations to design systems and services that are suited to serve their end users, resulting in the removal of waste, increasing capacity, improving quality and lowering the cost of the overall system.

### **3. Preventing the system absorbing variety**

Many organisations have established practices that effectively stop the system's ability to respond to change. A project that has no knowledge of demand is unable to absorb variety using the golden triangle as a benchmark. Not measuring the end customers satisfaction of the system prevents the system from absorbing variety, such as if a call centre relies too much on scripts and procedures and fails to listen to the customers in order to solve their problems.

Saynisch (2010, 21) highlighted that the "traditional project management cannot fulfil the challenges and requirements for mastering increased complexity in society, economies, and technology". He also defined the concept of "Project Management Second Order" as a new paradigm in project management, answering to the challenges. He emphasises that there are many "deficits in our way of thinking" which is typically associated with the adoption of new ideas, which would alter the status quo.

## **2.6 Chapter Summary**

This chapter explored the body of knowledge of discipline related to this study (quality, security, project management, software development, and systems theory) that influenced and grounded this study. This section examined challenges faced by information technology projects delivery and the likelihood of this phenomena to continue. Current software development and project management methodologies are not intended to deal with challenges related to the human aspect of projects. There is a need for a different approach to deal with the challenged projects and address issues that contributed to their derailment and their inability to achieve their intended outcomes.



Men who wish to know about the world must learn about it in its particular detail

Heraclitus (c. 535-475 B.C.)

## 3 Research Methodology

This chapter describes how the study was planned and implemented, based primarily on Yin's (2011) guidelines for conducting case study research, to answer the research questions. The chapter describes the research methodology including a discussion of alternative research methods, justifying the chosen method utilised for this research. It describes the design of the case studies and the data collection and data analysis processes. It highlights how validity threats were handled. Later in the chapter, it describes how the final research outcomes were validated and verified to ensure their suitability for the intended purpose.

### 3.1 Research Methodology

A research methodology encompasses the choices and decisions made concerning a research project and covers how the researcher plans and implements the research, including how data is collected and analysed (Silverman 2011). The research methodology applied in an empirical study defines the subset of acceptable research methods for that study (Yin 2011b). There is a considerable range of research methods available to information systems researchers. Easterbrook et al. (2008) identified five main research methods that are most relevant to information technology research:

- Controlled Experiment (including Quasi-Experiment);
- Case Study (both exploratory and confirmatory);
- Survey;
- Ethnography; and,
- Action Research.

While there is no single research method that can be called universal, valid and applicable as argued by Gill, Johnson, and Clark (2010), it is clear that all have their strengths and weaknesses.

This was made apparent in the comprehensive review conducted by Hofer and Tichy (2007) who conducted an analysis of all refereed articles which had been published in the Journal of Empirical Software Engineering from January 1996 to June 2006. Their findings

(Table 15) point to the case study as one of the most dominant research methods in information systems which they consider to be 'encouraging' as this research methodology allows for in-depth analyses of complex relationships.

**Table 15: Research Methods used in Empirical Software Engineering Research (Hofer and Tichy 2007, 6)**

Research Method	Percentage (%)
Experiment	37.6
Case Study	28.6
Co-relational Study	11.3
Survey	6.0
Meta-Analysis	5.3
Ex Post facto study	2.3
Ethnography	1.5
Phenomenology	0.8
Other	6.8

### 3.1.1 Quantitative versus Qualitative

The use of either a quantitative or qualitative research methodology is often determined by the objectives of the study. The distinct characteristics of each research approach, coupled with the research questions of the study being undertaken, guide the researcher to make appropriate decisions when selecting the an approach. Table 16 lists some of common characteristics of these two research approaches.

**Table 16: Comparison of Quantitative and Qualitative Research (Mack et al. 2005, 3)**

	Quantitative	Qualitative
<b>General Framework</b>	<p>Seeks to confirm hypotheses about phenomena</p> <p>Instruments use more rigid style of eliciting and categorising responses to questions</p> <p>Use highly structured methods such as questionnaires, surveys, and structured observation</p>	<p>Seeks to explore phenomena</p> <p>Instruments use more flexible, iterative style of eliciting and categorising responses to questions</p> <p>Use semi-structured methods such as</p>



		in-depth interviews, focus groups, and participant observation
<b>Analytical objectives</b>	To quantify variation To predict causal relationships To describe characteristics of a population	To describe variation To describe and explain relationships To describe individual experience To describe group norms
<b>Question format</b>	Closed-ended	Open-ended
<b>Data format</b>	Numerical (obtained by assigning numerical values to responses)	Textual (obtained from audiotapes, videotapes, and field notes)
<b>Flexibility in study design</b>	Study design is stable from beginning to end  Participant responses do not influence or determine how and which questions researchers ask next  Study design is subject to statistical assumptions and conditions	Some aspects of the study are flexible (for example, the addition, exclusion, or wording of particular interview questions) Participant responses affect how and which questions researchers ask next  Study design is iterative, that is, data collection and research questions are adjusted according to what is learned

### 3.1.2 Research Method/Interpretive Case Study

Myers (2009) suggested that case studies outline the story of the organisation involved in the research. One of the main purposes of this research was to attempt to understand the interaction and developments in information technology software development projects in order to tell the story of the organisations involved in the research.

Often, case studies follow the interpretive practice of the researcher. Kaplan and Maxwell (2005, 35) pointed out that “interpretive research does not predefine dependent and independent variables, but focuses on the complexity of human sensemaking as situations emerge”. Interpretive methods of research in information systems are designed to produce an understanding of the environment and the context of the systems under investigation, and the “process whereby information systems influence and are influenced by the context” (Walsham 1993, 4).

Hence, interpretive research is very well suited to the research objectives of exploring issues associated with the implementation of information technology projects in organisations. “Interpretive research does not seek any statistical generalisation but caters for an in-depth insight and theoretical generalisations can be drawn at later stages” (Walsham 1995, 391). Theoretical generalisations would be used to construct a model that would support the research contribution on how to overcome some of the challenges faced during the implementation of information technology projects.

Interpretive methods of research in information technology are “aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context” (Walsham 1993, 4-5).

One of the main advantage of interpretive cases study research lies in its ability to provide deep understanding of the phenomena under investigation which allows the researcher later on to generalise from the case studied to theory (Walsham 1995).

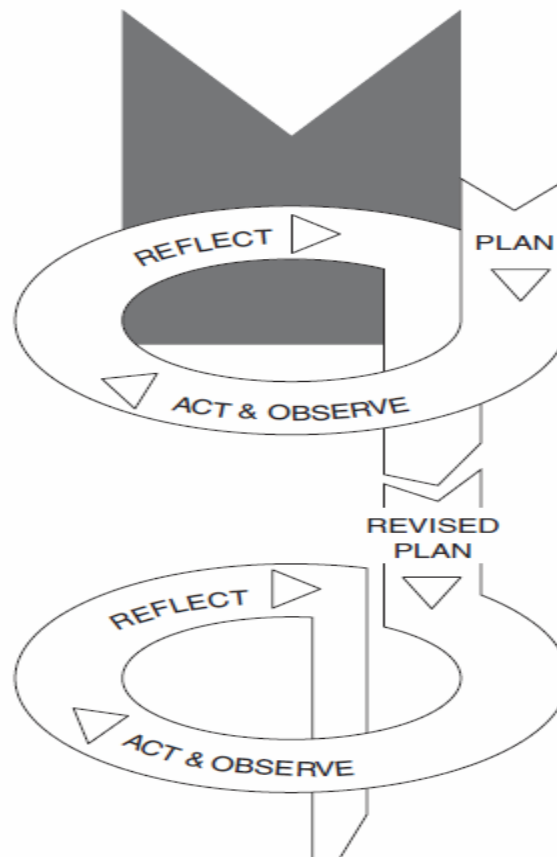
### **3.1.3 Action Research**

As the name suggests, action research is a methodology that has the dual aims of action and research, Dick (1993, 6) described action as bringing about change in some community or organisation or program. Dick also defines research as increasing understanding on the part of the researcher or the client, or both (and often some wider community).

Jung and McCutcheon (1990, 148) defined action research as “a form of collective self-reflective inquiry undertaken by participants in social situations in order to improve the rationality and justice of their own social or educational practices, as well as their understanding of these practices and the situations in which these practices are carried out”. Action research aims to contribute both to the practical concerns of people in an “immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework” (Rapoport 1970, 499).

Action research main objective is to learn through action, which would lead to either personal or professional development or both. Kemmis and McTaggart (2005) described action research as participatory research. (Kemmis and McTaggart 2005, 276) also pointed out to the nature of action research as spiral of self-reflective cycles that consist of

- “Planning a change;
- Acting and observing the process and consequences of the change;
- Reflecting on these processes and consequences and then replanning;
- Replanning;
- Acting and observing again;
- Reflecting again and so on....”



**Figure 23: Kemmis and McTaggart’s Action Research Spiral (Kemmis and McTaggart 2005, 278)**

Figure 23 illustrates the spiral model of action research proposed by Kemmis and McTaggart (2005a, 278), although the authors do not recommend that this be used as a rigid structure, since in reality the process more likely to fluid and subject to change during implementation taking into consideration the learning process embedded in the process.

### 3.1.3.1 Characteristics of Action Research

Burns (1994) stated four basic characteristics of action research as:

1. Situational;
2. Collaborative;
3. Participatory;
4. Self-evaluative.

There are number of verities of action research, McKernan (1996, 16) listed three types of action research:

- “The scientific-technical view of problem solving;
- Practical-deliberative action research;
- Critical-emancipatory action research”.

#### **3.1.3.2 Scientific-Technical View of Problem Solving**

One of the main objectives of the scientific-technical research approach is testing specific solutions employed by practitioners in its natural settings. In this type of research, the researcher typically identifies the problem and proposes a set of options on how to solve the problem. The practitioners are then involved in the solution implementation in the field (Holter and Barcott 1993). The interaction between the researcher and practitioner is technical, and that is essential in achieving the stated research goals. Lewin’s (1947, 148) model of action research identified two major stages:

- Diagnostic, in which problems are analysed and the solution is developed;
- Therapeutic, in which hypotheses are tested, directing change experiments in real settings.

The accumulation of predictive knowledge is the result of this approach to action research.

##### **3.1.3.2.1 Practical-Deliberative Action Research**

Holter and Barcott (1993) described the practical-deliberative action research, as a joint effort between the researcher and practitioner to identify the problems, their underlying causes and possible solutions. The problem definition is a result of deliberation effort between researcher and practitioner based on their shared understating of the issues faced

during the investigation. One of the direct benefits of that type of action research, it encourages improvements in practices building on the expertise gained in the field.

### 3.1.3.2.2 Critical-Emancipatory Action Research

Critical-emancipatory action research according to Grundy (1987, 154) “promotes emancipatory praxis in the participating practitioners; that is, it promotes a critical consciousness which exhibits itself in political as well as practical action to promote change”. (Holter and Barcott 1993, 302) identified two main goals for Critical:

1. To increase the closeness between the actual problems encountered by practitioners in a specific setting and the theory used to explain and resolve the problem;
2. Assist practitioners in identifying (and making explicit) fundamental problems by raising their collective consciousness.

### 3.1.4 Case Study

In this study, the case study approach was adopted to allow for a thorough understanding of the complex relationships within an IT setting as this is a research approach in which one or a few instances of a phenomenon are studied in depth. In particular, case studies typically examine the interplay of all variables in order to provide as complete and as descriptive an understanding of an event or situation as possible. Yin (2002, 23) provides a technical definition of the case study “as an empirical inquiry that investigates a contemporary phenomenon within its real-life context: when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used”.

Benbasat, Goldstein, and Mead (1987, 371) listed the eleven key characteristics of case studies as follows in (Table 17).

**Table 17: Case Study Key Characteristics (Benbasat, Goldstein and Mead 1987, 371)**

No	Characteristic
1	Phenomenon is examined in natural setting.
2	Data are collected by multiple means.

3	One or few entities (person, group or organisation) are examined.
4	The complexity of the unit is studied intensively.
5	Case studies are more suitable for the exploration, classification and hypothesis development stages of the knowledge building process; the investigator should have a receptive attitude toward exploration.
6	No experimental controls or manipulation are involved.
7	The investigator may not specify the set of independent and dependent variables in advance.
8	The results derived depend heavily on the interpretive powers of the investigator.
9	Changes in site selection and data collection methods could take place as the investigator develops new hypotheses.
10	Case research is useful in the study of 'why' and 'how' questions because these deal with operational links to be traced over time rather than with frequency or incidence.
11	The focus is on contemporary events.

Six types of case study have been identified and categorised by Burns (1994):

**Table 18: Case Study Types**

Case Study Type	Definition
<b>Historical Case Study</b>	Historical case studies tend to trace the progress of an organisation or system over a period of time. This type of case study depends intensively upon historical records, documents, and interactive interviews.
<b>Observational Case Study</b>	This type of case study is usually conducted in a group environment for a specific category of people (for example, a classroom environment with first year computing degree students). It often uses a variety of observation or interview methods as the

	major data collection tools.
<b>Oral History</b>	This usually involves extensive interviewing and collection of information from a single individual. Normally, the researcher does not have a particular individual in mind, but meets with a person for the first time while exploring the research topics.
<b>Situational Analysis</b>	In this approach, particular events are studied in terms of the views of all participants. All participants' views are collected and analysed to build in depth understanding of the situation. Interviews, documents, and other records are the key sources of this type of case study
<b>Clinical Case Study</b>	The main objective of this type is to understand a particular individual comprehensively. This type of case study typically utilises detailed interviews, non-participant observation, documents, and records.
<b>Multi-Case Studies</b>	Multi-case studies refers to a collection of case studies, which is a form of replication, or multiple experiments. Furthermore, the arguments and variables of each case must be consistent in order to produce similar or contradicted results. The outcome should validate the research proposition, or provided evidence to the need to review the proposed suggestions with another set of case studies for retesting.

Stake (1978, 6) pointed out that case studies can be used to “test hypotheses, and practically to examine a single exception that shows the hypothesis to be false”, while Burns (1994) stated that case study research can be either a form of quantitative statistical research or qualitative descriptive research, or even a combination of both

Case study research is the ideal research technique when asking the ‘how’ and ‘why’ questions, unlike quantitative research methods that focus on ‘who’, ‘what’, and ‘where’ questions. It is worth noting that case study is the preferred research method when the researcher focuses on real life and has limited control over the situation investigated as he is the observer rather than a participant.

Myers (1997, 3) claims that case study research is “the most common qualitative method used in information systems”. Case study research provides the researcher with the opportunity to collect rich and in depth information not usually offered by other research methods. The case study research method has the unique ability to capture as many variables as possible, and it could be used to identify how a complex number of issues manifest to produce a particular situation (Hancock 2002). The other benefit of the case study research is that it is highly flexible, which can incorporate any, and all, methods of data collection.

Kelly also suggested that case studies share some general features illustrated in Table 19.

**Table 19: Case Study Research General Features (Kelly 1999, 120).**

No	Feature
1	Case studies examine all aspects of the object(s) of analysis that are relevant to the study, taking full account of the broader context.
2	They utilise a variety of research tactics or methods in order to gain a thorough understanding of the object(s) of analysis.
3	They will begin with theoretical foundations which frame the process of inquiry, and will often conclude with insights into theory.

Case studies require a problem that must be understood holistically. With case study research taking place over a period of time which can range from a number of weeks to years, it involves multiple actors, and is influenced by events taking place during the investigation. Benbasat, Goldstein, and Mead (1987, 378) claimed that case study research is “well suited to identifying key events and actors, linking them in a causal chain. The time period is fundamental in allowing for complexities to emerge as this enables the researcher to study the phenomena in detail to determine causal relationships, a vital component of case study research.

### 3.2 Research Method Selection

According to Yin (2011a), the fundamental considerations in choosing a research method are the research topic itself and the type of research question to be answered. It is essential to consider factors such as time and resource constraints, and access issues (Yin 2011a).



Based on the research topic and research questions, the goal of the study is to deepen an understanding of an issue faced during the implementation of information technology projects and how those issues can be addressed. Therefore, this research method was needed to facilitate exploratory and confirmatory investigation.

Considering the options identified by Hofer and Tichy (2007), the survey method presents difficulties in addressing the current research objectives for more than one reason. First, a survey is unable to answer 'how' and 'why' type research questions. Second, a survey hardly deals with context, but its ability to do so is limited in comparison to other research methods. Finally, the survey does provide a onetime snapshot and limits the number of questions to attract an acceptable number of responses and provides only one source of data. As a result, the survey method is not ideal for the data collection of this study. However, it will be used to validate the results of the proposed solution for the discussed problems in this research. By contrast, this study needs to answer the 'how' type research questions and investigate the context of the phenomena discussed.

Similarly, although controlled experiments are able to answer 'how' and 'why' type research questions, such methods are not ideal for the research objectives as they won't reveal the level of detail required to understand the issues facing information technology implementation. Wohlin et al. (2000, 984) argue that an experiment is "conducted when the investigator wants to control the situation, with direct, precise, and systematic manipulation of the phenomenon studied". By contrast, the research and the research questions require observation in an actual environment with no manipulation of any sort, as the study seeks observation of the unconstrained dynamics of information technology projects in their original settings.

Similarly, action research was not selected as it would involve the researcher intervening in the course of the real life action, which would be counter to the objectives of the study.

Ethnography could be used to address some of the research questions. However, modern ethnography is built on fieldwork and requires the complete engagement of the researcher in information technology projects for an extended period of time. Taking into account that some projects can take years to complete, such a level of access was not possible to achieve for this research and would be nearly impossible to gain. The scope of ethnography is far more expansive than what was required here.

Yin (2011a, 18) described the case study method as “an empirical inquiry that investigates a contemporary phenomenon with its real life context, especially when the boundaries between phenomenon and context are not clearly evident”. Case study research provide rare chance to close match for answering the research questions and achieving the research objectives, and is recognised as a suitable methodology for information technology research according to Benbasat, Goldstein, and Mead (1987). Case study research investigates predefined phenomenon without applying explicit control or manipulation of variables (Cavaye 1996). Yin (2011a) suggested that case study research is appropriate when investigating the more interesting ‘how’ or ‘why’ type questions which can used to explain complex situations, where the researcher has little control or no control over the situation and plays the role of observer. This describes the requirements for this study in which gaining a deep understating from the field is paramount for answering the research questions. Consequently, case study was selected as the study’s research method.

More specifically, a multiple case study design was selected, as it provided more understating of the phenomena as it happened in multiple locations, each with its unique set of circumstances, and actors who provided more rich pictures that allowed the researcher to gain a rich picture of the problems. Moreover, the study design facilitated the process of answering the research questions.

### **3.2.1 Case Study Design**

This section describes the design of the multi-case study undertaken for this research. Research design can be defined as “the logical sequence that connects the empirical data to the research questions and ultimately its conclusions” (Yin 2011a, 19). It is a fundamental for research studies covering what questions to investigate, what data are relevant, what data are to be collected and analysed Philliber, Schwab, and Sloss (1980).

Yin (2002, 21-28) identifies five components of a research design that are especially important for case studies:

- A study’s questions;
- Its propositions, if any;
- Its unit of analysis;

- The logic linking of the data to the propositions; and
- The criteria for interpreting the findings

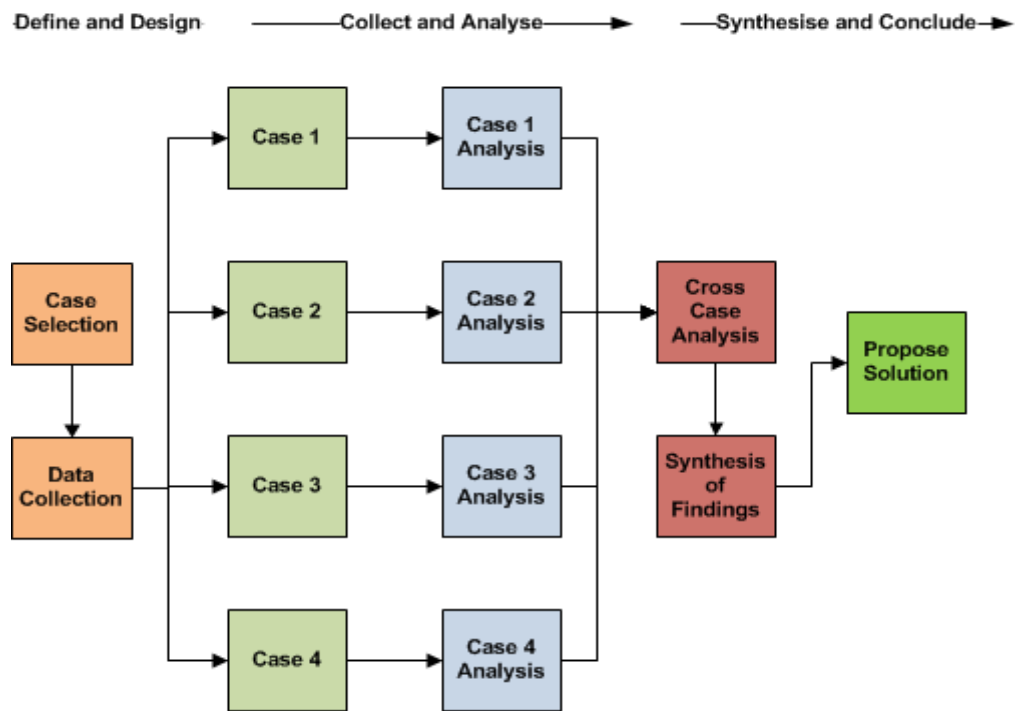
This study is guided by the following research questions:

1. What are the underlying factors in IT development projects at risk of failure?
2. How can management intervene in a holistic and structured way to address these factors and mitigate the risk of failure?

The research questions for this study have an exploratory element as they attempt to investigate issues and identify ways of addressing them. The unit of analysis was information technology projects identified later in section 3.5. The literature review presented in this research was used to inform and investigate the existence of the issues historically as faced by information technology projects. In the process of constructing the case studies, more evidence and issues were identified in support of the literature.

The primary criterion for interpreting the case based data was issues faced by the information technology projects, intentionally or unintentionally enacted, and it helped to develop the framework proposed in later chapters of this document.

The study was designed to collect data from multiple information technology projects that used varied software development and project management methodologies, via a multi-case design (Yin 2011a), with each project representing a specific case as illustrated in Figure 24.



**Figure 24: Multi Case Study Design**

Once organisations approved the research and the researcher was allowed access to the site, the data collection stage began in earnest and case reports were prepared. Next, a within-case study analysis was performed to identify issues faced by each project under study. Finally, a cross case analysis was undertaken by identifying similarities and differences across the four cases to gain a deeper understanding of the phenomena under investigation. The resultant findings were used to inform the research and the researcher in proposing an approach that could be used to address such issues.

### 3.3 Case Study Preparation

Preparations for this study were based primarily on Yin's (2009) recommended case study research guidelines as follows.

#### 3.3.1 Ethics Approval

To comply with Curtin University of Technology policy to protect human subjects and the organisations involved in the research project during the data collection phase of this study a formal ethics approval was submitted for approval. Formal approval was received in due course for the interaction with the human subjects. Where participants were asked to take part in interviews, questionnaire or provide documents, consent from

all persons who took part was received to ensure their privacy and confidentiality would be strictly maintained in the study.

### **3.3.2 Case Study Framework**

A case study framework provides systematic procedures to be followed throughout a case study (Yin 2011a). Adhering to a case study framework increases the research reliability, as well as ensures the data collection is consistent regardless of the individual characteristics of the case. It is a way of increasing the reliability of the case study research and is intended to guide the investigator in carrying out the data collection phase consistently and objectively, and subsequent analysis of each case. In this study, a case study framework was developed, based on Yin's (2009) guidelines that included an overview of the case study project, steps taken once in the field, and sets of questions that at minimum should be repeated across all sites researched. The aim of such a framework was to facilitate consistency in the multi-case research by enabling a common approach to be adopted across cases. The framework also helped to ensure a 'chain of evidence' during data collection and extending into data analysis to increase reliability of the study. The case study framework and brief description of each case can be found later in the chapter.

### **3.3.3 Case Selection**

The selection of cases was driven by the research questions and adequate access to suitable information technology projects. Purposeful sampling was used to select companies or organisations that employed information technology as part of their business. The choice of organisations in this study was also opportunistic, being built upon industry relationships initiated by the researcher. More organisations were asked by the researcher to take part, and some agreed; however, some of the projects were cancelled before the researcher had the opportunity to gain access to the site, and they chose not to continue. The selection criteria for the inclusion of projects are discussed in more detail shortly.

## **3.4 Data Collection**

Complex socio-technical <sup>1</sup>phenomena are best understood and explained through qualitative research, using “qualitative data such as interviews, documents, and participant observation” (Myers 1997, 4). Qualitative interviews are one of the most commonly used data collection tool in qualitative research (Myers and Newman 2007). Accordingly, the data collected to construct the case studies discussed later in this research were obtained via different methods, primarily through qualitative semi-structured interviews to elicit participants’ understanding of the issues faced in their projects. Data were also collected using other qualitative data sources, including direct observation, documentation and artefacts.

Therefore, a range of qualitative data collection methods was used to capture and triangulate the understanding gained from each information technology project to the others identified in this research. The raw data were recorded and analysed to capture the main findings of the case studies and used to inform the researcher for the solution proposed later in this document.

### **3.4.1 Interviews**

Formal and informal interviews were used in this study to obtain rich data to enable better understanding of the phenomena.

Hays (2004, 246) stated that, “interviews are one of the richest sources of data in a case study and usually the most important”, since they provide the researcher with information from a variety of different perspectives. They can provide direct access to the human participants involved in real world phenomena and are subject to the expertise, perceptions and opinion of the people involved. This limitation is handled by triangulating data collected using various data collection techniques (Yin 2002, 85).

Yin (2002, 108) argues that “interviews are an essential source of case study evidence because most case studies are about human affairs”. The human element of the interview should be understood by the interviewers and used to provide more insights into the situation under investigation. They can also provide reasoning to the situation from a

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<sup>1</sup> Social-Technical system views organisations as a social setting with unique cultures, structures, methods and machines that constitute a system

historical perspective, which would help the researcher to identify the relevant type of evidence.

Tellis (1997, 11) pointed out that “interviews could take one of several forms: open-ended, focused, or structured”. In open-ended interviews the researcher has the liberty to ask for the informant’s opinion on events or facts, which helps the researchers to validate the data collected. In focused interviews, the respondents are interviewed for a short period, with the questions likely to come from the case study itself, structure interviews is similar to a survey and questions are detailed and developed in advance. According to Bernard (1988, 205) “semi-structured interviews are conducted with a fairly open framework which allows for focused, conversational, two-way communication”. Yin (2009) notes that throughout the interview process, the researcher should:

- Follow a line of inquiry as reflected in the case study protocol; and
- Ask conversational question in an unbiased manner.

There are advantages and limitations to adopting the interview method in constructing a case study. The greatest value lies in the ability of the researchers to collect in-depth and detailed information from the setting.

In this research, semi-structured interviews were carried out in which respondents were asked about their projects, as well as their opinions about project events which in their view influenced the overall project outcomes. To obtain a top-down view of each case identified for the research, the interview always started with general questions about the beginning about the project, followed by more specific questions about the role of software development and project management methodology in the project, as well the steps that took place to address issues in the project. Such an approach enabled the researcher to ask the same questions for each case, and allowed sufficient flexibility to permit participants to discuss other issues that they felt to be important, relevant to their projects and related to their role in that project.

Participants were provided with information about the interview structure and how it would be carried out, in addition to an outline of the major objectives of the research. Twenty four formal interviews were conducted, each lasting an average two hours. All of them were conducted face-to-face within the organisation premises. All interviews were conducted in accordance with the case study framework. On average six participants

were formally interviewed from each project identified for this research. Informal interviews with the same participants, as well other members of the project team, took place to further the understanding of the issues faced by the project, as well as to ensure the consistency of the data collected. The following team members were interviewed for each project:

- Project sponsor;
- Project manager;
- Test manager;
- Business analysts;
- Developers;
- Test Analysts;
- Business representative.

It is not always plausible to assume that the root cause behind the constant delays in the project could have been found merely by interviewing people. Lying is an understudied activity, particularly in the information systems project. Yet lying is apparently quite common. In a 2006 survey of software practitioners by Glass, Rost, and Matook (2008, 90), “86% of the respondents had encountered such lying. The most common occurrences were in estimation and status reporting, with those forms of lying happening with 50% of projects; some respondents even claimed there was lying to the extent of 100%”. The survey respondents indicated when lying takes place, project staff at the bottom level of the decision-making hierarchy are most aware of it. However, most the respondents indicated that lying is human nature and that little can be done about it (Glass, Rost, and Matook 2008).

very difficult to find people who would have been willing to answer inconvenient questions informal interviews” (Myers 2009, 127). The reluctance is amplified by the fact that those people would be held responsible for the failure and they may be subject to losing employment with organisations studied, and if they were permanent staff they would end up being ignored or marginalised in future projects.

### **3.4.2 Direct Observation**



Evidence collected during direct observation provides additional details on issues being studied (Yin 2002). This is especially true in case studies involving information technology professionals, because the interaction of individuals within the project or the organisation cannot be understood without observing the actual project environment. Cooper and Emory (1995, 434) provide this definition: "Observation qualifies as scientific inquiry when it is specifically designated to answer a research question, is systematically planned and executed, uses proper controls, and provides a reliable and valid account of what happened".

There are two types of observations according to (Kumar 2005):

- Participant observation;
- Non-participant observation.

Participant observations can range from casual to formal and occurs when the researcher is not a passive observer. Instead, the researcher becomes an active member of the case study situation being studied (Yin 2002).

The "non-participant observer stands aloof from the case he is investigating and eschews group membership" (Burns 1994, 373). In this case, the researcher as observer will listen, watch and record the behaviour of case study participants but remain a passive observer, and a conclusion can be drawn later about the project.

In this study, the researcher had uninterrupted access for a period of time, followed by visits to the projects every two weeks. The researcher collected observational data by observing the day-to-day project activities, including attending project meetings where possible. The observations assisted by providing the researcher with direct knowledge of the projects and its issues, its history and a more detailed understating of the project team members. Observations played an indirect role in providing the researcher with the structure that would be used later to address project issues. It also provided a means of verifying the data collected in the interviews.

### **3.4.3 Documentation**

Yin (2009) notes that the most important use of documents is to validate and extend evidence collected from other sources. Yin (1989, 65) identified six main sources of evidence for case study research, which could be used in this research:

- “Documents;
- Archival records;
- Interviews;
- Direct observation;
- Participant-observation;
- Physical artefacts”.

These sources of data can be used to consolidate and/or elaborate data from other sources. They are also valuable in suggesting directions for interviews and observations (Hays 2004). Sometimes, documents can serve as substitutes for records of activity that the researcher could not observe directly (Stake 1978).

Project documentation and specifications were obtained and examined, which were used for background information about the project and its nature and constraints. Organisational and other contextual information was also collected (status reports, e-mails, meeting minutes) for each project. Such data informed the researcher and enabled triangulation against information obtained from formal and informal interviewers with the research participants.

#### **3.4.4 Surveys**

The survey research method most often used in social research according to (Jupp 2006, 284) has three defining characteristics, “its type of content, its form of data and the method of analysis employed”. In the survey research method, the researcher selects a sample population and administers a well- designed questionnaire to them. Collecting data using questionnaires provides the flexibility to decide the optimal size of the population being surveyed. Surveys can take a number of forms and distributed through different mediums . Hays (2004) defined three main categories of survey presentation namely, oral, written or electronic surveys.

A survey (Appendix A) was used in this research to validate the final research outcomes. This survey was sent to information technology experts who were engaged in current Information Technology projects and they were asked to validate this proposed framework presented in chapter 5.

## 3.5 Research Procedure

### 3.5.1 Case Study Selection

Organisations are unique entities – privately held organisations can be identified with a set of features that set them apart from publicly owned organisations or the public sector. What sets both apart is the way they operate. Those organisations that are considered to be in the public sector typically provide government services to the community, and do not typically compete with other organisations or seek profit. Private sector firms, on the other hand, do have goals like outdoing their competitors, and optimising their profits.

Most public sector organisations are managed under a command and control hierarchy, while private sector organisations mostly operate in a corporate setting. When it comes to policy decisions, public sector organisations operate under mandated laws and government policies, while a board representing shareholders governs private sector organisations.

Public sector organisations are accountable to the government and the government is held to its election promises, while private organisations are accountable to their shareholders and the company charter.

Case studies selected for this research represent the small to large organisations that operate privately or as part of the public sector of the Australian governments at state or federal level. The case studies are four organisations that use information technology to deliver a set of products or services to the public or to other organisations, and none of them are pure information technology providers.

One case study represents the financial sector operating in South East Asia, another one represents a state level public sector department and the third case study represents a public owned but privately operated power utility company. The fourth case study is of a federal government department that provides social services for nearly all Australians. Information technology is used as an enabler rather than being core activities to those organisations.

Geographically, the organisations were located in South East Asia, Western Australia and the Australian Capital Territory. While Australia is one country, each state has a distinct culture and government structure. Asia in general is different from Australia, and South

East Asia has a different culture when compared to Australian government or business cultures.

The overall size of the organisational workforces varied significantly and nature of each project studied was different.

1. South East Asia Stock Exchange (around 600 staff), with nearly 160 staff involved in the project;
2. State government department (1000 staff), with 10 staff involved in the project;
3. Utility company (600 staff), and 6 staff involved in the project;
4. Federal department (4000 staff), 500 working in the Information Technology division, 30 in the section and 8 engaged in the project.

The budgets and the duration of the projects varied from a few hundred thousand dollars to multimillion dollar investments by the respective organisations.

Projects studied during this research within the selected organisation comprised of green field (new development), software application upgrade, or migration, projects. To summarise (Table 20) the criteria used to select the cases studies, eight main criteria were established for selecting the sites (monetary amounts in Australian dollars):

**Table 20: Case Study Selection Criteria**

Case Study	Stock Exchange	Utility Company	State Department	Federal Government
<b>Industry</b>	Finance	Power generation and distribution	Public Sector	Public Sector
<b>Organisation Size (Staff)</b>	600	600	1000	5583
<b>Project Size (Staff)</b>	160	6	10	8
<b>Project Type</b>	Upgrade and Migration	Migration	Upgrade	Green field
<b>Engagement Type</b>	Outsourced	Internal/Outsourced	Internal/Outsourced	Internal
<b>Location</b>	South East Asia	Western Australia	Western Australia	Australian Capital Territory

<b>Project Budget</b>	\$SGD90 Million	\$AUD12 Million	\$AUD2 Million	\$AUD500,000
<b>Project Duration</b>	18 Month	12 Month	24 Month	6 Month

### 3.5.2 Data Collection

The structured interview was designed to obtain data about the project and project management practices related to the organisation. The first part of the interview attempted to collect data on the level of project success. The second part of the interview focused on the quality assurance process utilised in the project.

Data collection duration varied for each case study, in the case of the power utility company. Data collection took place over a four month period. Follow up phone calls, emails, and short meetings took place for another six months. Data was collected through semi-structured interviews with all project staff, including the program manager. Short meetings were held with the information services section manager.

In the second case study of the South East Asia financial institution, the researcher spent six months with the project until it moved from the testing phase into production. The researcher aimed to study a large scale project in depth, focusing on the project management, quality assurance methodologies, the internal and external 'factors' or issues which influenced the project, the outcomes of the project, and participants' perceptions of the project.

Data were obtained from formal interviews, questionnaires, numerous documentary sources and many informal discussions with members of the project which included the test manager, project managers, developers, test analysts and SMEs.

Ten semi-structured interviews were conducted with key players in the South East Asia Project, including the CIO, Chief Architect, Project Management Office Manager, Project Managers, Test Directors, Subject Matter Experts, Business Users, Developers and Testers. The interviews lasted from one to three hours and notes from the interviews were recorded. The documents obtained included project deliverables, schedules, business requirements, proposal, minutes of meetings, and status reports.

For the third and fourth case studies, data was collected through participant observation, with the researcher attending many project meetings, including the project steering committee meetings. The researcher also held formal and informal discussions with all staff in the project, as well other staff within the project management office. In addition, the researcher had access to the projects' documents stored in the department document management system, and was copied-in on most project e-mail correspondence.

### **3.5.3 Data Analysis**

The analysis of the case was performed in two phases. The time elapse between the phases was a few months. The delay between the first analysis phase and further detailed analysis was agreed between the researcher and organisation to allow for more events to take place in the project as part of the natural project lifecycle.

The first phase consisted of the evaluation of the project during the four months during which time the researcher attend meetings, discussions and held interviews formally and informally with staff engaged in the project. During this period the researcher analysed project documentation and distributed the questionnaire and collected the results. Although the first phase was conducted for other purposes than academic research, the overall research methodology is within the case study paradigm.

The second phase of the analysis was performed by the author. During this phase, the available project documentation was analysed again. The re-analysis of documentation was performed in order to gain new insights and avoid possible interpretational or reasoning errors that could be made during the first phase.

The second phase was based on the available documentation. The second round of interviews could not be conducted because the researcher did not receive permission to interview the people involved. As well, some of the original participants had left the project or the organisation. Some parts of the documentation that were difficult to understand, ambiguous or missing were clarified by contacting some people who participated in the project. Not all enquiries were answered, but the answers that were given provided clarification on specific details that were missing.

In the power utility case there were none of the normal difficulties in getting access to the relevant documentation. The documentation that was available to the researcher was rich

and allowed many different types of analysis to be performed. It was authentic and credible, and there was no doubt of the representativeness of the documents. The information gathered from analysis of project records, specifically the risk and issues logs, was invaluable in probing the hidden agenda that may have been the root cause behind the constant delays of the project.

The focus of the analysis was specific to stock exchange, where the researcher wanted to understand the context and process of the project and participants' views concerning its success and the challenges faced by the staff and management of the project. Special attention was paid to the social and organisational context within which the project took place. Multiple views of various research participants were explored. The validity of the interpretations provided by the participants was studied in a hermeneutic manner to see if they 'made sense' (Myers 1997, 22) and were believable both to the researcher and to the key staff involved in the project. Walsham (1993, 15) "suggests that the validity of the interpretive case study research depends on the plausibility and cogency of the logical reasoning used in describing the result from the cases, and in drawing conclusions from them".

Analysis commenced during the data collection process. The initial analytical objective was to determine a causal explanation for the issues faced by the project under investigation. Problematic outcomes were identified as they were uncovered and causal chains theorised (Miles and Huberman 1994). All issues were reviewed and validated against different sources of data collected from the project, including project documents, e-mails, interviews, and the questionnaire. Some were accepted; others were rejected pending further collection of relevant data from the project.

The process went through multiple iterations in order to produce a satisfactory explanation for each documented issue in the project, assisting in identifying which behaviour contributed the most to the final outcomes of the project. Some of the explanations received did not necessarily assist in explaining why such behaviours occurred in the first place, but it helped the researcher to draw conclusions as to why it happened.

### **3.5.4 Evidence Collected**

The researcher used several approaches to analyse the documentation collected from the cases investigated. These included critical incidents that related to the research problem and were deemed by the researcher to be important and pertinent the issue under investigation.

Use case documentation collected and analysed using the following method.

1. All documentation was classified into the following categories:
  - Documents that outlined the actual objectives of the project;
  - Project administration documents, for example meeting minutes;
  - Architectural and technical documentation of each application included in the separation project;
  - Documents that were directly related to the delay of the project;
  - Other types of documents, including e-mails.
2. The documentation was classified according to a general structure that is used in information technology projects. The phases used for the division were:
  - Requirements;
  - Design;
  - Coding;
  - Testing; and
  - Project management.

The classification was made in order to make more manageable the volume of documentation analysed by the researcher.

1. The documents collected allowed the researcher to construct the project timeframe and the issues faced the project from inception to closure;
2. The risks and issues that were considered by the researcher to have a significant impact on the project delays, or that were otherwise considered interesting, were identified and analysed;
3. The management dealing with the project delays, its documented reasons, and the root cause of the reasons were traced from the documentation.



The completeness of the material allowed the researcher to analyse the project in detail to try to gain a deeper understating of what went wrong. Initially by identifying the actual decision and documentation associated with it. Then the reasons for the decision were sought and the project was followed backwards in time in order to search for the actual causes in addition to identifying the root causes, the reasons for the consistent delays and how power utility management dealt with them.

## **3.6 Validity Threats**

Miles and Huberman (1994) pointed to the issue of validity in qualitative studies. The problem stems from the fact that qualitative research is often done by a small number of researchers in the field; with their focus on findings instead of describing how the results were achieved. The study design incorporated these tests to ensure high integrity case study research.

### **3.6.1 Construct Validity**

According to Kirk and Miller (1986, 22) construct validity refers to “whether there is substantial evidence that the theoretical paradigm correctly corresponds to observations”. The strength of qualitative research lies in its flexibility and the interaction between the research subjects and the researcher (Sykes 1991). Consequently, it allows researchers to validate their findings from a different number of viewpoints.

Construct validity was enhanced in this study by using multiple sources of evidence, establishing a chain of evidence, and having key informants review draft case study reports. The use of multiple sources of evidence ensured triangulation of data processing and data interpretation. Also, the study followed a predefined case study procedure that ensured consistency in examining each project. Finally, interview transcripts and initial case findings were provided to the key informant of each project for verification and validation of their accuracy. Together, these tactics promoted consistency and correctness in operational measures of framework constructs.

### **3.6.2 Internal Validity**

Meyer (2001, 346) stated that “internal validity concerns the validity of the postulated relationships among the concepts”. The main concern with internal validity of qualitative research that it is not easily open to examination. According to Sykes (1991, 290) “the

researcher can always provide a plausible account and, with careful editing, may ensure its coherence”.

Recognition of this problem has led to calls for better documentation of the processes of data collection, the data itself, and the interpretive contribution of the researcher. In this study, three forms of triangulation were used to support internal validity: multiple data types (interviews, documents, etc.); multiple sources within type (multiple team members, multiple documents, etc.); and, analysis triangulation. The first form of triangulation was confirmed by using multiple types of evidence and checking the consistency of the findings generated across these sources. The second form of triangulation was confirmed by selecting multiple people with different roles from each case for interview and by asking similar questions based on the case study procedure. The third form, analysis triangulation, managed the threat to interpretation by having the research findings validated by a panel of experts. Finally, the research procedure was used for guiding data collection and case study analysis. Also, cross-case synthesis enabled inferences to be made in a manner that avoided bias from individual cases.

### **3.6.3 External Validity**

According to Mitchell (1983, 190), case studies are not based on statistical inference; quite the contrary. The inferring process turns exclusively on the theoretically necessary links among the features in the case study. The validity of the extrapolation depends not on the typicality or representativeness of the case but on the cogency of the theoretical reasoning. Hartley (1994, 225) claims “the detailed knowledge of the organisation and especially the knowledge about the processes underlying the behaviour and its context can help to specify the conditions under which behaviour can be expected to occur. In other words, the generalisation is about theoretical propositions not about populations”.

Yin (2009) pointed out to the external validity threats to qualitative studies, whether the research results can be expanded beyond the case study and become more generalisable.

The study’s multi-case design enhances the possibility of generalising the findings to other information technology projects facing similar challenges. However, information technology projects have many forms based on their contextual factors (e.g., size, budget, location, engagement model), all of which may influence the behaviour of the project (Sarker 2009). As a result, it is difficult to generalise the study findings to other challenged

information technology projects. This is also supported by Potts (1993, 26) who pointed out that “searching for completely generic findings via case studies is illusory”.

Consequently, the study makes no claim to generalise its findings to other settings (samples or populations) in a statistical sampling sense. The only claim the study makes (which is underpinned by its aim) is to generalise from the empirical description in the cases to the theoretical statements found in the literature, as represented in the research framework; what Lee and Baskerville (2003) labelled a Type ET generalisation.

### **3.6.4 Reliability**

Miles and Huberman (1994) pointed out that reliability is the main concern in demonstrating whether the process of the study is consistent, stable and can be reused. Sykes (1991) highlighted two concerns in relation to the reliability of qualitative research. First, could the same research produce the same results when executed by two researchers? Second, if the research is replicated using the same investigator and participants, will it produce the same results?

Yin (2009) recommends using the case study protocol and case study database to stratify the reliability requirements of qualitative research. The first tactic was applied to this research; the second tactic was implemented partially, in which all data collected was stored in a spreadsheet.

## **3.7 Evaluation and Validation**

The primary method of this research was qualitative and exploratory in its nature. The researcher followed a number of systematic procedures while undertaking the study to mitigate threats due to participant or researcher bias. First, the research procedures were developed based on existing information technology projects that highlighted issues faced by those projects. The literature was used to generate the research questions, and develop the interview questions used during the data collection phase while constructing the case studies. Collecting data from multiple sources and with quite a high number of participants allowed the researcher to construct deep, rich and detailed case studies.

The main threat to providing a valid case study is data inaccuracy and incompleteness (Robson 2002). This was addressed by having the collected data validated by participants following the interview, which ensured a higher level of confidence in the accuracy of the

data collected. Moreover, key findings of the research and proposed solutions were presented to key participants. Those participants provided feedback that identified any omission and rectified misunderstandings in the data analysis. Such techniques ensured the research procedures were followed and the data collection and analysis processes were valid.

Survey and simulation, together, were used to evaluate the proposed framework. Simulation was used to identify how the model could be used, based on one of the case studies. It was not possible to apply the developed framework in any real scenario. Survey was used to get real practical feedback from people involved in projects, this helps to extend framework.

### **3.7.1 Survey**

To validate the proposed intervention framework, the researcher compiled a short survey targeting information technology professionals. The final survey was comprised of ten questions (Appendix A). Respondents could provide feedback using:

- Multiple Choice – Likert scales; and
- Free text boxes.

When using the Likert-scale, the respondents had to indicate if they agreed or disagreed on a seven-point scale. This scale was chosen because of its adaptability to the type of perceptual questions being used in the survey (Sekaran and Bougie 2010). Free text boxes were used to allow respondents to provide further, detailed, feedback on methods that they think could be used to improve/enhance the framework.

### **3.7.2 Simulation**

Simulation provides the researcher with a flexible tool that can be used to validate the results of their research. Eiselt and Sandblom (2010a, 395) defined simulation as “primarily concerned with experimentally predicting the behaviour of a real system for the purpose of designing the system or modifying behaviour”.

The framework is built to assist in addressing issues in challenged information technology projects and to make decisions regarding the future of the project. The intervention model is built to better understand the problem situation, with the intention of providing a way forward. The level of knowledge obtained during the problem definition would be used

to address the project issues. Woodside (2010) highlighted some of the benefits of using simulation, firstly, it clarifies understanding of the system and provides a baseline, which can be later used for comparison with more simulation results.

Using simulation has two benefits for the research. First, simulation is a very flexible tool. Second, simulation may be used to validate the framework at low-cost; alternatively, it can be compress time-frames to allow more rapid validation (Woodside 2010). Simulation can be used to bring the “best of stakeholders by nurturing the opposable mind” (Martin 2007, 56).

Applying multiple simulation scenarios with different variables increases the knowledge about the case under investigation. Consequently, that would provide decision makers with knowledge that they can build upon when dealing with challenged projects. Case-description of the scenario is provided. The steps used, based on the framework, will be described in detail, including how and why these steps are taken. Likely outcomes will be described. This will show and demonstrate how the intervention model can be used in a real situation.

### **3.8 Chapter Summary**

The chapter examined the different research methodologies that could be employed in an information systems research project. Case study research was selected as the main research method, since it provided the ability to explore the phenomena under investigation. The selected case studies represent a wide spectrum of information technology projects and allowed the research to gain deep insights into the phenomena and reasons leading to the problems evident. Moreover, it provided guidance on what sort of approach would be needed to address issues faced by the information technology projects. Simulation and survey were used to validate the proposed framework; by fielding the framework to industry experts, and valuable feedback was collected and presented in chapter 5.

The sure way to miss success is to miss the opportunity  
Victor Chasles

## 4 Case Description and Analysis

This chapter describes four cases of information technology projects that used a variety of software development and project management methodologies and presents initial within-case analysis of each case. The participating organisations and individuals in the cases are referred to by pseudonyms to maintain privacy and allow the researcher to publish the organisations' documents as part of the research.

For each case, the project is described in hierarchical fashion starting with the organisation background and project structure, project management methodology, then analysis of the project issues followed by an overall problem definition. The problem definition will be used later in the chapter to inform the chapter conclusion and provide a set of issues. Later in the document, the problem definition will be used to inform the proposed framework and how it can be applied.

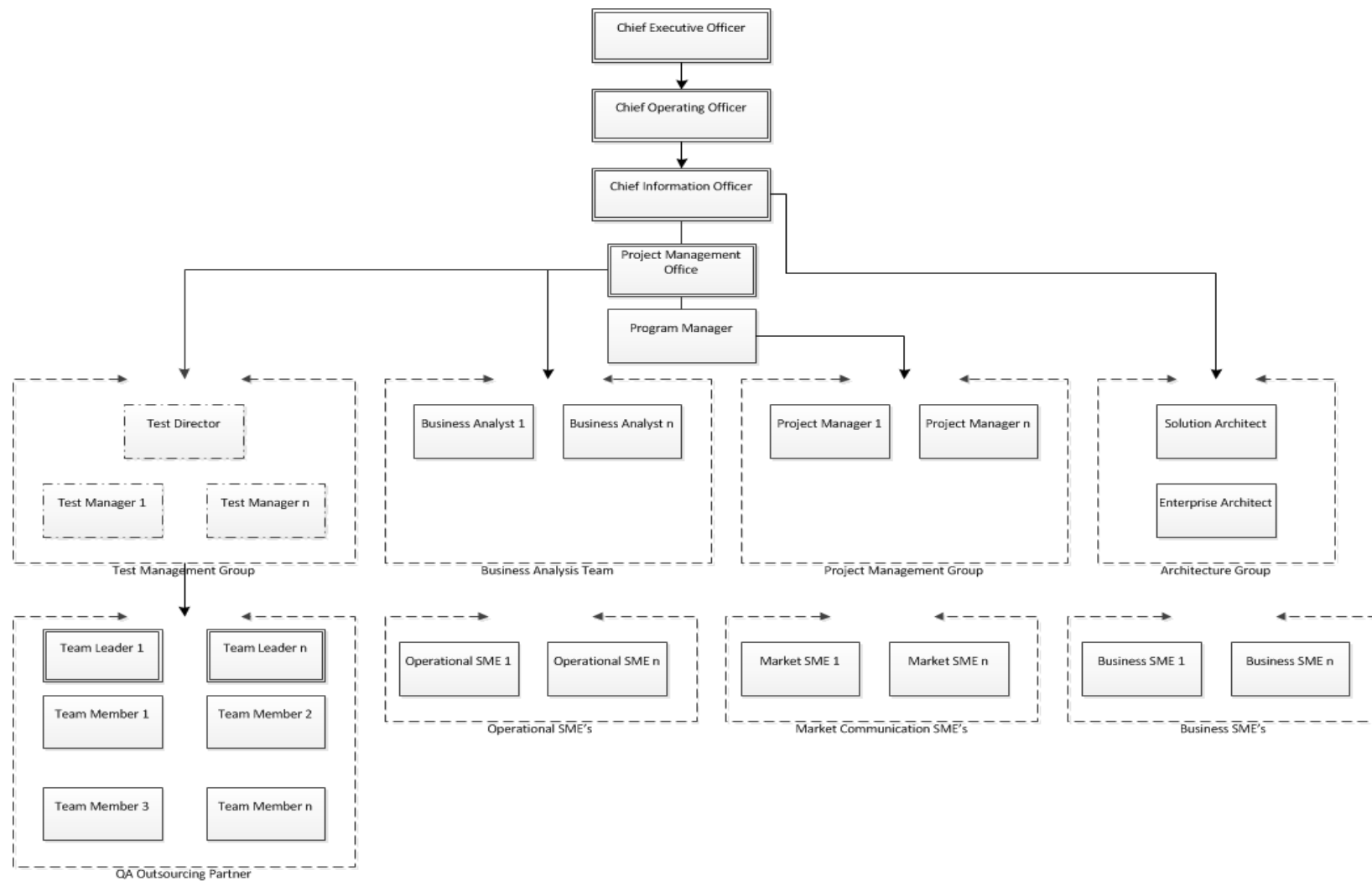
The first case study is of a financial powerhouse in South East Asia and the rest are of public and private organisations operating within Australia.

### 4.1 The Stock Exchange Case Study

#### 4.1.1 Organisation Background

The Stock Exchange, established on first of December 1999 following the merger of two well-established financial institutions, is South East Asia's first demutualised and integrated securities and derivatives exchange.

The stock exchange has an internal technology department which controls all aspects of technology related projects within the exchange. Figure 25 illustrates both the importance and the close proximity of the Chief Information Officer (CIO) to the highest levels of the hierarchy within the organisation. It also highlights the structure of the project team which was engaged for the case study.

**Figure 25: Stock Exchange Project Structure**



The exchange had 450 full time employees, and uses multiple external vendors to provide essential technology services which include:

1. Infrastructure support;
2. Internal Information Technology customer support;
3. Software suppliers;
4. Testing Services;
5. Software security assessment.

The exchange had an internal technology department that employed twenty project managers and business analysts who worked on different projects. From the structure above it is clear that the CIO had overall responsibility for all technology projects within the exchange.

On an average day, 1200.9 million shares valued at SGD\$1373.3 million (22/3/2011) changed hands on the exchange. As such, technology played a pivotal role in ensuring a smooth operation enabling delivery to thousands of traders. Technology was also crucial in ensuring that transactions executed complied with all government and Exchange rules and regulations.

#### **4.1.1.1 Project Background**

The project under investigation started on November 2007 to fully upgrade the derivatives market infrastructure for its trading, clearing and data platform, with the aim of providing more complex and diverse products as well as the potential to support growth in the derivatives business conducted by the exchange and its partners.

The project was described by the Chief Operating Officer (COO) at the post-launch as a significant investment in improved technology for the exchange (SU-JIN 2009) which would enable the organisation to deliver enhanced capabilities as well as support the growth of the derivatives business in the South East Asia region.

#### **4.1.1.2 Project Structure**

The project size varied from inception until its completion. During the peak period of the project a total of 165 staff worked directly on the project. The project was managed by the Project Management Office (PMO) with one Program Manager primarily responsible for

the overall delivery of the project, and three Project Managers managing various elements of the project. One Test Director reported directly to the Program manager and worked alongside the project managers. The Test Director had overall responsibility of delivering all testing services to the project and was supported by nine Test Managers. The PMO engaged six business analysts and seventeen Subject Matter Experts (SMEs) who did not directly report to the project, but worked closely with the project.

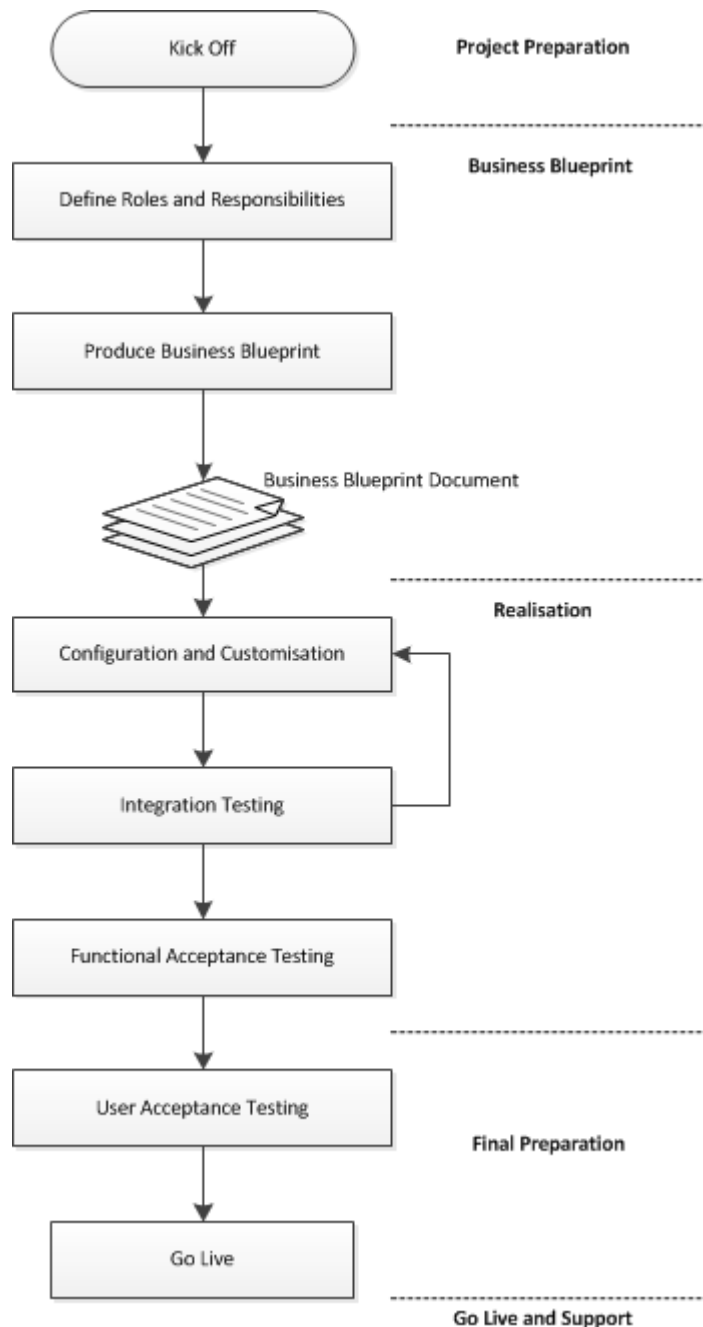
The project engaged two external vendors; one vendor to supply the customised derivatives platform including various upgraded platforms; the software vendor had twenty dedicated developers in Sweden, ten support staff located in stock exchange headquarters. The support staff included the test manager, program manager, project manager and technical staff who interacted with the project with varying frequency depending on the stage of the project.

The second vendor engaged by the exchange was a Quality Assurance consultancy service. The vendor supplied sixty five Test Analysts, five Test Leads and one Test Manager and one Account Manager responsible for liaising with South East Asia Limited and resolving any issues or conflicts during the project.

The exchange had an agreement with a global vendor which was responsible for maintaining the Exchange infrastructure and providing services to the project. The vendor appointed one project manager and two team leaders to liaise and support the project deliverables.

#### **4.1.1.3 Project Methodology**

The Software Development Life Cycle (SDLC) utilised in the exchange was the waterfall methodology. The methodology mandated the project to have defined detailed scope, project organisation, detailed requirements, and to establish governance framework that would be used to control the project progress.



**Figure 26: Overview the Stock Exchange Project Methodology**

As illustrated in Figure 26 the project divided the implementation into five distinct phases, each with specific purpose. 'Project Preparation' provided initial planning and preparation for the exchange project. This included defining the project objective, scope, schedule, engaging external vendors, establishing an internal project team and communicating the benefits to the exchange clients.

The purpose of the 'Business Blueprint', was to create a business process map, which contained the details of how the exchange ran business functions before implementing the new system and how it intended to run it afterwards. Creating this document was by no

means an easy task, since existing systems were implemented a decade earlier, and lacked formal documentation; the process relied heavily on capturing knowledge maintained by existing staff, although few actually worked on the original system. During a formal interview with one SME, he raised the issue that many of the issues faced during the testing phase of the project were due to *“human errors and not system errors”*. When asked to explain, he pointed out that many of the business rules for the existing system were only known to him and another operational staff member.

‘Realisation’ involved implementing the business blueprint by the external vendor. This phase included unit testing completed by the vendor on the customised product. The phase ended by signing off on Functional Acceptance Testing (FAT), which was designed to simulate the reengineered business model and confirmed that the system worked as expected in an environment very similar to the actual production environment.

‘Final Preparation’ finalised everything in readiness for going live with the new systems and process. This covered User Acceptance Testing (UAT), Industry Wide Testing, Penetration Testing, Data Migration, user training, and ‘cut over’ activities. On the successful completion of this phase, the Exchange would be deemed ready to switch to the new system and turn off the legacy system.

The ‘Go Live and Support’ phase was the last phase of the project and planned to last 90 days from the go live date in which the existing system would remain on standby in case critical defects were found upon implementation.

#### **4.1.1.4 Project Issues**

When using the traditional golden triangle (Budget, Scope, and Schedule) which is commonly used to benchmark project success, the stock exchange project would be considered an astounding success. The project went live on the date that was announced to the market a year earlier, with minimum budget deviations and delivered the agreed scope planned two years earlier. It is worth noting that the software vendor who supplied the software application to the Exchange used the project as a showcase on how to deliver significant change to other exchanges around the world.

However, deeper analysis made possible by the researcher’s involvement in the first six months of the project, revealed a different perspective on how success was measured. For

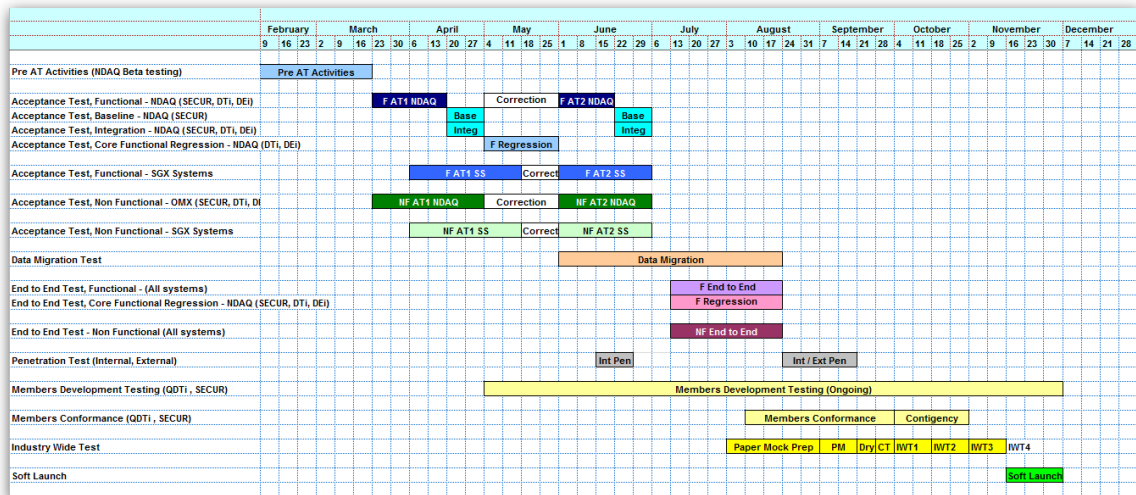
an outsider, many of the issues faced the project look typical of information technology project and senior management could deal with them.

However, because of the factors of software complexity and the size of the project, such a linear relationship cannot be used for estimation, and given the original estimates for the project were completed two years in advance with a certain set of assumptions, it became clear that certain management expectations could not be met. Whilst Stock Exchange senior management had significant experience in the Information Technology industry, they did not necessarily understand every point of the issues outside their domain knowledge, with many issues related to contractors assigned to the project from vendor companies.

#### **4.1.1.5 Project Plan**

South East Asia Limited outsourced all software development to external vendors; hence, there were specific schedules with the exception of one milestone in which all testing activities would commence. Whilst testing activities were outsourced as well, it was planned and executed onsite and managed by the exchange. The schedule showed all planned testing activities ten months in advance, and the schedule and all activities were signed off by the Exchange as well as by all external vendors participating in the project as shown in Figure 27.

The testing schedule was revised many times between February and August, as many more testing stages were required due to the high number of outstanding defects in the systems under test. Six hundred defects were discovered during the first phase of Functional Acceptance Testing and fifteen hundred defects were found during the course of quality assurance activities conducted, while sixty defects were flagged as critical or showstoppers in which testing had to stop until they were fixed.



**Figure 27: Stock Exchange Overview Testing Schedule**

Quality assurance relied heavily on the SMEs, initially to endorse all testing artefacts before commencing any quality assurance activity. During test execution, it became apparent that test analysts used in the project had limited or no knowledge of the system under test, thus SMEs' support during execution became critical, otherwise the project schedule would have been impacted. However, SMEs originally engaged in the project were engaged on a part time basis as they had to plan and work in subsequent projects. Another aspect which was overlooked by management was fatigue, as test phases were planned to last six weeks, including weekends, public holidays and in some instances with twelve hour shifts. At the end of the first phase, it was clear to the test management group that a different approach would be required in subsequent test phases, otherwise it would be difficult to maintain momentum and energy, and could lead to defects slipping through the testing regime. However, senior management's view was that no new approach was required, as the testing resources were part of an external company that provided services to the Exchange and there were contractual agreements to which the vendor must adhere.

#### 4.1.1.6 Work Allocation

Work allocation involved internal and external stakeholder management and coordination. The South East Asia Limited Project had one hundred and sixty five people directly working in the project at its peak, with many working on multiple tasks that involved conflicting priorities. At one stage, external vendors were engaged to undertake penetration testing to ensure the new system developed with the minimum number of

security flaws. However, with the additional test phases that were added in response to the high number of defects reported in the first functional acceptance test phase, other scheduled test phases were in danger. Penetration testing conflicted with the subsequent functional test phase execution plan, and no environment was available for the penetration testing to be conducted. Penetration testing was part of the QA scope and was performed by large consulting firms. Some of the issues faced during the penetration execution were:

1. Ten working days were allocated for the penetration test, with three days lost while trying to secure access to the Exchange testing platform for the consultancy firm performing the penetration testing, due to delayed approval from the Exchange's head of IT security.
2. Penetration testing shared the same platform with functional testing, which required putting constraints on the types of testing allowed by the consultancy firm performing the penetration testing. Functional testing ranked higher on the priority list for the project.
3. The environment configuration used to perform the penetration testing did not match the actual production system, and had no security applications installed except the basic username/password requirements.
4. None of the applications had any specific security requirements except integration with the Exchange's Active Directory platform.

The findings of the penetration test presented concerns for the project, with 70 issues identified, many of them critical (mainly design flaws). The developers of the sub-systems objected to the penetration test results, and argued that the signed-off requirements documents included no security requirements. Instead, there was a notable lack of contractual agreement concerning the need to implement a secure system, conducting formal unit testing or undertaking code review.

Most of the findings were dismissed by upper management (at the CIO level), with the direction that focus must remain on the commitment to go live on the date announced to the market. The sub-system developers were asked to address ten issues that were deemed important by the Operations department and the remaining sixty issues to be addressed in the future with no specified date. The exchange did not press forward with

the changes required to address the recommendation of the penetration testing as resources were directed immediately after the project work onto another IT project.

#### **4.1.1.7 Consultant Management**

The stock exchange engaged many consultants during the project, with the majority being hired by vendor companies. Many lacked actual finance domain experience especially in the testing area, in which estimates provided were not adhered to despite the additional resources the vendor company kept adding to the overall headcount, in an attempt to meet the deadlines. The infrastructure vendor presented another problem to the project team. Since the vendor's first priority was to keep the current production environment performing with minimum interruption, the same resources tasked to assist the project also worked for Business As Usual (BAU) activities, and they were never assigned 100% of their time to the project. The issue was escalated many times to the Exchange senior management and some improvements were noticed by the project team in terms of responsiveness to the project's urgent needs.

#### **4.1.1.8 Overwhelming Documentation**

The exchange invested significantly in technology to improve their operations, efficiency and ability to provide better services to their end users. However, they did not have the same level of investment in systems to support their staff, part of which could be attributed to the organisation's culture. For example, the project introduced a new tool to manage test planning, test execution and defect management. Business users including the SMEs' resisted the use of the tool, as well the external vendor responsible for undertaking the testing activities. The result was that all test planning was instead done using Microsoft Word. Another aspect of testing which was required and imposed on the project by the project SMEs was that a screen shot must be taken before and after the execution of each step of every test case. With more than four thousand test cases, with each test case including an average of ten steps, it became clear this was a factor impacting on the test analyst's ability to adhere to deadlines.

The Test management group estimated that this process took on average 25% of the daily working hours of each test analyst with no apparent value to the project outcomes, but delaying the ability of the project to meet its mandated timeframe. However, senior



management and business SMEs confirmed that the process was required, since they had little confidence in the resources employed by the testing services vendor.

#### **4.1.1.9 Internal Conflicts**

The stock exchange project had many meetings in which the responsible managers were required to report on completed activities, planned activities, issues and risks. Some of these meetings were held three times a day during the testing phase of the project, including an extensive daily testing report that was submitted to the CIO and COO on a daily basis. The report required two test managers to spend around two hours every day to compile and ensure the information provided was correct at the time it was published. As the project progressed and more testing was required to ensure the software was fit for purpose, the tension between the Test Management and Project Management grew. The project manager requested more and more phases of testing to satisfy senior management demands with regard to the quality of the final product, but they did not pay attention to the people actually required to perform those extra activities. The exchange senior management provided functional testing sign off to the vendor delivering the software three months prior to the completion of testing activities.

With the sign-off certificate issued to the vendor, the balance of power in the project tilted toward the vendor and away from the exchange. The test management struggled to get the vendor attention's to ratify defects found in subsequent unplanned test phases.

The exchange distinguished itself with the reputation that staff worked there for life, in contrast to many of the consultants who were employed temporarily to provide specialised services during the project. Many of the long serving staff in the exchange demonstrated unease toward external staff and many issues were reported to senior management. In many cases senior management seemed to favour internal staff at the expense of the temporary staff.

#### **4.1.2 Problem Definition**

This section discusses the project events described in the previous sections. While little indication from the events in the stock exchange project was related to factors that were critical to project completion, other factors such as social, and cultural issues seemed to have more impact on the project progress as summarised in Table 21.

The stock exchange project objectives were clear and realistic from the management point of view *“to deliver a new platform and gain competitive advantages against its rivals in the region”*. The project suffered badly from lack of precise planning in advance; the project plan was drawn-up nearly two years in advance, before many of the staff responsible for delivering the outcomes were recruited or had joined the project. An assumption was made that the vendor software company would deliver a product with production readiness for functional testing conducted by the Exchange. An experienced Program or Project Manager would be able to dismiss that assumption as unrealistic; however, the whole project plan and the go-live date was set based on such assumptions. Scope is an important element of any project, normally used as a control mechanism. The exchange project had a scope, but it was not used to control the project, since no single change request was logged during the entire life of project, despite the increased scope of testing. Many of the changes to the scope were decisions made at the executive level and mandated to the staff responsible for delivering the project.

The go-live date itself was not subject to change or even discussion, as it would draw external attention to the project from regulators and corporate customers. The pressure to adhere to the original schedule and deliver the extra testing phases was retained in-house. Senior management direction to the project team was that the project had to be delivered, regardless of the changed schedule and expanded scope. In some instances staff had to work twelve hour shifts just to keep up with the workload. Middle management noticed increased staff turnover in the vendor companies responsible for delivering testing and infrastructure services, and that was communicated to senior management, which was dismissed, since it was not an Exchange project problem, but a vendor problem that they had to fix.

An SME once commented about the problem he faced when dealing with testers from the vendor company due to their lack of knowledge of the Exchange business and in the finance industry in general, that could derail the entire project. A concept seemed logical to management on the ground, but was unclear to senior management and it proved difficult to communicate by the Test Director.

Once the news became known that Functional Acceptance Testing (FAT) was signed off by senior management even before it was completed, a sense of disillusion and disbelief

came to the test managers' group who advised and advocated against the decision. The advice was ignored, and they were instructed to continue testing and move on with the planning of more testing phases. As a consequence the tension in the relationship between the test management group and senior management grew when more critical defects were found in the newly added test phases. Test management complained about the delayed response received from the software vendor company in attending to defects assigned to them. Senior management emphasised the need for all defects found during the new test phases to be addressed, but they were reluctant to pressure the vendor companies to provide timely services.

As more phases were added, it became clear that the sign-off provided to the vendor before the completion of FAT was premature. The program manager and project management group kept adding more phases to address new defects leading to the detection of more than fifteen hundred defects during the testing phases of the stock exchange project. Of these defects, sixty seven were classified as critical defects (in which the system could not be in production) and five hundred and thirty four were classified as high severity defects.

As the project progressed and more defects were reported in the software, the management required more reporting. Originally, the test management group spent two hours per day on building their daily report. With every test phase added to the project, senior management required more reports. In the second phase of testing, they demanded a daily presentation for the previous day testing activities, and action plan for each critical and high defect on a daily basis, including the party the defect was assigned to.

**Escalation** and **clawing back time** were the two words used by senior management in their daily interaction with the project team. One of the managers raised the question, whether the project issues could be escalated if they had been over-ridden in previous meetings. Test managers' advice was being ignored at the cost of the staff that had to work extreme hours to deliver the project as communicated to the market. No clear answer was provided from senior managers, other than the project must meet its deadline. However, as more issues and defects in the software kept arising, senior management decided it could no longer accept the vendor company's delayed response, and the issue was escalated and the response time was shortened considerably.

**Table 21: Factors Critical to South East Asia Limited Project Implementation**

	<b>Issues of Stock Exchange Project Implementation</b>	<b>Observed/Reported</b>
1	Limited Senior Management Support	O
2	Unstable Software	R
3	Increased project scope during implementation	O
4	Difficulty aligning to specific requirements	R
5	Tight Internal resourcing	R
6	Time consuming implementation	R
7	Schedule delays	O
8	Poor support by the software vendor	O
9	Task conflicts among team members	O
10	Culture clash	O
11	Bureaucratic project organisation	O
12	Unqualified personnel or inappropriate team composition	R
13	Incorrect estimation of staff learning curve	R
14	Limited user involvement	R
15	Data conversion behind time (Data Migration)	O
16	Inadequate know how	O

A task that is critical to the project was Data Migration (DM) in which the data from the existing system was to be migrated to the new system before going live. The task was delegated to two project managers who were also responsible for other projects in the main program of work.

With three months to the go-live date, it became apparent that the specification written by the project managers lacked details and the developers responsible for developing the necessary tools were unable to commence their development tasks on time. The Test Director took the view that his team should take the lead on the task and business analysts must be appointed to assist in the collection of detailed requirements. Once the process of requirements gathering commenced, it became clear the task required more resources and would take longer to complete than originally anticipated. One of the difficulties faced all involved, was the lack of documentation of the existing system, and

workshops were required to gather information from staff who either worked with the systems for a long time, or were part of the original team who built the system. Most of the information was based on verbal communication with little or no evidence to support. To reduce the risk, multiple sessions were held to obtain sign-off for the specification as the official document which was used to build the data migration tool and was used to build test plans before it could be used to complete the data migration process prior to moving the new system into production.

Staff involved in the project showed signs of exhaustion as the project reached its conclusion, and many contracted staff decided to leave before the end of their contract terms. SME's became frustrated with the repeated requests to attend meetings to explain why certain defects must be fixed prior to moving to the next phase of the project. Project managers became unwilling to report negative news to senior management as it could be viewed as a sign of trouble in the project. Whilst it is obvious that project managers were unsuccessful in raising the attention of senior management to project issues early enough; it is just as plausible that the senior management responsible for the project were not prepared to fully recognise the social and cultural issues underlying the problems faced by the project team. Although the project team indicated that they did not have the full support of senior management team, this may not have been the case. It could simply be that senior management did not share their concerns about practices embraced by project and test managers in order to deliver the project desired outcomes.

## **4.2 Power Utility Company Case Study**

### **4.2.1 Organisation Background**

The Power utility was one of the largest of Australia's energy retailers, with over 900,000 residential and business customers. It was formed from the disaggregation of its parent power utility company and currently generates annual revenue of more than AUD\$1.5 billion.

The primary activities of the utility included trading, marketing sales of electricity. The power utility had a legislated monopoly on the sale of electricity to residential and other customers who did not consume large amounts of electricity.

To manage 900,000 customers, the power utility since its inception invested in information technology. The utility had an independent technology department led by the Chief Information Officer, who reported to the company Chief Executive Officer, and also has responsibility for the Project Management Office (PMO) controlling all information technology projects. The utility had two information technology providers; one provider who was responsible for the information technology infrastructure and another provider who was responsible for providing support and maintenance of software applications onshore and offshore.

The utility employed around six hundred staff, of which sixty worked in the information technology department led by the Chief Information Officer and PMO. Most of the staff working in the information technology department were contractors assigned to various projects. Application development and support were outsourced to a foreign vendor, with staff working onshore and offshore. Infrastructure management was outsourced to a local vendor who was also engaged with the parent company prior to the formation of power utility.

Figure 28 illustrates the project team structure within the organisation and the reporting lines.

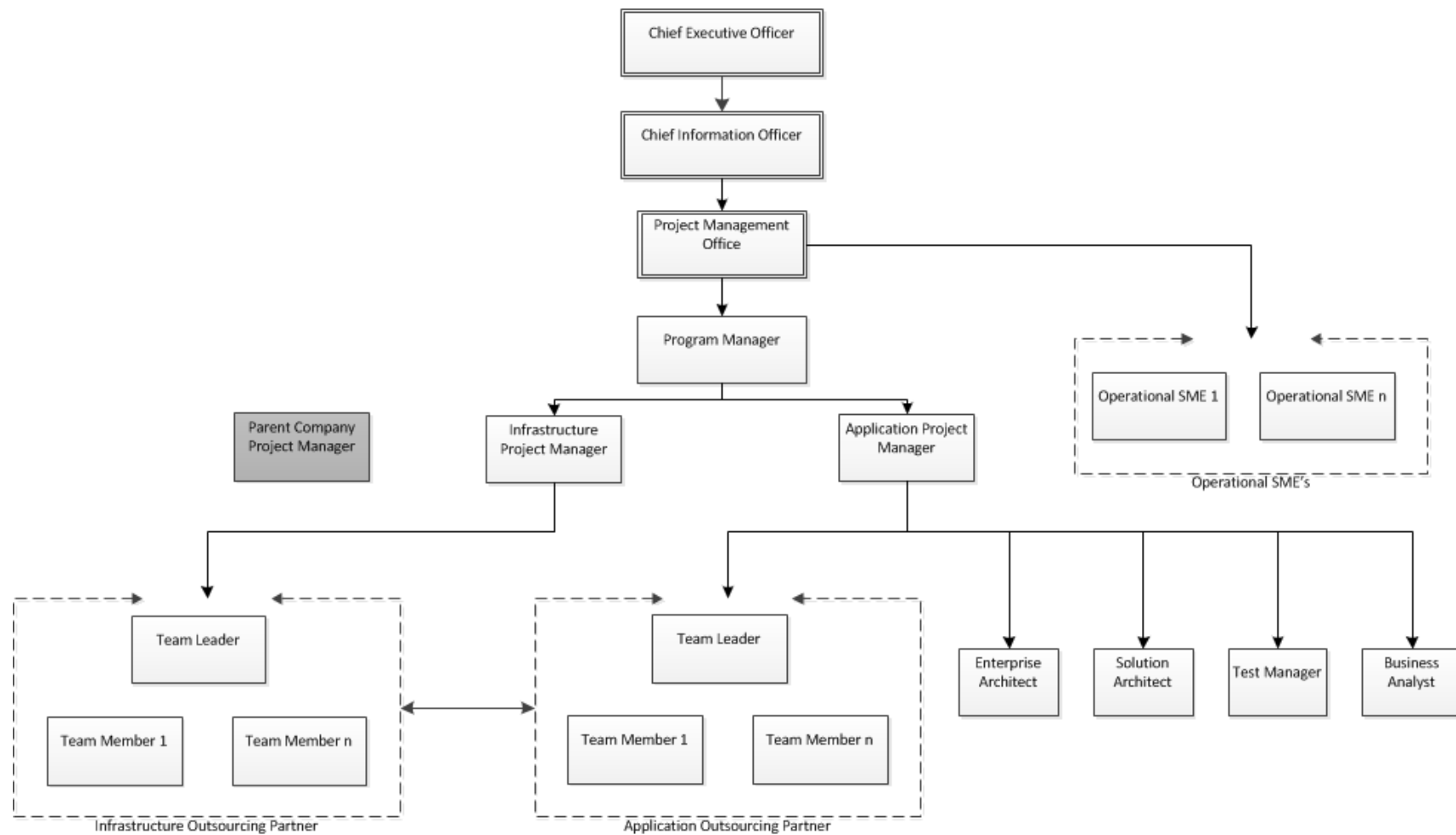


Figure 28: Power Utility Project Structure

### 4.2.2 Project Background

The project under investigation had commenced eighteen months earlier and was driven by a master plan managed by the previous owner. The major component of the power utility business strategy was the separation from the previous owner as stated in the company 2009/2010 business plan (Fruin 2008, 15):

“Intimately tied to Sourcing, the Separation Program will pick up those services not delivered by the Sourcing Program to ensure IT independence. The program will encompass commercial arrangements, continuing service level agreements, intellectual property and capability from the previous owner.”

The utility had many objectives for undertaking the above program of work. One of the main objectives of the project was to establish an independent information technology capability within the power utility and to host all applications currently hosted by the previous owner internally. The drive for this project was the result of the previous owner’s declaration that it no longer wished to provide IT services to the newly formed company. Another motivation was legislative, as the privacy of the company’s own customers could not be shared with another organisation after a certain period from its formation.

The project management plan stated the following as the objectives that should have been addressed as part of the separation project:

1. Establishment of independent enterprise IT infrastructure;
2. Relocation of those business and core applications from parent company, including the transfer of infrastructure IP and application support IP to the relevant support partner (outsourcing partners);
3. Decommissioning of redundant applications;
4. Information Service Management Extension to provide an enterprise-wide solution
5. Commercial transition from the parent company to the power utility.
6. Re-platform application where substantive benefits are attainable, without compromising delivery.



It was also stated in the project management plan that the project would not only be touching applications which were visible to the business but had numerous activities which needed to be undertaken to allow the business application to work without impacting the business, which included infrastructure, services desk, desktop, network and security aspects.

One of the main guiding principles to the project was that applications would be undertaken like-for-like. Technology reengineering would only be considered where significant commercial benefit was attainable and delivery would not be compromised. The stated project outcome as per the project management plans was:

“A fully independent IT infrastructure arrangement that is capable of supporting its entire application portfolio requirements. This environment will be supported by appropriate and limited Infrastructure Management Outsourcing and Application Management Outsourcing arrangements. In conjunction with these activities, the establishment of its own independent commercial arrangements” (Fruin 2008, 5).

The utility decided six months later that it would not be part of the previous owner-led separation program, but instead it would establish its own separation and sourcing efforts due to changes in the company’s internal IT priorities. The company also recognised that this effort would have required significant involvement from the previous owner’s internal resources.

The company established its own separation project and a parallel sourcing project to engage external vendors to support the IT department. These projects were tightly linked, with a number of cross dependencies. The separation project was managed as a strategic IT effort, whereas the sourcing project was considered as business transformation. The separation in the context of the project meant moving applications hosted by the parent company to a newly established hardware platform within the company. The project suffered from having a low profile within the company, and had attracted a negative reputation for running over time with no definite end date.

The project had two dedicated project managers, one responsible for the software application migration and another for the infrastructure. However, due to cost pressures, the power utility decided to have only one project manager to manage both software and infrastructure. The project manager had four dedicated staff working with him, a business

analyst responsible for documenting existing application behaviour, a test manager responsible for carrying out test strategies for testing migrated applications, solution and enterprise architects who were working with various stakeholders to ensure the newly migrated infrastructure and applications worked seamlessly with no impact on the existing production environment.

The project relied heavily on both partner vendors to provide the required staff to undertake the work required in order to have a successful software and infrastructure migration. The utility subject matter experts, who had intimate knowledge of the systems, worked with the business analysts to document system features, as well as assist in the verification process, once the migration was complete.

The parent company, which all systems hosted, had one project manager responsible for liaising with the power utility project team in all matters related to the project. The project manager was responsible for coordinating the project schedule and to ensure that the parent company had adequate resources for the tasks agreed with the utility.




#### **4.2.2.1 Bill Payment System**

The separation project had twenty three major applications within its scope; ten of these applications had been classified as having business critical impact. One application within the scope was used to process a very large amount of bill payments from customers on an annual basis. The bill payment application had been in production for nine years, hosted by the parent company.

The bill payment system customers use the application to pay bills via credit card as shown in Figure 29. The transactions were passed to the Interactive Voice Response (IVR) system and stored temporarily in the IVR Oracle database, before being forwarded to *Systeme, Anwendungen und Produkte in der Datenverarbeitung* known as (SAP) for payment processing. The bill payment application was selected to be the first application to be migrated from the parent company infrastructure to power utility infrastructure.

**Payment Number :**

Your payment number is 10 digits long. It is located in the box labelled "Payment Number" on the right hand side of the payment slip portion of your account. Do not enter any spaces in the number.

**Credit Card Type :**    

**Credit Card Number :**  -  -  -

Please enter your 16 digit credit card number (15 if American Express). Use the tab key to move between the boxes.

**Card Expiry Date :**  /

**Amount you wish to pay :** \$

Please enter amount you wish to pay including the decimal point.  
A transaction fee of 0.7% (incl. GST) will apply to payments made by credit or debit card.

**IMPORTANT NOTICE :** **Once you click on the "Pay Now" button, it can take from 10 to 60 seconds to process your payment. Please do not click on Pay Now again. A payment details confirmation screen will appear next.**

Figure 29: Bill Payment System User Interface

The bill payment system utilises a simple user interface to interact with their retail customer while paying their electric bills.

The architecture Figure 30 of the application remained the same, but the network architecture Figure 31 was subject to change during the separation project. This was mainly to improve the infrastructure and its ability to withstand future load.

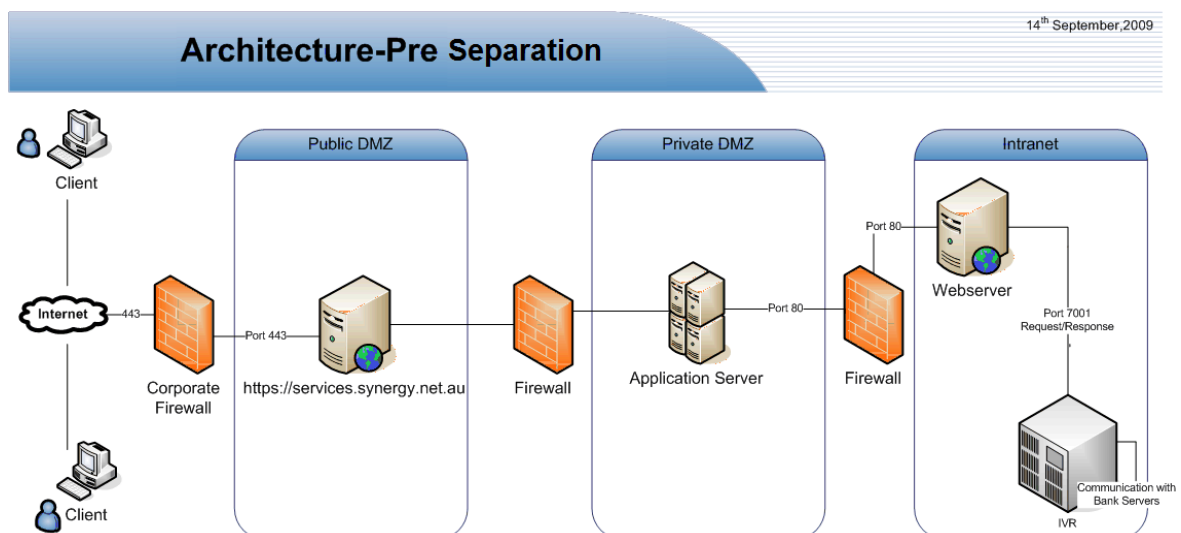
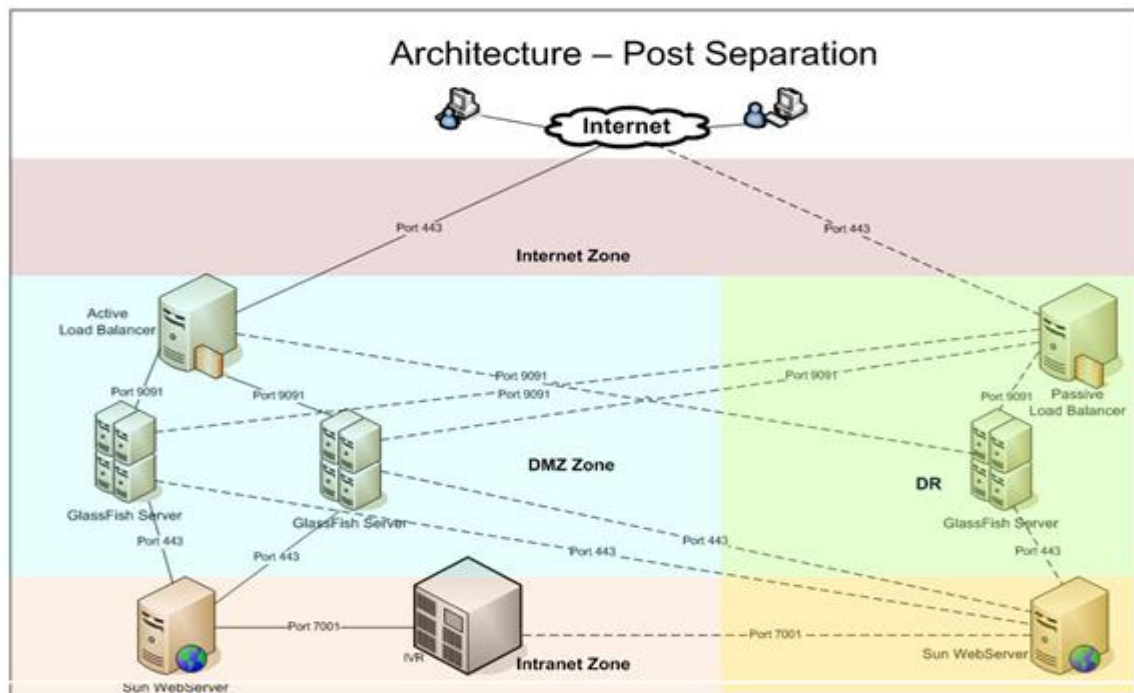


Figure 30: Power Utility Bill Payment System Pre Separation Architecture



**Figure 31: Power Utility Bill Payment System Post Separation Architecture**

The test strategy proposed by the test manager working on the separation project was written with the understanding that there were to be no functional changes to the application and only extensive regression testing would be conducted to ensure that the bill payment application behaviour remained the same.

However, after completion of all planned testing activities, the Operations department which was responsible for the application once it moved to the new infrastructure, refused to sign the test plan and other associated documentation to move the application from the testing environment to the production environment.

They raised the concern that the bill payment application dealing with large numbers of financial transactions on a daily basis was not subjected to security code review and penetration testing to assess its readiness for production.

The initial response from the project manager, which took place in a meeting (also attended by the researcher), was “the application has been in operation for so long and no functional changes have been made in the current project. Going through the process of procuring and conducting the required test will impact the project timeline”.

Tensions arose and meetings were held between heads of departments to resolve the issue. Operations made it clear that the application would not go to production unless it

went through a security code review and penetration testing by a third party. The IT program and project manager explained their view that the only change the separation project brought was a new network infrastructure with the same application going to run on it without any changes to their functions.

With the deadlines approaching, the IT project and test managers reluctantly accepted the additional scope. The project manager raised a project change request for more funding and a change in the implementation deadline and the test manager initiated the process to engage a third party vendor to conduct a code review and penetration testing. As a result, the implementation date was pushed back by another six weeks.

The software penetration testing results were a surprise to the project team as whole, with many security issues related to the application. What was more surprising was the response of the organisation as whole and specifically the Operations department who requested the penetration testing and code review to be conducted.

The key findings of the penetration testing are listed in Table 22 and Table 23:

**Table 22: Penetration Testing Results**

No.	Findings
1	Numerous cross-site scripting issues exist within the Application, allowing an attacker to potentially compromise the browsing session of legitimate users, and force them to perform arbitrary actions within the Application.
2	The application is vulnerable to cross-site request forgery, potentially allowing attackers to execute actions on behalf of legitimate users.
3	The application does not limit the amount of submission attempts made to webforms, allowing an attacker to launch a brute force attack to discover valid input.
4	The application has been designed using a two stage http post request, allowing an attacker to bypass any input checks and controls integrated into the application.
5	The Intrusion prevention system in place does not appear to inspect https traffic, allowing an attacker to proceed attacking the web server uninhibited by IPS filters.

No.	Findings
6	The webserver discloses information that might assist an attacker in identifying potential vulnerabilities.

**Table 23: Code Review Results**

No.	Findings
1	An inconsistent approach to security principles has been applied within the application.
2	This has resulted in poorly implemented security controls that are not effective.
3	An existing security framework appears to exist however it has not been used.

The company which undertook the penetration testing advised that the bill payment application was considered to be at a HIGH risk of compromise from the Internet primarily due to the presence of a number of injection and brute force vulnerabilities. Overall, the security posture of the application was found to be well below best practice. Only a few secure coding principles were followed and security mechanisms were applied inconsistently.

One of the recommendations was related to the intrusion detection system in the utility. That issue was raised six months earlier by the power utility network infrastructure team who submitted an earlier recommendation to deploy multiple intrusion detection systems as well as an application layer firewall to be installed on the application server to ensure the security in depth principle was applied to sensitive applications. The proposal was not accepted by the Operations Department due to budgetary constraints.

Once all the results of the penetration testing and code review were presented to the Operations department for assessment, the Operations department's response to the penetration test report was "in terms of recommendations from operational security, we are in a position where I think we can move the application into production as scheduled".

The operations department response was a surprise to the project team, as they accepted all the operational risks associated with the deployment of the bill payment system into

the production environment without addressing any of the security concerns raised during the penetration testing conducted.

To explain the Operations department action, it is important to look at the Operations department and the changes they went through following the inception of the utility.

First, the Operations department did not fully support the project as they did not recognise the benefits: increased efficiency or productivity. The Operations department was never engaged early in the process, especially during the initial stages of the project to identify which application was required to migrate to the new infrastructure first. The project also put too much demand on the Operations department during the implementation phase of the project, without taking into account that their first priority was to attend to production support and not to project activities.

The Operations department had seen many changes to its operating model which had resulted in the loss of a significant number of experienced staff and this left the department understaffed as many of the highly experienced staff either retired or left the organisation. As well, the utility went through multiple rounds of restructuring that affected the project team. For example, three project managers turned over in one calendar year, which did not send positive signals about the project progress overall to the wider organisation.

Prior to the Operations department requesting the penetration and secure code review testing on the bill payment system, an email was sent from the Operations Manager to the information technology project management office in regard to an incident in the production environment in which an 'Easter egg' code was detected in one of their systems. A cartoon character was inserted in the program and appeared under certain operational circumstances. To their dismay the issue was never resolved by the IT group and a change request was required. The change request highlighted that there would be a cost associated with the request to remove the cartoon character.

From the operations team point of view, the Easter egg code should have been discovered by the project team during the various phases of the project, especially the testing phase.

### **4.2.3 Project Issues**

As the project was plagued by troubles, the researcher attempted to understand them. The following is a summary of the observations made by the researcher.

1. The causes of the delays in the project seem to have existed from the initial stages of the project.
2. A perusal of the phases of the project did not reveal all important details behind the project delays.
3. Perusal of the phases of the project showed omission of important details but did not completely reveal the causes behind the project delay.

These observations make it clear that the delays in the project cannot be effectively explained by one or two reasons recognised as belonging to particular phases of the project. The conditions contributing to the project delays seem to be present in the project and the organisation overall, prior to the project ever coming into existence, and therefore not due to anything specific that may have taken place during the project itself. Therefore, the researcher scrutinised the relevant documentation that was made available and classified as belonging to the pre-project phase in order to investigate pre-existing conditions prior to the project commencement.

The project to migrate existing systems to fulfil the requirements of competent and knowledgeable customers, revealed many design problems that could not be expected to be resolved in a reasonable time frame and with reasonable cost. Those problems can be attributed to the continuous delay of the project delivery dates. Although some of the design problems were resolved and progress was made, the level of confidence in the project team was compromised.

The project had created detailed descriptions of the migration process, but failed to conduct a single training session prior to the actual migration. First, the migrated application did not go according to plan, and decisions were made to delay it indefinitely until all technical issues were addressed. The project team did not have sufficient staffing to address such requirements, and the management agreed with their decision to deploy the application into production without sufficient preparation in order to meet the approaching deadlines. Additionally, most of the staff working in the project were external to the utility, and many of them had just been recruited as contractors or staff of



the utility outsourcing partners. The staff did not have sufficient system and business knowledge to make informed decisions.

The level of support received from the Operations department was below the project requirements, but the Operations department's first priority was to keep the production environment operating with minimal disruption. They considered involvement in the separation project as non-productive activity, which would not be of high value. The Operations department's relationship with the IT department showed signs of strain, which was never addressed by the utility senior management.

The project track record during the project life time never contributed to building a reputable name for the project within the organisation, with three project managers turning over in the one year, and not a single application migrated to the new infrastructure six months after the due date. The project reputation was damaged beyond repair within the organisation and very few wanted to be part of it. The project suffered severely from limited senior management attention, with two sponsors changing as a result of the organisation restructure, and other projects scoring higher in the list of the utility IT priorities.

Whilst the schedule was fixed in the project initiation document and was deemed achievable but too optimistic by the majority of the staff working on the ground, this was a view that was not shared by the power utility senior management. The schedule was tight but regardless of this both the outsourcing partners and the utility senior management signed for the project to proceed. It could be assumed that the outsourcing partners agreeing to the schedule was a reflection of the fact that the utility did not negotiate over the price quoted in the tender, given it was the first significant tender to be won by the foreign outsourcing partner in the local market. The outsourcing partner had one hundred thousand employees globally and winning the contract in the Australian utility market represented a significant market entry. However, this was a mistake, made early before the actual scope of the project was known and agreed by all stakeholders, which made the realisation of the project's successful outcome more challenging.

There was considerable organisational failure in the way the project was managed from the beginning, leading to the problems and constant delays. Part of it could be attributed to the organisation not employing any project management methodologies.

The management of the project execution was impacted by the lack of senior management support and the way that the power utility managed its change management process at organisational or project level. Centralised management of the project implementation was consistent with the structure (e.g. PMO) but with neither the need to expedite the execution of the separation project strategy nor the lack of project milestones and organisational change skills. The lack of encouragement for inter-department communication followed from the need to establish a central separation project authority was further limited by the internal organisational conflicts that were never accounted for when the project schedule was published.

The project suffered from its early days including political, social and structural difficulties as it progressed through its lifecycle. While management requested the project to comply with the parent company request, the message was never communicated with urgency to the people on the ground responsible for executing the project. Moreover, the value of the project to the organisation was never fully known to senior management and that was magnified by the limited, or lack of, sponsorship to the project which would allow the project to gain more political clout in a relatively small organisation with limited resources and an uncertain future.

The project had a relatively small information technology department and relied mostly on its outsourcing partners or direct contracted staff to perform most of organisation technology related activities, including project management, software development and support, infrastructure development and support, business analysis and quality assurance.

That in turn left the organisation with minimum business knowledge related to their information technology applications, adding to that the high turnover of staff working directly in the project, having multiple project managers in a short period of time did not bring stability to the project or its staff.

The Operations department, responsible for maintaining the applications once they were in the newly established production environment, was under-staffed and had encountered a few incidents that affected their confidence in the information technology department's ability to deliver reliable software applications as a result of that project or others. The Operations department in turn decided to take a zero risk approach with the

newly migrated application and demanded extra quality assurance steps that were rejected by the project, then accepted to keep the project moving.

From a technical perspective, the organisation's choice to migrate the application like for like from the parent organisation infrastructure to the newly developed infrastructure was not a sound decision, although financially it may have made sense as no extra development was required. However, the bill payment application went through multiple rounds of quality assurance verification, including penetration testing that revealed significant security flaws that could pose a security risk, but more importantly reputational risk to the organisation which if materialised could have cost the organisation significantly. The organisation at the end made a decision to go ahead with the deployment of the application regardless of its documented security flaws.

The organisation, during the project, decided to outsource software development, support and infrastructure management to a third party with the objective of reducing the overall number of staff engaged in its information technology department, as well as allowing the organisation to focus on its core businesses. The outsourcing agreement was considered beneficial to the organisation's financial bottom line, but the organisation had no previous experience working with vendors at the level and size of project required.

The original duration of the project was never adhered to due to the issues discussed; however, it is not clear why the management allowed the project to continue at any rate. It could be attributed to the fact that the project budget was presented as an under-spend which could be linked to the limited number of resources that were available to work on the project.

In summary, the project suffered from internal organisational politics <sup>2</sup>and structural difficulties from its inception. The value of the project was not fully known and appreciated by key decision-makers and the project champion did not appear to be fully committed to the project. Short-term contracts for the hire of external contractors led to a high turnover of staff resulting in a lack of ownership. The quality of the application was identified as a concern prior to going live. Penetration test findings highlighted gaps in the application logic, as well a number of design flaws that would allow experienced

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<sup>2</sup> Politics refers to Projects and project managers are competing with their colleagues in other areas of the business for control, resources, status and power

hackers to damage the payment gateway resulting in damage to organisational reputation. However, the application went live despite the identified risks.

#### **4.2.3.1 Derailment Trigger**

The project suffered from a set of problems that can be categorised as derailment triggers:

1. Major project (SAP Implementation) assumed to go live on 31 July 2009, which was not the case – the project went live three months later and suffered a series of production issues.
2. Deadline of 31 March 2010 was agreed with the parent company as the date on which the utility must have the separation project completed.
3. The power utility and its parent company resources capacity and incentive to deliver, impacted the timeframes for delivery. Resources mobilisation in the utility took place only after the major internal project was completed which impacted the separation project timeframe and required additional resources which were not available internally and had to be acquired externally.
4. Delivery boundaries with the major internal project were unclear and undefined, which required constant management effort that was not available due to conflicting organisational priorities.
5. Multiple key projects being undertaken concurrently resulted in ineffective communication requiring additional effort.
6. IT Service Management delivery approach and responsibilities required further clarification.

It was indicated to the organisation's senior executives that the separation project, which was supposed to commence in January 2009 and never materialised, was due to resource allocation to the major internal project and the direction to remove all unnecessary risk for the lead-up to the major internal project go-live date. As a result, the resource relocation was delayed to commence in August 2009, which in theory removed any interruption separation which may have influenced critical internal project deliveries. However, separation continued to have a number of critical path deliveries that were impacted by the major project and were not mitigated accordingly. The project provided the milestone plan in Table 19 to the project executives, which never counted the exhaustion factors

within the organisation coming out from critical project with nearly every staff worked beyond the mandated working hours for so long to affect the delivery.

**Table 24: Separation Project Major Milestones**

<b>Milestone</b>	<b>Completion Date</b>
Network Implemented	31 May 2009
Detailed Migration Planning complete	30 June 2009
Infrastructure ready to commence Migrations	24 July 2009
Application Group 1 relocated	31 August 2009
Application Group 2 relocated	30 September 2009
Application Group 3 relocated	31 October 2009
Application Group 4 relocated	30 November 2009
Application Group 5 relocated	18 February 2010

#### **4.2.4 Problem Definition**

The organisation during the project faced continuous pressure from its parent company, as well as internally dealing with their critical internal project (SAP Implementation) which impacted the separation projects from different directions:

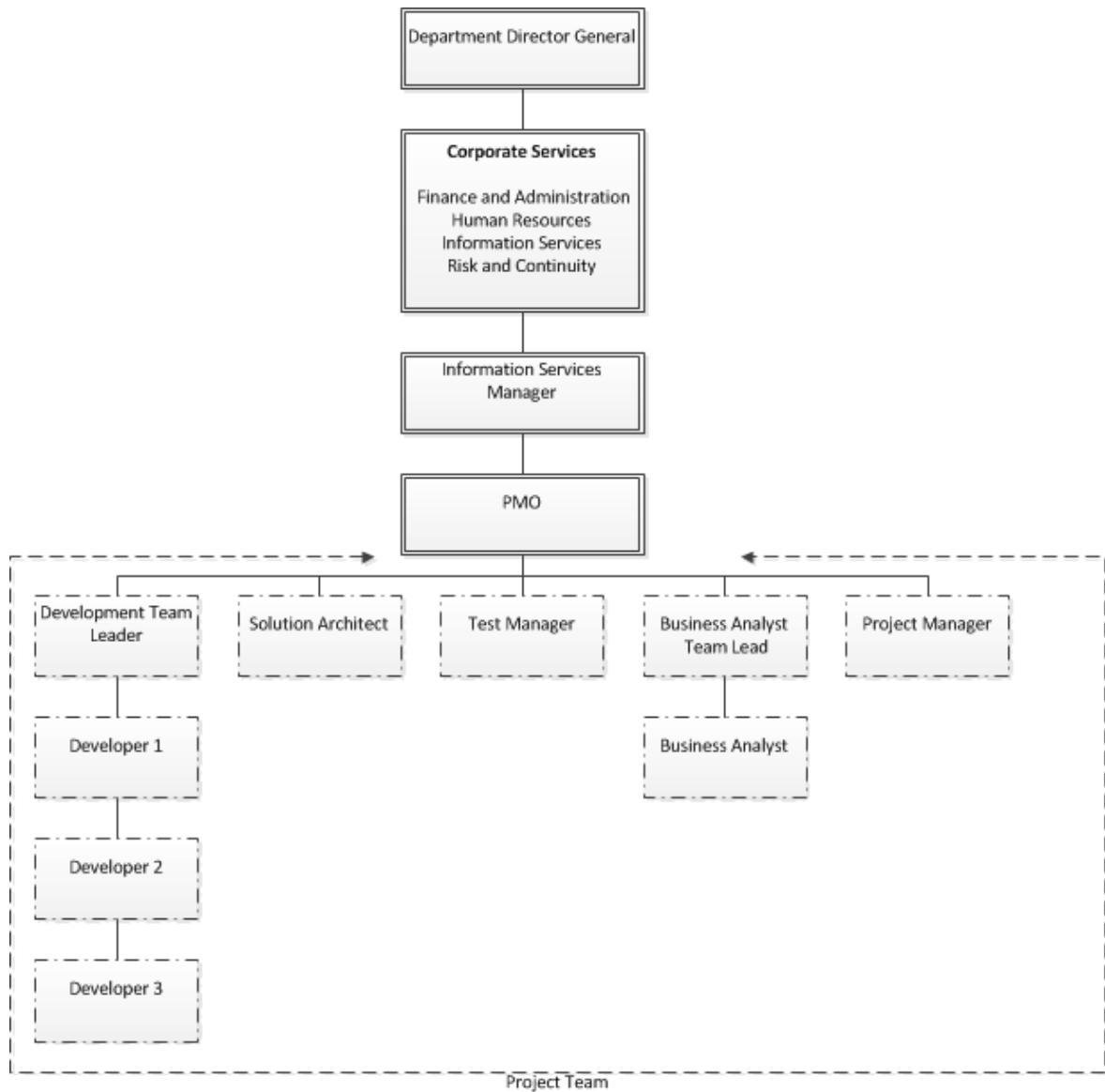
1. Delivery timeframe reduced to less than six months instead of the original ten month timeframe stated in the project scope document or around 50% of the original timeframe.
2. Several resources shortage severally impacted the power utility ability to deliver on its commitments.
3. The Information Technology group suffered from reputation damage which impacted the level of confidence in their ability to deliver.
4. The Separation project lacked a strong sponsor within senior management team.
5. The power utility did not have previous experience dealing with outsourcing partners.

## **4.3 State Government Department Modernisation Project**

### **4.3.1 Organisation Background**

The state government department engaged with the public to ensure applicable safety and protection standards are being enforced. The department comprised eight divisions. Corporate Services was the division responsible for delivering information technology support services to the department. The department had a workforce of nine hundred and forty nine full time employees. The count doesn't include any staff who were working for the department via third party as part of outsourcing agreements or direct contractors.

The Corporate Services Division actively delivered information services to the department and the public through the department external facing website. In the 2009/2010 department annual report, the division was credited with: continuously implementing productivity and service management best practices with the introduction of automated scanning of compliance documentation; governance and processes to improve the effectiveness and management of project delivery, asset management, service desk, incident management and large scale deployment of technology; and the increased adoption and use of the corporate electronic document and records management system.



**Figure 32: State Government Department Project Structure**

The project management office had the overall responsibility for delivering all information technology projects within the department. Figure 32 illustrates the department's project structure.

The department had outsourcing agreements with local vendors to manage the technology infrastructure and some elements of its software development lifecycle. It also engaged a boutique size consultancy to provide specialised architecture and business analysis services to various projects. The Corporate Services Division engaged information technology contractors for new projects as required.

### 4.3.2 Project Background

The project under investigation started in late 2007 to enhance and modernise an existing complaints and licensing system to accommodate licensing, certification and registration processes and to facilitate new licences from various divisions.

The modernisation effort was limited to the infrastructure that was used to support the application, but the core technology used remained the same, even if it was no longer supported by the vendor. The enhancements were limited to improving the overall usability, security and performance of the application, as well as fixing a number of outstanding defects that lingered for a number of years. Self-service functionality was part of the overall project scope, with a number of existing systems to be decommissioned. The application was developed using legacy technology that was no longer supported by the vendor; the enhanced system planned to be developed using the same legacy technology.

The Corporate Services Division project management office employed approximately forty staff, 90% being contractors (Project Managers, Business Analysts, and Architects). The division had a separate IT section responsible for managing infrastructure, and call centres to handle internal and external support enquiries. All staff engaged to deliver the project were contractors with the exception of the program manager.

The project had a contract project manager who was engaged directly by the department. The solution architect and business analysts were employed by the boutique consultancy. The test manager and developers were engaged by the local vendor. The boutique consultancy rejected a takeover bid from the local vendor earlier in the year, which contributed to a tense relationship between the vendors responsible for delivering the project.

The project also engaged a number of temporary internal staff used to assist in quality assurance and administration tasks as assigned to them by the project management office.

#### **4.3.2.1 Project Methodology**

Eighteen months earlier, the department engaged a global consultancy to assess the methodologies and ways to improve the Corporate Services Division project delivery capabilities. The consultancy found that there was general lack of governance measures in the methodology currently adopted by the department. Areas where governance details were deficient include:



- Explicit reference to formal sign-offs for phases and deliverables;
- Consideration of implementing and utilising a Technical Architecture Office to review and approve candidate technical architecture designs’;
- No Enterprise Architecture for internally developed information systems.

A well-defined and implemented Enterprise Architecture would support the software development process within the department by providing the fundamental underlying technologies and implementation strategies.

The consultancy recommended the department put IT Governance Framework in place, which would be aligned with the PRINCE2 project management methodology, Rational Unified Process software development methodology and an aspect of the ITIL service management framework. The proposed Enterprise Architecture introduced the concept of the following groups:

- Change Office;
- Change Advisory Board (CAB);
- Technical Architecture Group (TAG);
- Enterprise Architecture Office (EAO);
- IT Steering Committee;
- Enterprise Architecture Review Group (EARG);
- Technical Architecture Review Group (TARG).

The consultancy, based on the data collected through interviews with the business, recommended the department move away from the waterfall approach and adopt a Unified Process (UP) based methodology that would be aligned with the PRINCE2 project management methodology.

With the consultancy proposed software development process and its alignment with the Enterprise Architecture, the consultancy also introduced the use of Solution Architecture Overview (SAO). The creation of SAO was intended to support this process by identifying the high level scope for IT projects undertaken by the department, relating project scope back to business requirements and associated business drivers and provided a base for creating high level estimates for development projects.

The department enterprise framework was part of an improvement strategy devised by the newly appointed manager of the Corporate Services Division. The project Start Up Process (SU) in PRINCE2 was designed to ensure that the prerequisites for initiating a project were in place. In software development projects, some analysis is required to be performed to allow a Business Case to be developed. An EAO Impact Review (outputting a Summary Review) was conducted based on the results of the analysis of this phase.

The second part was the Managing Project Delivering (MP) module in which main outputs from the project were managed as a series of products within the concept of the PRINCE2 framework. A detailed analysis and design phase was completed as one of the first products to be delivered by each project. The Detailed Review was conducted based on the results of the analysis and design performed during this phase.

Where the product had been implemented into the production environment, an End Stage Review would be conducted based on the actual details of the product delivered.

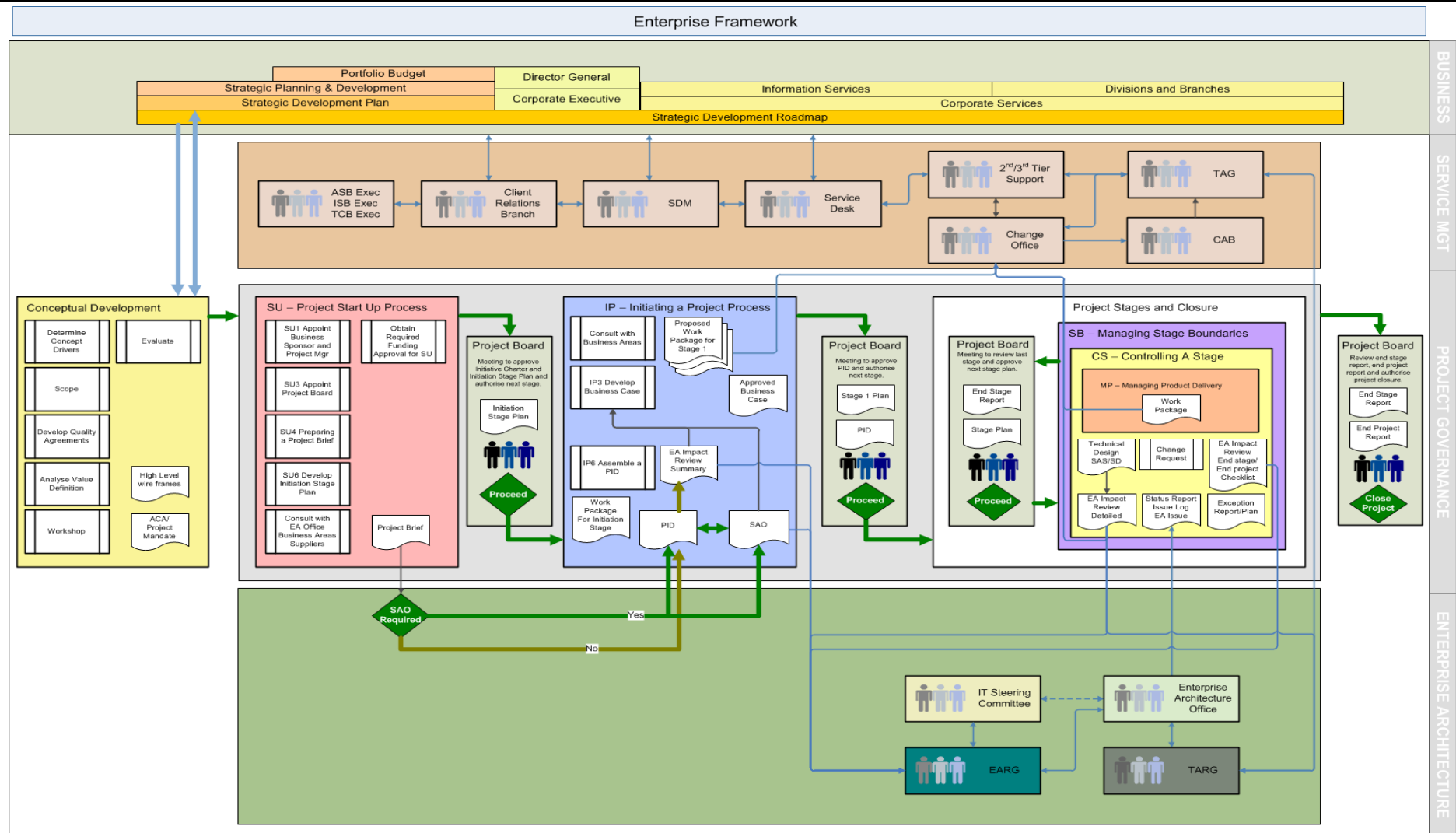


Figure 33: Proposed Enterprise Architecture Impact Review Process with PRINCE2

In order to successfully implement both the PRINCE2 and Rational Unified Process (RUP) methodologies successfully within the department, they cannot be considered and implemented in isolation; rather they must be integrated and implemented collaboratively.

Figure 33 depicts how a typical software development project implementing the RUP software development process would integrate with the PRINCE2 project management methodology.

The department considered the following principle as the basis for alignment of the two methodologies (Bailey 2008, 24):

- “PRINCE2 planning covers the entire project lifecycle. Due to RUP’s iterative nature within phases, PRINCE2 planning would be of necessity be iterative as well;
- Overall project governance is undertaken by the project board with senior management representation;
- PRINCE2 project management directs and monitors the software development effort;
- RUP planning manages the software development aspects of the project at a day-to-day team level;
- A RUP iteration roughly equates to a PRINCE2 management stage”.

Although the projects would have the same high-level flow through the lifecycle, the type of project being undertaken would impact on the tasks and outputs completed in each of the PRINCE2 stages and RUP phases as follows (Figure 34).

- 1. Software Integration Project**

This type of project is focused around the implementation of third party software to fulfil a set of specified business requirements.

- 2. Software Development Project**

This type of project would be focused around the customised development for use within the organisation.

- 3. Hybrid Software Development & Integration Project**

This type of project would have a combination of customised development and the implementation of major third party components.

#### 4. Maintenance Project

This type of project may not strictly require all components of the lifecycle; however, it would constitute the application of a formal process for maintenance and support implementation as well as general monitoring and product upkeep.

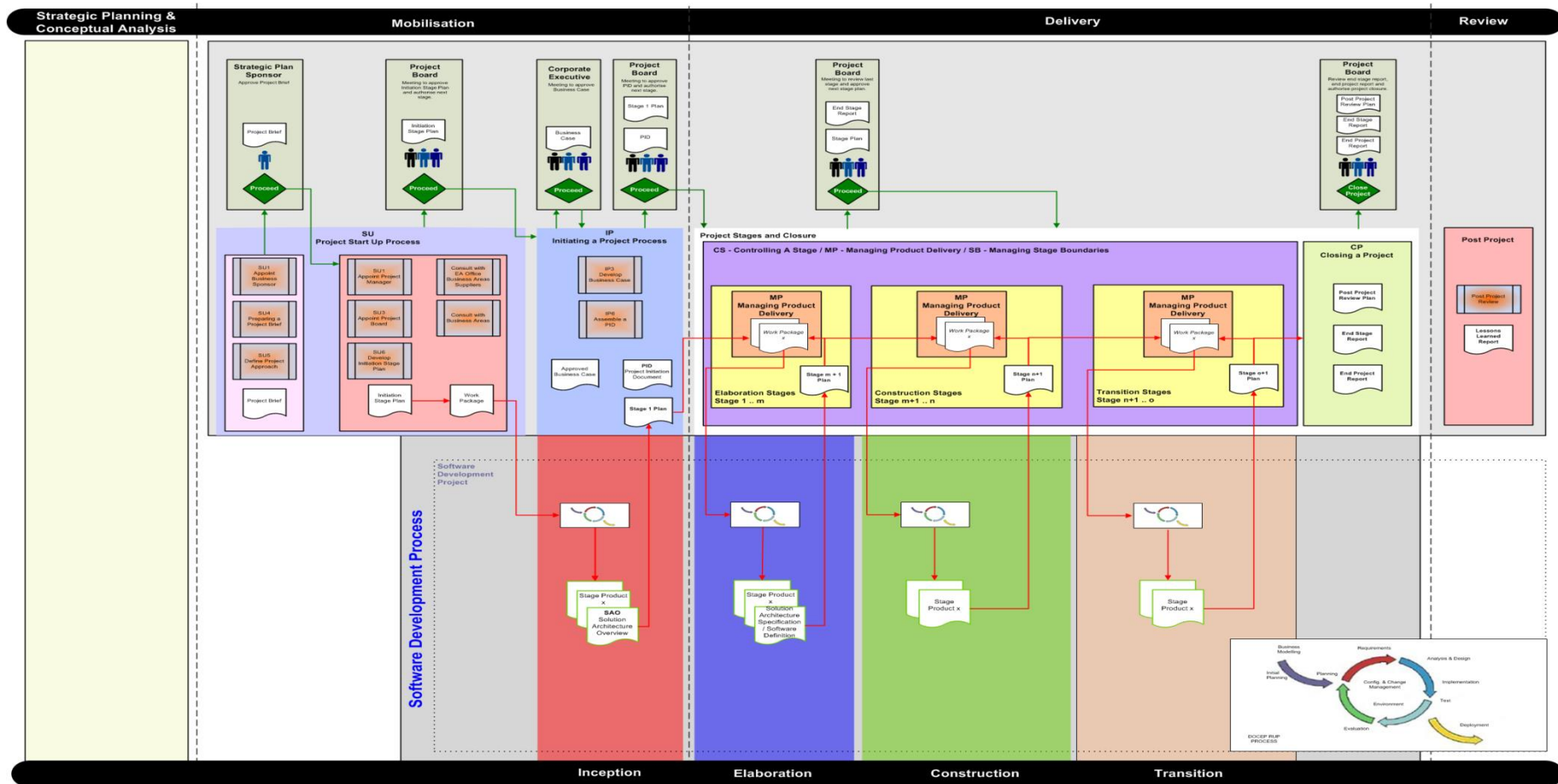


Figure 34: Integration of Software Development Process with PRINCE2

The department implemented an ITIL based Service Management approach within their organisation. The department selected elements of ITIL Service Support processes to be implemented organisation wide for:

- Incident Management;
- Problem Management;
- Change Management;
- Release Management.

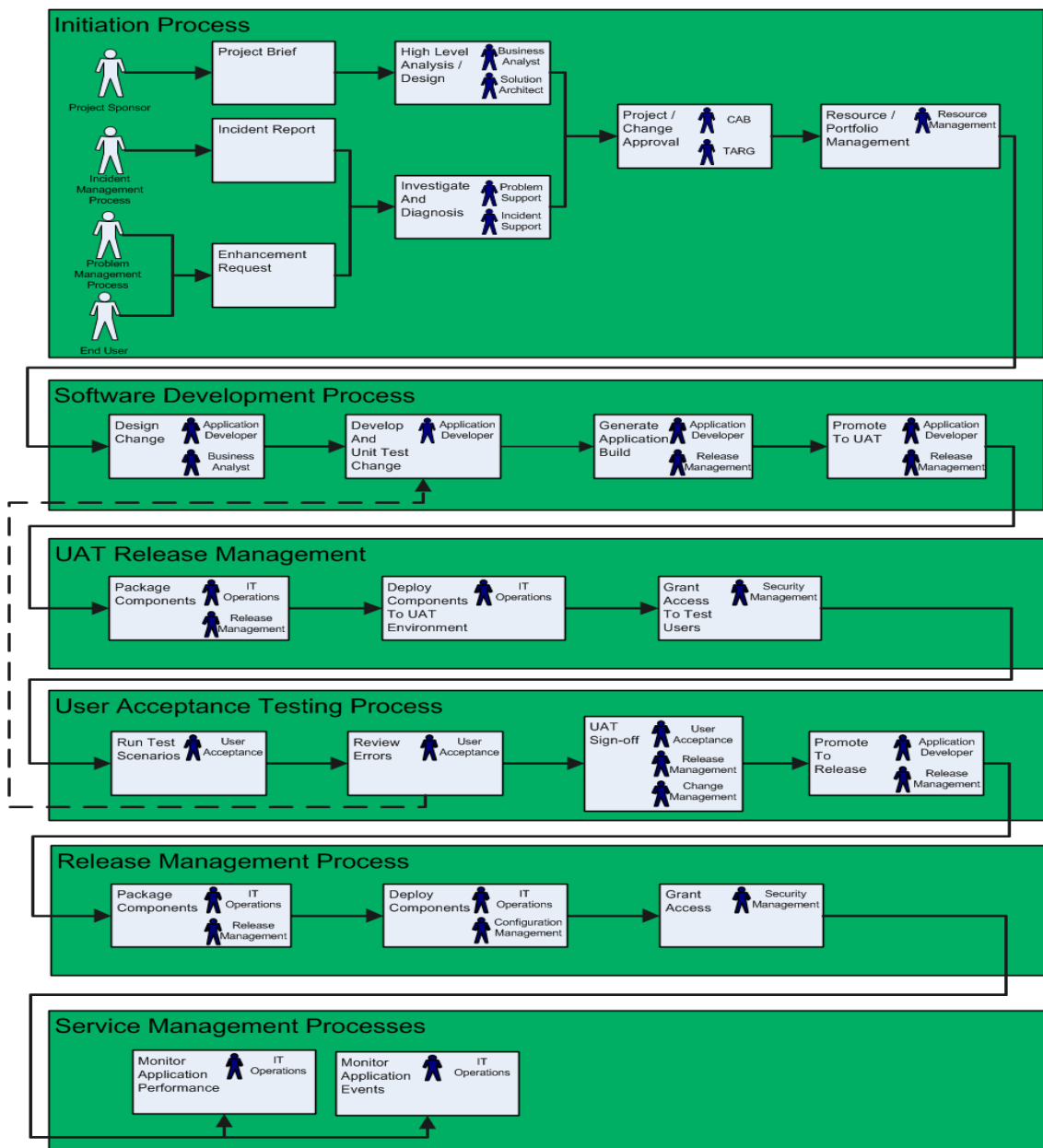


Figure 35: Overall Software Development Process

#### 4.3.2.2 Business Drivers

The department was part of a state government that is working to serve their electorate. The department vision was: *"A fair, safe and prosperous community"*. The department identified in its annual report some of those business drivers. The researcher selected the business drivers that were relevant to the information technology project under investigation.

#### **4.3.2.3 System Costs**

System costs must be constrained. Duplication of functions should be eliminated with a greater focus on reuse and portability. Developed systems and applications should be exploited to their full potential. Common technologies and approaches should be used across the organisation to deepen the experience pool and technology sharing.

#### **4.3.2.4 Customer Focus**

There needs to be a stronger customer focus so the services the department delivers are valued and continued to be supported by the community and industries at large. This will be enhanced by more effective and unified communication mechanisms that allow the department and its customers to interact.

#### **4.3.2.5 Information to Knowledge**

There was an increasing need within the department, as well as the ability, to link with the public, industry and partner organisations through information and knowledge sharing. Integrated business processes and data flows would allow the department to provide practical and consolidated views and reports at operational and management levels that could be used to achieve goals and drive future directions.

#### **4.3.2.6 Productivity**

To enable efficient service delivery, the department needed to ensure that staff have access to leading technologies that were well integrated, easy to use and available within high performance networks. Continuous business improvement was an additional factor and the ability to capture and then implement and support improvement strategies, would need to be an area of high focus.

The e-enablement of management and business processes was another opportunity for creating a more responsive working environment within the organisation. The

department must better leverage its information systems to support improved business performance, compliance and auditability.

#### **4.3.2.7 Security and Reliability**

Security, reliability and integrity of systems were of high importance. Highly capable security systems needed to be developed to guarantee the security of core information while still allowing controlled access to an increasing range of stakeholders. Better metrics were needed to monitor and assure service levels.

#### **4.3.2.8 Online Capability**

The department could make a giant leap to provide online capabilities for many statutory obligations, as well as management, integration and access to information resources. The agency must be able to effectively and securely integrate with organisations to provide value via efficient services and consistent approaches to information management.

### **4.3.3 Complaints and Licensing System Project**

The corporate licensing build project aimed to modify the complaints and licensing systems to accommodate new types of licensing, certification and registration processes to facilitate the merging of new divisions into the department.

At the same time, the project aimed to significantly enhance the application usability, performance and general functionality available to existing users, whilst meeting the needs of the new divisions. Another objective of the project was to improve the supporting payment and renewal processes in addition to enabling some aspects of the licensing process, such as lodging applications, renewal payments, enquiries and self-service functionalities.

Once the new application was deployed into the production environment, the number of current licensing systems belonging to the merged divisions would be decommissioned. This should result in streamlined business processes within the department, improved services to the public, and reduction in the information technology maintenance budget.

The project listed the following objectives in the business case presented to upper management prior to their approving the project to go ahead.

- Extend the current system functionalities to meet the licensing requirements of new divisions;



- Attain a configurable system that can adapt to changes in business requirements (and processes);
- Enable storage, management and use of entities (e.g. businesses and individuals) in a central repository;
- Implement a robust security model that enables data sharing and restriction, as well as functional authorisation;
- Enhance the current system to deliver improved usability, performance and general functionality.

#### **4.3.4 Project Issues**

The project was planned and executed using PRINCE2 as the project management methodology of choice, and RUP to manage the software development. There were nineteen stages identified for the project, including project start up, project initiation, and twelve managed product stages and project closure. Each managed product stage went through a complete RUP lifecycle including design, coding, testing and deployment. Within each of the identified stages, a number of licences were planned for implementation or enhancement.

The application was developed using legacy technology that is no longer supported by the vendor, and with the enhanced system planned to be developed using the same legacy technology. The use of legacy technology presented an issue to the project in the form of lack of qualified developers available in the market. The project struggled to attract contract staff with the right skillset, and when it was found, it proved to be very costly on the project budget as the project progressed.

Documentation is one of the elements required for maintaining software when it moves from the development stage to support mode. The system under development was developed many years ago, when the department did not adhere to strict development guidelines. Lack of, or non-existent, documentation to assist the new development team proved fatal to the project. The original project schedule estimated one month would be required for the new development team to analyse the existing system before moving to the build stage of the project. The development team initially spent less than the estimated

one month analysing the existing code, but in the later stages and with each subsequent change to the code, more time was put aside for code analysis.

The project manager made a set of assumptions about the required testing for the new code. Originally, it did not put any time in the schedule for the development to conduct unit, or integration testing.

The project original estimates to functionally test the entire application was eleven hundred hours. Six hundred and forty hours was allocated for the test manager, who was hired to establish the testing strategy and train internal staff on how to approach software testing. As the project development progressed and delays became apparent, estimates were never revised. When the number of hours budgeted for the test manager expired, the project sponsor decided that the project could no longer afford to have a test manager and his services were no longer required. Two internal department staff trained by the test manager to undertake basic testing activities were declared sufficient to undertake the remaining testing stages for the project.

Trying to understand some of the issues that faced the project, the researcher turned to one of the early exception reports put to the project steering committee to approve extra funding to the project. Figure 36 and Figure 37 are extracts from the exception report and some of the options which were put forward for the management to consider.

EXCEPTION REPORT			
<b>Project:</b>	4003 Corporate Licensing Build Project		
<b>Exception Number:</b>	XR001		
<b>Date:</b>	16 Jun 08	<b>Raised by:</b>	
<b>Title:</b>	4003 Project Budget and Schedule Increase		
Purpose			
The Exception Report is produced when costs and or timescales for an approved stage or project plan falls outside the agreed tolerances in terms of schedule or budget. This document is authored by the Project Manager for the attention of the Project Steering Committee.			
Cause of Exception			
<p>The exception for the 4003 Corporate Licensing Build Project has been raised as it highlights the increases in schedule and budget to the project. This exception has been caused due to a number of reasons:</p> <ol style="list-style-type: none"> <li>1. 4003 Development environment issues (4003 IR003, 4003 IR007, 4003 IR009, 4003 IR010, and 4003 IR011).</li> <li>2. Delayed delivery of the Corporate Licensing System (CMS) Environments (4003 IR005, 4003 IR012).</li> <li>3. Change in DBA resources affecting support (4003 IR005).</li> <li>4. Change in some contractor resourcing rates due to change in contract structure to a Common Use Agreement (CUA).</li> <li>5. Developer Resources unavailability (4003 IR002, 4003 IR008).</li> <li>6. Testing Resources unavailability (4003 IR004).</li> <li>7. Increased requirement of Project Management resource from 60% to 100% allocation due to high volume of issues and complexity of project.</li> </ol>			

Figure 36: Corporate Licensing build Project Exception Report

Impacts			
The business case has not been altered as the initial objectives of the project are still to be met.			
As at 20-Jul-08, there is a known impact of 70 project days' delay to the Go-Live release 1 project schedule. The projected Release 1 Go-Live date is now March 2008.			
As at 20-Jul-08, there is a known cost impact of \$AUD 251,806 to the 4003 project budget.			
Number	Factor	Cost	Delay (Project Weeks)
1	Environment Issues/Delay	\$ 79,300.87	3.02
2	Resource Rate Change	\$ 18,015.35	NIL
3	Lead Resource Shortage	\$ 67,442.53	NIL
	No requirement for lead handover	-\$ 7,107.00	NIL
4	Increase in PM allocation from 60% to 100%	\$ 94,154.88	NIL
5	Extension of Release 1 LHRW Go-Live due to resource unavailability of test and developer resources	NIL	6.99
6	Christmas Holiday	NIL	4.00
	<b>TOTAL</b>	<b>\$251,806.62</b>	<b>14.01</b>

Options	
There are a number of actions/options available to the 4003 Project Steering Committee for handling the exception:	
1.	Raise a change request (4003 CR003) for the extended duration delay of 15 days and the costs to the amount of \$79,300 incurred due to the issues with the delivery of the development environment. This includes Project Management costs of \$22,490 for an additional 40% allocation required for the period from 29 Apr 08 to 15 Aug 08. Seek remuneration from Information Services.
2.	Raise a change request (4003 CR005) for extra 4003 project funds to the amount of \$18,016 to be transferred from 4003 contingency for the rate change of resources due to contract changes.
3.	Raise a change request (4003 CR006) to the amount of \$60,335 for the increase in resourcing rate due to developer resources availability and the subsequent retainment of the current Lead developer for the duration of the project Oracle developer tasks.
4.	Raise a change request (4003 CR007) to the amount of \$94,155 for the increase in Project Manager resource allocation from 60% to 100% due to high volume of issues and complexity of the project. *Note that additional funding is for the period from stage 6, 18 Aug 08 up to 25 Sep 09 (22 Jun 09 + 70 days).
5.	Raise a change request (4003 CR008) to extend the duration for release 1 LHRW – Go Live by 35 days. This is due to development and testing resource unavailability. *Note: This will have a flow on effect for the scheduled Go-Live of releases 2 to 7.

**Figure 37: Exception Report Impacts and Options Presented to the Project Steering Committee**

According to the exception report published in July 2008, the project was behind the original estimates by seventy working days and the go live date was moved to March 2009. That was the beginning of a long list of delays that will be discussed later.

The report listed three factors which attributed to the delays. Two of those factors related to the project's ability to attract the right candidate to lead the project development effort and in order to attract the right candidate it required certain financial agreements. The third factor, which points to certain assumptions made earlier by the project steering committee, was the project manager effort allocation. When the project started, assumptions were made that a full time project manager would not be required. A few months later it was clear that was not the right approach and a full time project manager was required in order to deal with the mounting issues.

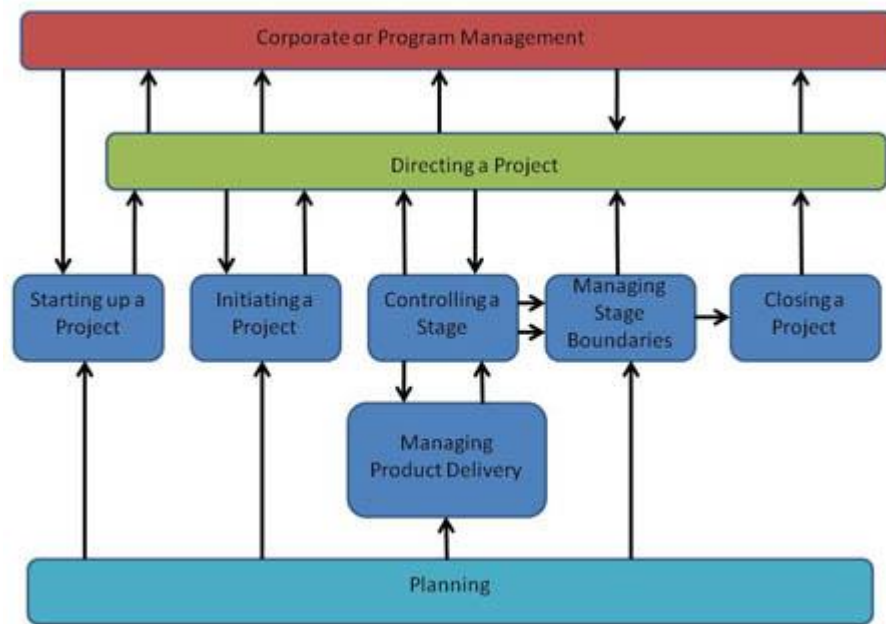
The development and testing environment was not available when it was required by the project which led to having developers use their own personal computers to develop and deploy codes. The issue was escalated to the appropriate management level within the department and certain arrangements were made to resolve the issue in a timely manner.

When the first code was deployed to test, it did not take long to find that the code was not in a state to allow testing to progress at all. The code was rejected and an urgent meeting was held with the development team leader to understand why there were a high number of critical defects in the code.

The answer was simple and clear: no unit or integration testing was done by the development team due to the tight timeframe. This revelation shocked the project and test manager and indicated that more action was required if the project was to ever meet its revised schedule. However, no immediate action could be taken due to the nature of the organisation and the project sponsor requested a quality assurance checklist to be signed by developers before handing over the system to the testing team.

The development team leader did not agree with the decision and threatened to walk away and more negotiations were required to reach the desired outcomes without impacting the project overall results. In the end, the issue was settled with a one page checklist that had to be completed by the development team leader prior to declaring development as complete for the stage.

While the project was officially managed by PRINCE2 in which each stage (Figure 38) has a set of products that must be delivered, execution of the project did not actually follow the methodology.



**Figure 38: PRINCE2 Process Model**

From the outside, all processes and especially the documents were completed to reflect PRINCE2. Nearly all documents adhered to PRINCE2 and RUP methodologies. The day-to-day running of the project was a different affair. For example, when the project manager started to see consistent slippage on the stage deliverables, she initiated daily stand up meetings to resolve operational issues before they materialised. The technique was borrowed from the Agile development methodology and it was considered acceptable to use this technique, especially when faced with project deadlines looming and prior experience of late delivery of work products, if delivered at all. However, when the project sponsor took notice of the daily meeting, it was shut down since it was not authorised and was not part of the approved project management methodology by the department.

The project had two business analysts working on the project use-cases for each component of the systems; they also worked on clarifying requirements to the development team and testing team.

By September 2008 and after the project steering committee agreed to move the go live date to March 2009, more issues with the overall progress of the project were reported, including a significant increase in the number of defects recorded against the components that were developed. Moreover, the development team leader made it clear he was not

interested in continuing as team leader. Instead, he wanted to be a senior developer and move away from the day-to-day management of the development team and focus on writing codes only. As a result, the senior business analyst was appointed to be the development team leader, with responsibility for management of all development activities, including the planning of upcoming development stages and ensuring the quality of the code delivered is of higher quality than what was delivered in the earlier stages.

The decision was authorised by the project sponsor, and did work well in the first few weeks of its implementation. However, it had serious side effect on the testing team. As the main source of system knowledge became more engaged with development activities, the testing resources viewed the project manager as siding with the development team when it came to defects being raised. The dilemma was created by appointing the person with the most business knowledge to be responsible for the development activities, instead of being the source of truth for business issues in relation to defects raised by the testing team, who suddenly felt a marginalised part of the project. A few weeks later, the test manager contract was not renewed due to funding issues, and two other testing resources decided to move back to their divisions. That left the project with one testing resource that also acted as a personal assistant to the Corporate Services Division general manager.

In a project status report published on 21 September 2008, it was highlighted that the business analyst team were under resourced to complete the work on the new security model. "The Business Analysts are working hard with current work being undertaken refining the security model. The Business Analysts team are currently under resourced"(Chau 2009, 7).

The implementation of a robust security model that enables data sharing and restriction, as well as functional authorisation, was one of the main objectives used to authorise the project in the first place to go ahead. The new security model was part of the original system estimates, and a significant amount of analysis and design was invested to revamp the security model that would be an integral part of the enhanced system.

The project original estimates were completed by the solution architect, with no input from the development team as it was completed before any of the developers joined the

project team. The estimates also included provision for testing, as part of the new development methodology officially adopted by the department.

With the project deliveries pushed back by a few months and with the development team now on-board, the business analysts produced the revamped security model specification. The development team immediately indicated that the time estimated to build that security model must be doubled or it has to be modified to reflect the estimates. They made it clear that they would not be able to deliver a significant feature of the system based on estimates that were provided a few months earlier, as it did not take the complexity of the changes into account.

With the project manager recently getting approval for project and budget extension, the security model scope presented another issue that would again impact the project team's ability to meet the newly announced go live date.

Later on, the security requirements were deemed excessive and went through various revisions. It was necessary for the project team to simplify the security requirements and present cheaper options to the business. The new security model required features where one or many system users could be assigned to a particular licence type and staff roles performing tasks on particular licences restricted to their access level and their work duties.

The proposed security model was deemed insufficient by the business, as it only added one new layer of granularity to split the users amongst the various divisions, with each division having one or more supervisors with one or many reporting staff. The business argued that the security model requirements were known to the project before they approved the project. The project team responded by highlighting the complexity associated with implementing the security model as it was first envisioned.

The project team and the project sponsor indicated that if the business was willing to wait longer and increase the project budget, the project team would ensure that the security model was delivered as per the original requirements. After a few weeks and many heated meetings, the business agreed on the proposed simplified security model with minor changes that addressed some of the concerns raised by the business. The project status report (Figure 39: Project Schedule



submitted to the project sponsor on 21/09/2008 included a project schedule which showed more slippage on the project end date, which was moved to April.

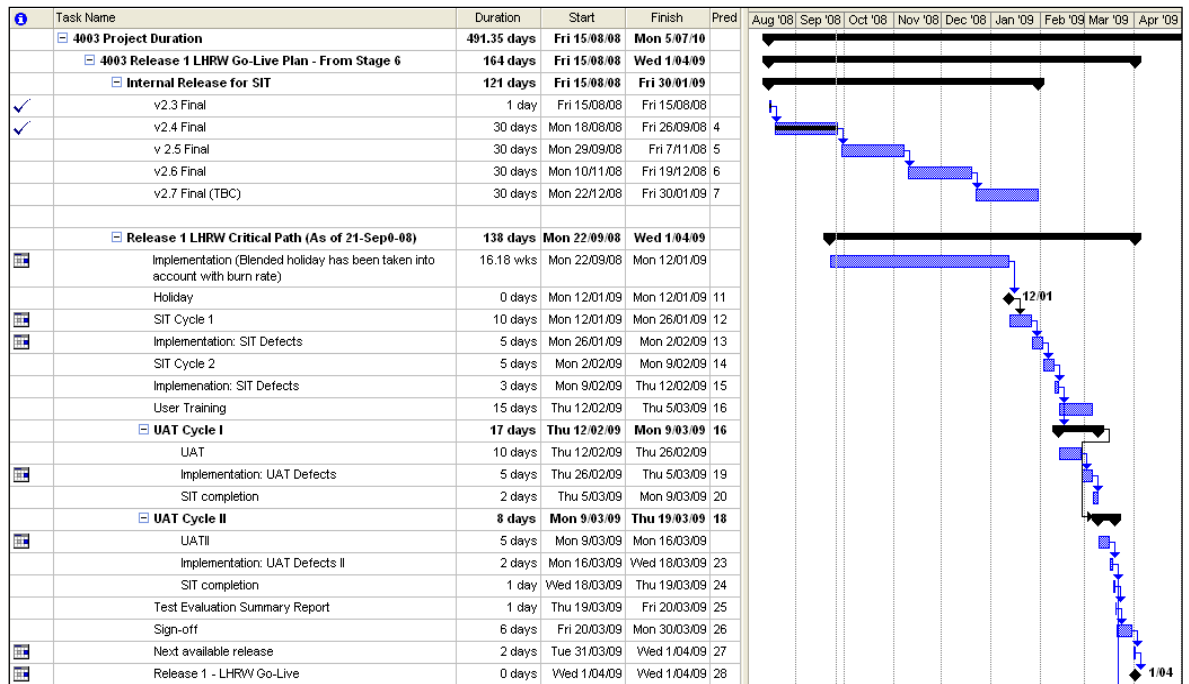


Figure 39: Project Schedule

Table 25: Project Cost Status

	Budget	Actual to Date	Remaining	Approved Tolerance (above budget)	Projected Budget	Status
4003 Corporate Licensing Build	\$1,758,081	\$694,903	\$1,063,178	-\$329,090 to +\$82,273	\$2,022,385	RED
Completed Stages	\$509,208	\$503,366	\$0	N/A	\$503,366	COMPLETED
Accommodation	\$74,803	\$29,148	\$45,655	N/A	\$74,803	GREEN
Stage 6: Construction General Features	\$236,956	\$162,388	\$74,569	N/A	\$236,956	RED
Stage 7: Construction LHRW, LHRW Assessors, CoC (WS)	\$TBC*	NIL	\$TBC	N/A	\$TBC	GREEN
Stage 8: Construction LHRW, LHRW Assessors, CoC (WS)	\$TBC*	NIL	\$TBC	N/A	\$TBC	GREEN
Stage 9: Final Stage of Release 1: LHRW, LHRW Assessors and CoC (WS)	\$TBC*	NIL	\$TBC	N/A	\$TBC	GREEN

Table 26: Project Time Status

DETAIL	Start Date	Baseline End Date	Projected / Actual End Date	Variance	Status
Corporate Licensing Build	14 Jan 08	22 Jun 09	TBC	TBC	RED

<b>Release 1 – LHRW Go-Live</b>	<b>04 Mar 08</b>	<b>27 Mar 09</b>	<b>03 Apr 09</b>	<b>+6 d</b>	<b>AMBER</b>
Stage 6: Construction General Features	18 Aug 08	26 Sep 08	26 Sep 08		GREEN
Stage 7: Construction LHRW, LHRW Assessors, CoC (WS)	29 Sep 08	07 Nov 08	07 Nov 08		GREEN
Stage 8: Construction LHRW, LHRW Assessors, CoC (WS)	10 Nov 08	19 Dec 08	19 Dec 08		GREEN
Stage 9: Final Stage of Release 1: LHRW, LHRW Assessors and CoC (WS)	22 Dec 08	27 Mar 08	03 Apr 09	+6d	AMBER

As can be seen in Tables 20 and 21 the project status was RED which indicated immediate action required to be taken by the project sponsor. The researcher agreement with the project ended in October 2008 and returned in March 2009 to verify if the project could go live in April 2009. Unfortunately, this was not possible as the project had suffered a staff exodus and the project was re-baselined again, and some features of the systems had been cancelled. At the end the project went live in December 2009. The final project budget was 50% above the original estimates. By the time the project went live, no testing was undertaken by the project team, and any testing still required was conducted by the business analysts. The senior software developer had resigned in March 2009.

#### 4.3.5 Problem Definition

The enhancement project was managed under a program of work in the division, employing PRINCE2 as the project management methodology. The program included many projects, including a project preceding the project under investigation with the objective of identifying the scope and establishing the solution architecture, with other projects to follow. The division had other information technology projects managed by the PMO running in parallel. Whilst the organisation as a whole adopted PRINCE2 as the project management methodology of choice, the project under investigation invested significant time and energy complying with the methodology requirements, especially the reporting element of the methodology.

Significant time was applied prior to the project starting up to establish a work breakdown structure (WBS) for each of the project stages, mostly completed by the solution architect and the senior business analyst with no input from the development team. That is explained by the project's inability to engage appropriate resources early enough. However, once the project successfully engaged developers, the process of WBS planning was managed by a solution architect and senior business analyst. Only when it

became apparent that no concrete deliveries were being made against the early stages of the project, did the development team leader become involved in the process.

RUP was used as the software development methodology and the project was planned to be implemented over a number of stages. Projects within the PMO were also required to adhere to the newly implemented enterprise architecture; the enhancement project in particular was the first project to fully implement this new approach and the project sponsor actively monitored the project to facilitate any issues faced when adopting the new architecture.

That was challenged when the project began to face difficulties in adhering to the project schedule, but more importantly to the budget. Before the project officially started, the solution architect provided WBS for each of the project phases, which planted the first seed of trouble as the project progressed. RUP and the enterprise architecture adopted by the department required adherence to the stages as the development lifecycle was limited to four weeks. The development team could not deliver any outcomes in the first two stages, whilst the project traffic lights remained GREEN. The project manager explained in the project status report that due to time-boxed stages, AMBER or RED time status indicated the severity of tasks not being completed as scheduled and therefore requiring rollover into the next stage.

Quality is one of those terms that can be defined to fit the change of project progress; the organisation went to great lengths to define and adopt methodologies, including an iterative software development lifecycle. The software development lifecycle required different stages of quality assurance to qualify the software under development as being fit for deployed into production. Once the project budget started to show strains, the first person asked to leave the project was the test manager, and as the project progressed, the test team was downsized to one individual, who also acted as personal assistant to the general manager of the Corporate Services Division.

The development team did not help the project to achieve the desired quality, and they did not implement unit testing in an attempt to deliver the tasks within the stage. The quality of the components delivered to the test team was low. The project team decided that unit testing and integration testing must take place prior to delivering code to the test team. Initially, that approach was resisted by the development team and it was argued

that this would delay and impede their ability to deliver software components on time. The first round of testing using the new approach delivered better outcomes, with the defect count being relatively low compared to previous stages. However, in later stages of the project, most of the quality assurance team was let go, and business analysts and developers were required to undertake testing activities to contain the project budget.

Software testing requires independent professionals who are skilled and trained to write and execute test cases in order to examine the software components in accordance with the requirements. With the test team losing their members, a decision was made to utilise the business analyst in testing. The decision was viewed as the most logical way forward, taking into account that the business analyst already had a deep understanding of the system and had participated in writing the business requirements. The direction simply contradicted the investment and direction by the organisation to adopt methodologies that were able to produce and maintain higher quality software products.

Significant investment was made by the department in implementing PRINCE2. However, the PRINCE2 approach to testing is naïve and based entirely on the requirements of ISO9000. The main sponsor of the methodology (the British Government) was aware of the problem due to a number of high profile project failures highlighted in the McCartney report (Commerce 2002) which made a number of recommendations concerning requirements and test management. However, none of those recommendations were incorporated into the methodology.

The problems with the application of the methodology also could be attributed to the department culture. The department had rigid work practices, the new executive moved rapidly to implement the new methodology and framework, with little or no consultation with various levels of staff, except upper/senior management in order to gain their approval. However, the workers executing the new vision and direction were rarely consulted on whether the new direction would actually result in improvement or not.

Rogers (1983) argued that getting a new idea adopted, even when it has obvious advantages, is often very difficult. Changes could take years to become the norm and widely adopted. Taking into consideration the conservative nature of government departments in general and the department in which the case study under investigation took place, change is not part of the normal activities practiced by staff. Instead, they

engage in a set of procedures practiced for a long time and which are rarely altered or changed.

Training was one of the tools used to promote the organisational change, and it is worth noting that full time staff members of the PMO had the opportunity to gain professional certification on project management (PRINCE2). Once a member of the PMO gained such certification after a five days training course, they were put in charge of a small project. However, there is no evidence provided by the department that the staff who took the project management training performed any better than staff who did not attend the training or became certified project managers.

Following the delayed launch of the project in production, the researcher tried tirelessly to obtain the post implementation report that mandated the officially adopted methodology. However, the department refused to provide such reports, citing various reasons such as the project manager responsible for the project was no longer employed by the department, or they were still in the process of writing the report six months after the project closed.

Three months following the go live of the project, the general manager of the Corporate Services Division resigned from the department citing personal reasons.

## **4.4 Federal Government Department Project**

### **4.4.1 Organisation Background**

The department's main responsibility is service delivery on behalf of the Commonwealth of Australia, providing access to variety of social, health and other payment services. The department directly employed around 5,583 full time Australian public servants, and nearly 600 staff engaged in the department's IT division, with many of the staff engaged on short term contracts that ranged between three and six months. The actual number of information technology contractors working in the department is not listed in the department annual report. The department relied on one major vendor who had a ten year contract with the department to manage their information technology infrastructure, including desktops, applications, data centres and telephony systems.

The department's stated outcomes in the portfolio budget statement for 2011/2012 were: "Support individuals, families and communities to achieve greater self-sufficiency,

through the delivery of policy advice and high quality accessible social, health and child support services and other payments; and support providers and business through convenient and efficient service delivery” (Plibersek 2011, 14).

One of the key strategies outlined by the department is to develop an information technology capability that supports the services delivery and government priorities.

The engagement with the department allowed the researcher to gain access to various information technology projects managed by the department. In this section, three distinct case studies within the department will be discussed, and at the end, an overall conclusion will highlight the common issues faced by the three projects.

#### **4.4.2 Project Background**

The Government planned to spend \$15 million over 18 months to provide assisted access to the Certificate level IV in Home Sustainability Assessments for assessors who retained accreditation with the Association of Building Sustainability Assessors. There had been some criticism as to the quality of training that had been provided to home sustainability assessors. In part to address this, the department managing climate change and energy efficiency (DCCEE) assisted in developing a Certificate IV course and provided some incentive, for those who remain in the industry, to attend. The program was managed by DCCEE and administered by the Human Services Portfolio. An applicant was able to apply for reimbursement under the scheme for an amount of 50 per cent of the tuition fees for a Cert IV HAS course in which they were enrolled to a maximum of AUD\$2500 (GST inclusive).

The payment is made upon enrolment into an approved course and the course Tuition fees are paid in full. This program will be known as the Training Assistance Scheme through Supported Access to Certificate IV training (Sustainability Assessor Payment Scheme).

The Training Assistance Scheme project was based on the requirement by Medicare Australia and the DCCEE. The mechanism is to provide a reimbursement of AUD\$2,500 to recipients under the scheme. DCCEE estimated that a maximum of 6,000 people would require reimbursement from April 2011.

The project was originally planned for budget year 2009/2010. However, due to some complexity getting the approval from the department owning the system and the department developing the system, the project moved into the 2010/2011 financial year. When the project was first costed six months earlier, no other projects were planned to be executed by the project team responsible for delivering the system. However, with the delays getting all the required approvals, the project team was committed to deliver two other projects in the first quarter of the 2011 calendar year.

With three projects to be delivered in the same timeframe by the same project team, resource constraints became apparent and with the project starting 10 January 2011, following the 2010-11 Christmas holidays, a limited number of staff were available to commence the project as planned. The department responsible for implementing the project traditionally used the waterfall software development methodology; all projects within the department must be implemented using the official project management methodology adopted by the department. The quality assurance branch of the organisation officially adopted the V-Model in 2010 (Cayirylys and Doherty 2010, 2) for all testing activities undertaken by the department.

#### **4.4.2.1 Project Objectives**

The first step of the intervention model was to understand the project objectives and their relation to the derailment trigger. The project was to provide the capability for operators to enter claims that would allow payments for an amount equal to 50% of the tuition fees for courses in which clients were enrolled, to a maximum of AUD\$2500. The project's proposed delivery date was 27 April 2011 and the start date 10 January 2011. The scheduled start date was adhered to, the initial project meeting took place and the project manager commenced setting up all required paperwork, but due to Christmas holidays the actual work only commenced in late January. Critical information required for constructing the system required meetings between the two departments which was again delayed due to staff unavailability. Once the business specification was finalised, a number of change requests were made by the system owners to address some issues with the original design, which resulted in the business specifications being not available to all teams to commence their tasks as per the schedule (e.g. quality assurance and development).

Once some progress was made by the project team, the business demanded that the project be brought forward by six weeks and be made available to end users by 17 March 2011. The IT project team made it clear to the system business owners, that meeting the new proposed date would have implications for other projects and that the system quality may be impacted. The system owners escalated the matter to their senior management, and IT senior management agreed to absorb the six weeks on condition that the business agreed to pay some costs associated with staff working overtime. The business agreed and IT committed to deliver the project in just six weeks from the day the agreement was reached in mid-February. The project schedule is illustrated in Figure 40.

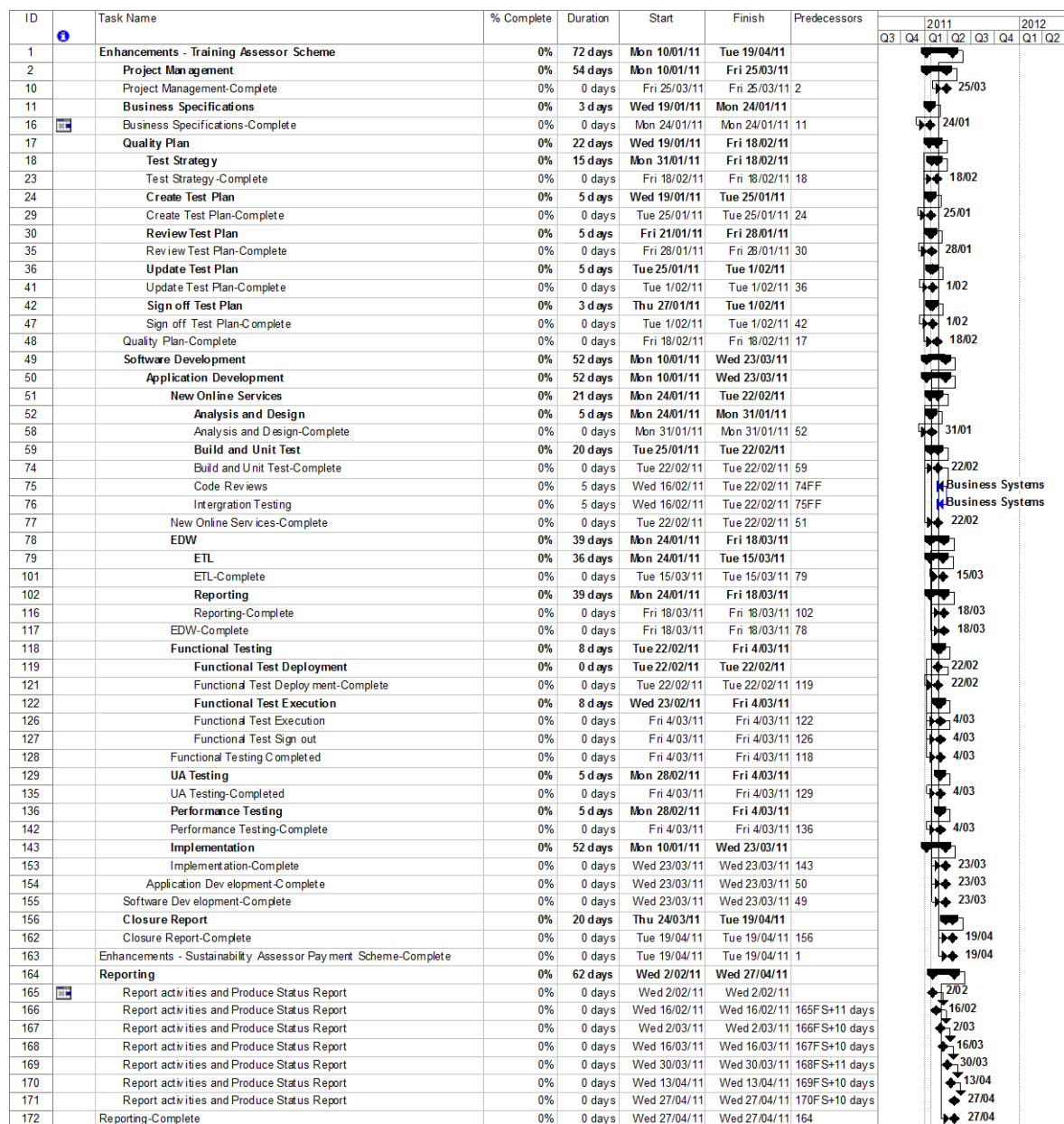


Figure 40: Original Project Schedule



In this project the following were identified as challenges faced, and the project's ability to deliver on its agreed objectives:

- Changes to the project scope;
- Reducing project timeframe by six weeks;
- Availability of staff during the holiday season.

Whilst IT senior managers agreed with the system business owners that the system delivery timeframe could be shortened by six weeks, the project staff were not consulted about the decision and were not pleased to be told that they must work overtime to absorb the increased scope of the project, as well as the changed delivery date. With no senior management on the ground to address the project team concerns, they understood that they had to adhere to the decisions being made.

#### 4.4.2.2 Approach

The researcher engaged with the department in late 2010 and was allowed to select one of the many projects undertaken by the department. One of the selection criteria was to select a small to medium size project and with reasonable budget. The 2010/2011 financial year project budget was AUD\$338,000; Table 27 represents the approved total cost of the project over its lifecycle.

**Table 27: Total Cost of Project (AUD\$)**

<b>FY</b>	<b>Period</b>	<b>Actual</b>	<b>Budget</b>	<b>Variance</b>
FY 2010/11	JAN 11	\$40,354	\$0	\$40,354
	FEB 11	\$116,254	\$137,795	-\$21,541
	MAR 11	\$78,782	\$63,520	\$15,262
	APR 11		\$95,619	-\$95,619
	MAY 11		\$22,994	-\$22,994
	JUN 11		\$18,072	-\$18,072
<b>FY 10/11 Total</b>		<b>\$235,390</b>	<b>\$338,000</b>	<b>-\$102,610</b>
<b>TOTAL</b>		<b>\$235,390</b>	<b>\$338,000</b>	<b>-\$102,610</b>

The rationale with respect to the choice was to have a project team of around ten project team members that would allow the researcher to interact and communicate with each team member individually.

#### **4.4.3 Project Issues**

The department had a set of approved methodologies for software development, quality assurance and project management. The department utilised the waterfall model to develop software applications, in which software development activities can only start following the delivery of approved business specifications which could be used for code development and functional and user acceptance testing. On the other hand, the department employed the V-Model to conduct quality assurance activities, notably referred to as testing. The V-Model offers more flexibility than the waterfall model in which test planning activities can commence once draft business specification was delivered to the project team responsible for testing, without waiting for the final signed hard copy. The department has a Project Management Office (PMO) in which Project Managers (PMs) were assigned to manage projects.

Project managers in the department did not control resources; the program manager owned all project resources including developers, testers, and recently, the business analysts. Project managers in the department were also not responsible for managing the project budget; the budget was owned by the relevant business area and assigned to the project. PM engagement in this process was very limited and mostly related to approving timesheets to staff working on the project tasks. The costing process to initiate the project also included the original project scope, once completed and approved by the business and the relevant IT branch. The project manager was responsible for managing the change request process, but it was a process that was often negotiated at executive level and sent to the project manager later to manage, with no or little input from the project manager or the project team.

The Verification and Validation sections were responsible for appointing the Test Manager for each project within the department. Test Managers were responsible for managing the quality assurance process prescribed in the department Quality Assurance (QA) framework. However, they did not own any testing resources, but used resources assigned to the project by the program manager. It may be a professional tester, or

developers, who would be asked to perform testing duties. In the project investigated, all testers assigned were part of the test team allocated to the program manager.

The department senior executives advocated quality assurance, whenever problems were identified in production. They sent messages that the department needed to invest more on quality assurance and be more detailed on the level of testing undertaken. However, a few years earlier, senior management, due to financial constraints, decided to disband the department quality assurance team and mandated that all testing activities, including functional acceptance testing, were to be completed by developers as a measure of financial prudence.

Understanding the organisation culture and social construct is critical to the design of a successful intervention plan. The department on paper enacted methodologies that would ensure successful project delivery. The scope changes and project timeframe reduction identified earlier were initiated by senior managers, who were also responsible for enacting processes and methodologies approved by senior management to ensure successful project delivery.

Cutting the project schedule by six weeks and adding more scope challenged the way in which the software development methodology, project management methodology and the quality assurance framework adopted by the department could be applied for the project studied.

The department as part of the Australian Government, promoted work/life balance and the staff enterprise agreement promoted that concept, by stating that seven hours and thirty minutes were the number of hours to be worked per day. However, senior management made the decision to reduce the project timeframe by six weeks and had the expectation that staff engaged with the project would work overtime to achieve the desired outcomes. The expectations would come in the form of overtime memo signed by senior management.

#### **4.4.4 Problem Definition**

The researcher was allowed unrestricted access to all project team members. The researcher was allowed to observe all project meetings, including weekly meetings with the project sponsor. The researcher also had one to one meetings with all team members,

including the project manager, development team leader, test manager, three testing resources, and four developers. The objective of those meetings was to establish an understanding of the intervention required to ensure the project met its objectives. The process was iterative in nature, however it did not take long to understand why the project team felt not only pressured, but in some instances threatened by senior management and in their view lack of understanding of the project problems.

Out of the ten project team members, only the project manager and the development team leader were full time employees of the department, and the rest of the team were contractors who were engaged by the department on six month contracts which could be either renewed or terminated at any point in time by the project sponsor. For the full time employees, saying **NO** could mean that one's career progress could be hindered by the project sponsor at a later time. In practice, the project sponsor never actually stated that not delivering the project as per the new timeframe could lead to disbanding the project team, although this was indirectly indicated.

The project team, fearing the consequences highlighted by the project sponsor and the prospect of losing their livelihood, felt pushed to accept the new timeframe mandated by senior management and accepting that they had to work overtime to be able to deliver the project within the new timeframe.

That level of unease within the project team was evident when having one to one meetings or informal discussions. However, during official project meetings, none of those issues were recorded in any documents that may be retained by the department and could be accessed by senior management.

The researcher was able to meet other members of other project teams informally. Many indicated that project teams within the department generally lacked power even at director level, and decisions must come from senior executives, otherwise it would be overridden even if the decision was taken in the best interests of the project.

When asked whether other project teams faced the same challenge of losing significant duration from their project timeframe, the answer was YES. Another question was directed at project managers with regard to the department project management methodology post project review process. Many indicated that they had never completed such a report, because no one asked. Project managers indicated that their status report

was filed with the project documents, financial records, and risks, and were rarely reviewed by senior management. One project manager indicated that he had done that once and since then he kept issuing the post project review reports with the same lessons learned in his first project within the department.

The test manager and testers indicated that the department promoted quality assurance and software testing to develop high standard applications. However, they pointed out that the test environment used for testing did not work correctly and during one previous project the test environment was down on forty occasions and for a total of sixty business hours. However, the expectations that the project delivery dates would not change, meant the workers needed to work weekends to compensate for that delay. When asked whether senior management were aware of the issue with the test environment, the answer was YES. The test manager pointed out that there was another project to upgrade the test environment, but unfortunately, it was six months behind its original schedule.

Essential to successful projects is project stakeholder's engagement. Project stakeholders vary in their level of interaction with the project team. The project sponsor in the project under study was the least engaged with the project; his engagement was limited to fortnightly meetings with the program manager to discuss any showstoppers. Other stakeholders in the project included the business and policy branch of the organisation, since they were the ultimate end users of the system. Their engagement consisted of one meeting per week with the project leadership, but since their desks were very close to the IT project team, that allowed more frequent informal interaction between both sides. That close relationship, between IT and the business and policy team allowed many issues to be resolved in a much more efficient fashion given the limited project timeframe.

The researcher engaged each stakeholder to discuss their concerns in regard to the project and the issues identified as causes that would derail the project team's ability to deliver the project outcomes.

Business and policy highlighted their concerns that IT in general did not engage them during the design phase of the project, and in their experience with previous projects, IT would only show them the application design once completed. Feedback provided by business and policy was frequently ignored or downgraded by members of information technology department working on the project. Business and policy were able to get their

views heard by IT once they escalated a matter to their senior managers, otherwise little of their feedback would be taken into consideration by IT while building the application.

The test team, while part of the project team, was also an important stakeholder in the project. The test team viewed the department adopted software development lifecycle to be in favour to the development team. They highlighted that in previous projects, code was never delivered in accord with the project schedule, and management requested them to work extra hours to compensate for the development team schedule slippage. On the other side, the test team stated that on many occasions when they requested assistance, the development team leader offered staff to assist with test execution but not during test planning which they believed takes up to 70% of their effort. Team members pointed out that they were suffering from knowledge drain with many team members left to pursue other career opportunities, and that left the team in many cases unable to uncover critical issues since they lacked the detailed business knowledge of the systems for which they were responsible.

One of the largest groups of project stakeholders was the development team. Their main concern was related to the specifications produced by the business team and how those specifications always lacked the details required to develop a high quality system. The same issue was raised by the test team in regards to the business specifications content quality. They also pointed out that the development team did not produce technical documentation or design documents that would help them during test planning and execution.

When asked why they did not produce technical design documents as mandated by the department software development methodology, the development team was unable to give a satisfactory answer. The answer was at best unclear and was blamed on the limited time assigned to the development team to develop software applications. While the argument could be correct, it was countered by the test team showing that for one project with two hundred defects detected during the testing phase of the project, many of those defects were attributed to bad coding practices. The development team in this case did not conduct unit or integration testing on the code before it was deployed in the test environment for the test team to commence their quality assurance activities.

The project management group was an important stakeholder in projects within the department. The project manager assigned to the project took the initiative to be co-located with the project team to ensure clear communication channels were maintained with the project team, and issues were dealt with in a timely manner.

#### **4.4.5 XML Project**

Politics can be lethal and devastate the most well-intentioned project team. The following events are a description of one of the projects observed over a period of six months in an Australian Government Federal Department responsible for delivering welfare and health services to Australians.

The project had many failed starts for many years. The project was designed to replace a manual process then currently in place to update the list of pharmaceutical schedules that were used to administer an eleven billion dollar scheme as per the recent Australian Federal budget ("Budget 2010-11" 2010). The project involved two federal departments; one supplied the Extensible Markup Language (XML) schema which would replace some of the manual processes, and the other department was to implement the solution to convert the schema into software programs that would output files consumed by the existing mainframe applications used to administer the scheme.

The project officially started on November 2010 and was originally planned to be completed by 1 October 2011. The following was required by 31 March 2011 in order for the project to be completed as per the agreed schedule.

1. Validated XML schema;
2. Signed-off mapping and business rules;
3. Sample production data to assist developers.

However, none of the required items were delivered by the end of March 2011 and the technical team was unable to validate the XML schema until the end of July 2011. The project technical team requested a change request to move the project deadline from October 2011 to April 2012. The original change request was rejected by senior management and the technical team were asked to shorten their delivery dates to January 2012. The business team became aware of the challenges, and were unable to deliver business specifications as per the agreed schedule, and agreed to sign the change request.

However, the policy team used various delaying tactics and tried to avoid signing the document in order to make the new project schedule official.

The information technology project manager started to report a high risk in February 2011 and the project traffic light was RED. Business also reported the project RED, but policy reported the project GREEN.

A few meetings were held between the two departments at operational levels (project manager, technical leads, and test managers) to discuss the delays and what could be done to facilitate the project delivery with varied degrees of success.

By the end of July the First Assistant Secretary was made aware of the incorrect project status presented and demanded that the project must be delivered by the original October dates. The message sent shock waves throughout the department, and the project technical team was asked again to absorb all the delays encountered by the project to date. Given that the project was nearly five months behind schedule, and the mandate came from senior management to not only deliver the project as per the original schedule, but also absorb the project delays as well as the incorrect reports delivered to senior management, pressure on the project became untenable. Many team members started to think that leaving the project could be the best thing they could do, giving the level of political and senior management pressure, and their unwillingness to address documented project risks.

The project team spent three days replanning their activities and requested a tripling of their staffing if the project was going to be delivered as per the senior management wishes.

The operational level staff faced with squeezing their staffing, requested the project to have unlimited overtime for all the staff participating in the project. They were also faced with the reality that senior manager's wishes could not be rejected, as the consequences could mean jeopardising their career or contract with the department. One scenario expressed to some operational level managers was that around one hundred and twenty million dollars' worth of information technology projects between the two departments would be at risk if the project team did not deliver the project as mandated by senior management.

The researcher made the following observations on the case.

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1. Misleading reporting to avoid security is a widespread phenomenon in information technology projects as reported by Glass, Rost, and Matook (2008);
2. Senior management make decisions and mandate deadlines without communicating with the people who are responsible for delivering the project;
3. Adding more resources and extending the project budget are the first remedies when projects in trouble;
4. Operational staff have very limited decision making and their input is mostly neglected by senior management.

Another project within the same organisation faced a similar set of difficulties during its development lifecycle. The project started as a strategic initiative by the information technology division of the organisation, with the aim to modernise the technology used to conduct Business to Business (B2B) with external vendors including General Practitioners, Pharmacies and Hospitals. The project was planned to commence on January 2011 and to be concluded by the end of June 2011, and the deployment to the vendor environment only as a proof of concept.

Whilst the project planned to commence in January, the project manager was appointed six weeks later and the team responsible for developing the application was understaffed. Developers and quality assurance staff joined the project in mid-April, and in this organisation it could take up to two weeks for new starters to receive their personal computer access and access to various tools that may be used to assist them in their job. The project was presented as a technical implementation and business and policy were not engaged in the project. However, as the project progressed, it became apparent that their input was required. Business and policy did not accept that, as they deemed the project low priority against their current workload and too technical.

The project started with one developer who had very limited knowledge of the technology proposed for implementation. With a steep learning curve required, deadlines were never met compounded by the delays in procuring additional development staff. Once the new developer joined the project, more issues were identified in the code and a request was made to restart the coding to overcome design limitations which led to more development schedule delays and consequently to the testing effort.

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The limited involvement from business and policy sections of the department led to more troubles for the quality assurance team who did not have knowledge of the system under test and to gain that knowledge, it required close interaction with business and policy.

In mid-May the project manager communicated a message from the project sponsor, that the new code must be deployed to the production environment only and not to the vendor environment, while maintaining an end of June delivery date. The communication was verbal and no official change request was ever made; the change meant the application was no longer a prototype but a production class application. In early December 2011, the researcher initiated a communication with the project manager to understand the project progress. Given that the project was planned to be completed by mid-December 2011, the following comment was received “Well let me tell you, all that we have done is completed test planning with the hand crafted data. there has been no progress to that”.

#### 4.4.6 Web Services Project

Other projects within the same area were impacted by the delay and more resources were deployed in order to meet the deadlines to change the scope that created tension within the project and with other project managers as they were unable to deploy their code and commence testing.

The project initial budget underestimated the challenge and complexity of the change; as it did not anticipate many of the technical difficulties and delays associated with implementing the new technology. Table 28 provides details of the total cost of the project phases over its life as per the project closure report.

**Table 28: Project Cost over its Life (AUD\$)**

Phase	Stage name	Planned Cost	Actual Cost	Variance
100	Initiation	-	\$10,651.81	\$10,651.81
200	Analysis	\$54,000.00	\$82,558.31	\$28,558.31
300	Design	\$166,000.00	\$3,159.01	-\$162,840.99
400	Build & Test	\$50,000.00	\$323,789.21	\$273,789.21
500	Handover	-	-	-
	<b>TOTAL</b>	<b>\$270,000.00</b>	<b>\$420,158.34</b>	<b>\$150,158.34</b>

The project actual cost was more than its planned cost by around 55%. The project officially closed on 1 July 2011, but with seventy outstanding defects that had yet to be addressed, including twenty seven critical and highly critical defects. It was agreed by the project team to address these defects as part of the business as usual activities, but the business and policy unit objected to that decision as it meant they were financing a project of which they were never a part. The systems are currently in production and many external vendors expressed their intention to integrate with the new technology in their products' future release. That situation may never occur, since the system was deployed to the production environment with no technical and design documentation, which is critical to external vendors in order to commence using the new system, which was meant to be part of the second phase of the project, cancelled due to the lack of funds.

Table 29 provides a summary of the issues and related processes faced by the project as per the project closure report.

**Table 29: Summary of Lessons Learned From the Project Closure Report**

Issues	Process
<p><b><u>Business Case - Project Initiation phase</u></b></p> <ul style="list-style-type: none"> <li>• Scope was unclear (i.e. it was assumed that webservices were built for whole Aged Care events and not for the subset of events)</li> <li>• Availability of funds was only up to end of June 2011</li> <li>• Non-moveable timeframes due to fund availability</li> <li>• Scope changed for the deployment of code from Vendor to Production environment in the approved costing (resulted in more work effort, timeframe and budget)</li> <li>• Performance testing, NOI process &amp; Vendor related documentation are out of scope for this project</li> </ul>	<ul style="list-style-type: none"> <li>• Suggestion is to capture the detailed requirements in the Business Case and by conducting JAD session before the project approval to identify the impacts, requirements and timeframes and also by documenting the clear project requirements in detail. Budget has to be reassessed and allocated to accommodate the increased scope.</li> <li>• PCR was approved by the Project Sponsor to accrue an additional budget of A\$170k but it was not established in the finance system which resulted in budget overspends.</li> <li>• The project approval was delayed which impacted the project commencement date. The project implementation date has not been changed which tightened the project timeframe.</li> <li>• Suggestion is to document the scope changes clearly and assess the impact of the change.</li> <li>• The outstanding work activities for the project has to be completed for the full utilisation of the system by the users.</li> </ul>
<p><b><u>Communication Issues</u></b></p> <ul style="list-style-type: none"> <li>• Within Team (Internal)</li> <li>• External (Business)</li> <li>• Other Stakeholders (Owner/Sponsor)</li> </ul>	<ul style="list-style-type: none"> <li>• Communication within the team was very minimal in the beginning of the project and later it improved a lot.</li> <li>• Business was not engaged in this project and impacted the timeframe in addressing the queries.</li> <li>• Meetings have been conducted to discuss the issues as well as the progress of the project.</li> </ul>
<p><b><u>Resource Issues</u></b></p> <ul style="list-style-type: none"> <li>• Availability</li> <li>• Skills/Knowledge</li> </ul>	<ul style="list-style-type: none"> <li>• Resources are working on different projects and also on priorities.</li> <li>• Resources doesn't have time to acquire skills/knowledge in Web Services technology.</li> </ul>
<p><b><u>Project Dependencies issues</u></b></p> <ul style="list-style-type: none"> <li>• April Release</li> <li>• Impact to other enhancement projects</li> </ul>	<ul style="list-style-type: none"> <li>• April release testing was delayed and this impacted the resources to commence work on the project.</li> <li>• Other enhancement project is dependent on the project delivery.</li> </ul>

## 4.5 Closing Thoughts (Case)

Case studies presented in this chapter comprise a representative sample of the Australian and Asian based Information Technology Industry. There are many more projects currently undertaken that are faced with significant challenges, but remain unreported due to their nature (e.g. defence projects, financial services) or due to the size of the organisations undertaking them (e.g. small or family corporations). Public sector or high profile projects are always under scrutiny from the media, public or the organisation's stakeholders.

At an estimated capital cost of AUD\$1.76 billion, Fiona Stanley Hospital (FSH) is Western Australia's largest ever publically funded building project. When it opens in April 2014, FSH will be Western Australia's premier health facility. The hospital will have information technology integrated into its operation and is intended to be the first paperless hospital in Australia. It is also the Western Australian Government response to the Reid Report on Health Reform as FSH will also become a tertiary hospital as well as meeting the report's main objective of providing patient centric health care services. The Western Australian Auditor General's report on FSH hospital, released in June 2010, stated that:

"Many of the lessons in this report for capital works projects echo those in previous reports. Like other projects, initial unrealistic timelines and budgets were based on a limited understanding of what the project would involve. Despite the risks and complexity in such a major project, attempts were made to fast-track it. This proved both inefficient and ineffective." (Murphy 2010, 4).

As illustrated in Table 30 the current business case has FSH budget stand at AUD\$1.76 billion in comparison to the original estimate of AUD\$420 million, and the opening date around three to four years behind the original opening date. The report states that the "original estimates were unrealistic and were not based on a good understanding of what this major project would involve. Better definition of the requirements of the hospital has resulted in scope changes which have increased forecast costs, and delayed the opening" (Murphy 2010, 5).

**Table 30: Fiona Stanley Hospital Budget History From 2004 to 2007 (AUD\$) (Murphy 2010, 14)**

<b>Government Approved Budget</b>	<b>Original Budget 2004-05</b>	<b>First Budget– September 2005</b>	<b>Revised Budget– November 2006</b>	<b>Revised Budget– December 2007</b>	<b>Current Business Case Budget– June 2008</b>
	(\$m)	(\$m)	(\$m)	(\$m)	(\$m)
Construction and building works	420	300	486	755	755
General site works		24	61	69	69
Car decks		9	25	50	50
Contingency		22	87	110	110
Escalation		232	211	431	431
Professional fees		55	114	186	186
Furniture, fixtures and Equipment		96	107	146	146
Art		4	1	1	1
Allowances		-	-	13	13
	<b>420</b>	<b>742</b>	<b>1092</b>	<b>1761</b>	<b>1761</b>

The report highlighted the planning phase of FSH was far from being efficient or effective. When the Health department tried to accelerate the planning, it resulted in more delays and introducing core? risks to the project. Therefore, the overall project governance was impeded by the lack of timely information.

The Attorney General stressed that significant risks remained on the project. Many of these risks have been identified, but without any effective mitigation plan to address them. Particular attention needs to be paid to transition and workforce planning, and the delivery of key ICT systems. Without effective management of these risks FSH may be further delayed, cost more and may not deliver all the planned services to patients when it opens. Some of the key findings reported by the AG are (Murphy 2010, 14,21,27):

- Between 2004 and 2007, the capital budget for FSH grew from AUD\$420 million to AUD\$1.76 billion as project definition improved:
  - The capital budget for FSH has increased in stages;
  - The original cost estimate for FSH was unrealistic because it was based on a minimal understanding of what services the hospital would deliver;
  - Significant scope and design changes have increased the size and estimated cost of the hospital.
- The AUD\$1.76 billion capital budget covers the cost of construction and some fit-out, but not everything needed to open a working hospital.
- The opening date for the hospital is between three and a half and four years later than originally planned. Inadequacies in planning the project delayed the start of construction, and the increases in scope extended the construction timeframes.
- WA Health's parallel planning process did not achieve its objective of fast tracking approvals:
  - WA Health's original business case was behind schedule and had information gaps; it took eight months to fix it.
  - FSH Steering Committee oversight was hampered by a lack of timely and accurate information; and this delayed approvals.
- The project has relied heavily on external project planning and management expertise but the costs of consultancy contracts have not been well managed.
- The FSH project has lacked robust financial and project management systems since it started, but these are now being put in place.
- Project governance and management arrangements are now clearly defined ahead of awarding the major construction contract.
- Further scope and design changes if approved could result in the building costing more than the 'guaranteed maximum price'.

- Failing to effectively coordinate the facilities management and the construction contracts could delay the hospital being ready on time and increase whole life costs; the State is responsible for managing this risk.
- Transition, workforce planning and ICT are major risks that have not yet been adequately addressed:
  - A transition plan for making the hospital operational is not yet in place; FSH is waiting for South Metropolitan Area Health Service (SMAHS) and WA Health to complete their plans;
  - FSH workforce planning is behind schedule, despite the need to have over 2000 trained staff recruited and in place when the hospital opens;
  - New technology including a patient administration system (PAS) may not be ready and tested in time for the hospital opening, adversely affecting patient services.

The West Australian Auditor General's report is clear on the list of issues that challenged the FSH project since its inception. However, the Western Australian Health Minister in a media statement issued on the Western Australian Government website on 29th November 2011 stated that "since building started at the Murdoch site in September 2009, the major public hospital project continued on-time and on-budget to open its doors in 2014" (Hames 2011, 1). The headline of the media statement states that Construction of the AUD\$2billion Fiona Stanley Hospital project has passed halfway. The statement highlights an increase of nearly AUD\$300 million dollars when compared to the Western Australian Auditor General report issued a year earlier.

## 4.6 Conclusion

In this chapter we looked into a varied selection of information technology projects. The case studies and outcomes suggest that a project's social and cultural sub-system risks increase the technical sub-systems risk, as determined by the project's objectives and technical complexity. Projects operating within organisations that have a high level of instability or with resistant cultures increase the social and cultural sub-system risk, which has direct impact on technical risks associated with information technology



projects. Requirements, and scope stability have significant impact on the risks surrounding the project and has a direct connection to the project's overall technological complexity. Project management process, such as project planning, risk and issue management, and reporting used as control mechanisms could provide early warning to senior management of project issues. However, there seems to be a gap between project teams and senior management in terms of understanding.

Each project faced a unique set of social, cultural, economic and technical challenges that have impacted the projects' ability to deliver on its commitments to the project stakeholders. While many claimed success, the definition of success itself could be interpreted differently depending on the level of engagement with the project. Many of the organisations in this study have adopted a complete set of software development, and project management methodologies to deal with the projects, small or complex, but in practice the level of adoption varied depending on the cultural and social dynamics of the organisation.

Common problems to emerge from the analyses of these case situations are as follows:

- *Socio-Cultural Challenge: Inconsistent application of software development and project management methodologies.* Socio-cultural differences can bring entrenched opposing behaviour patterns to projects that can be challenging to harmonise. As attested by the cases studied, organisations' application of software development and project management methodologies are far from being consistent. Most methodologies have an element of risk management which in theory should be used to predict and foresee challenges to the project and assist senior management in their decision making.
- *Socio-Cultural-Economic Challenge:* Application of methodologies requires training, but the value returned on the training is not measured. Organisations invest significant resources adopting software development or project management methodologies, and that includes training the staff responsible for implementing them. However, once the training is completed (normally one week), there is often no mechanism applied to actually measure the value of the training provided to staff against productivity and efficiency improvements within the organisation.

- *Socio-Cultural Challenge:* Command and Control management decision making impede a project's ability to deliver outcomes. Command and control style of management is rigid and fails to adapt to changing project environments.
- *Socio-Cultural Challenge:* Insufficient Planning in the early stages of the project. Planning remains a mystery and very hard to do early in the project due to the lack of information. However, project plans must be drawn and in many cases adhered to without taking into account the actual project life operating environment.
- *Socio-Cultural Challenge:* Slow response or recognition from senior management that the project deliverables are being challenged. Management, depending on their level of engagement with a project, can influence the outcomes of the project. If the management are detached from the issues facing the project, it is unlikely that there will be early intervention to issues facing the project, but mostly reactions when serious events start preventing the project from being delivered.
- *Socio-Cultural Challenge:* Misleading project reporting that is designed to please rather than address issues as they arise. Reporting is critical in projects, and organisations depending on the project stage will require different types of reports. The report could be related to the budget, milestones, and resources utilisations. It is quite often that project staff will report that they are 80% done with their tasks and they are working on the last 20% of the task. Reporting in information technology projects is mostly subjective, since it is nearly impossible to validate against the actual outcomes. For example, if a developer reports that the piece of code he/she is working on is nearly complete, the definition of nearly complete can be interpreted in the project schedule as being 80% complete, but the project manager is unlikely to validate that claim against the lines of codes in the program.
- *Socio-Cultural-Economic Challenge:* Cumbersome processes lead project staff to work around them. In government departments when a project manager under-spends his/her project budget, they are required to file too much paper work. The researcher has found it leads to project spending the excess money on tasks that have little or no benefit to the project to avoid completing cumbersome processes.
- *Economic Challenge:* Resources engagement models do not always help the project finances. Reliance on contracting and outsourcing agreements and organisations

inability to invest in retaining knowledge, training, and skills has long term impact on their ability to compete in knowledge based economy. The short-term approach of using contractors and outsourcing may have the lure of monetary saving, however it also has the potential to leave organisations unable to cope with unexpected events, as they do not have the resources or knowledge in-house to cope.

- *Socio-Cultural Challenge:* Political interference in the way projects are managed could damage the project. Ministers, Public Servants, Chief Information Officers with their political power frequently interfere in high profile information technology projects. Unfortunately, most of that political interference is done with no knowledge of the project dynamics or issues affecting the project. That level of interference can be the result of a negative media report or incorrect briefing. The interference can take the shape of replanning the project to meet a political agenda, certain payment milestones or in some instances, an election campaign. Political interference when done without analysing the impact on the project staff, could lead to unintended consequences on the project and in some cases on the organisation as a whole.
- *Economic-Cultural Challenge:* Project funds are spent on least valuable activities. Projects start with budgets and they commence spending them rapidly. However, in some instances, the funds are not allocated to the most valuable activities that would contribute the project delivery, but could be allocated to low return activities.
- *Economic-Social-Cultural Challenge:* Projects commence with no clear objectives on what they need to deliver, and the sponsor continues providing funds in the hope that outcomes may be realised.
- *Technical-Economic-Social-Cultural Challenge:* Inadequate planning of projects in the early stages due to a lack of technical knowledge of what is required for the project success. Organisations require complete project plans in the early stages of the project in order to make decisions (e.g. finances, resources, training). However, they tend to forget that the plans drawn during the project bid or the writing the business case to obtain funding to commence the project, have no resemblance to the actual project plan that will be used to deliver the outcomes. Project business cases, or bids, are written a long time before the project commences and many of the

risks stated within them do not reflect the risks faced by the project during its lifecycle.

- *Social-Cultural Challenge:* Communication or the lack of it in projects remains a fundamental problem. Communication is a personal skill and not every project manager or senior manager has that skill. Projects are challenged and remain challenged due to limited or no communications to the staff working to deliver the project. Managers may be talking among themselves about the project challenges, project staff may be doing the same thing, but with no common, transparent and frequent way to convey those communications, project staff feel marginalised when decisions are made without consultation and in return they resent the changes imposed as part of the project.
- *Social-Cultural Challenge:* The gap between Strategic Planning and Project Management where the strategies do not directly address the major issues associated with IT projects (e.g. resource allocations, project sponsorship, project profile). This lack of integration presents a gap which has the potential to deliver an inadequate return on investment made in information technology.
- *Social-Cultural Challenge:* Lack of involvement by senior decision-makers in the change management process that directly affects security and quality issues. Without champions in the organisations projects may still be delivered, but risk not finding and fixing security and quality issues whilst in production, which will ultimately be costly and could negatively impact the organisation's future operations.
- *Social-Cultural Challenge:* Training does not mean competency. Organisations, small and large spend heavily on training. Unfortunately, five days training in project management or programming techniques does not translate to competency in the skills required to complete the job. Organisations fail to measure the actual benefits from such investments, and in many cases do not have the capability to assess the staff performance against the investments made in the form of training provided.
- *Social-Cultural-Economic Challenge:* Project deadlines are designed with political or economic motives and they rarely reflect the actual realities of the project or the staff working on the project.

- *Technical-Economic Challenge*: There is a disconnect between the project bid or business case developed for the project, and the final project outcomes.

This chapter examined four cases studies from various industries, project size and operating environments. Each project faced similar, yet unique set of issues influenced by its environment, which affected its outcomes. The case studies provided inputs for the framework that will be discussed in chapter 5.

The unpredictability inherent in human affairs is due largely to the fact that the by-products of a human process are more fateful than the product.

Eric Hoffer (1902-1983)

## 5 Intervention as Solution

### 5.1 Introduction

How often do projects fail? According to Rubinstein (2007, 1) “almost two thirds of information technology projects fail”, a point substantiated by the review of literature presented in Chapter 2. With a consistently high rate of failure, and the price organisations incur for carrying out needed organisational change, shouldn’t organisations look for different approaches to deal with the phenomena?

Organisations adopted project management methodologies, either out of the box or with customisations to suit the organisation’s own culture. However, there is no concrete evidence in the literature to support the argument that project delivery will be improved upon adoption.

When issues start to be identified in projects, many issues end up being ignored or put on the back-burner in the hope that they will fix themselves. Once the project starts missing deadlines and milestones, management and project sponsors get involved and end up running the project instead of the appointed program and project managers. Senior management involvement in many projects ends up causing more issues and could be potentially counterproductive. Increasing the level of staffing or funds available to the project issues does not necessarily lead to dealings with the issues identified, as it could increase the scope of the issues identified earlier and cause more issues.

Dealing with project issues is not part of any project management methodology; project and software development methodologies are designed to deal with optimal conditions or best case scenarios in which tasks and milestones are achieved according to plans. However, information technology projects, large or small, are full of challenges and issues including technical, cultural, social and economic variables that may impact the project’s desired outcomes. Intervention is not prescribed in any of the existing project management methodologies. The framework described in this chapter aims to provide a different approach when dealing with challenged projects. It attempts to provide a methodical, systemic approach when dealing with troubled projects, instead of the apparent ‘trial and error’ and ad-hoc approach that relies more on experience or instinct.

## 5.2 Causes of Project Failure

What are the causes of information technology project failure? Are they primarily due to the technical nature of the project, its budget, culture or are they rooted in people issues or organisational culture? The literature review and case studies presented in this document identified that people are behind many troubled information technology projects.

Markus and Benjamin (1997, 55) state that “many people see managers’ and IT specialists’ belief in the ‘magical power of IT’ as the root cause of project failure”. However, it is ironic that the project participants have confidence that they have adequately completed the job despite the failure to implement change. They also highlighted the irony when the failure to implement change can take place even when all project participants have confident that they have adequately completed their job.

Information technology projects remain challenged to deliver on their promises, as they remain constrained by the golden triangle. This is despite the industry wide adoption of various project management methodologies, although the magic bullet theory of change is widely understood, but does not appear to be working in practice.

When large or small projects, the investigation is regularly directed at the technical elements of the project. Yet, the literature review and recent research direct us into a non-technical direction as it appears social and cultural issues assume greater significance. Sauser, Reilly, and Shenhar (2009, 665) highlighted that the “problem is often rooted in management’s failure to select the right approach to the specific project Information technology project managers, and technical specialists may have the best of intentions, but they tend to have very few processes or tools at their disposal to manage the human side of project implementation”. Therefore, they rely on their experience, common sense and communication skills to facilitate the project and attempt to resolve issues as they arise. While in most instances that should be appreciated, intentions and personal skills vary and are generally inadequate to ensure the successful implementation of information technology projects.

A valid question may need to be asked: what can we do to improve the rate of information technology project success? As human factors are often identified as the source of many of the failed or challenged projects, the answer could lie in using change management principles to address these factors. Although this theoretical answer is



simple, the framework presented in this chapter will provide a new approach and practical solution, and if applied to challenged or failed information technology projects, it could prove to be effective in changing the outcomes of the project.

The framework presented relies on two elements. First, project managers, and stakeholders involved in implementing the framework must understand the impact that change management can have and how this might lead to project success, thus providing the relevant staff with the reasons to acquire new skills related to people and talent management. Second, they must learn how to apply the framework and use it to facilitate the desired outcome changes.

The amount of money spent on a project, together with other factors, can bias a manager's judgment, resulting in 'escalation of commitment' behaviour (Brockner 1992) in which failing projects are permitted to continue in the hope that things will get better and an outcome will be achieved.

Project escalation can absorb valuable resources without producing the intended results. While escalation is a general phenomenon occurring with any type of projects, information technology projects are particularly susceptible to this problem (Keil 2000).

The sunk cost effect is a psychological factor that can promote escalation and refers to the notion that "people have a greater tendency to continue a project once money, time and effort have been invested" (Arkes and Blumer 1985, 124). The prospect theory (Brockner 1992) suggests that people instead take the risk averse approach and will engage in risk seeking behaviour when faced with a choice between losses. People prefer to make additional investments regardless of the level of certainty of rewards rather than terminating a project and losing all of the investments already made according to the prospect theory.

In the context of information technology projects, the intangible nature of the final product (Abdel-Hamid and Madnick 1991) can make it difficult or nearly impossible to estimate the amount of work completed. This difficulty is magnified in the notion of the 90% complete syndrome which is normally used by information technology professionals to emphasise that the project may be salvaged as most of the work is done and investing a little more will make it happen. According to Glass, Rost, and Matook (2008) status reporting in IT projects is frequently 'lying' and untruthful predominant in information

technology projects, in which 52% of the survey noted overly optimistic reporting, whereas only 2% noted overly pessimistic reporting. Status reporting lying was mostly motivated by telling management what they wanted to hear although some of the survey respondents lied to hide bad work, or their inability to achieve, or confront management about their unrealistic expectations.

### **5.2.1 Change Management Ideas**

Before introducing the proposed framework, we will try to introduce some of the change management principles which are very important tools for managing the human side of any information technology project.

#### **5.2.1.1 Project Implementation Begins before People Join the Project**

Change effort is a sequential process in which a small group within the organisation, mostly senior managers, develop an implementation strategy and attempt to promote it to the organisation or section of it affected by the change. Naturally, this group faces resistance and the prospect of failure. A broader, more systemic view of change is crucial to the project success and some element of that comes in the form of early planning, even before the project hires its first staff. Managers responsible for information technology project should engage resistance groups, and instead of viewing them as obstacles working against the proposed change need to see them as change agents in implementing a new information technology project.

#### **5.2.1.2 People Support What they Create**

The most effective way to reduce resistance to change is to engage those people impacted by the change in the initial stages and ensure frequent contact. This is related to the first point about project implementation commencing prior to hiring the first staff. Such involvement provides a rationale and allows for people to buy into the project from day one and is a very important element of an effective change strategy.

#### **5.2.1.3 Two-Way Communication is Essential**

Two-way communication in itself may not be sufficient to ensure the implementation of change in challenged information technology projects. Nonetheless, continuous, regular, and honest two way communication is a critical tool in the change process. Universally, no one likes surprises that may affect their daily activities; managers do not like surprises,

and the same can be applied to employees and other stakeholders that may be impacted by the change.

Inevitably, the two-way communication is effective in engaging project stakeholders (e.g. project manager, project team, or project sponsor and business stakeholders) in a meaningful dialogue about the vision and scope of the proposed project, or the challenges facing the project and the ways in which the project collectively can be used to overcome these challenges. This is intended to reduce resistance to the proposed change.

#### **5.2.1.4 Collaboration is the Key**

Collaboration is an essential component to effectively deal with issues and challenges to information technology projects. Believing in the power of collaboration to utilise the potential power of groups, it is imperative that the projects commence before the first staff member is recruited to the project. People are more inclined to support what they create and have a sense of ownership, which is why two-way communication is critical in the management of information technology projects, and why commitment is an essential requirement that project stakeholders can provide, rather than something senior managers demand of them.

#### **5.2.1.5 Problem Structuring**

Project managers have a tendency to adopt problem solving approaches, since they are dealing with immediate issues, while ignoring a problem-structuring approach. Furthermore, structuring of the situation/problem is likely to be assumed as not being part of the project manager's job description.

The Project Management literature "tends to assume the existence of a pre-existing business plan, with clearly defined goals and constraints, clear customer requirements, and goals that can be decomposed" (Pollack 2007, 266).

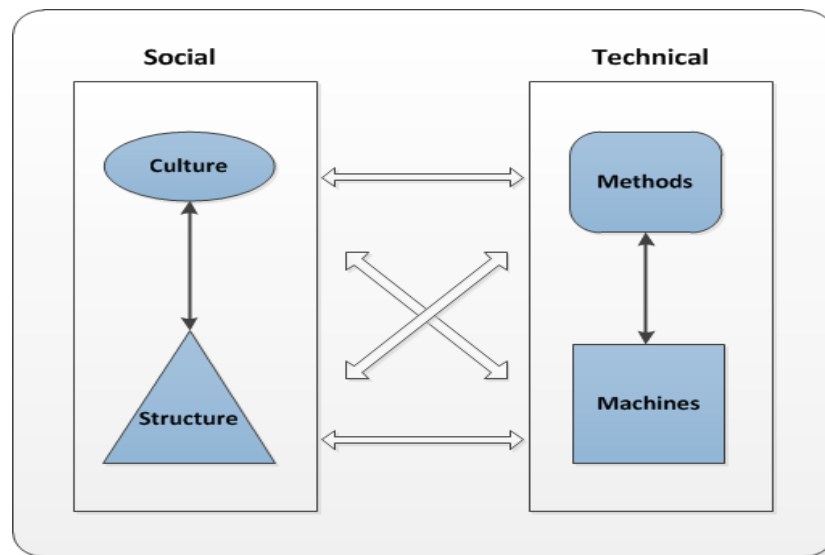
Current project management tools and techniques could be used for general planning tasks such as milestone planning, but there are number of tools and techniques that emphasise problem structuring.

### **5.2.2 Socio-Technical Approach**

The Socio-Technical approach (Kowalski 1994) is quite suitable for the research and would be used to address the research questions. Kowalski used the General Systems

Theory (Skyttner 2001), highlighting the work of Ludwig von Bertalanffy and Joseph Litterer who formulated the elements of the theory. One perspective presented by Tarimo, Kuwe, et al. (2006) views organisations as a social setting with unique cultures, structures, methods and machines that constitute a system – a *Social-Technical system*.

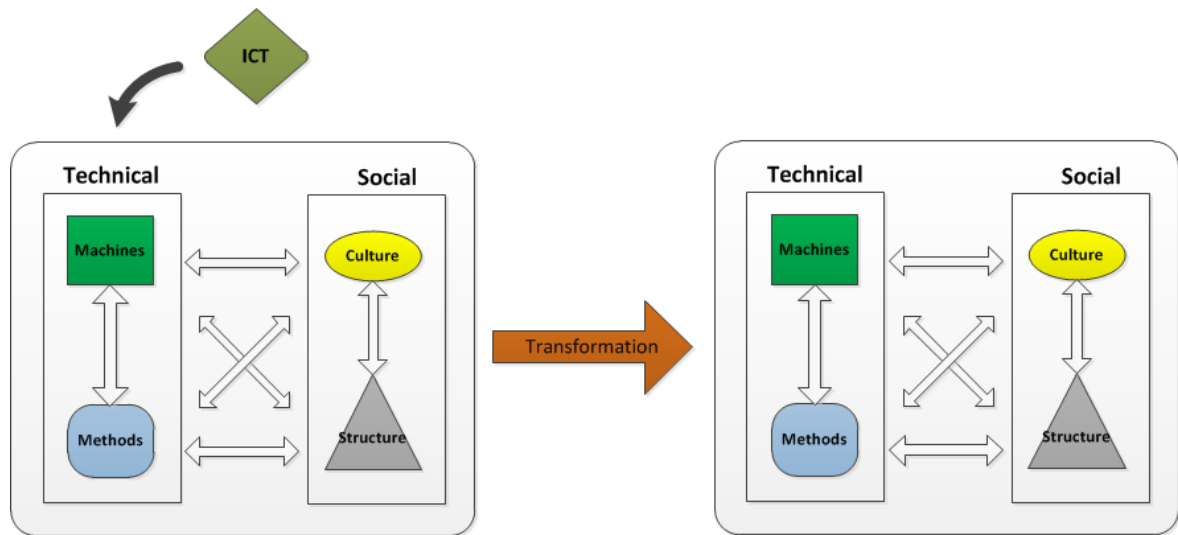
Kowalski's Socio-Technical security system for protecting information; the model of which is depicted in Figure 41 is viewed as a social sub-system; it has culture and structures as components, whereas the technical sub-system has methods and machines. Kowalski (1994) argued that any changes in one of the four components of a socio-technical system will disrupt the stability of the system. Consequently, the system feedback mechanism will attempt to correct itself and gain stability again.



**Figure 41: Socio-Technical System (Kowalski 1994)**

In his thesis, Chaula (2006, 6) analysed Kowalski's Socio-Technical model, in which "changes in 'Machines' do not only affect the 'Methods' used but also the 'Culture' and 'Structure' as the system tries to attain balance". Kowalski used this model to focus the analyses on ethics, politics and law, operations and management, and the technology.

From the General Systems theory point of view the following diagrams show a Social Technical system in which Information Technology is being introduced (e.g. new system implementation) in the technical sub-system (Machines and Methods), thus a transformation will take place in order for the system to accommodate the changes brought about by the introduction of the new system implementation and allows the system to maintain itself.



**Figure 42: Socio-Technical System (Kowalski 1994) as cited by Tarimo, Kuwe, et al. (2006)**

Whilst Kowalski's Socio-Technical system was introduced originally in the area of security, it remains a highly valuable and valid model that could be applied in the area of software information technology project management. Kowalski's model is used in this research as a conceptual aid to thinking about the issues impacting software information technology projects in which organisational culture and project structures have an impact on project outcomes. We will examine the use of the proposed intervention framework to improve project structure and develop a culture of success.

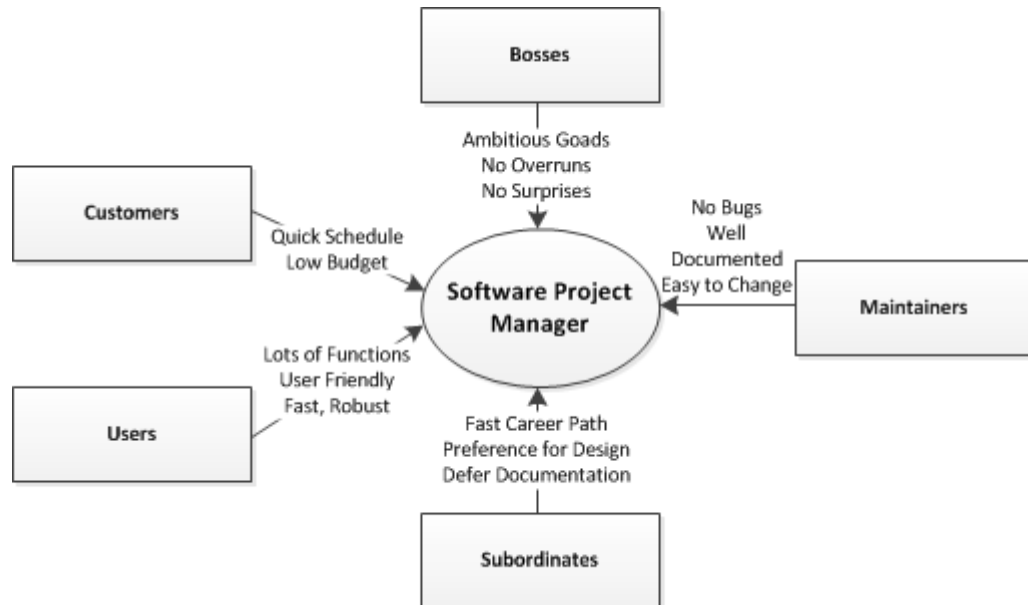
### 5.2.3 Theory-W

Software project management is a very complex balancing act, with the skilful integration of software technology, economics and human relations in order to produce desired outcomes. Software projects are people intensive efforts that may span a few weeks to years and the final product may have wider implications on the work and performance of many different classes of people internal or external to the organisation.

Software project managers face the dilemma of trying to simultaneously satisfy a variety of stakeholders: business, policy, end users, development team, testing team, business analyst, sponsor and management, and each stakeholder group has its own views, ideas and desires with respect to the software project's final product.

The users are too excited, or too sceptical, looking to get a robust, user-friendly system with many functions and capabilities that will assist them. The stakeholders desire a quality product delivered in the shortest possible time at minimum cost. Project managers

desire a project with ambitious goals, no budget overruns, and no surprises. The development team members look for interesting technical challenges that would aid their career (Boehm 1989, 902). These conflicting requirements, coming from the combined stakeholders, prove to be the root of most software project management difficulties.



**Figure 43: The Software Project Manager's Problem (Boehm 1989, 903)**

Boehm's (1989) Theory-W introduced a set of steps to create a Win-Win situation while running software projects.

**Table 31: Theory-W Win-Win Steps (Boehm 1989, 905)**

<b>1</b>	<b>Establish Set of Win-Win Preconditions</b>
	a. Understand how people want to win;
	b. Establish reasonable expectations;
	c. Match people's tasks to their own conditions;
	d. Provide supportive environment.
<b>2</b>	<b>Structure Win-Win Software process</b>
	a. Establish a realistic process plan;
	b. Use the plan to control the project;
	c. Identify and manage your win-lose or lose-lose risks;
	d. Keep people involved.
<b>3</b>	<b>Structure a Win-Win software product</b>
	a. Match product to users'/maintainers' win conditions.

Theory-W's approach to software project management revolves around the creation of Win-Win preconditions, and some further conditions for structuring the software process and the resulting software product. The following is a summary of Theory-W which creates and deals primarily with the process of creating win-win situations.

1. **Understand How People Want to Win:** Critical principle in ensuring success is making sure the project manager identifies the key people in the project; they may not necessarily be the senior management who make the project an astounding success, but may be the one tester who works hard to deliver software projects defect free. "Often, software projects have failed because a key constituency (users, bosses, hardware procurement personal, subcontractors) has not been included in the win-win schema" (Boehm 1989, 904).
2. **Establish Reasonable Expectations:** A significant number of software problems arise from the fact that stakeholders' expectations differ depending on the level and type of engagement with the project, which leads to a set of impracticable expectations. Similarly, software people often have unrealistic expectations about what is easy and what is hard for users to do (Boehm 1989, 905).
3. **Match People's Tasks to Their Win Conditions:** The key principles here involve searching for win-win situations and expanding the options space to create win-win situations (Boehm 1989, 905).

Theory-W for software project management, argues that making winners of all project stakeholders is both a necessary and sufficient condition for running successful software projects.

Projects that set up win-lose or lose-lose scenarios will be unsuccessful. Having all stakeholders sitting on the same side of the negotiating table creates a more collaborative spirit that would aid in achieving the project's desired outcomes. Conflicts between these groups are at the "root of most software-project management problems and affect the organisation's ability to set goals, define delivery dates, prioritise assignments, and adapt to changes" (McConnell 1996, 560).

Specifically, Theory-W Management supports rapid development in the following ways:

- **Clearer project objectives:** Because a Theory-W project begins by identifying each of the stakeholders' 'win' conditions, the project's objectives are clear from the start. The negotiation that takes place at the beginning of the project reinforces and documents the project's objectives. Setting clear objectives is probably the most important key to motivating developers, and motivating developers is probably the most important key to rapid development.
- **Better customer relations.** Many projects are set up to provide a win for the customer and a loss for the developers, or vice versa. It's hard to maintain good relations when one of the parties is losing, or expected to lose. Theory-W projects by their very nature improve relations between developers and customers because everyone stands to gain.
- **Reduced customer-related risk.** Many risks arise from the customer side of a development relationship, including feature creep, slow communication, and micro-management. Establishing a Theory-W relationship with your customer helps to minimise or eliminate such risks. It helps you to manage the remaining risks because you can keep a close eye on customer-related risks and get early warnings about them.

#### 5.2.3.1 Side Effects of Theory-W Management

Depending on the project stakeholders' win conditions, Theory-W can provide advantages that are more far-reaching than scheduling efficiency. It can provide improved usability, maintainability, customer satisfaction, and team morale (McConnell 1996).

Theory-W emphasises asking the 'Why' question while attempting to create the win-win situation for all stakeholders, and also assists in documenting the rationale for the 'Why' and have it as part of the project records. This would assist in resolving any conflicts if they arise during the later stages of the project.

#### 5.2.4 Different Problem

Politics in information technology projects vary depending on the organisation. Verner, Overmyer, and McCain (1999) discuss 'The Mythical Man-Month' written by Frederick P. Brooks (1995), wherein it stated that in the 25 years since publishing the book that the lack



of senior management support remains largely the cause of numerous project failures? Project manager input was ignored when critical decisions were made, or they were simply given little or no authority to make decisions related to their projects. They also pointed out that projects failed due to the absence of a project champion or sponsor, and that project politics remain at the core of project failures.

Raz, Barnes, and Dvir (2003, 28) highlighted that “there are other relevant mismanagement practices that affect schedule expectations such as external pressures; internal politics, and distorting estimates to win the project”.

An organisation’s culture strongly influences its achievements. There are a number of definitions for organisational culture (Brown 1995). The well-known definition by Schein (2010, 88) that “organisational culture is the pattern of basic assumptions accepted and used by the organisation”. The organisation and its culture have impact on the project culture and how the project will operate within the overall organisational culture, Firth and Krut (1991) pointed out to the critical role of the organisational culture within the project during its initiation stage.

Project managers responsible for managing information technology projects mostly face two cultural challenges. Firstly, how to quickly develop a suitable organisational culture that would ensure the project they lead will progress and achieve its outcomes. Secondly, how to accommodate the project’s internal culture with the wider organisational culture.

Public-choice theory, the concept for which economist James M. Buchanan won the Nobel Memorial Prize. It states that “while government agencies pretend to be virtuous and sophisticated, they are actually as primitive as crustaceans. Government offices will do anything to survive or take away from the private sector” (Shlaes 2011, 1). The public choice theory whilst it is far from the research core topic, is a basic concept that suggests that government agencies will adopt methodologies as a way of demonstrating capabilities or project image that often far from true.

### **5.2.5 Reasons for the Framework**

The reason for developing the framework is to assist practitioners who are involved in information technology projects to address challenges and problems in their projects that may lead to the project’s failure. The literature review and the case studies showed that

even organisations that adopt project management and software development methodologies in their implementation remain challenged and in many instances are unable to deliver successful projects if measured using the project management golden triangle (cost, schedule, scope). The wide adoption of project management and software development promised to address a failure in delivery. Things are actually made more difficult for methodology users because methodology creators generally do not discuss or present situations where their methodologies have been unsuccessful or have failed to bring about successful transformations (Jayaratna 1994). Benjamin (2006) in his thesis, concluded that a project management methodology is likely to be a primary factor in project failure, which is opposite to the traditional belief that project management and software development methodologies would guide projects to successful development.

### **5.2.6 Aims of the Framework**

In the light of the above reasons, the aims of the framework are to:

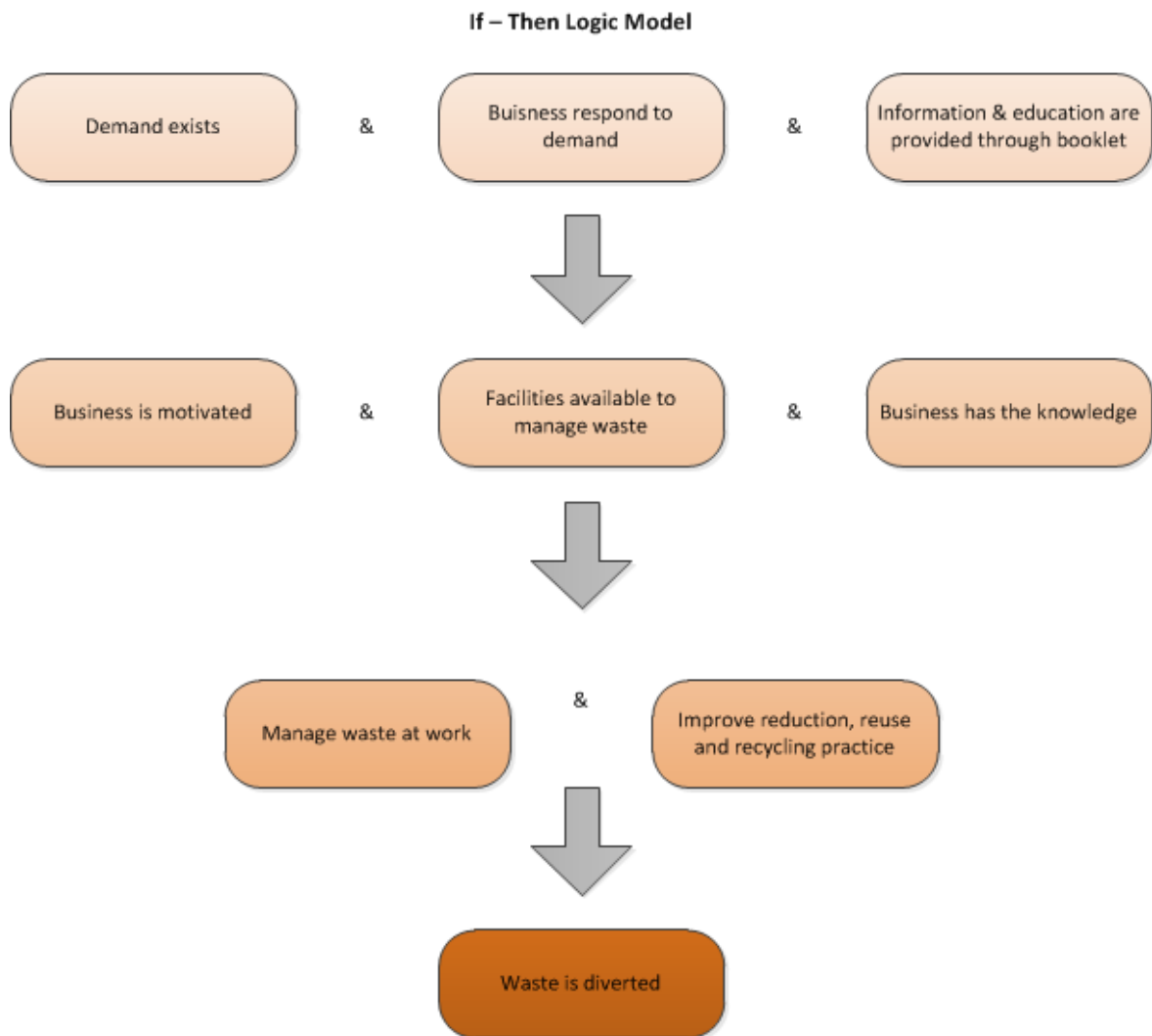
1. Serve as a way of understanding issues facing project delivery;
2. Present a new approach to addressing issues that hinder project delivery.

## **5.3 Intervention is Not New**

Done, Voss, and Rytter (2011) examined if short-term Best Practice Interventions (BPIs) can create enhancements/improvements that can be maintained in the long run. They defined BPI as “an activity designed to introduce new practices through a series of short focused activities in the organisations”(Done, Voss, and Rytter 2011, 500). They argued that intervention is composed of two parts. The first part targets limited improvements in one operational area within a limited timeframe. The second part focuses on introducing practices and laying the ground within the organisation for more fundamental changes through action learning and putting into application the feedback received. Done, Voss, and Rytter (2011, 501,502) also listed the prerequisites for the intervention to be successful:

1. Clearly communicated strategy and objectives for change;
2. Organisational readiness for change;
3. Key performance indicators (KPIs) aligned to the program of change objectives;
4. Reward and recognition of positive short-term results.

Purcell and Magette (2011) developed a logic model that used intervention to address issues, including addressing socio-economic variables in waste management in the BMW plant in Dublin. Figure 44 depicts how the logic model works as a technique for identifying an objective using the “if then” logic to link essential events to outcomes. The Logic model starts with the desired outcomes, and moves into deep analysis by identifying the various needs and available options and how those needs could be addressed.



**Figure 44: Waste Booklet Logic Model (Purcell and Magette 2011, 2184)**

Checkland’s (1981) influential work on Soft Systems Methodology which led to significant progress in Operation Research (OR) and the identification of OR as a social process (Ormerod 1996).

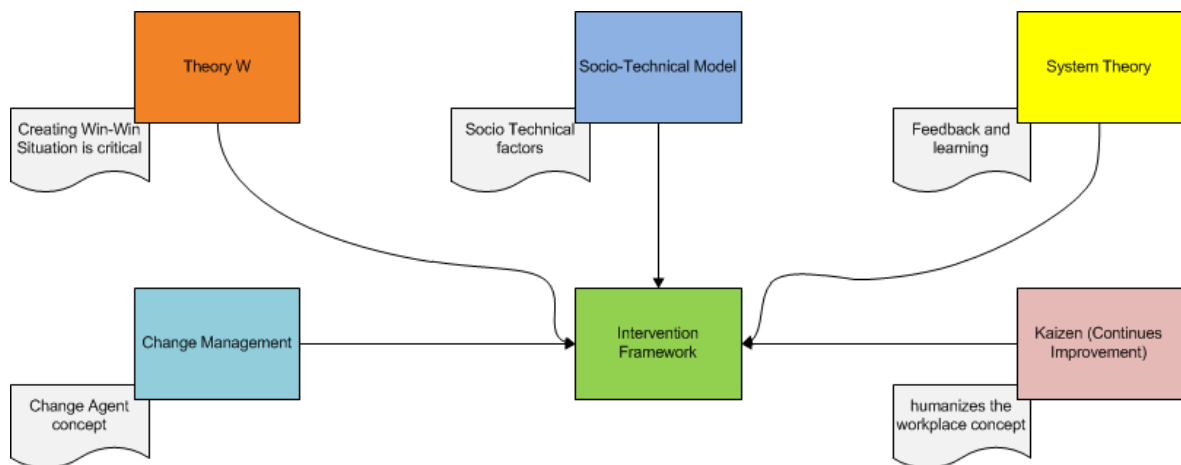
The arguments originated with the objectives to employ OR ability to deal with difficult management problems. Such intervention effort involves complex stakeholder

relationships, and requires ongoing negotiations that would allow the desired outcomes to be achieved. Similarly researchers, such as Eden et al. (1981, 40) claim that “interventions are negotiated social orders in which ambiguous activity is enacted in a group”.

Cardinal et al. (2001, 694) described an intervention framework to deal with contradictions, antagonism and paradoxes caused by the natural differences, which exist between the different stakeholders and the confrontation of multiple strategies between them.

## 5.4 Framework Motivations

The proposed intervention framework draws from existing and well-established theories, models and frameworks as illustrated in Figure 45.



**Figure 45: Intervention Framework Motivations**

The framework essentially builds upon the socio-technical model by (Kowalski 1994), but extends with adding culture and economics as factors impacting information technology project ability to deliver their outcomes.

Theory W by Boehm (1989) emphasized on the creation of win-win situations for projects in order to succussed, one the main premises behind the intervention framework is establish the win-win situation/environment, for all participants in a challenged information technology project with the aim of reducing such challenges, and attempt to deliver all or parts of the project objectives.

General Systems Theory form part of (Kowalski 1994) and since the proposed intervention framework was built upon the socio-technical model, the adoption of elements of the

systems theory was natural. The systems theory and its emphasis on looking deeper into human factors that impact social systems, with information technology project being viewed as social systems with all the pros and cons that can be associated with that, hence the extension of culture and economics in addition to social and technical adopted from the socio-technical model.

Systems theory also stress the importance of feedback mechanism as a way of correcting systems behaviour and ensure it can adapt to varied inputs. Such concepts in manufacturing and termed as “continue improvements”. Intervention having foundation on systems theory, feedback plays a critical role in establishing and intervening in problematic projects. The ability of the framework not only to learn from the existing settings, but continuously investigating and answering the “WHY” questions. The approach does allow the intervention framework to be able to respond to every changing project environment and deal with various pressure point in the project during the intervention effort.

The proposed intervention framework borrowed the concept of change agent from change management. The change agent in the intervention framework can be the person, who is undertaking the overall responsibility of steering the project direction and dealing with the challenges which impacted the project and impeded its ability to deliver outcomes.

## **5.5 Intervention Framework for Information Technology Projects**

This section outlines the major steps that are followed when formulating and validating the proposed intervention framework.

While each project has its own unique environment, staff and organisational culture that could impact on the intervention outcomes, the literature review provided sufficient evidence that information technology project delivery remained challenged and many end up in failure, costing the economy significant through productivity loss. Adopting project management methodologies provided organisations with methodical ways of managing projects, although such ways did not help in changing the final outcomes of many challenged projects.

Eiselt and Sandblom (2010b) discussed the modelling process and presented the major steps required when formulating, solving and implementing the framework.

1. Problem Recognition;
2. Authorisation to Model;
3. Model Building and Data Collection;
4. Model Solution;
5. Model Validation;
6. Model Presentation;
7. Implementation;
8. Monitoring and Control.

#### **5.5.1.1 Overview of the Framework**

The Framework builds upon existing models of information technology, mainly the socio-technical of Kowalski (1994). Enterprise-wide models refer to major activities that impact decision makers in organisations large or small, such as corporation or government agencies. This framework attempts to address social, cultural and technical issues within information technology projects and provide a methodical way for intervention. The framework addresses many of the issues in the literature in relation to project failure:

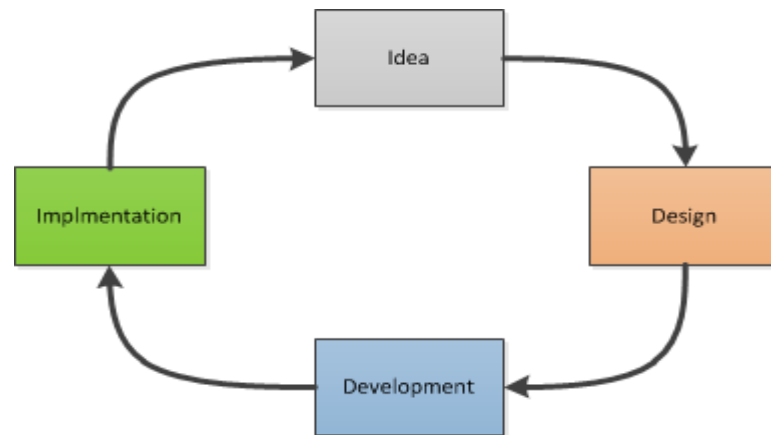
1. Factors related to the project;
2. Factors related to the organisation;
3. Factors related to the project manager and the team members; and
4. Factors related to the overall environment.

Key components of this framework are the project life cycle, and social and technical factors impacting the project.

#### **5.5.1.2 Project Life Cycle**

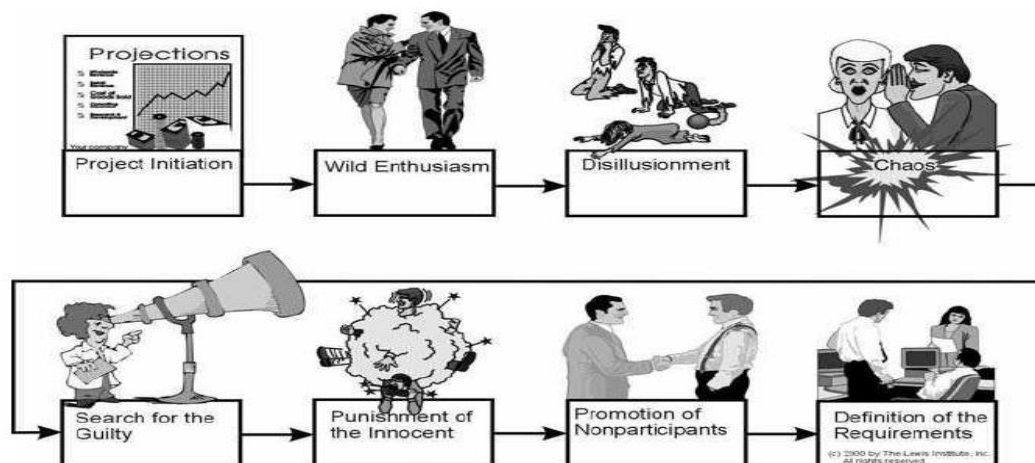
The life cycle of the project starts when the system is conceived as an idea within either the business to implement a new process or improve existing one, or within the information technology group to enhance or introduce new technology to the organisation, with the aim to improve productivity and have a more efficient workplace.

The life cycle starts with the idea, development or procurement and ends when the system is deployed into the production environment. A typical project life cycle process is defined in stages namely, idea, design, development, and implementation.



**Figure 46: Basic Project Life Cycle**

Lewis (2007, 10) life cycle of troubled projects is quite representative of the real world when compared to theoretical based project management methodologies (e.g. PRINC2 or PMBOK) in which the human factor is not seen as essential. The life cycle illustrated in Figure 47 could be used to indicate when intervention is required in challenged information technology project.



**Figure 47: Life Cycle of a Troubled Project Lewis (2007, 10)**

### 5.5.2 Intervention Framework Proposal

In the literature review we discussed projects, small and large, in private and public organisations, failing and costing the economy millions if not billions of dollars in lost productivity, and wasted investments. Projects are triggered by a mindful decision to

undertake an action; they are theoretically based on clear, well defined set of objectives and deliverables. The project management process is initiated with a high level of uncertainty and in some cases it continues until the end of the project. The project uses tools and techniques as prescribed in the various project management methodologies to create work breakdown structures or work packages, risk analysis and mitigation strategies, planning, followed by quality, time and cost control. Theoretically, they are designed to enable better information gathering and simulation, and are aimed at the reduction of uncertainty. In the case studies presented in this research, successful or failed projects were not defined in a clear cut way, but in a way that suits the organisation's internal power structure, and management desires. Information technology projects have been challenged and have failed for decades, and organisations have opted to adopt software development and project management methodologies as a way of reducing the risk of failure and boost the project's chances of success. Unfortunately, there is no evidence to support claims that adopting software development or project management methodology enhances the project's chances of success as presented in the literature review and in the cases examined by the researcher. Ivory and Alderman (2005) suggest that there is need for flexibility and local response for emerging problems in projects and the need for some level of intervention to deal with problems on the ground. They stated that intervention is not merely a 'corrective' to poorly designed project management system, but an essential and 'normal' part of project management activity.

Adopting the same traditional solutions by introducing more methodologies, frameworks or models does not seem to assist in making projects more successful, especially as most of the problems identified in relation to project failure relate to human interaction and the management of staff within the unique project environment, which is not covered by any of the existing project management methodologies.

Projects fail and will to continue to be challenged and fail in the future. One of the aims of this research project is to introduce a different approach when dealing with projects in trouble, instead of taking an ad-hoc approach and use the traditional method of adding more staff, budget or stretching the deadlines.

Escalating commitment "occurs when decision makers, having already committed significant resources to a project, commit even more resources even if they receive



feedback that the project is failing (Hill and Jones 2010, 29). This may seem to be unreasonable response giving the feedback received about the project progress. A more rational response might be cancelling or suspending the projects, instead of committing more resources to a failing effort. Feeling personally responsible for a project apparently tempts senior managers to continue with failure despite the apparent evidence that suggest otherwise.

The interventionist approach assumes that the information technology project will remain challenged in the foreseeable future, and instead of management escalating their commitments with little or no evidence that type of intervention will result in different project outcomes, the project will fail. The framework proposes to use social science to intervene in challenged projects with the aim to address the challenges, or decommission the whole project.

Skyttner (2001) described models that are employed to develop new knowledge, to modify existing knowledge or to give knowledge to new applications. From the pedagogical point of view, models are used to render theories more intelligible. Models can also be used to interpret a natural phenomenon or to predict the outcome of actions. Through the use of models it becomes possible to know something about a process before it exists. The model can be subjected to manipulations that are too complex or dangerous to perform in full-scale. Also, to use a model is less costly than direct manipulation of the system itself.

The deviation from the project objectives set up during the early stages of the project will be the derailment trigger which will ignite the need for change in the project, whether that change will be a simple tuning in a project parameter, or whether it is the circumstances that initiate a series of events that puts the project at risk from achieving its outcomes and meetings its objectives. Feedback will address the processes required to manage both the emergent inputs gathered during the problem definition, planning and during the evaluation process of the intervention effort to address issues leading to the project outcomes being challenged. There are three other important elements taken into account while attempting to understand the problem during the intervention process; they are:

1. The making of the decision to continue or abandon the project;
2. The assessment of its benefits during implementation; and

3. The change that may influence its implementation.

These changes will be initiated by either emergent inputs or the failure to achieve the objectives of the intervention effort.

Some theorists associate learning purely with the acquisition of knowledge. Bramley (1991, 95) defines it as “acquiring the ability to behave in new kinds of ways”. Nevis, DiBella, and Gould (1997, 2) defines learning as “the capacity or processes to maintain or improve performance based on experience”. In the context of this framework, ‘learning’ will be defined as “the capability to self-assess and feedback to improve and innovate” as defined Thiry (2009, 223) and it considers that there is both a social process and the need for improvement in learning.

The learning cycles in the framework are designed to gain deep understating of the social, cultural, technical or economic issues which are impacting the project and posing risks to its ability to deliver in accord with its objectives. There is a minimum of one learning cycle and no maximum number of learning cycles that can be employed during the intervention stage. One of the processes required to establish understanding, is to engage project stakeholders as the present source of knowledge during the learning phase, as well as gaining an understanding of the social dynamics of the project.

One of the main requirements for the team tasked with the intervention effort is to fully understand stakeholders’ needs and expectations. Sensemaking has been described by a number of authors. Louis (1980, 226) described it as a “recurring cycle comprised of a sequence of events occurring over time. The cycle begins with individuals from unconscious and conscious anticipations and assumptions, which serve as predictions about future events”. Thiry (2001, 71) summarised sensemaking as “A system of interactions between different actors who are building a collective understating of a situation, developing a strategic model of the intervention and defining a shared desired outcomes”. When the situation is ambiguous, Quinn (1996) promotes the term ‘good conversation’, which has the following features in the process of establishing an understanding of the situation:

1. **Issue oriented:** focusing on specific problems and alternatives courses of action;
2. **Rational:** meaning intelligible, reasonable and well argued;

3. **Imaginative:** in the sense that they encourage open social interaction; and
4. **Honest:** in that inputs must be true and agreed outputs honoured.

Once the sensemaking process is triggered that the project is being challenged to deliver its desired outcomes. Stakeholders, particularly senior managers then need to initiate the sensemaking process, which in the context of organisations and projects can be defined as “an individual process grounded in social interaction” (Thiry 2001, 72).

Creativity, imagination and lateral thinking are essential during the holistic problem definition of the intervention effort. These are important components during the idea generation process or what can be described as the finding of the way out of the current situation. Reaching that holistic problem definition may take time and significant effort in order to understand and propose a solution that will satisfy the diverse needs of the various project stakeholders, and achieve the right balance between the conflicting needs of each stakeholder. One technique that can be used successfully during the problem definition space of the intervention is creative thinking which promotes the alternative use of evaluation, analysis and vertical thinking “in order to produce a greater quantity of more innovative ideas and apply better selection and validation of the alternatives” (Thiry 1997, 225). During this process, all alternatives will be put on the table for discussion and each alternative will be assessed based on the understanding established in earlier phases of the intervention process, with the objective being to having a scope that is agreed, accepted and signed off by all stakeholders prior to moving to the next step in the intervention effort. This stage can often be the most difficult to accomplish in the intervention. Projects in crisis by definition lack many elements of stable projects such as objectivity, clear direction and high morale. Instead, they mostly suffer from a lack of direction, low staff morale, internal and external conflicts and a blame culture in which each group of stakeholders point to other groups and their shortcomings. Once sensemaking is worked through the stakeholders to re-establish some balance, it is time for the actual scoping effort to commence.

Problem understanding is closely related to the stages in problem solving first described by John Dewey: “What is the problem? What are the alternatives? Which alternative is best?” (Simon 1960, 43). In the intervention framework, problem understating plays pivotal role in identifying the root causes behind the issues identified in a project.

When identifying social, cultural, technical and economic problems that faced the project and limited its ability to accomplish its objectives, it is important to avoid the pitfalls of decision-making fatigue. Decision fatigue is the newest discovery involving a “phenomenon called ego depletion, a term coined by the social psychologist Roy F. Baumeister, he experimentally established that there is a finite store of mental energy for exerting self-control” (Tierney 2011, 1).

Decision fatigue happens when people are not consciously aware of being low on mental energy. The more they are subjected to choices and the demand to make decision, the harder it becomes for the brain, and ultimately, they resort to shortcuts to avoid being subjected to such a high level of mental stress. One of those shortcuts is to simply do nothing instead of engaging in making decisions. When such problems exist in information technology project, it leads to bigger problems in the long run. The requirements and design stage of projects are the most likely phases in which decision fatigue can take place.

It is critical for the individual or group responsible for the intervention process, especially during the problem definition process to ensure the intervention solution provided has no more than three alternatives for the scope, with each alternative having a full brief of benefits and shortcomings addressing each stakeholder’s concerns. The rationale behind that is to minimise the number of choices available for the stakeholders responsible for agreeing to the intervention scope. An experiment conducted by Mark Heitman, Andreas Herrmann and Sheena Iyengar (2010) involved real car buyers giving them choices of four styles of gearshift knobs, thirteen kinds of wheel rims, twenty five configurations of the engine and gearbox and a palette of fifty six colours for the interior.

As customers started selecting features for their new cars, they initially and carefully weighed the early choices. However, once decision fatigue set in, they started settling for the default option. As they moved into the colours and the wide variety of shades associated with each colour, the quicker people became fatigued and settled for the path of least resistance by taking the default option. The options presented as part of the intervention approach should be narrowed down to no more than three choices to avoid the selection dilemma described by Levav et al. (2010).

One of the outcomes of the problem identification process could be a recommendation to decommission the project and disband the project team and make no further investment to the project or as Skyttner (2001) suggests, ridding the information system of excessive and out-dated information in order to correct its performance.

During the second phase of the intervention framework a planning process takes place to create a usable, flexible, consistent, and logical approach that will guide the intervention effort activities. The intervention plan will provide a control mechanism for coordinating changes across the entire project.

The planning process proposed in the intervention effort will be iterative in nature. It will be conducted in collaboration with the various stakeholders and will allow for their input to influence the planning stage within the agreed scope boundaries identified in the previous stage. The planning phase will consider historical information from the project and past projects within the organisation which can be useful resources for understanding how these project plans fared in terms of the accuracy and completeness of their estimates. Previous project plans can also serve as a source for drawing upon new ideas and lessons learned.

The planning process must consider policies and procedures adopted within the organisation. Organisation policies and procedures can assist the intervention effort, as well as being a source of frustration. For example, procurement policies in government agencies could mean lengthy durations acquiring new tools or hiring new temporary staff, which in turn can have an impact on the final outcome of the intervention effort. In the private sector, a hiring freeze could mean that the project can no longer add any new resources in order to achieve its agreed intervention scope. Therefore, the planning phase must consider organisation policies in order to present viable intervention efforts that will achieve the agreed intervention scope.

The former United States Secretary of Defence Donald Rumsfeld once said: "There are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns – the ones we don't know we don't know" (Rumsfeld 2002, 1). The planning phase for the intervention effort will build on the quote from the former United States Secretary of Defence, as it highlights that there are events which will remain

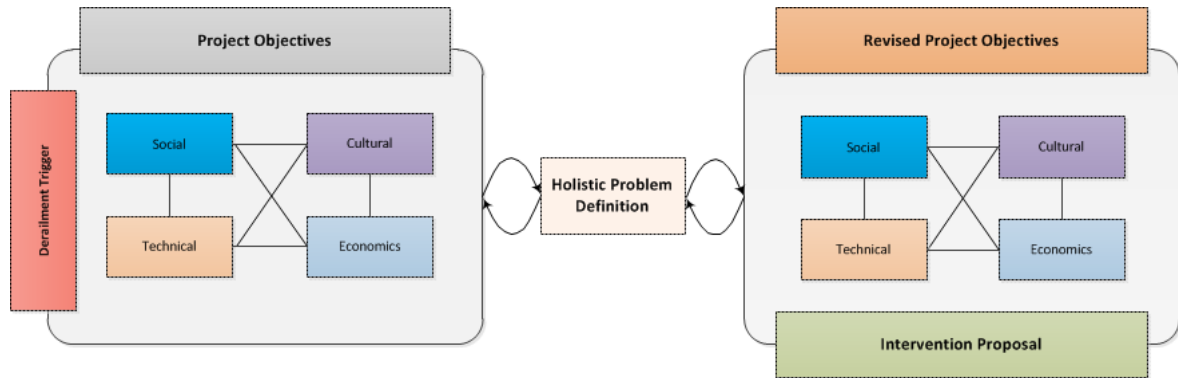
unknown to the planners until they happen. In this case, planning must focus on the known activities which are considered vital to the project. Planning for the intervention framework will adopt the Quality circles which are part of Kaizen at Toyota Car Company and also widely promoted by the Six Sigma approach. Toyota applies the 80/20 rule by effectively focusing 80% of their energy on the 20% of problems that will yield 80% of the total benefit (Liker and Meier 2006).

Intervention planner during the problem definition phase should hold a prioritising exercise with all stakeholders to ensure that all planned activities will be either set to high, medium or low, focusing the effort of the planning on items that will provide the greatest benefits to the project's agreed outcomes.

Once the intervention plan had been approved by the project stakeholders, including the project sponsor, the changes required to address the issue led to the project being unable to deliver to its agreed objectives. The intervention framework includes a learning and innovation loop. Wijnen, Kor, and Twynstra Management (2000) and Görög and Smith (1999) argue for continuous re-evaluation and replanning in order to achieve the desired organisational benefits of the project. This view can be associated with what Argyris and Schön (1978) called 'double loop learning', while Quinn (1996) argued that when the relationship between means and ends is not well defined, control will operate through self-organisation and encourage people to speak up and to challenge the received wisdom. Quinn (1996) saw good conversation as a way to exercise control in a positive or proactive way and states that whatever perspective is taken extensive discussion should occur between parties involved in the control processes.

Skyttner (2001, 344) pointed out to the situation in which "the precise information is not timely, and the timely information is not precise", while the proposed framework may suffer from it. Hence, it is fundamental that the whole framework is understood to be cyclical; repetition and feedback of the framework steps are essential to allow the intervention effort to continue learning about the situation and continually provide information to decision makers. Even redefinition of the original problems faced by the project and the proposed scope and plan of intervention may be necessary and may result in the recommendation to decommission the project and not continue with the intervention effort.

The main objective of having feedback processes within the framework, is to maintain an output that will satisfy the intervention scope agreed requirements, with the aim of creating a framework being informed and adaptive and able to respond to the constant changes in a project environment.



**Figure 48: Proposed Intervention Framework for Quality and Assurance in Information Systems Projects**

### 5.5.3 Intervention Framework for Quality and Assurance in Information Systems Projects

The framework provides a methodical way to develop and plan intervention. It primarily builds on the socio-technical model, which attempts to address social, cultural, economic, and technical issues within information technology projects. Incorporating the socio-technical model allows the framework to address issues related to project failure, including factors related to the:

1. Project;
2. Organisation;
3. Project manager and the team members; and
4. External environment.

A 'derailment trigger' is an event or situation that causes deviation from the project objectives, forcing the intervention process, at any stage of the project. This may involve a simple adjustment in a project parameter, or may be as serious as a set of circumstances that put the entire project at risk of failing to achieve desired outcomes. Consideration of the four elements of the socio-technical model (social, cultural, technical, and economic) can help identify crucial derailment triggers.

The intervention framework illustrated in Figure 48 promotes constant learning to gain a deep understanding of the social, cultural, technical or economic issues which impact on the project and pose risks to its ability to deliver its objectives. There is a minimum of one learning cycle with no limits on maximum number of learning cycles that can be employed during the intervention stage. The process commences with identification of the underlying causes of the problem, followed by formalisation of the problem definition, then the creation of a solution that may incorporate new project objectives and which leads to the intervention proposal.

Feedback addresses the processes required to manage both the emergent inputs gathered during the problem definition and the planning stage. It can incorporate the evaluation process of the intervention effort to address issues leading to the project outcomes being challenged.



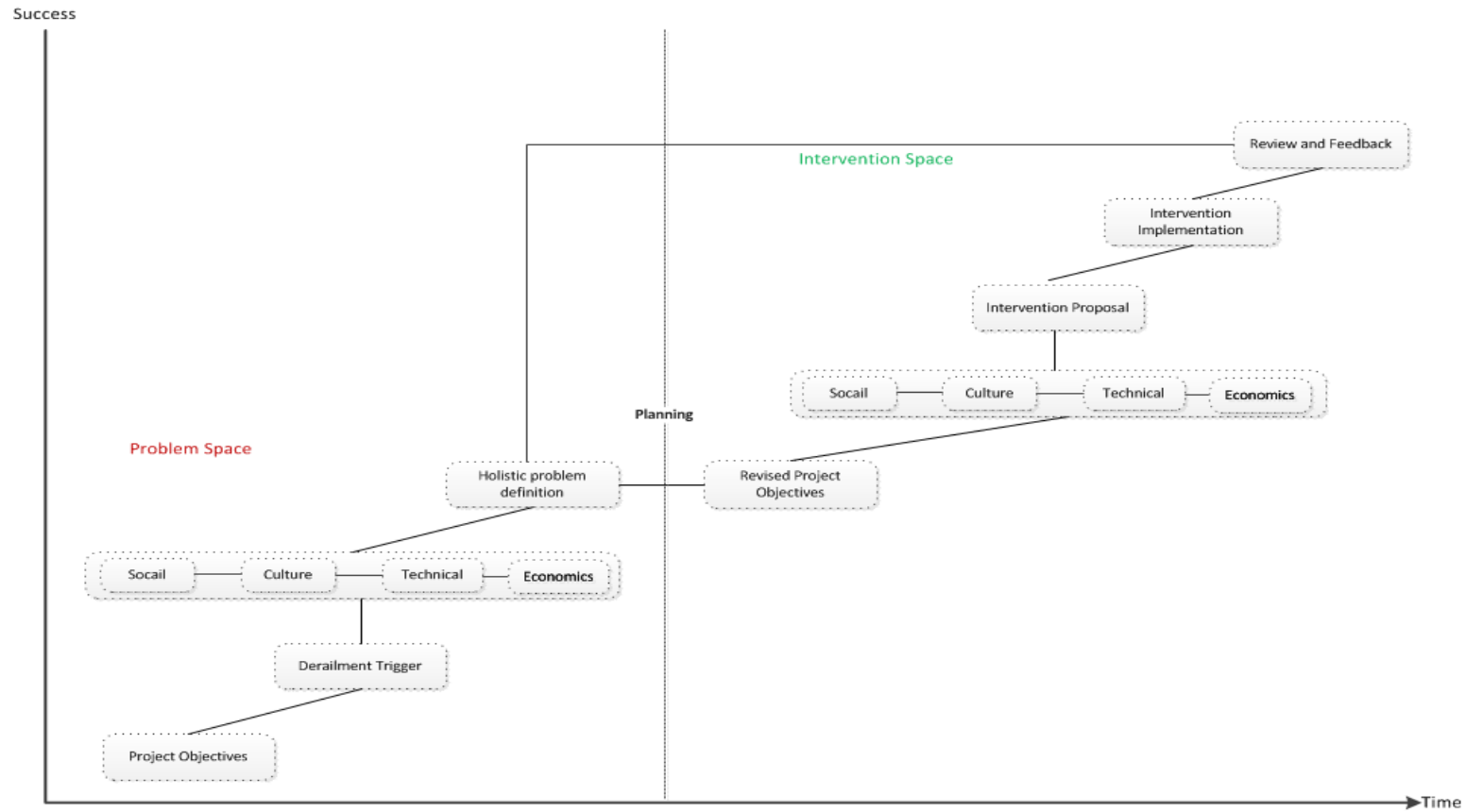
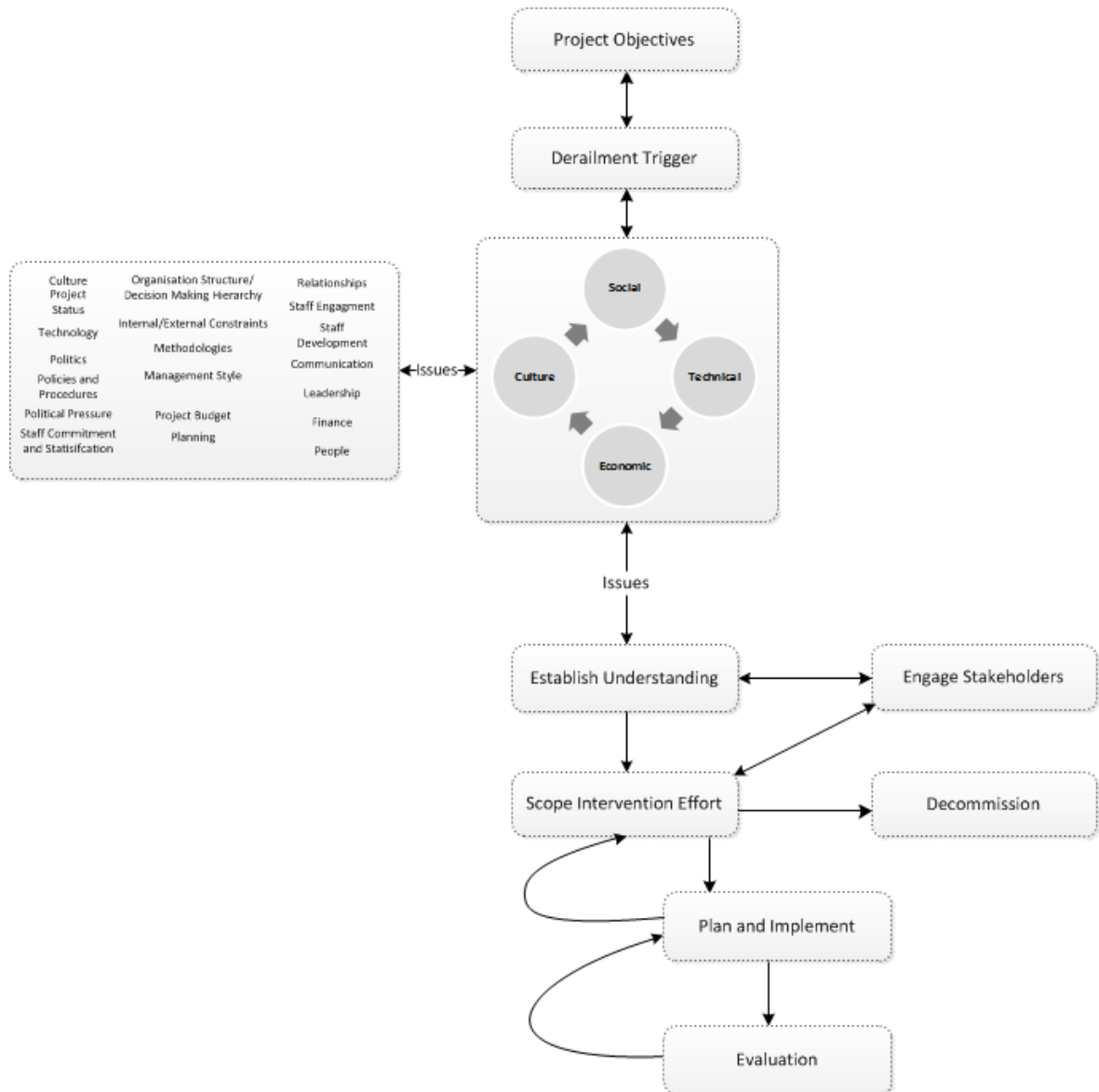


Figure 49: Moving Towards an Intervention

During the second phase of the intervention framework (the 'intervention space' in Figure 49) a planning process takes place to create a usable, flexible, consistent, and logical approach that will guide the intervention effort activities. The intervention plan will provide a control mechanism for coordinating changes across the entire project.



**Figure 50: A Process for Developing an Intervention Plan for Projects at-risk**

The organisation will be capable of achieving positive results if it can establish an understanding of the derailment trigger. This will require the project managers to relate to the economic, technical, social, and cultural elements; ensure they have the right people involved in the project; identify key stakeholders; successfully scope intervention efforts; achieve buy-in; and ensure project processes are developed to help the planning and implementation of the intervention effort. Processes are developed to help the planning and implementation of the intervention effort.

Reaching that holistic problem definition may take time and significant effort to understand and propose revised project objectives that will satisfy the diverse needs of the various project stakeholders and achieve the right balance between the conflicting needs of each stakeholder. One technique that can be used successfully during the problem definition space of the intervention is creative thinking, which promotes the alternative use of evaluation, analysis that would be used to produce ideas that could be evaluated.

A fundamental requirement to establish understanding is engaging project stakeholders as they present a source of knowledge during the learning phase, as well as gaining understanding of the social dynamics of the project. A key requirement for the team tasked with the intervention effort is to fully understand stakeholder's needs and expectations. The interaction between individuals to build a collective understanding of a situation, or 'sensemaking', is required to reach consensus on intervention towards mutually desired outcomes.

The planning process proposed in the intervention effort will be iterative in nature as users work through a sequence of steps that may involve re-visiting tasks and engaging in iterative conversations with stakeholders Figure 50.

Explicit and accurate information is desired for the planning process, but it is rarely precise or delivered at the right time, and may force further iterations. It will be conducted in collaboration with the various stakeholders and will allow for their input to influence the planning stage within the agreed scope boundaries identified in the previous stage. The planning phase will consider historical information from the project and past projects within the organisation which can be useful resources for understanding how these project plans fared in terms of the accuracy and completeness of their estimates. Previous project plans can also serve as a source for new ideas, which may draw on previous projects and the lessons learned.

Once the intervention plan has been approved by the project stakeholders (including the project sponsor, who must be willing to undertake the necessary changes to resolve the issues identified) an intervention framework can be implemented. This will then be evaluated and may need to be adjusted further.

During the intervention, efforts must be made to understand the process through:

1. Making the decision to continue or decommission the project itself;
2. Appraising the benefits during implementation, and;
3. Identifying and understanding changes that may influence the execution.

It is critical that the whole framework is understood to be cyclical; repetition and feedback of the framework steps are virtually indispensable. Redefinition of the original problems faced by the project and the proposed scope and plan of intervention may be necessary and may result in the recommendation to decommission the project and not continue with the intervention effort.

## **5.6 Framework Evaluation**

The researcher conducted the survey between March 2012 and April 2012. Although the survey was distributed by e-mail, the researcher requested the survey participants to provide written responses as well. Approximately fifteen surveys were disseminated. An explanatory document stating the objectives of the intervention framework was also included.

The survey had two main objectives:

1. Obtain feedback on the proposed framework from information technology experts;
2. Address the framework's shortcomings based on the feedback received.

The survey contained ten questions and is available in Appendix A. Four questions focused on the survey participant's background. Three questions related to the framework and used Likert-scales to measure whether the participant believed the framework would be useful. Three questions were open text and allowed participants to comment on the framework strength and weakness and provide suggestions on how it can be improved.

### **5.6.1 Survey Results**

The survey targeted project managers, program managers and senior executives in a number of global information technology organisations. Of the fifteen surveys sent out, responses were received from nine participants. Summarised results for questions 1 to 7 are available in Table 32. The average survey participant had ten years of experience in

information technology, with the exception of one participant who had less than five years' experience in information technology.

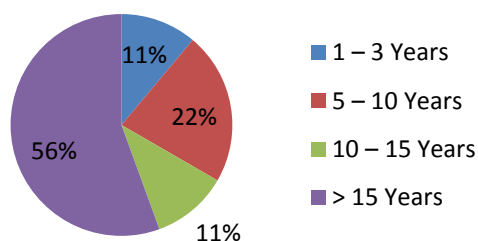
Six of the nine participants worked in more than fifteen information technology projects while the remaining three participants worked in five or more projects.

The third question was in regards to the number of projects which faced major difficulties. All participants indicated that a number of projects faced problems, with three participants indicating all projects faced major difficulties. The fourth and last question directly related to the participants' education, three of the participants had PhDs, two had Master Degrees, one had a diploma and three had industry certification.

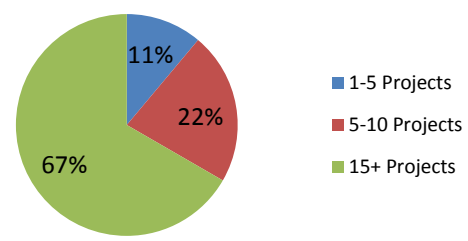
**Table 32: Survey Q1-Q7 Summary**

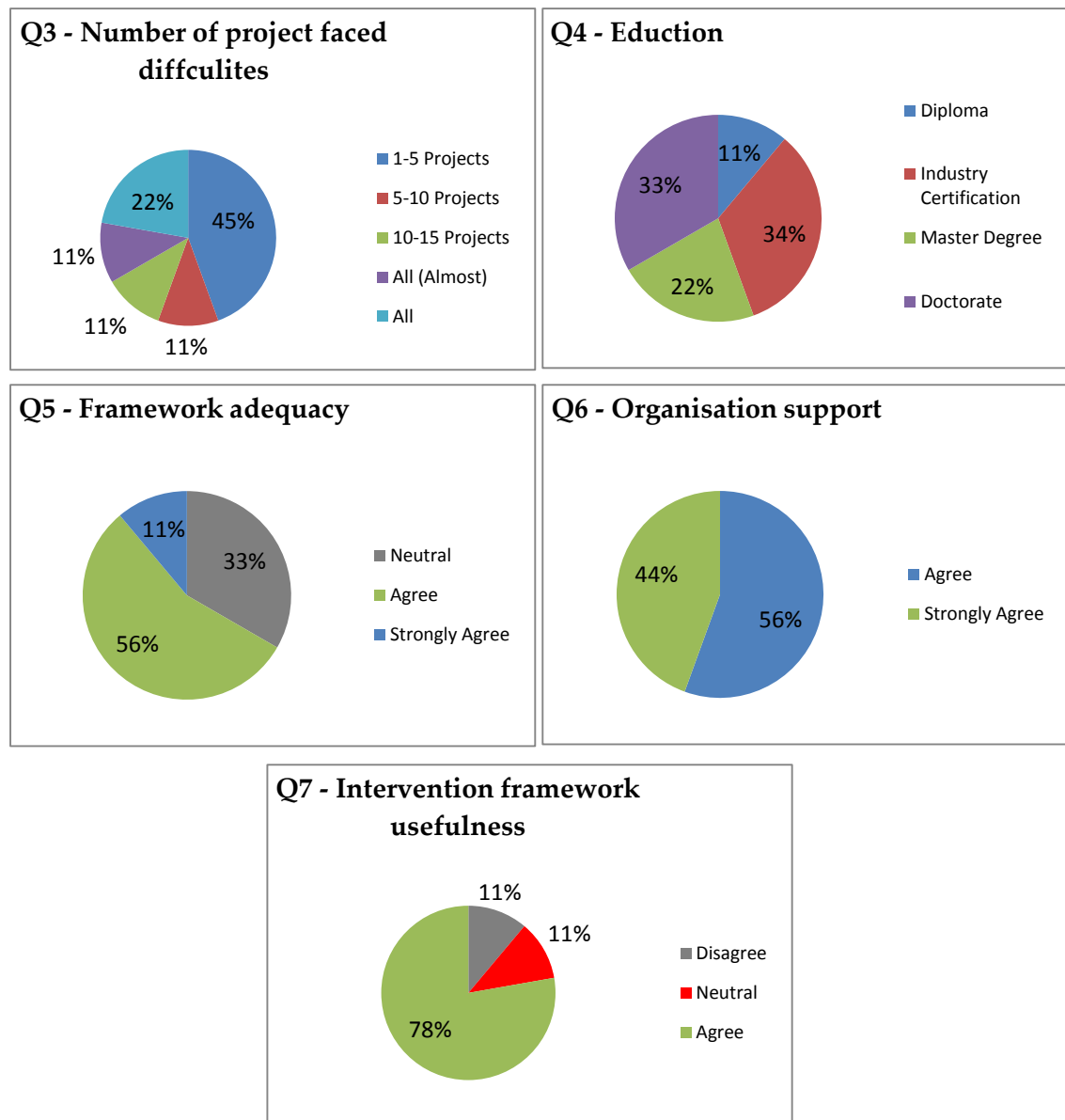
	Q1	Q2	Q3	Q4	Q5	Q6	Q7
<b>Respondent 1</b>	5 – 10 Years	15+ Projects	10-15 Projects	Industry Certification	Agree	Strongly Agree	Agree
<b>Respondent 2</b>	10 – 15 Years	5-10 Projects	1-5 Projects	Master Degree	Strongly Agree	Strongly Agree	Agree
<b>Respondent 3</b>	> 15 Years	15+ Projects	5-10 Projects	Industry Certification	Agree	Strongly Agree	Agree
<b>Respondent 4</b>	> 15 Years	15+ Projects	All	Master Degree	Neutral	Agree	Neutral
<b>Respondent 5</b>	5 – 10 Years	5-10 Projects	1-5 Projects	Industry Certification	Neutral	Agree	Agree
<b>Respondent 6</b>	> 15 Years	15+ Projects	All	Diploma	Agree	Strongly Agree	Agree
<b>Respondent 7</b>	> 15 Years	15+ Projects	All (Almost)	Doctorate	Agree	Agree	Agree
<b>Respondent 8</b>	1 – 3 Years	1-5 Projects	1-5 Projects	Doctorate	Agree	Agree	Agree
<b>Respondent 9</b>	> 15 Years	15+ Projects	1-5 Projects	Doctorate	Neutral	Agree	Disagree

**Q1 - Years of experience**



**Q2 - Number of projects**





**Figure 51: Graphical Representation of Q1 – Q7**

The fifth question was intended to verify the framework adequacy in addressing issues contributing to the project's inability to achieve its objectives. Six participants indicated that they either agreed or strongly agreed with the adequacy of the framework while three participants indicated a neutral response. One of the framework requirements is organisational support, and all nine participants indicated that they agreed or strongly agreed that having such organisational support is critical to successful intervention. The last question in the series of Likert scale questions was whether the survey participants have confidence that the framework would assist in addressing project issues. Seven participants indicated that they agreed that the framework would have positive impact on addressing project issues and enable the project to achieve its objectives. However, one

participant disagreed that the framework would bring any improvement to projects and another participant's answer was neutral.

Question eight asked about the weaknesses of the framework to which the answers were varied, revealing some issues with the proposed framework. More than one survey respondent questioned how the framework could be applied, especially in small projects that do not have long execution periods. The second weakness identified by a number of respondents, was in relation to social, cultural, technical and economic factors which have impacts on projects outcomes. These respondents made it clear that in order accelerate the adoption and use of the framework, a basic list of factors should accompany the framework. This would make it easier for the intervention to take place without spending too much time identifying similar issues again in each project.

Question nine was closely linked to Question eight and asked about the strengths of the framework. Majority of the respondents indicated that the framework provides an effective method to understand common derailment triggers of project issues. Responses indicated that the framework addressed most of the issues which cause projects failures. Another strength noted was that the framework was well-structured and easy to follow.

The final survey question was in relation to how the framework could be improved. One recommendation was to apply the framework at the initiation stage. Another recommendation was inclusion of how the framework could be integrated with existing project management methodologies or be part of the tools used by organisations managing information technology project. Establishing the efficacy of the framework was also important and one recommendation was that the framework should be applied to failed projects to demonstrate its advantages against other frameworks or models.

### **5.6.2 Feedback Response**

There were two major concerns identified in the survey feedback, one is in relation to the application of the framework and the second relates to the factors associated with social, cultural, technical and economic issues associated with information technology projects. I can address this concern by conducting an experiment or a simulation. However, the first consideration is that I can't do this because the projects have all been completed. Second, there is simply not enough time to do this within the scope of this project.

Techniques such as simulation provided the researcher with tools which could be used to effectively apply the framework to projects which formed part of the research, and those project findings were used to build the framework. Simulation as a technique was discussed in the research methodology chapter. Two case studies were selected for simulation (Section 5.7), one case for a project with a federal government department, which was required to be completed within a limited period. One of the survey participants advised that by applying the framework earlier in the projects, the intervention results could be more positive. The simulations (Section 5.7) demonstrated that applying the framework earlier, as per the survey participants feedback, could yield better results. The second case study was for the power utility company discussed in chapter 4. The case was more challenging and the intervention approach simulated differs from the first case. The intervention simulation in both cases was informed by the case studies findings in chapter 4. The researcher also added more detailed process on how the framework can be applied, including steps (Section 5.5.3).

The second concern identified by the survey participants was related to the list of social, cultural, technical, and economic factors that need to be investigated in order to identify the issues influencing the project ability to achieve its outcomes. The implication was that the existing framework did not assist the users in identifying and understanding these elements. This is not surprising as the elements are not clearly incorporated in the existing methodologies that respondents are familiar with. The survey feedback, while strongly supported the framework, indicated that it could be enhanced.

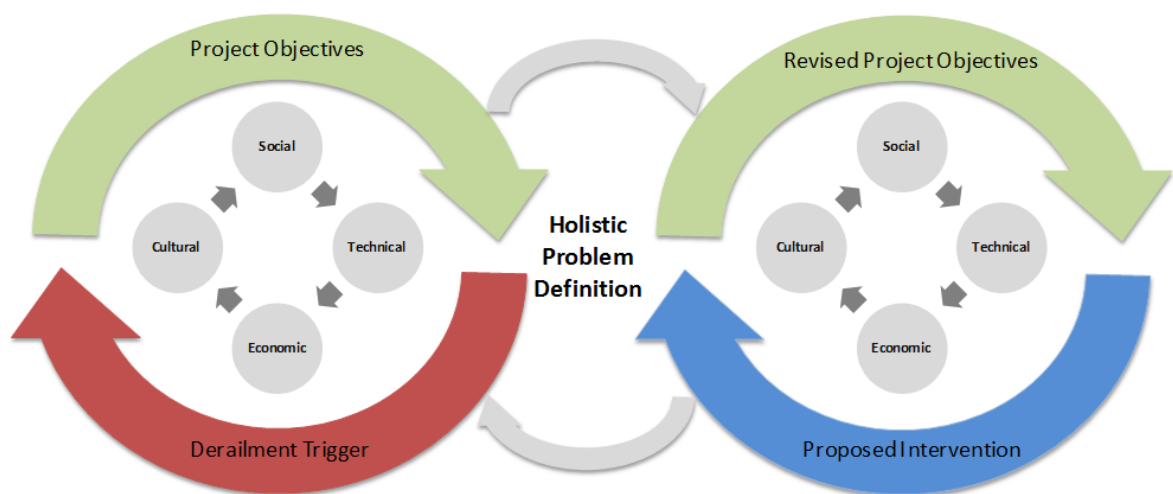
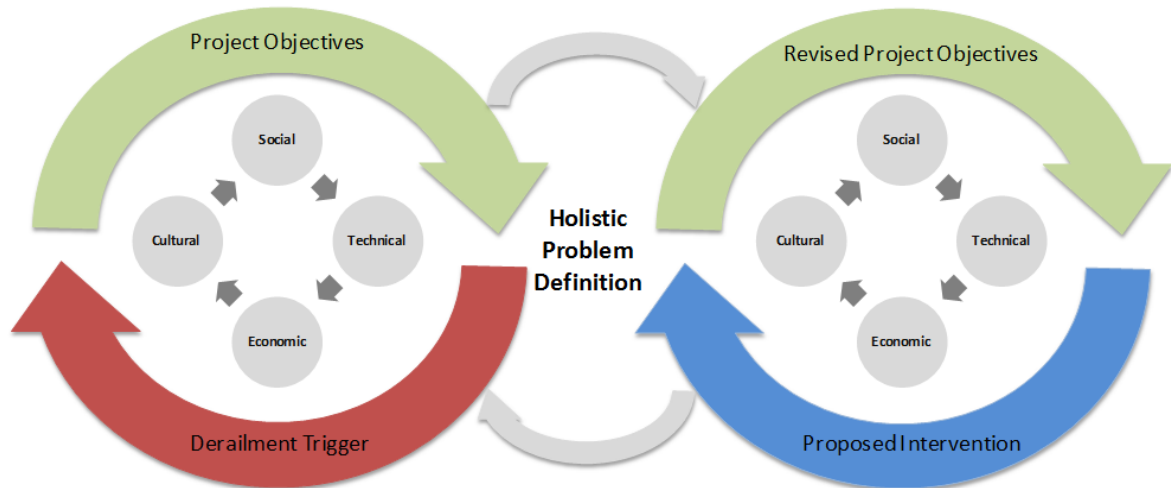




Figure 52 illustrates the final iteration of the framework. Changes included clearer direction of the how the framework phases connected to each other, as well how the continued feedback loop work while in the problem or solution space.



**Figure 52: Intervention Framework for quality and assurance in Information systems projects**

Changes also included how the social, cultural, technical and economic factors impact one another. Problem definition in the framework is a continuous process as the understanding of these issues affects how the project grows and influences the proposed solution.

A list of factors and issues, influencing information technology projects have been presented in various sections of this thesis. Survey participants' feedback indicates that consolidating those factors and presenting them with the framework would improve it and encourage its usage, since it would require less time spent on investigating issues and be more directed toward addressing issues. This list and description of possible factors is presented in Table 33. The list in Table 33 summarises and consolidates the list of common factors identified in the research and not an exhaustive list of factors. It is included to provide guidance and starting point to commence the intervention process.

**Table 33: Social, Cultural, Technical and Economic Factors**

Factor	Description
Project Objectives	Overall project objectives and its relation to the organisation.
Project Status	The current state of the project.

Factor	Description
Organisation Structure/ Decision Making Hierarchy	Patterns of organisation, lines of authority, formal relationships and channels of communication among members of the project team or organisation.
Leadership	Organisational and project leadership and their distance and visibility to project staff.
Planning	How projects are planned and whether the plan reflect reality or only represent the desires of management. Forcing people to ignore undeniable uncertainty injects mistrust and undermine the validity of the planning process.
Management Style	Identifying the style of management within the organisation and project.
Relationships	Relationships between managers and subordinates
Communication	Level and type of communication within the project
Culture	Overall organisation and project culture
People	The nature and skills of the people undertaking series of tasks to achieve set of objectives.
Policies and Procedures	The project set of documents that describe how the project operates.
Politics	Projects and project managers are competing with their colleagues in other areas of the business for control, resources, status and power.
Staff Development	Types of staff development provided by the organisation and project to the staff.
Staff Commitment and Stratification	The level of staff commitment and stratification being part of the project. For example, attrition rate can point issues within the project.
Staff Engagement	Type of staff engagement (Contractors, full time...etc)
Political Pressure	Pressure originating from outside the project and frequently change.
Methodologies	Software and Project Management methodologies.

Factor	Description
Finance	How is the project being financed and what is the main source of the project budget.
Project Budget	The status of the project budget.
Internal/External Constraints	What type of constraints internally and externally facing the project? For example, legislation that must be met?
Technology	The use of computers in solving some specific user problem. In this sense it can serve as a means to an end although information technology can also generate new ends because of its active nature.

## 5.7 Framework Simulation

Information technology project vary in their purpose, size and whether they are green field projects or upgrade existing systems. However, they have one common feature, which is the complex interaction between people working on those projects and the systems they are developing. Simulation is one tool that can be used to effectively and efficiently in simulating such unique interaction. Simulation is useful for the intervention framework case studies, as it would be far too expensive, difficult, and nearly impossible to repeat the cases studies, as the actual projects are temporary organisations and no longer exist, and the individuals who were part of these temporary organisations either no longer work for those organisations or have been deployed to other areas. Using simulation allows the research to apply the intervention framework on those case study settings and provide recommendations on how to address them. Moreover, it provides a valuable mechanism on how to apply the intervention framework to challenged projects.

Simulation also provides an opportunity to gain a deeper knowledge and understanding of certain phenomena. It also provides training to practitioners who may apply the framework in real-world situations without real-world consequences.

### 5.7.1 Federal Government Project

#### 5.7.1.1 Intervention Space

Once the problem definition is established, and all stakeholders are engaged again in the project, scoping the intervention can commence. For the project investigated by this

researcher, the scoping process was straightforward due to the project limited timeframe. The scope of the intervention was identified as the following:

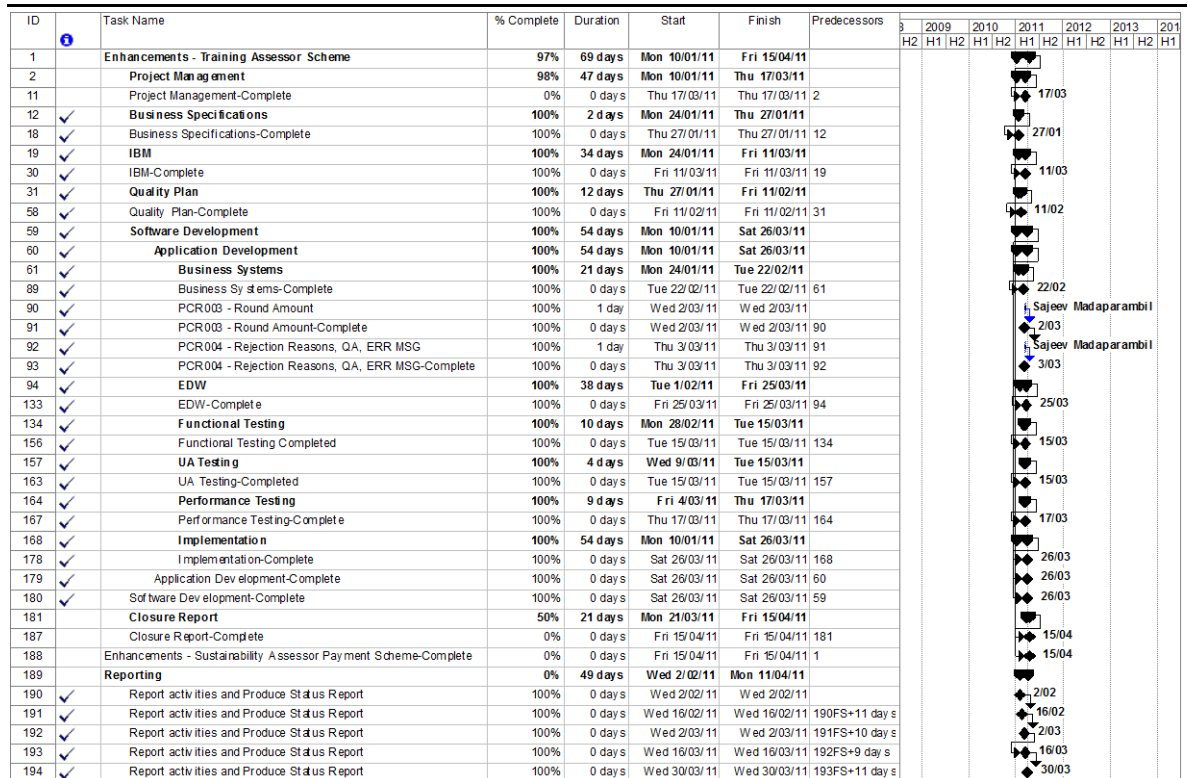
1. Deliver all agreed project objectives within the agreed timeframe with the project sponsor.

While the scope of the intervention was straightforward, the understanding established in regards to the department software development and QA methodologies, would play a critical role in the way the intervention effort was managed within the organisation. As part of the scoping, the knowledge gained about the project team was used to make an informed decision whether to decommission or continue with the project. The project team in general worked together well and at a personal level they had a good healthy interaction that included monthly birthday morning teas, soccer games and other social activities which allowed them to act as one group. At the end of the phase of establishing an understanding, it was clear that a recommendation to abandon the project was not an option. The project team demonstrated that they had the competence, and would deliver the project regardless of the challenges that lay ahead. Senior management would not accept a recommendation to abandon the project and would proceed with the project regardless. It was also clear that using the department software development methodology would not assist the project to achieve its goals, but it would actually work against it. The same applied to the project management methodology which appeared to be only outlined on paper, but not practised in managing projects.

#### **5.7.1.2 Implement and Review Intervention**

In the project engaged to apply the intervention framework, the planning phase incorporated all prior knowledge of the project, its people, objectives and the problems encountered, so as to construct a holistic problem definition. The plan was presented to project stakeholders, and more importantly the project sponsor, with the following schedule outlining the steps required.

## INTERVENTION as Solution



**Figure 53: Final Project Schedule as Delivered Following the Implementation of the Intervention Framework**

1. Use hybrid software development model (RUP and Agile)
2. Build quality in the software development lifecycle upfront.
3. Implement secure coding practices.

The benefits of the above plan were mostly concerned with reducing the stress on the project team responsible for implementing the project. Using hybrid software development methodologies allowed the project team to produce a detailed list of features to be agreed with the project stakeholders at the outset. By agreeing the software features set early in the development stage, the project team was able to commence building the complex features early, while simpler features were planned later in the development cycle. Quality assurance was also engaged in the planning process to understand the project scope and had access to developers and business analysts to discuss features, as well as working with them on the content of the specifications.

By allowing testers to work closely with the team during the development process, the development of the quality assurances plans commenced early in the project. The agile development methodologies proposed the use of daily stand-up meetings. Adopting this approach allowed the project team to discuss and review issues as they were identified,

instead of waiting another week for the weekly project team meeting. It also allowed all team members to affirm their understanding of the software features and allowed team members to discuss potential schedule slips at an early stage. The daily meetings promoted more team interaction and allowed the team to be more coherent as they were able to discuss concerns in front of other team members, instead of behind closed doors.

The division of the software into feature sets, permitted the release over three deployments every two weeks, promoting the building of quality into the application early in the project, allowing defects to be detected and communicated to developers and the business for discussion in the daily project meeting. System stakeholders were integrated in the project team and participated in the daily meetings. They also worked with business analysts and testers to conduct user acceptance testing for every completed set of features of the application. When all features were delivered toward the end of the development cycle, full integration testing took place to ensure all the features functioned as agreed in the project release agreement.

The software implemented a set of security features to protect end users' privacy as required by the department. Secure coding practices were promoted within the development team as the way forward to implementing security in the application as part of every feature agreed with the project stakeholders.

As a result of implementing the intervention framework, the project was delivered three days earlier compared to the original project schedule. More importantly, no overtime was required during the project. The project manager had to present a project change request to the project sponsor to justify the project underspends, and the reasons for returning money to the system owners. The daily project meeting acted as the feedback mechanism for the entire project team to address any issues with the intervention plan.

## **5.7.2 Power Utility Project**

### **5.7.2.1 Intervention Space**

The list of problems that impacted the project had their roots in the power utility as a new organisation lacking the experience and knowledge to manage multiple projects concurrently.

The critical project which consumed most technical, business and management resources, was the SAP implementation of multiple modules, including Human Resources, Enterprise Relationship Management and Finance. The project was envisioned to provide the utility with a modern platform that would be used to manage the organisation internally, but more importantly to manage the relationship with its customers, including billing.

Whilst the management recognised the risk of initiating the separation project at the same time as the SAP implementation, the power utility as a new entity lacked man power, knowledge and management expertise to manage both concurrently. This situation led to the senior management focusing on completing the SAP implementation without addressing the impact on staff ability to engage in the separation project.

The intervention framework sought to address each issue highlighted as a result of the investigation and completed as part of the separate problem definition phase, whilst focusing on achieving the revised project objectives as stated by the project sponsors:

1. Establishing new infrastructure as per the original schedule;
2. Relocating applications from the parent company to power utility newly established infrastructure, including decommissioning any redundant applications;
3. Establishing outsourcing agreements for applications and infrastructure.

The organisation's lack of confidence in the Information Technology department's ability to deliver real outcomes was attributed to the Information Technology inability to produce results as originally announced.

Communication holds the key to increasing the level of confidence between the Information Technology department and the rest of the utility company. First, the IT department is required to share the issues that can be attributed to their inability to adhere to the project milestones. By being transparent with the rest of company, the IT department would have the ability to share and receive feedback from other departments about their reluctance or inability to provide staff to help with the projects that impact their area.

Second, it allows for more personal engagement with other departments' resources in the projects managed by the IT department. It is quite often the case that business expertise such as specialist experts from one part of the organisation are key to the successful implementation of a technology based project. By allowing those resources to be the bridge between the project and their department and allowing the transparent flow of information about the project progress, issues and potential delays within the organisation, it creates willingness in all parties involved to work on those issues and assist in addressing them.

IT project status reports traditionally produced for managers or senior managers, highlighting risks, issues and progress, are rarely distributed to the rest of the organisation or even the staff engaged in the project. Sometimes, that is done to suppress bad news from spreading and in some instances that can be used to direct blame toward a certain section, department or individual. However, when people see the information flowing, they can become more willing to share why they believe something went wrong and what can be done to address it. Rumours and misinformation can have a very negative impact on the way the project is managed, and once they take root within the organisation, it can become very difficult to change the negative image of the project.

Building on that goodwill and information sharing allows the project managers to have two way communications with areas involved or interested in the project, and provide them with the opportunity to address those issues as they arise.

In the case of the Operations department, their request to conduct penetration testing and more rigorous security testing on an application prior to the move to the new infrastructure seemed excessive. The Operations department will have the final responsibility for managing all applications once deployed in the new infrastructure established by the utility. Having a representative from the Operations department involved during the project planning, execution and also in the testing of the application, should assure the Operations department that no further testing would be required. The application could be safely deployed into the production environment, as the Operations department contributed in the testing process of the application and had access to the same level of information provided to senior managers of the utility.



The project suffered from continuous pressure to its schedule. The initial project plan estimated ten months for delivery of the project, whilst in reality it was only six months. Absorbing such a hefty delay to any project could prove beyond the project's capacity unless the project delivery date was extended, more resources added, the project scope reduced or resources working on the project worked more hours.

In the power utility case, reducing the scope of the project was not considered, taking into account that the parent company would no longer host that critical application beyond a certain date. Adding more resources either internally or externally could provide the project with a better chance of delivering in accord with its objectives, but bringing the right skills to the project could have taken weeks to recruit and integrate into the project with consequent delays. The project could have also mandated that all project resources must work a certain number of hours to compensate for the project delays and ensure timely delivery. While such a mandated could have been made, it could cause an adverse reaction and reduce the project's chances of being delivered. Staff may have also chosen to leave the project, notwithstanding the project coming on top of another significant project which required nearly all of company staff to work extra hours, including weekends.

The intervention framework in this case proposed to study how the tasks within the project were performed and that was achieved by directly observing them or studying the outputs of each staff member engaged with the project. The purpose of that process was to find ways to cause the staff to produce the required outcomes with the minimum effort. For example the project required various levels of reporting which required inputs from all the staff within the project; that input would normally be collected in meetings, by e-mails or verbally. All of that can be reduced to one task repeated every week and managed by the project manager to hold one meeting for 30 minutes to collect the information required for the reports.

Co-locating all project staff in one area would reduce the number of e-mails exchanged on a daily basis, and would encourage open discussion and early resolution of issues as they arose.

Project technical documentation can consume significant effort, time and resources to get those documents finalised. Technical resources are not known for their flawless writing skills, but having a technical writer responsible for taking the drafts provided by the

technical resources and converting them into a high quality document would reduce the number of review cycles required and in turn allow for speedy sign off. Engaging the reviewers early in the process of producing the document, articulating the expectations and addressing any concerns by the reviewers while writing the document, meant that the document when officially released for review, attracted minimal reviewer comments, as they had already had early access to document and most if not all of their concerns had been addressed, leading to speedy sign off.

The utility does have some form of Project Management Methodology that has its roots in PRINCE2. The power utility utilisation of this methodology is not uniform and not used across all projects within the organisation portfolio. From an application point of view, the methodology is cumbersome and requires significant effort to be applied to projects in general, in addition to requiring a significant level of documentation. Given the project status, it was deemed wise to cease using the methodology and to adopt a lightweight project management methodology that put more emphasis on delivery and less emphasis on the documentation. This allowed the project staff to focus on delivering work products related to the project's final outcomes.

The utility is a young organisation which did not have the same level of expertise as was available to its previous parent company when it came to dealing with third party vendors.

The power company decided that the Information Technology management was not a core part of its business, therefore negotiated and signed agreements with two vendors to manage the development and support of applications used internally by the utility, with another agreement to manage and maintain the newly developed infrastructure. The agreement provided the utility with the ability to scale resources according to need when the occasion arose. However, scaling resources to fill certain positions within a project (e.g. Separation) did not automatically mean that the person selected for that position had the business knowledge required. The staff member may have had the required technical expertise in dealing with certain applications, but in the power utility case the business knowledge was essential in dealing with such systems. With many outsourcing agreements, an assumption is made regarding the provision of training, with clients leaving that for the vendor to manage. In this context it is worth highlighting that

application knowledge does not always equate with how the application is used within that organisation.

From an intervention perspective, dealing with third party vendors can be a very productive experience for both parties. The main objectives of the intervention are to deliver the project outcomes as agreed with the various stakeholders. Third party vendors have an interest in being able to deliver outcomes to their clients in order to maintain the business relationship and extend it for future engagements.

In this case, the third party vendors were engaged as an integral part of the project team responsible for the delivery of the separation project, including the new infrastructure. By escalating the level of engagement with the third party vendors and ensuring that they were not seen as an external party, but a critical part that would contribute to the success of the project, it provided an incentive to those organisations to contribute to the overall effort required to achieve the project outcomes. In so doing, it would provide them with an opportunity to showcase their delivery capabilities, thus enabling them to secure or extend the existing commercial agreements.

The power utility was also required to ensure that the engagement with third party vendors had provisions for training and knowledge transfer, but more importantly, staff retention. Whilst training and knowledge transfer is essential, staff retention could prove more challenging, but essential for a young organisation such as the utility company. The utility was also required to establish contingency and knowledge retention policies that could be used internally to validate and verify the work products provided by the third party vendors. This can be used as an insurance policy in case the relationship between the utility and the third party vendors did not work as planned, ensuring that the power utility would have sufficient internal staff with an adequate level of knowledge to manage their systems on an on-going basis.

Life consists not in holding good cards but in playing those you hold well

Josh Billings (1818-1885)

## 6 Conclusion and Recommendations

### 6.1 Introduction

This final chapter reviews the contributions of the study; evaluates the quality of the study and its findings; identifies limitations; discusses implications for research and practice; and maps out some future work that would extend the value of the study, before reaching conclusions about the current research.

### 6.2 Contributions

This study has made several distinctive contributions to software development knowledge, as discussed in the following.

#### 6.2.1 Intervention Framework

Most published studies focus on Critical Success Factors (CSF) of projects and while they are valuable, none of them provided a way forward to assist a troubled project to achieve that success. The research identified that social, culture, technical and economic issues implied a project's ability to address planned objectives. Hence, an important contribution of this dissertation, and basis for the case studies examined, is the development and simulation of an intervention framework that can be applied to challenged information technology projects with the aim of guiding those projects out of their challenging circumstances and providing a way forward to address their stated objectives. While intervention is not a new approach, being widely used in the area of health care and health prevention, it is new to the area of information technology and under-represented in the literature review. The framework simulation of two case studies provided a reference guide about how to apply the framework to a challenged project for future validation and investigation. In using the simulation to apply the framework on actual case studies, provided valuable insights into how the framework can be applied and consequently change the outcomes of the projects facing challenges to achieve their outcomes. Survey was used to get feedback from experts working in information technology projects, which helped to extend the framework and improve it based on the feedback received.

### **6.2.2 Detailed Exposition of at Risk Information Technology Projects**

Yin (1989) observed that a full and rich description of a rare phenomenon contributes to knowledge. The phenomenon studied in this research is not rare, but it is a common part of information technology projects that is deserving of an explanation that is not readily forthcoming, as well as the analysis of the problem using socio-technical perspective in information technology projects and the richness that has not been attempted before, to better understand this phenomenon that is usually 'accepted' as part of life in project.. The description provided by multi-cases of information technology projects being challenged to deliver their outcomes is detailed and rich, and provides analysis from social, cultural, technical and economic perspectives.

It is envisaged that researchers would find the detailed description of the case studies and the issues faced by the projects detailed in Chapter 4, an illuminating example of the practice and would prove most useful when applying the proposed intervention framework to projects facing similar challenges.

### **6.2.3 Usefulness of Case-Study Approach in IT Projects Research**

Case studies are considered useful in IT related research (Cavaye 1996) where they can be used to "achieve various research aims: to provide a description of phenomena, develop theory, and test theory" (Darke, Shanks, and Broadbent 1998, 275). They are also seen as being particularly useful for taking an existing poorly understood area with some untested and somewhat simplistic theoretical explanation, and improve that theory (Babbie 2010). It was realised in the literature review, that it is very much the case of information technology projects being challenged in their ability to deliver their outcomes, despite adopting a variety of project management methodologies and software development life cycles.

The use of the case study methodology in this study enabled the researcher to gather rich data from the research participants and develop a thorough understanding of the complex nature of information technology projects and the environments in which they operate. The development of such a level of understanding allowed the researcher to uncover various issues, which influenced projects and their place within the project context and how they impeded the project's ability to deliver their outcomes. The researcher

considered that the use of the case study was instrumental in gaining the level and depth of understanding that was obtained and it is unlikely that such understanding would have been obtained by other research approaches.

This study demonstrated the usefulness of the case study approach in research of challenged information technology projects, as well as IT management more generally, by showing the level of understating that can be achieved through the use of this approach.

The study also contributed to the body of knowledge in terms of the guidance provided about how to undertake a case study of challenged information technology projects, with considerable practical directions on how to select the case, engage and recruit participants, and identify and collect data relevant to the issue faced by the project which might impede its ability to deliver its outcomes. This study demonstrates the usefulness of the Qualitative Data Analysis method in the investigation of Information Technology project management practices. The method was similar to that described by Boyatzis (1998), but involved some adaptation to the form of the data being collected from each case study in the research. The description of the method used, and the explanation about how the case studies were constructed and analysed would be of interest to those researchers undertaking qualitative studies investigating information technology project management practices.

#### **6.2.4 Improved Understanding of the Non-technical Issues in IT Projects**

The study sought to better understand non-technical issues in information technology projects which have an impact on the projects' ability to deliver their outcomes in the context of varied sizes of projects.

The findings go some way to close the gap in the understanding of non-technical issues in projects and provide an intervention framework to address those issues. It also advances knowledge in that area and should be of interest of all researchers seeking to better understand how non-technical issues can have a devastating impact on information technology projects. It is also thought that these findings and framework will be of interest to researchers investigating the use of project management and software development methodologies.

## **6.3 Evaluation**

In the evaluation of how 'good' are the findings from this study, Miles and Huberman (1994) suggest five criteria for evaluating the threats to the validity (that is, the quality or 'goodness') of conclusions drawn from qualitative research. The study is assessed against these quality standards in the following.

### **6.3.1 Objectivity/Confirmability**

This standard relates to whether the study could be objectively replicated by others or whether the conclusions depend on the researcher. As described in the research methodology chapter, the study was explicitly designed using methods to be objective and confirmable. Development of the initial research framework was effected from the literature, and the execution of the multi-case studies used established research methods that employed data collection, analysis and synthesis techniques, that facilitated high visibility and traceability of process, data and conclusions.

### **6.3.2 Reliability/Dependability/Auditability**

This standard relates to "whether the process of the study was consistent, reasonably stable over time and across researcher and methods" (Miles and Huberman 1994, 348). Several procedures were systematically followed to maintain consistency in the study. The aims of the study were clearly defined. The literature was widely scanned using a literature review protocol to ensure data was collected across the full range of relevant publications.

A case study protocol detailing the procedures to be followed in the research was developed. Experienced researchers examined the protocol and monitored the development of the case studies from inception to conclusion. Data were collected, interviews were recorded, documentary evidence collected and validated for accuracy by informants. All data was stored, analysed to ensure consistency of handling and enabled for independent verification. A high level of consistency was found in results across the cases studies presented in this research, providing confidence in the reliability of the findings. Variations could be explained by case-specific factors.

### **6.3.3 Internal Validity/Creditability/Authenticity**



This standard relates to whether the findings make sense, are credible, provide an authentic picture of the phenomena and are internally coherent (Miles and Huberman 1994). A key factor supporting authenticity and credibility of findings in this study was the triangulation of data, both of data types and sources within data types, while taking note of the different environments in which projects operated.

So, while interview data was the primary type of data collected, data of other types was also collected specifically, observation, documentation and artefacts. Furthermore, within each type, such as the interview, data was collected from multiple sources, each with their own point of view including senior management, program manager, project managers, developers, business analysts, test managers and test analysts. This ensured that any bias from an individual source would be highlighted by conflicting evidence from another source, enabling the inconsistency to be examined and resolved.

Another key factor supporting authenticity and credibility of the findings was that the literature was substantially derived from practice rather than from pure theory or being dominated by industry experience reports. Also, the findings were consistent across the case studies presented in the research or augmented with new findings supporting the study proposition. This indicates a high level of congruence and expansion of findings in a manner consistent with the original proposition. These findings were not only internally consistent, they also made sense, and when the framework was applied to some of the case studies, the final outcomes were also consistent.

#### **6.3.4 External Validity/Transferability/Fittingness**

The standard relates to whether the study's findings are transferable to, or might fit, other contexts, and how far they can be generalised. The study findings based on multi-case studies and the framework presented, build on well-established models and enhance the possibility of generalising the findings and the applications of the framework to information technology projects in domains which were not part of the study. However, information technology projects have many forms based on their contextual and environmental factors (e.g., size, budget, organisation, culture, technology, methodology) and the issues which led to the project being challenged and put at risk of failing to achieve its outcomes, all of which may influence the behaviour of the project (Sarker 2009). As a result, it is difficult to generalise the study findings to other information

technology projects. This also supported by Schofield (2000) who claims broad generalisability should not be the goal of qualitative research, further substantiated by Potts (1993) who suggests that searching for completely generic findings via case studies is illusory. As a result, the study makes no claim to generalise its findings to other settings. The only claim the study makes which is underpinned by the study objectives is to generalise from the empirical description in the cases to the theoretical statements found in the literature, as represented by the framework: this is called a type ET generalisation according to (Lee and Baskerville 2003).

### **6.3.5 Utilization/Application/Action Orientation**

Finally, this standard relates to 'pragmatic validity', that is, whether the findings are useful or actionable in research and practice. It has been argued above that the developed intervention framework to address issues in challenged information technology projects has utility to both research, as a set of theoretical propositions that can be carried forward for future research and validation, and practice, which can be applied by change management practitioners in projects at risk of not delivering their stated outcomes. In section 6.5 below, it will be further argued that the findings have implications for research and practice, and application in future research. However, one qualification of this utility is necessary. The findings suggest that the framework can be applied to information technology projects to suit the specific circumstances of that project. This study used simulation to apply the framework and has not attempted to examine or define the dominant drivers that might shape how it might be adopted in practice.

Taken together, evaluation against these five standards provides a high level of confidence in the quality of the study and its conclusions.

## **6.4 Limitations**

Without detracting from the contributions and quality of the study, discussed in the previous sections, this research has some limitations. The results of this study must be considered in light of number of limitations which include: the weakness inherent in the reliance on a small number of case studies presented in the research; the possibility that the participants are non-representative; the possibility of researcher effects; and the reliance on varied communications including verbal and informal meetings with some of the research participants.

### **6.4.1 Challenges Generalising**

In the experimental methodology, this second way of generalising has been referred to as “external validity” (e.g., Cook & Campbell, 1979), and has a parallel in qualitative research.

The parallel occurs on those occasions when a particular part, or all, of a qualitative research study is the subject of attempted replication. For instance, within a single qualitative research study, a potential occasion for such replication might be the conduct of a multiple-case study, where two or more cases are selected because they are believed to be similar (Yin 2009). The more similar the findings from the cases, the more a replication might be claimed. However, the opportunity to replicate only may exist when doing a multiple-case study, which is an infrequent design in qualitative research. The more frequent modes of doing qualitative research will not present the same opportunity. For this reason, this second type of generalisation is probably a less desirable way of seeking a conclusion from a qualitative study (Yin 2011b).

While it is not the intention of this study to provide generalisable results in the conventional ‘quantitative’ sense, it was an objective to provide an intervention framework that would be useful to those interested in information technology projects at risk of failing or being challenged to deliver their desired outcomes. Findings that had some application in practice to the broader context were also expected. To meet this objective, it was important that the organisations selected for the case studies be actively implementing information technology projects at various stages of their life cycles, representing the widest possible spectrum of organisations in the society, as well as having various degrees of maturity in the way they manage information technology, as well as different engagement models, including the reliance on internal resources, external resources, outsourcing or offshoring.

### **6.4.2 Single or Multi Case Studies**

The single case study approach is criticised because it offers no possibility of replication of findings (Yin 2002). Hartley (1994, 208) claims that “detailed knowledge of the organization and especially the knowledge about the processes underlying the behaviour and its context can help to specify the conditions under which behaviour can be expected

to occur". Simply means that generalisation should be focused on the theory and not on the sample size.

Generalisability "is normally based on the assumption that this theory may be useful in making sense of similar persons or situations" (Maxwell 1992, 279). Generalisability could be improved by employing a multi-case study approach, which can be used to replicate the results of the case study.

Given the choice of multi-case study as the research methodology (Chapter 3), the generalisability condition is partially supported in this study. Through the discussions and observation made in those case studies, I have demonstrated the need to balance between the need for deep, rich engagement with the subjects of those cases and mapping the issues faced by the projects over time and the similarity of the issues faced by the case studies selected for the research. In doing so, I purposely provided a rich, picture like look at each case selected for the research, allowing the reader to make judgements about the issues faced by the projects and built the case for the framework introduced later in the study. The number of case studies selected for this research are informative but not necessarily indicative or representative of the information technology industry. More case studies are needed to provide cumulative insights into project issues and intervention practices to mitigate the challenges by considering a range of projects settings. Also, other research methods such as a field survey could be employed to gain insight into more projects, however, the richness of the issues and the contact with project participants may impact the research findings.

### **6.4.3 Non-representativeness**

Non-representativeness was seen as a potential problem in the recruitment of the project managers and project team leaders because of the possibility that recruits may come from one or more departments within each organisation that would have extreme views about the projects or how information technology is managed within the organisation. It was thought that the engagement strategy with the project may lead to biased groups of participants. Various controls were put in place to manage for this potential problem (Research Method section) and it is believed that the limitations that a biased sample would impose on the study's findings were minimised.

While these aspects of the study are considered to have been adequately addressed it cannot be ruled out that either the cases or the participants involved are not within what would be considered normal bounds and hence the results applicable to a typical organisation, thus reducing the usefulness of the findings.

#### **6.4.4 Researcher Effects**

Researcher effects must also be considered as placing limitations on the findings. These effects arise because the researcher is considered an 'outsider' by the case studies participants (Miles and Huberman 1994). The effects come about because the researcher disrupts the social and institutional relationships and the participants are uncertain as to what role the researcher is play and may "craft their responses to be amenable to the research and to protect their self-interest" (Miles and Huberman 1994, 265). Given the sensitive nature of the research topic and the human propensity not to discuss failure or mistakes openly, there is a reluctance to participate in the case studies and be as forthcoming in responses as might otherwise be the case, especially during the formal interviews or where the researcher attended official project meetings. However, none of that existed when the researcher and participants had informal discussions or communicated using electronic mail.

The effects may also occur when the researcher becomes too involved in the case.

Miles and Huberman (1994) refer to such behaviour as "going native", and in this case the researcher may side with one particular group within the case study. Given the aims of the researcher and the project as whole, it was necessary to gather the comments and opinions of participants across a wide range of roles; this effect was thought to be less of a concern to the overall quality of the data collected from each case study.

A number of controls as suggested by Miles and Huberman (1994) were put into place to assist in minimising these effects, including:

- The researcher's intentions about what was being studied and why it was being studied, were made very clear to every participant in the study. An engagement agreement was signed with each organisation prior to the researcher being allowed access to the projects.

- The inclusion of a less formal data collection approach (information meetings and discussions) and attendance at project meetings was designed to develop a greater rapport with participants and overcome any reluctance to participate ; and
- The overall approach taken to data collection was deliberately designed to gather a wide variety of data from sources and situations and hence allow triangulation of the data collected.

While it is believed that these mechanisms worked well and the response from the research participants in some instances exceeded the researcher's expectations and the data collected reflected the real nature of the cases and the organisations they represented, the possibility of the researcher effects clouding the findings of the study cannot be ruled out and hence should be kept in mind when making use of the findings and applying the framework in organisations with projects at risk.

#### **6.4.5 Framework Remains Empirically Unvalidated**

In addition to these limitations it is also acknowledged that the framework was not validated in any of the case studies investigated as part of the research and used to construct the framework itself; it was only simulated to validate its mechanics and how it could be applied. The final point was that the proposed intervention framework is a theoretical contribution that needs to be validated in practice. While the simulation provided initial validation of the framework application and how it could be implemented in an information technology project at risk of failing, the framework requires validation in practice that did not form part of this study, as it can be very time consuming and the project studies as part of this research no longer exist. The framework proposed requires preferably independent, validation in organisations with information technology projects at risk of failing.

While Simulation used to identify how the framework could be used on two case studies. Survey was used to get feedback from experts working in information technology projects, which helped to extend the framework and address the feedback received.

### **6.5 Implications**

The study has implications for research and project management of projects in practice. First, an implication for both research and practice is that when viewing project management and software development methodologies in isolation from the social, cultural, economic and technical perspective of the projects, leads to projects at risk and failure to deliver their promised outcomes. Imposing such methodologies without understanding and addressing the issues within the projects mostly lead to unintended consequences and in many instances it was cause for derailment. Today, there are too many competing methodologies, each promising that project outcomes will be addressed and delivered, many with attempts to address technical issues that actually have minimal impact on the project, but most leave the human factor responsible for delivering the project, out of the methodology. PRINCE2 defined projects as: “A management environment that is created for the purpose of delivering one or more business products according to a specified Business Case” (Commerce 2002, 7). The researcher proposed a new definition: “The craft of management people, with the purpose of delivering number of agreed products, using set of tools”. The definition puts more emphasis on the human elements that are responsible for delivering the outcomes of the project, assisted by a set of tools, methodologies, processes, procedures or framework. The researcher believed, supported by the case studies presented in this study, that whilst project management and software development mythologies are an essential element in delivering successful projects, the human factors remain above all, the most critical element, and without managing that element successfully, projects will continue to fail and struggle to deliver their desired outcomes.

Other implications for research and practices are discussed separately in the following subsections:

### **6.5.1 Implications for Research**

An important implication of the study for research is that it extends and presents a new approach for understanding issues in challenged information technology projects. The framework is built upon the Model of Technology and Social Change by Kowalski (1994). The framework presented in this study borrows from the well-established concept of intervention in the healthcare field, which is widely used for preventative healthcare and it refers to procedures and processes taken to prevent diseases before they occur rather

than curing them after they take hold. The intervention concept is new to the field of study undertaken in this research and it may contradict existing well-established knowledge that the use of project management and software development methodologies does help in delivering successful projects. On the contrary, there is little evidence in the literature to support the use of methodologies such as PRINCE2 or PMBOK to assist in delivering successful information technology projects.

At a higher level of thinking, another implication for research is that the study reinforces Theory W (Boehm 1989) and the need to establish win-win situations in projects for all players in order to establish the environment that would allow the achievement of desired outcomes. The study supports prior research findings in the number of established critical success factors required for successful projects in the information technology field. It also reveals an implicit premise that projects will continue to fail, failure itself should be more carefully studied, with intention to influence project outcomes from failure to a degree of success. The intervention framework presented will need to be validated and improved in actual projects.

### **6.5.2 Implications for Practice**

Most fundamentally, the case studies described in Chapter 4 and the conclusion in section 4.6, as well the intervention framework presented in Chapter 5, have great utility for information business managers, IT managers, and project managers facing challenges in their projects, and their overall ability to deliver the project objectives. The simulation of the framework presented in Chapter 5, sections 5.4 and 5.5, would be useful to practitioners when applying the framework to their projects which details how to engage with the project participants and how to establish holistic problem definition for issues encountered in the project. For example, the intervention framework supports the use of a hybrid set of project management and software development methodologies in cases where the project faces time pressures, while in other situations it can be used to recommend the continued use of the de-facto methodology with a series of changes to suit the project circumstances. Furthermore, if geographical distance is an issue for the project, then a strong, preferably integrated, set of communications tools would be required to address that communication gap in the project and would ultimately assist in addressing that shortcoming. The intervention framework provides a solid response for the majority



of the issues faced by information technology projects today, including social, cultural, economics and technical issues that were shown to be behind the majority of challenges that affected the project's ability to address their outcomes. Furthermore, the introduction of the intervention framework provided the practice with a different perspective on how to deal with challenges not prescribed in their adopted methodology and used to manage a project or software development. It also can be used to inform the practice that failure is not always related to technical issues beyond the organisation boundaries, but that failure can originate from within the organisation's social and culture systems and without addressing such issues, delivering successful projects may remain a challenge for them.

## **6.6 Future Research**

Opportunities exist to extend the study in further research. First and most obviously, since the intervention framework was only simulated in two case studies, there is an opportunity for the framework to be validated in actual project cases facing challenges to deliver their project-desired outcomes. Most effectively, the validation would follow a similar research method to that applied in the current case studies. This would provide the opportunity to confirm the framework in practice and fill any missing gaps in knowledge as result of the initial simulation completed as part of this study. Statistical research on a bigger sample of information technology projects to produce statistical generalizable results. That would complete the proposed framework and inform further research and practice.

Related refinement and extension of the intervention framework would benefit from further, independent case study based investigation. Then progressively beyond that, as the intervention approach and the framework becomes accepted into the body of the established knowledge, validation using other methods, including quantitative methods such as field surveys, would further confirm and refine the framework as a base of theory on the application of intervention in project management.

There is a need to further investigate other related aspect of the phenomenon variously noted in this study, including but not limited to: the role of the project manager and what sort of qualities required to fill such job; emotional intelligence in project management and its impact on project outcomes; the value of project management and software

development methodologies in projects; and the measurement of the ratio of successful projects delivered whilst adhering to such methodologies.

Finally, the opportunity exists to increase the rate of success in projects in the information technology domain by moving the emphasis from technical issues to social, and cultural issues that have far more reaching impact on the overall reputation of the IT discipline and its value to organisations. There is need to systematically examine the adaptation of project management and software development methodologies and better understand whether such adaptations have an impact on the ability of organisations to deliver successful projects. Such research might include comparative case studies of projects with similar characteristics, implemented in organisations or departments with one adopting generic methodologies and the other one modified to suit the organisation's own culture.

## **6.7 Conclusion**

IT projects have traditionally been accepted to fail. Powerful methodologies have been developed, enjoying wide spread use, to help guide the management of projects, yet they seem to have had negligible impact on preventing failure. It is possible, however, to treat a project like a patient with failing health, whereby an intervention, much as a doctor's intervention, can imbue a project with new health and vitalisation. The use of an intervention strategy will allow project managers to arrest the slide of a project to failure and deliver more successful projects.

This dissertation reports a case study based research that has aimed to contribute knowledge and understanding of the reasons behind information technology projects' failures and produced an intervention framework that would address such challenges. The findings of the case studies supported emergent views that the social-cultural aspects of project management need to be addressed in order to increase the chances of projects' success. Thus, it has provided some support for the industry experience-based views in the literature but also points to areas where future researcher is needed. A key finding and contribution of the study is the intervention framework that can be used to address social, cultural, economic and technical challenges in information technology projects and increase their opportunity of delivering their desired outcomes.

# Appendix A Framework Survey

1. Years of experience in IT/IS and project management

- ☐ 0 - 1 Years
- ☐ 1 - 3 Years
- ☐ 3 - 5 Years
- ☐ 5 - 10 Years
- ☐ 10 - 15 Years
- ☐ > 15 Years

2. Number of projects you have worked on

- ☐ 1 – 5 Projects
- ☐ 5 – 10 Projects
- ☐ 10 - 15 Project
- ☐ 15+ Projects

3. Number of projects that faced major difficulties (time, cost, expertise, scope, meeting objectives)

- ☐ 1 – 5 Projects
- ☐ 5 – 10 Projects
- ☐ 10 - 15 Project
- ☐ All

4. Which of the following best describes your highest qualifications

- ☐ Diploma
- ☐ Bachelor degree
- ☐ Master Degree
- ☐ Doctorate
- ☐ Industry Certification
- ☐ None of the above – Please Specify

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5. The intervention framework is adequate in achieving its 'objectives' particularly in addressing issues that contribute to the derailment of IT projects.

The framework objective is to assist practitioners in developing and implementing intervention strategies in 'at risk' projects. This is achieved as the framework:

1. Serves as a way of understanding of problems facing project delivery
2. Presents a new approach to guide users who wish to address issues hindering project delivery.

- ☐ Strongly Agree

- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree
- ☐ Comment

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6. The ability of the organization to provide a supportive environment conducive to the implementation of the intervention framework is of vital importance.  
This is dependent on capability to manage the people, processes, stakeholder engagement, project characteristics.

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree
- ☐ Comment

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7. If I were to implement the intervention framework I am confident that it would be successful in achieving its objectives.  
The framework objective is to assist practitioners in developing and implementing intervention strategies in 'at risk' projects. This is achieved as the framework:

1. Serves as a way of understanding of problems facing project delivery
2. Presents a new approach to guide users who wish to address issues hindering project delivery.

- ☐ Strongly Agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly Disagree
- ☐ Comment

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8. What are the weaknesses in the framework?

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9. What are the strengths of the framework?

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10. What changes would you recommend to the framework?

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# Appendix B Glossary of Terms

The following glossary terms have been collated and adapted from Jayaratna (1994), Westland (2006) and Systems (2010).

**Business case:** a document outlining the justification for initiation of a project. It includes a description of the business problem or opportunity, a list of the available solution options, their associated costs and benefits and a preferred solution for approval.

**Customer:** anyone who is affected by the product or by the process used to produce the product, Customers may be external or internal.

**Customer dissatisfaction:** a state of affairs in which deficiencies (in goods or services) result in customer annoyance, complaints, claims, and so on.

**Customer satisfaction:** a state of affairs in which customers feel that their expectations have been met by the product features.

**Deficiency:** any fault (defect or error) that impairs a product's fitness for use. Deficiencies take such forms as office errors, factory scrap, power outages, failures to meet delivery dates, and inoperable goods.

**Deliverable:** a quantifiable outcome of a project which results in the partial or full achievement of the project objectives.

**Dependency:** a logical relationship between two or more project activities. The four types of dependencies are: start-to-finish, start-to-start, finish-to-start, finish-to-finish.

**Framework:** a meta-level model (a higher level abstraction) through which a range of concepts, models, techniques, methodologies can either be clarified and / or integrated. A framework is a static model.

**Information systems (Discipline):** a discipline including subject knowledge and skills that are considered essential for understanding and on that basis improving or changing information systems functions and through them the context (organisation).

**Information systems (Functions):** within an organisational context, refers to a formally organised set of activities that gathers, processes, stores and delivers useful information to organisational members. It has four other functions. Collectively it performs five

information functions, namely processing and usability, educating and learning, systems development, management and control and strategy.

**Information systems development:** is an information function that is responsible for identifying, analysing, designing and implementing new information systems that are required for organisation survival and growth.

**Information technology:** refers to the use of computers in solving some specific user problem. In this sense it can serve as a means to an end although information technology can also generate new ends because of its active nature.

**Issue management:** the process by which issues are formally identified, communicated, monitored and resolved.

**Issue:** events that are currently affecting the ability of a project to produce the required deliverables.

**Knowledge:** is gained from understanding. It helps us to understand the context in which information can become meaningful.

**Methodology:** is an explicit way of structuring one's thinking and actions. Methodologies contain model(s) and reflect particular perspectives of 'reality' based on a set of philosophical paradigms. A methodology should tell us what steps to take, in what order and how to perform those steps but, most importantly, the reasons 'why' those steps should be taken, in that particular order.

**Milestone:** the recognition of an important event within a project, usually the achievement of a key project deliverable.

**Model:** is a complete and coherent set of concepts which can underpin our understanding and actions. If we can externalise it then it gives us a chance to examine, understand and analyse their relevance and completeness. They also help us to design abstract or physical things.

**Network:** information system(s) implemented with a collection of interconnected components. Such components may include routers, hubs, cabling, telecommunications controllers, key distribution centres, and technical control devices.

**Problem:** is a mismatch between the perceived 'current state' of a situation and the perceived 'desired state' for that situation.

**Product:** a good or service that is acquired from an external supplier to assist with the production of a project deliverable.

**Product:** the output of any process. To many economists, products include both goods and services. However, in popular usage, 'product' often means goods only.

**Product feature:** a property possessed by goods or services that is intended to meet customer needs.

**Project:** A unique endeavour to produce a set of deliverables within clearly specified time, cost and quality constraints.

**Project activity:** a set of tasks which usually result in the partial, or full, completion of a project deliverable.

**Project life cycle:** a series of phases which are undertaken to deliver a required project outcome.

**Project management:** the skills, tools and management processes required to successfully undertake a project.

**Project phase:** a set of project activities and tasks which usually result in the completion of a project deliverable.

**Project plan:** a document that lists the phases, activities, tasks, timeframes and resources required to complete a project.

**Project schedule:** a series of planned dates within which activities and tasks must be completed to achieve project milestones.

**Project task:** a specific work item to be undertaken which usually results in the partial completion of a project deliverable.

**Project team:** a group of people who report to a project manager for the purpose of delivering a project.

**Quality:** the extent to which the final deliverable conforms to the customer requirements.

**Quality assurance:** the preventative steps taken to eliminate any variances in the quality of deliverables produced from the quality targets set.

**Quality control:** the curative steps taken to eliminate any variances in the quality of deliverables produced from the quality targets set.

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**Quality management:** the process by which the quality of the deliverables and management processes is assured and controlled for a project, using quality assurance and quality control techniques.

**Quality planning:** the process of identifying the approach to be taken to ensure and control the quality of the deliverables and management processes within a project.

**Risk:** a measure of the extent to which an entity is threatened by a potential circumstance or event, and typically a function of: 1) the adverse impacts that would arise if the circumstance or event occurs; and 2) the likelihood of occurrence.

**Risk management:** the process, within which risks are formally identified, quantified and managed during a project.

**Risk mitigation:** a set of actions to be taken to avoid, transfer or mitigate risks, based on their priority. This includes the preventive actions to be taken during the project to reduce the likelihood of the risk occurring as well as the contingent actions to be taken to reduce the impact on the project should the risk occur.

**Risk planning:** The process of identifying the approach to be taken to mitigate risks within a project.

**Scope:** the total aggregation of deliverables produced by a project.

**Security policy:** a set of criteria for the provision of security services.

**Security requirements:** requirements levied on an information system that are derived from applicable laws, Executive Orders, directives, policies, standards, instructions, regulations, or procedures, or organisational mission/business case needs to ensure the confidentiality, integrity, and availability of the information being processed, stored, or transmitted.

**Skills:** are our ability to apply knowledge in practice. Skills reflect competence in the use of knowledge. These can be gained from continuing training and experience.

**Software:** computer programs and associated data that may be dynamically written or modified during execution.

**Software assurance:** level of confidence that software is free from vulnerabilities, either intentionally designed into the software or accidentally inserted at any time during its lifecycle, and that the software functions in the intended manner.

**Software engineering:** is a series of steps undertaken to develop software to match the quality and needs of software specifications.

**Solution:** a set of deliverables which once combined, solve a particular business problem or realize a particular business opportunity.

**Stage:** consists of a set of activities.

**Step:** refers to sets of activities that are performed by a methodology. The order in which to undertake a series of steps shows the methodological structure.

**Subject:** an active entity (generally an individual, process, or device) that causes information to flow among objects or changes the system state.

**Systems:** are powerful concepts which focus the mind of an observer or a problem solver on the integrative aspects of parts. Collectively the parts display emergent properties which are not found in the parts. Ontological use of this term makes the observer accept the boundary of a system without question. Epistemological use of the term makes the observer exercise a choice of where to draw the boundary and name that enclosure as a 'system'.

**System development lifecycle:** outlines the steps which give rise to the birth (creation) of an 'action system' and terminates when it begins to perform.

**System integrity:** attribute of an information system when it performs its intended function in an unimpaired manner, free from deliberate or inadvertent unauthorized manipulation of the system.

**System life cycle:** comes into being only when a 'system' that is developed by the systems development cycle becomes operational. It includes activity sets which enhance and help to adapt this 'systems' to change in the environment.

**Threat:** any circumstance or event with the potential to adversely impact organisational operations (including mission, functions, image, or reputation), organisational assets, individuals, other organisations, or the Nation through an information system via

unauthorized access, destruction, disclosure, modification of information, and/or denial of service.

**Threat assessment:** process of formally evaluating the degree of threat to an information system or enterprise and describing the nature of the threat.

**Validation:** confirmation (through the provision of strong, sound, objective evidence) that requirements for a specific intended use or application have been fulfilled (e.g., a trustworthy credential has been presented, or data or information has been formatted in accordance with a defined set of rules, or a specific process has demonstrated that an entity under consideration meets, in all respects, its defined attributes or requirements).

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