UNIVERSITY OF TECHNOLOGY SYDNEY

An Interpretive Framework for Complexity in IT Projects

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CERTIFICATE OF ORIGINAL AUTHORSHIP

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged.

In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Student:

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Date:

DEDICATION

I would like to dedicate this dissertation as a tribute to my father Ansar Basha and my mother Razia Ansar for having encouraged and supported me in my learning and helping me become who I am today.

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My journey to complete this Doctoral Degree has been lengthy and tedious. It was difficult to find time to write as I was working full-time on strategic projects and changing jobs. I am indebted to a number of academics, professional colleagues, and my family, for without their support and guidance this achievement would not have been possible.

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ABSTRACT

So learn that you may full and faultless learning gain,
Then in obedience meet to lessons learnt remain.
- Valluvar (Thirukkural 391)

This research was prompted by the continuous failure rate in IT system implementation projects, in one of the largest telecommunication organisations in Australia where the researcher was working as a program manager. There was a consensus among the project management professionals that the human condition experienced by the role of a project manager has severe social implications. This research study is a response to the concern expressed in the project management community that existing project management methodologies are limited by their unduly normative and mechanistic approach.

Research in project management has confirmed that the conventional project definition is not inclusive of the social dimension and attempts to measure the project's success in simplistic terms, using scope, time and cost as parameters. Failing to recognise the inherent complexity (Murray 2000, p. 34) in IT projects is one of the prime reasons why many projects are considered failures. Recent research directions in project management have shown an urgent need to develop theories from project environment to reflect the complexity of projects. (Cicmil & Hodgson 2006; Cicmil et al. 2006; Kwak & Anbari 2009; So'derlund 2004; Williams 1999 ; Winter, Smith, Morris, et al. 2006).

In recent management publications of repute, the application of complexity theory principles has been widely suggested as an effective way to deal with organisational complexities (Sullivan 2011). Complexity theory has also drawn the attention of scholars and practitioners in the project management community. Emerging trends in project management research point to treating projects as complex adaptive systems (Austin et al. 2002; Harkema 2003; Milosevic 1989;

Pundir, Ganapathy & Sambandam 2007; Whitney & Daniels 2013; Whitty & Maylor 2009) learning and temporary organisations (Lundin & Söderholm 1995; Packendorff 1995; Turner & Müller 2003) and organisational techno-social processes (Small & Walker 2012).

A simple inquiry, namely, 'Can complexity theory principles be used to understand the projects better?' led to this research. Based on the literature review two primary research questions were formed:

1. What are the factors believed to cause complexity in IT projects?
2. How does human interaction engender social complexity in IT projects?

Given the explorative nature of this research, a 'constructionist' research paradigm with participant observer mode was adopted (Guba & Lincoln 1994; Strauss & Corbin 1990a; Strauss 1998). For more than two years, detailed data was collected in a large telecommunication organisation. Qualitative data analysis techniques, such as context analysis and grounded theory principles (coding and memo), were applied to narratives and observations collected in a case project.

In order to answer the research question, 'What are the factors believed to be causing complexity in IT projects?' a practitioner's definition of complexity was elicited through extensive interviews in the telecommunication organisation. The complexity factors in the real environment as experienced and perceived by practitioners were listed, analysed and classified. It became evident that the practitioner's view of complexity differs from a mathematical definition of complexity: the practitioner's is born of their experience. The practitioners mentioned such characteristics as 'uncertainty', 'unprecedented', and 'unexpected' to identify a project situation as 'complex'. However, the demarcation between complicated and complex was not distinguishable in practitioners' perception or understanding of complexity.

The classification followed a typology of complexity factors found in the literature review: technological, structural, directional and temporal (Remington & Pollack 2007a).

The research has revealed that environmental, directional, temporal (time) and social complexities are prevalent; they are experienced mostly in comparison to technical and structural complexity and are contrary to the general belief that IT projects are complex due to technological factors.

It was found that complexity originates in three layers: the product, the project (organisational process) and the social. The research participants believed that not all situations in a project manifest complexity, but a few situations exhibit inherent complexity and it is experienced in spurts. As a result of this analysis, a construct called ‘tipping point’ has been proposed to refer to these atypical project situations in this research. A tipping point is defined as a state where projects experience chaos, conflict, contest and decision-making, and external intervention is required. When I cross-validated this construct with the research participants, they concluded that the number and frequency of tipping points were indicative of the level of complexity the project stakeholders were experiencing.

This research presents the analysis using headings complexity factors, echo of complexity, relationship, action-to-reaction, and emotions. The research has illustrated that, as all types of complexity factors require human interaction, they lead eventually to social complexity.

In order to explore deductively the second research question, ‘How does human interaction engender social complexity in IT projects?’ a framework using a range of lenses has been applied to a case project. These lenses are Context, Connectedness (Cohesion & Coupling) and Adaptive-Reflexive Response.

Giving preference to transformative teleology, a process perspective has been adopted to analyse the social complexity through the proposed lenses. The lens 'context' explored meaning creation, multi-dimensional interpretations and cognitive schemata at individual and organisational level.

The 'connectedness' lens attempted to demonstrate the influence of private networks beyond formal organisational boundaries and interconnectedness in project decision-making. The 'adaptive response' lens traced the dynamic creation of positions through deliberations in project tipping point situations. The 'reflexive response' lens depicted the time-phased reflexivity in project team members' interactions. The application of these lenses to the case project data attempted to unveil the unfolding complexity; it was concluded that these lenses were suitable for comprehending the underlying social complexity in IT projects.

Recently published literature on application of complexity theory frames to projects, concepts of the complex responsive process of power relating (CRPR) (Cicmil et al. 2009; Cooke-Davies et al. 2007; Stacey & Griffin 2005; Stacey 2000a) and in social theories, symbolic interactionism and organisational sense making (Weick 1995) have provided the necessary theoretical foundation to these lenses. Concepts such as Chaos Theory, Strange Attractors and Complex Adaptive Systems have been mapped in general terms to the project data.

This research has contributed to a body of project management knowledge by introducing 'context', 'connectedness' (Cohesion & Coupling) and 'adaptive-reflexive response' lenses as well as the construct 'tipping point' to comprehend underlying complexity in IT projects.

Further research can be carried out in other industries to confirm the complexity factors arrived at in this research. Agent-based models can be built as competing and cooperating (co-opting) mechanisms for complex scenarios in projects.

Explorative research can be carried out to develop other lenses to capture social complexity in projects. Cross-validating the framework across multiple industries can offset the bias associated with this qualitative research.

The framework is useful for the practitioner to understand project complexity, as the stakeholders do experience it in varying stages of a project. The classification of the complexity factors (static) may help the industry to acknowledge project complexity and create a typology of projects for better treatment through fostering a higher form of collaboration.

This thesis presents the results of an investigation to understand the nature of project complexity factors and how social complexity is generated in IT projects because of human interaction.

Papers Published

1. Syed, G. & Sankaran, S. 2009, 'Investigating an interpretive framework to manage complex information technology projects', *Proceedings of the International Research Network on Organizing by Projects,*, Berlin.

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Chapter 1 –Introduction

1 Introduction

> *Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire world, and all there ever will be to know and understand.*
>
> *- Albert Einstein*

In modern day organisation, projects have become primary vehicles (Winter, Andersen, et al. 2006) of delivering a product or service.

The word 'complexity' is invasively appearing in many business magazines (Harvard Business Review) journals (Academy of Management) and copious management literature is pouring in; for example, Stacey's work provoking the business community to comprehend complexity and advising co-opting mechanisms (Stacey 2000b). Complexity has without doubt become a dominating research theme in recent times.

Businesses have become 'complex' and projects are the main vehicles for delivering business strategy, products and services. However, project management methodologies have failed to acknowledge the inherent complexity in delivering projects and have not yet incorporated multiple dimensions of complexity, such as the social dimension (Winter, Smith, Cooke-Davies, et al. 2006).

Prominent project management researchers like Cicmil, Remington, Maylor, Hodgson, Sheffield, Sankaran and Crawford − having noted this gap − have published several articles in international project management journals calling for a complementary paradigm to project management practice.

It is stated that to reflect the real field (projects in organisations) and better manage the projects, project management theories should attempt to develop frameworks from actual projects through the lived experiences of the practitioners (Cicmil & Hodgson 2006).

The telecommunication business is a core enabler of communication (ICT) in our modern day society. In Australia, three telecommunication carriers compete aggressively, promoting products and services for just 25 million people. Xfone is one of these carriers known for its product innovation. Working in Xfone, as a program manager, I was perplexed to note the human condition and emotional states the project sponsor, project manager and solution designers underwent during the project life cycle. Project events were like a play performed in a theatre in which power and politics were enacted in real time.

The project manager's role in Xfone is not for the faint-hearted; they undergo social pressure, ignominy, pain and trauma. When some of them were branded as ineffective, others were celebrated as heroes, emerging unscathed. Conversations with my colleagues revolved around how current project management methodology in this company was short-sighted and the project managers complained that the metrics used to conclude a project as a success and the project manager as effective or ineffective were non-inclusive of the social aspects.

Xfone was undergoing structural changes at the time this research was being carried out; the parent company's invasive culture had caused human resource and legal problems. The Program Management Office (PMO) was applying more and more rigid governance regimes as a control and loss of trust in upper management led to interdivisional conflict. The project failure rate was drastically increasing and the stringent application of process and procedures not only did not improve the success rate, it caused further group conflicts.

I was very concerned that something was wrong in the definition itself of a project. I felt that the emergence and volatile nature of the organisational landscape, including social interactions, should be acknowledged in the project management framework.

Upon reflection of the above-mentioned prompts, I concluded that if business is becoming complex − given that projects are the main vehicles for delivering products and services − it might explain why both academics and practitioners are asking for a framework to comprehend complexity. It should be possible to develop a complementary framework to existing project management methodologies from the experiences of project managers, architects, sponsors and vendor managers.

In 2009, I conducted an extensive literature review to understand complexity theory and its applicability to project management.

1.1 Statement of Research

The purpose of this research is to find out what is meant by complexity in IT projects and what could be a possible definition of project complexity. It was commonly agreed among practitioners that human interaction in project environments generates complexity. If this is the case, how does human interaction generate complexity? From these thoughts and an initial review of the relevant literature, I formed the following research questions:

- What are the factors believed to be causing complexity in IT Projects?
- How does human interaction engender social complexity in IT projects?

Thus, the purpose of this research is to a) define complexity as perceived and believed by the practitioners, b) trace the complexity factors, and c) classify the complexity factors if possible. The research also aimed to d) propose a framework using lenses to trace social complexity in/generated by human interactions.

In order to find answers to these questions, the general principles of complexity theory should first be discussed. Then, a suitable methodology should be defined to collect and analyse data from the project environment. Finally, a philosophical ground should be defined for the framework as a theoretical foundation.

1.2 Overview of Literature Review

The literature review focused on theories of complexity, project complexity, organisational sense making, organisational interaction and actuality of project management. The literature review short-listed a few strands of complexity theory as suitable for this research. These short-listed strands of complexity theories were complex adaptive systems (CAS), theory of social systems (TSS), and complex adaptive responsive process of power relating (CRPR).

A paradigmatic base was developed in terms of treating a project as a system or a social process. Formative and transformative teleological, i.e., causal, frames were selected for the proposed complexity framework. The classification of complexity factors − technological, structural, directional and temporal −, was adopted from the literature.

1.3 Overview of Research Methodology

A qualitative research methodology is more suitable since the framework is being developed out of a practitioner's perception and experience. For me, a researcher working as a project manager (PM) inside the organisation being researched, the constructionist paradigm with participant observer mode was the most relevant paradigm. It provided me with an option to take part in the research observations as an active agent. At a meta level, the constructionist paradigm permits researchers to include their own interpretations.

The data, which was captured in voice recordings and handwritten notes, consists of interview responses, narrations, project records and observations. Analytical techniques such as open coding and axial coding, and context diagrams based on grounded theory were used.

1.4 Overview of Research Design

The research was carried out in three stages:

> Stage 1 had the objective of developing the practitioner's definition of complexity and tracing the complexity factors through preliminary interviews and feedback sessions.
>
> Stage 2 had the objective of mapping the complexity factors to already existing typology and tracing any new types of complexity.
>
> Stage 3 had the objective of developing the lenses through which to trace social complexity in projects from the data analysis of a case project.

1.5 Ethical Issues

As the narrations were personal experiences of people in many organisational layers, the confidentiality and de-identification of people were key concerns from an ethical perspective. The research participants might be emotionally impacted when replaying their experiences. An option was therefore provided to them to exit from the interview if they wanted to at any time.

I obtained consent from the research participants to participate in this research through an invitation letter. The research participants and I signed a non-disclosure agreement.

A codification system was created for the research participants. Data was kept in the researcher's laptop, accessible to the researcher and his supervisor only. Ethics approval was obtained from the Research Ethics office of the University of

Technology, Sydney. The ethics clearance number is UTS HREC REF NO. 2010-193A / June 2010.

1.6 Research Findings Summary

The research found that project practitioners had a general understanding of complexity. The complexity factors expressed by the research participants were recorded and classified into technical, directional, structural and temporal complexity. It was found that the environments in which the projects build the applications (products), integrate with other applications and bring them into operational are complex. Environmental complexity was conceived as a combination of technical and structural complexity. Time pressure also acts as a complexity factor. In Xfone, the project stakeholders did experience complexity mostly because of direction, environments and time pressure.

A construct called ‘tipping point’ was proposed during this research. This is a situation where projects experience conflict and reach an impasse. This research proposed three lenses, Context, Connectedness (Cohesion & Coupling) and Adaptive-Reflexive responses to trace social complexity in tipping point situations. Several abstractions or encapsulations, such as ‘power’ and ‘trust’, were found during the data analysis that could have been used as lenses to capture social complexity in projects. But Context, Connectedness (Cohesion & Coupling) and Adaptive-Reflexive Responses were selected because of their relevance to project environment and philosophical grounding.

The ‘context’ lens explored creation, multidimensional interpretations and cognitive schemata at individual and organisational level. The ‘connectedness’ lens attempted to demonstrate the influence of private networks beyond formal organisational boundaries and interconnectedness. The ‘adaptive response’ lens traced the dynamic creation of positions through deliberations in a project's tipping-point situations. The ‘reflexive response’ lens depicted the time-phased reflexivity in project team members' interactions.

It was evident from the narratives that the project outcomes were achieved through recursive interaction. The research concluded that social complexity arises because of individual self and identity, network group behaviour and power relating. A possible definition of project based on interactional aspects has been attempted. This framework is called complexity framework for projects (CFP) in this research.

1.7 Contribution to Theory

The Directional and Temporal complexity factors were confirmed by this research. Environmental factors and time pressure were two new additions to the classification of complexity. This research has proposed a construct called tipping point and the lenses of context, connectedness (in terms of cohesion and coupling), and adaptive-reflexive response to understand social complexity in projects. The framework is an addition to the existing project management body of knowledge.

1.8 Implications for practice

The framework provides a means to comprehend inherent complexity. It can be used as either a predictive or investigative framework. This research emphasis on human interaction has illustrated that increased collaboration among stakeholders can lead to project success.

1.9 Thesis Map – chapters outline

Chapter 2: presents a summary of literature reviews and identifies gaps

Chapter 3: discusses research design and research settings

Chapter 4: a data analysis chapter that presents the field definition of complexity and traces the complexity factors

Chapter 5: a data analysis chapter that maps the complexity factors to classifications found in literature

Chapter 6: a data analysis chapter that traces the social complexity in a case project

Chapter 7: presents the triangulation of findings

Chapter 8: discusses the findings in detail and presents the relevance of the lenses

Chapter 9: This conclusion chapter summarises the findings.

1.10 Writing Style

The data captured from the field is presented in two voices − the voice of a narrator and the voice of the researcher, myself. In order to distinguish the voices, I have put the code names of the narrators wherever applicable.

A set of headings ‘Complexity Factors’, ‘Echo of complexity’, ‘Relations’, ‘Action to Reaction’, and ‘Emotions’ have been used consistently in data analysis.

1.11 Limitations

Limitations of this research come from the fact that the research was conducted in only one organisation. The bias associated with any qualitative research is also applicable to this research. An attempt to offset the bias was made by cross-validating the findings through a focus group session. The proposed constructs have a certain degree of subjectivity.

1.12 Key Definitions/Terms of References

Complexity, Chaos, Emergence, Edge of chaos, Tipping Point, Information Systems, Information Technology, Interactionism, Constructionism, Convergence, Project Management, Actuality

Key terms used in this research are listed in Glossary.

Chapter 2 Literature Review

2 Literature Review

The more you know, the more you know you don't know.

− *Aristotle*

2.1 Introduction

As a project management practitioner, prompted by the higher rate of IT project failures, intrigued by social perspectives, perplexed by human conditions, personal experiences and observations − and concerned by a general belief that project management methodology does not include social perspectives − I was interested in exploring possible alternate interpretive frameworks for IT projects. From my initial discussions with my colleagues and other academic scholars in 2008, I inferred that understanding the inherent complexity in IT projects may lead to better management of projects and result in a better outcome.

I conducted a literature review in four knowledge areas: a) IT project failures b) critical views on project management methodologies and actuality of projects c) project complexity and d) social theories to identify research gaps and define the research objectives. The first two knowledge areas were explored to gain insights into the prompts for this research. The study of complexity in general and project complexity in particular was to delineate the area of the problem domain. The readings on social theories were to set forth a foundation for this research from which to develop a framework based on practitioners' experience.

In this literature review, the focus was to find out if any project management frameworks were available based on complexity theory principles, and gaps that had not yet been addressed or included in these frameworks.

This chapter presents a synthesis of the literature review conducted for this research.

2.2 IT Projects – Failure Analysis

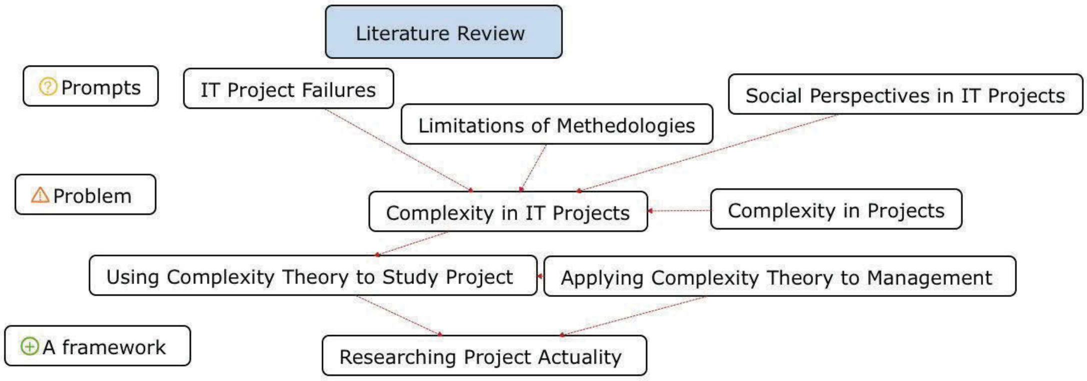


Figure 2-0: Research Path

Information technology has had an indelible impact on our daily life and revolutionised the business world. Rapid IT innovation has led to a global knowledge economy and accessibility to information across all demographic boundaries. However, despite advances in the use of software development processes, software engineering concepts, tools (UML, JIIRA, SVN), and project management practices, the literature has recorded an increased rate of IT project failures.

Some excerpts from industry reports highlighting the increased rate of IT/IS project failures are presented below (underlining and bolding show author's emphasis):

- **Report 1**: 2014. The Gartner report tells of how 'in Australia, it took the tragic death of an 11-year-old boy to highlight the massive failure of the Victoria Police Link crime-reporting IT systems project'.

- A report by the Victorian Government Ombudsman described the Victoria Police Link project as 'fatally hampered by a poorly constructed business case that grossly underestimated

the *cost and complexity* of the problem'. Worse, it took the project team four years to identify the project was $80 million underfunded. Citing the *business process complexity* as one of the reasons for project failures, the Gartner advises on project governance.
Source: http://www.gartner.com/newsroom/id/2790817 Gartner Application Architecture, Development and Integration Summit, 21-22 July 2014 in Sydney.

- **Report 2:** 2014. An article published in 'The Age' pointed out IT project failures as a concern.
  The Age, http://www.theage.com.au/it-pro/business-it/australian-it-project-failures-spark-new-ict-governance-standard-20140114-hv88k.html

- **Report 3:** http://paulwallbank.com/2014/02/20/you-cant-get-there-from-here/ - NBN - A project in search of a scope: 'The project's failure is a worrying commentary on the abilities of Australia's management elites in both the private and public sector.

  However the lesson for the entire world is that understanding both where you are and where you want to go to is essential for a project's success. Spending on well planned and necessary infrastructure is good, but to avoid disasters like Australia's NBN, it's good to start with understanding the problems you want to ***fix and a project scope that clearly identifies*** the work that needs to be done.'
  http://www.afr.com/business/telecommunications/nbn-contractors-fail-to-deliver-20130402-j0yr1 - 'The issues are part of a litany of problems exposed in the confidential documents, which are slowing the rollout, ***including poor project management*** by the major contractors and attempts to blame others involved in the rollout, like Telstra, for slowdowns.'

- **Report 4:** 2013. KPMG Project Management Survey Report, July 2013. Statistics show that in 2012, the rate of success had decreased, despite using a ***project management methodology consistently***.

	2010	2012
Consistently on budget	48%	33%
Consistently on time	36%	29%
Consistently delivering stated deliverables	59%	35%

- Report 5: 2013: The Chaos Manifesto 2013 reports on project failures advocatde a tool based on project complexity using lenses. The excerpt from this report reads as follows: ‘In the November 2012 Demand Assessment Requirements Tracking Survey (DARTS), we asked 300 CIOs, ‘What does complexity mean for you in a project context?’ Sixty-three percent said it means how complicated the project is, while another 31% said it means the level of uncertainty for the project to succeed.’

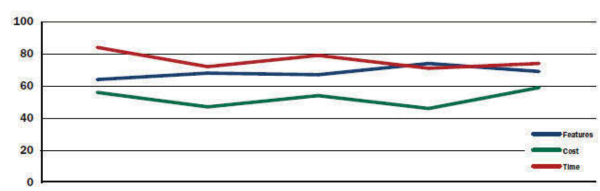
RESOLUTION

	2004	2006	2008	2010	2012
Successful	29%	35%	32%	37%	39%
Failed	18%	19%	24%	21%	18%
Challenged	53%	46%	44%	42%	43%

Project resolution results from CHAOS research for years 2004 to 2012.

OVERRUNS AND FEATURES

Time and cost overruns, plus percentage of features delivered from CHAOS research for the years 2004 to 2012.



	2004	2006	2008	2010	2012
TIME	84%	72%	79%	71%	74%
COST	56%	47%	54%	46%	59%
FEATURES	64%	68%	67%	74%	69%

Figure 2-0A: Research Directions

- **Report 6:** 2012. A report on government ICT projects stated, 'the 2011 Victorian Ombudsman's report identified ten such projects that have so far cost the government $1.44 billion more than was originally budgeted'.

- **Report 7:** The South Australian government published the following report advising on failures of IT projects in the government sector: http://sa.acs.org.au/gallery/leaders_lunch/20120516_Common_causes_of_failure_in_major_ICT-enabled_projects.pdf

- **Report 8:** 2012. The Gartner analyst, Lars Mieritz, argued that project size was one of the key factors causing project failures. Published: 1 June 2012 ID:G00231952.

- **Report 9**: 2008. The Plan IT Report states more than half of Australia's software projects were still failing. http://www.planit.net.au/resource/failed-software-projects-still-a-reality-for-australian-and-new-zealand-organisations/

- **Report 10:** A few samples of industry reports from prior to 2008 recorded project failure rates. Chaos report (2004), The Robbins-Gioia Survey (2001), Conference Board Survey (2001), KPMG Canada Survey (1997), and OASIG Survey (1995) all recorded an increased rate of IT project failures, ranging from 36% to 42%. The EEE article 'Why Software Fails' 2006, stated that the problem only got worse as IT grew more ubiquitous.

The project success rate has been decreasing globally for the 10 years from 2004 to 2014 and the reports on these IT project failures acknowledged that the project management methodologies of one type or another were applied in these projects. The project failures have been attributed to business process (Report 1), lack of clear project scope (Report 3), project size (Report 8) and poor project management (Reports 3 and 4). Note that the word 'Complexity' was mentioned in some of these reports (Report 1 and Report 5).

One of the reasons for the failures could be that the growth of information technology during this decade was colossal in terms of innovation. It is important to note that the criteria to determine the success or failure of IT projects are primarily based on the parameters of scope, time and cost (budget), the infamous triple constraints. The business outcome, usability and quality of the services were considered as key parameters to determine the project success only in a few cases. The project failures could be grouped into the following categories (Lyytinen & Hirschheim 1988):

- Correspondence failure: the systems design objectives or specifications were not met.
- Process failure: system could not be developed within the allocated budget or schedule.
- Interaction failure: user attitude, satisfaction and frequency of use did not correspond to the level of system usage; that is, the system was implemented out of necessity yet without increased task performance.
- Expectation failure: the system did not meet stakeholder requirements, expectations or values.

The rate of information system project failure remains high in comparison with other high tech projects (Yeo 2002). The study of system failure still suffers from an inadequate conceptual clarity of the information systems failure notions and remains a confused field (Checkland & Holwell 1998). David Avison and his fellow researchers (Avison, Gregor & Wilson 2006), citing cases from Australia, observed that poorly designed, carelessly implemented systems would lead to organisational failures.

2.3 Reasons for Failure

A) Business urgency, ambitious goals, ambiguous scope and time pressure:

IT systems provide capability to businesses and enable them to reach out to their customers with services, products and options faster than before In reviewing the research papers, it was evident that there was a business-driven urgency to complete the projects while the scope was simultaneously being altered by the dynamic business world (Tichy & Bascom 2008). Due to dynamic, volatile market conditions, tough competition, variety of demands, shorter shelf-life, multiple players, and complex governmental regulations, businesses expected, and continue to expect, IT systems to be implemented in ever shorter spans of time (Brroks 1995) with less and less cost as an enabler in realising the business strategy (Lijima 2015).

Ambiguous requirements, changing scope with limited information, commitment to deliver with great urgency can lead to a high level of complexity in IT projects (Murray 2000).

The project scope could not be defined accurately during project planning because of lack of accurate information. Once the project plan was finalised, it was ‘locked in’ and ‘frozen’, as baseline plan while the business world continued to change. Organisations tried to control the variance to the baseline plan. When this control was ineffective, the project slipped from its original plan and thus was considered a failure.

B) Teams, Stakeholders, Culture and Communication:

The failure factors for IT projects (Table 2-1) have been identified and various remedial measures to address these factors have been recommended in numerous articles. Kappelman et al. show that lack of top management support, a weak project manager, the organisational culture, stakeholder commitment to project, a lack of subject matter expertise and poor communication style in *people-related* factors and weaknesses in the scope definition and change control process in *process-related* factors as highly influential failure factors (Kappelman, McKeeman & Zhang 2007).

Note that the classification is based on 'People and Process'. The factors cannot be distinctly classified into these groups as people execute their tasks and interact with others through a process. The process could be prescribed, revolutionary or context sensitive. The subjectivity in these categories decreases our ability to prevent failures through normative responses. Virtual teams characterise IT projects.

The British Computer Society Thought Leadership debate (2005) commented that IT projects were basically change projects − unlike engineering projects − and therefore required increased communications. The Bull Survey (1998) reported that the poor communication amounted to 51% of IT projects failure, whilst 39% was due to lack of planning.

Implementing complex projects successfully requires understanding of the stakeholders, dealing with the interplay between stakeholders and managing their expectations effectively (Yuttapongsontorn, Desouza & Braganza 2008).

Communication and stakeholder relationships have been emphasised; both parameters have subjectivity in them and no one unique communication model would be sufficient to address the communicational needs of today's diverse work force.

Table 2-1 Failure Factors

Category	Factors
Business	Ambiguous or changing requirements, volatile market conditions, business urgency, inaccurate business case, over-ambitious business goals, lack of goals.
Technology	Immature technology, poor technology platforms, obsolescence, innovative technology, mix of technology.
Time	Shorter duration, time pressure, estimation flaws.
Team	Skill set, culture, multiple locations, geographically distributed teams, communicational style, leadership, power and politics, management challenges.
Stakeholders	Unrealistic expectations, Organisational politics, lack of project governance, micro-management, inter-divisional rivalry.
Project	Project size, processes, governance and decision-making, poor management, inconsistent application of methodologies.

Synthesised from: (Busby & Hughes 2004; Glaser 2005; Kappelman, McKeeman & Zhang 2007; Lijima 2015; Rodriguez-Repiso, Setchi & Salmeron 2007; Savolainen, Ahonen & Richardson 2012; Stoica & Brouse 2013; Tichy & Bascom 2008; Tsoukakas 2001; Ulfelder 2004; Van Scoter 2011; VanDoren 2009; Whitney & Daniels 2013; Wilfong 2014; Yeo 2002; Yuttapongsontorn, Desouza & Braganza 2008)

Yeo (2002) proposed a framework to categorise the factors of failures based on three sub-systems a) strategic planning, b) organisational system, and c) formalisation of information system as spheres of influence. Using this S3 framework, when survey results were analysed, the failure factors were found more in the areas of project planning and organisational culture. It is to be noted that there was an attempt to depart from traditional project management methodology (S2) and include organisational context.

The S3 (Yeo) framework acknowledged that strategic planning was through ‘discourse’ and political process. However, the onus of successful implementation of a project was left entirely to the project manager (Yeo 2002, p. 245). The framework did not differentiate between each sub-system, nor did it advise if this classification of failure factors was to prompt preventive action or active risk management in these areas.

Project failures were also attributed to factors such as a) different perspectives and multiplicity of meaning creation in projects (Kirby 1996), b) project models that did not recognise complex dynamic nature and interrelationship within the project components (Reichelt & Lyneis 1999), c) project organisational structures such as matrix organisations that were not flexible (Alsène 1999) and, d) project selection which was neither beneficial to the organisation nor directly linked to organisational strategy (Munns & Bjeirmi 1996), managerial abilities and environmental variables (Belassi & Tukel 1996).

On the flip side of the failure literature, there were several studies (project success literature) that determined the essential ingredients for project success; that is, the critical success factors (CSF). These studies confirmed that stakeholder engagement and involvement was one of the topmost factors to assure project success (Hartman & Ashrafi 2002). Organisational culture was also a key factor in improving the IT project success rate (Wilfong 2014).

Most of the time, IT projects are executed in a matrix organisational format, where the resources report to a functional manager and are assigned to multiple projects. This can lead to role conflict (Jones & Deckro 1993), which in turn leads to engagement ambiguity and creates tension in the stakeholder relationship.

IT projects do bring significant change to process and people, causing social disturbance within organisations (Kerzner 2013). Emphasising power and politics in project management, Pinto (1997) argued that the senior managers should manage the networking relationships well to gain success. Projects are organisational entities that must build on relations of power. 'All organisations are relations of power, even the most egalitarian' (Brown et al. 2010).

The primacy of the project team over the formal functional organisation (Pinto 1997) should be given importance. It has been reported that a project's success is associated with the personality types of the project's team members (Moore 2014). A constructive relationship between business units and IT departments is recommended for project success (Coughlan, Lycett & Macredie 2005).

Agile software engineering methods have recently emerged as a new and different way of developing software compared to the traditional methodologies. However, the failure factors are no different from the findings of traditional software development projects as they also point out to delivery strategy, project management methods, customer involvement and team environment (Chow & Cao 2008).

Earlier studies focused simply on listing the factors for failure, which are noticeable at the outset and symptomatic; but the current studies focus on the root cause of these factors and attempt to trace the causal relationships among them. From the research papers reviewed, I concluded that a significant deviation in research is taking place, such that attributing factors to project failure is not because of the factors themselves but because of the interaction and causal links.

The mechanism that generates these failures has been addressed as a 'latent pathogens and incubation process' in which these pathogens react. Busby et al categorise the pathogens as people, task, environment, standards and process, organisational structure, technology tools, strategic goals, organisational priorities, and the incubation process as the ability to accommodate change, ability to face uncertainty, and complexity of design (Busby & Hughes 2004).

Though the correlation between the factors has been established through the 'incubation process', the interaction between the various elements and their interdependence has not been studied in this research.

Classifying factors into People, Task, Methods and Environment, one study attempted to trace the causal links between them and found multiple causes for project failures, multi-dimensional processes where people, tasks and project environments were interconnected. The study also confirmed that through process improvement, the causes associated with people, tasks and methods could be remediated and project performance improved. The causes associated with environment were, however, emergent in nature (Lehtinen et al. 2014). The multi-level causal links were pointed out, but the *dynamic nature* of these causal links − how they form − was not explored.

Recent research has nominated three reasons why appropriate responses could not be applied in seeing the early warning symptoms of project failure: project managers' optimism, social normalisation and project complexity. It also confirmed that increased **project complexity** prevents the generation of time-bound appropriate responses to problem signs (Haji-Kazemi, Andersen & Klakegg 2015; Williams et al. 2010).

As noted in this section of the literature review, failure factors are predominantly associated with human interaction. After acknowledging emergence, uncertainty and subjectivity in human interaction, a framework needs to view the project as an adaptive system rather than a static system. In recent failure analysis, project complexity has been included as a lens to create taxonomy (Al-Ahmad et al. 2009).

An analysis of failure factors gives rise to the following questions:

a) Is it possible that the methodologies are too prescriptive and distanced from the field of reality? Why do project management methodologies not attempt to address these interactional, relational aspects that have caused failures? Is there a need to view a project as an entity of complex social interaction?

b) Could it be that the failure factors are symptomatic indicators of project complexity? Should we consider context-based success and failure criteria rather than judge all types of projects using the same criteria?

The complexity triggered by the interactions demands a higher form of collaboration and context-based response development. This, in turn, would require project managers to be able to thrive in such chaotic environments (Whitney & Daniels 2013). This is a starting point for this research, to view a project as a complex system and find out the factors of complexity, inter-relationship, interaction, and the concomitant compounded complexity that emerges out of these interactions.

2.4 Project Management Research directions

2.4.1 Why new approaches to Project Management?

It is important to ensure a line of inquiry for this research is relevant and addresses the current concerns of the project management professional community, including academic research scholars and practitioners. Project management methodologies have been reviewed and researched actively since 2004, through research networks such as ‘Rethinking Project Management’, EPSRC Networks (2004 - 2006), IRONP Conferences and ICCPM Conferences. Professional bodies like PMI have sponsored research in improving their frameworks.

A critical assessment of existing methodologies has described them as deterministic, planning- and control-based, created a long time ago in an industrial era, technocratic, and rationalistic (Morris & Hough 1987). It is important to include traditional endogenous factors as well as exogenous factors (Winter, Smith, Morris, et al. 2006). The conventional approaches to project management ignore the human side − or at least attribute the human side to leadership, structure and control with normative advice, despite a lack of empirical evidences (Packendorff 1995).

The traditional project management methodologies assume objectivity and universality, and treat an ability to communicate as a given. As the projects are vehicles to achieve organisational objectives in the knowledge economy, and since the stakeholder mindset has changed because of social complexities, project management methodologies need to change (Jaafari 2003). The standard project management methodologies treat projects as an analytical process and ignore systemic and social aspects (So'derlund 2004).

Project management methodologies are based on an assumption that planning can be done accurately, changes can be measured and variance can be controlled effectively. In reality, estimates in software application development and information systems implementation projects are nothing but educated guestimates: they are subjective and based on the experience of the estimator (Agarwal 2001).

Therefore, the assumptions of normative models have failed to remain constant. Traditionally, the success of a project is determined by meeting the scope, time and cost, known as the golden triangle (Tesch, Kloppenberg & Frolick 2007). This narrow definition misses out on other success factors of a project, such as new learning, new business opportunities, and organisational experience earned as an outcome of a project − even though the project may not meet time and cost parameters.

The positivist approach, based on rhetoric, reification, use of instructional language and Newtonian reductionism, produces uniform responses while ignoring the multi-dimensional causes in project situations. There are embedded assumptions in classical project management: the political, social actor perspectives are discarded and the project manager is treated as an 'implementer' (Cicmil et al. 2006).

There is a need to include hard and soft paradigms in project management methodologies (Cicmil & Hodgson 2006; Crawford & Pollack 2004; Williams 1999). There is a gap between theory and practice; there is a difference in know-how and application of methodology; the methodologies should therefore reflect the real field event-response scenarios rather than enforced responses by legal bodies (Hodgson & Cicmil 2007b). An analysis of large projects that have failed provides insights and empirical evidence that applying more control through formal structures and prescribed processes as one reason why failure conditions are exacerbated (Turner & Keegan 1999, p. 308).

As an outcome of this critical engagement towards proposing alternative approaches to existing project management methodologies, various research directions have been identified. These research directions can be classified into two categories. Category A aims for a fundamental, paradigmatic shift in terms of epistemology, ontology and methodology. Category B aims to improve on existing methodologies by adding another spectrum. The following section presents a summary of these emerging research directions:

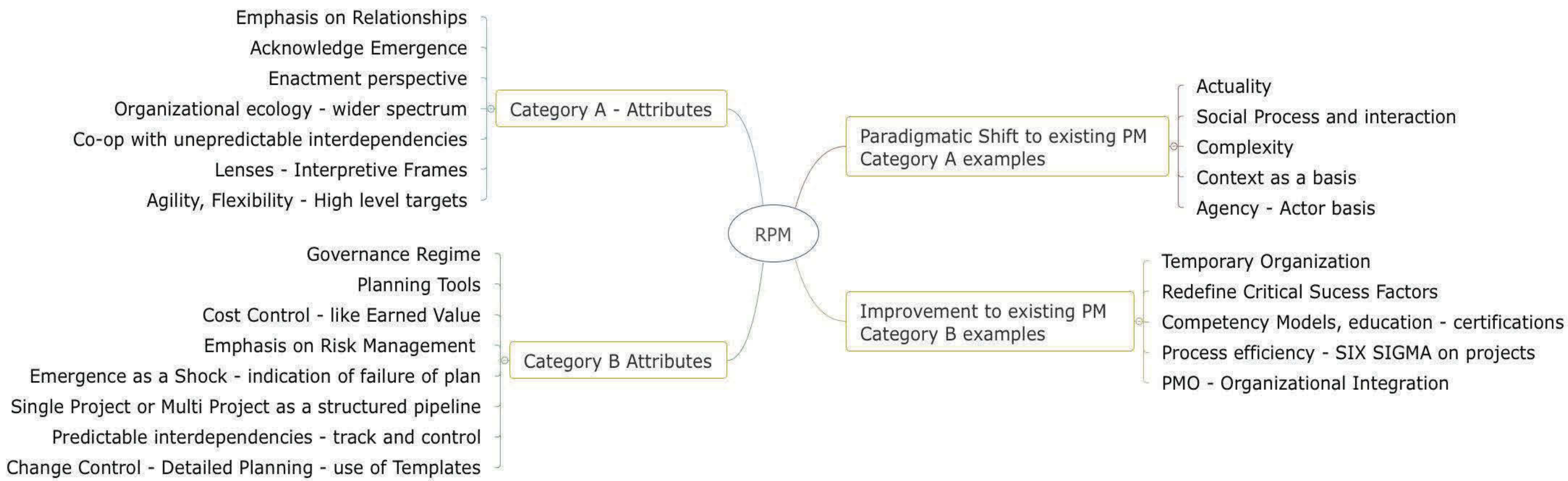


Figure 2-1 Research Directions

2.4.2 Alternative Approaches – what is being proposed?

Winter et al. (2006, p 639) observe there should be consideration of reflective practice from the field and they call for new ontologies and epistemologies to understand the complexity of the projects. In their own words, 'the research in project management methodology is not to abandon the conventional methods but to enrich and extend the field beyond its current intellectual foundations, and connect it more closely to the challenges of contemporary project management practice'. The EPSRC initiative documented the research direction in the following categories.

Table 2-2 Research Directions Winter et al. (2006, p 642)

Research Directions (EPSRC 2004-2006)	
Theory of Practice:	Social process
	Social interaction among people
	Illuminating the flux of events
	Stakeholder relations, power and politics
	Value creation as prime focus
	Broader conceptualisation
Theory About Practice	Theories of the complexity of projects and project management
	Partial theories of complex terrain
	Illuminate complexity
Theory in Practice	Practitioners as reflective practitioners

In Table 2-2, adapted from EPSRC findings, the study of project complexity is shown as a growing field (Winter et al 2006). Note that the study of stakeholder relations, power, politics and value creation do not attempt to change the foundational principles in project management, but adopt the theories of organisational studies into project management to improve efficiency.

Recent emphasis on project management competency, education, knowledge management, process improvement, and temporality of organisation falls into the 'improvement' category (Category B).

Research directions into social process, social interaction, complexity of projects and reflective practitioners are attempting a paradigmatic shift from normative methodologies. Research in these areas focused on uncertainty, spontaneity and autonomy.

Per Svejvig and Peter Andersen (2015) conducted a structured literature review and recorded six streams of emerging trends in project management research as follows:

a) contextualisation
b) social and political aspects
c) rethinking practice
d) complexity and uncertainty
e) actuality of projects
f) broader conceptualisation.

These categories cover a broad range of different contributions with diverse and alternative perspectives on project management. The study of complexity is active and a considerable number of research papers are being published on project complexity (Svejvig & Andersen 2015, p. 285). The research directions proposed by Rethinking Project Management (RPM) have created a new mindset for practitioners with a set of ideals. These ideals focus on ultimate value, deep personal identification with project goals, investment in trust, devolved, collective responsibility, willingness to continually adapt, people development, learning orientation, creativity and innovation, and a proactive view (Sauer & Reich 2009).

Table 2-3, adapted from Svejvig et al., presents a summary view of emerging trends and their importance.

Comparing classical project management with rethinking project management. - Adapted from Per Svejvig, Peter Andersen (2015)		
Packendorff (1995, p. 328)	Project metaphor: the project as a tool. Process: linear, with the phases plan, control and evaluate	Project metaphor: the project as a temporary organisation. Process: iterative, with the phases expectation setting, actions and learning
Jugdev et al. (2001, p. 36)	Project management: as a set of tools and techniques used to achieve project efficiencies. Success: measured by efficiency performance metrics. Practice project management: focus on the project details at the operational level and tactically	Project management: as a holistic discipline used to achieve project/program/organisational efficiency, effectiveness and innovation. Success: a multidimensional construct measured by efficiency, effectiveness and innovation. Sell project management: be an advocate and champion of project management by aligning its value with the firm's strategic business priorities
Winter et al. (2006c, p. 642, original emphasis)	Simple life-cycle-based models of projects, as the dominant model of project and project management with the (often unexamined) assumption that the life-cycle model is (assumed to be) the actual terrain	New models and theories that recognise and illuminate the complexity of projects and project management, at all levels. The new models and theories are explicitly presented as only partial theories of the complex terrain. Approach: adaptive project management
Shenhar and Dvir (2007, p. 11, original emphasis)	Approach: traditional project management. Project goal: completing the job on time, on budget and within the requirements	Project goal: achieving multiple business results and meeting multiple criteria

Andersen (2008, p. 5, 10, 49)	Management style: one size fits all. Perspective: task perspective. Project definition: a project is a temporary endeavour undertaken to create a unique product, service or result (Project Management Institute, 2004, p. 5). Main focus: execute the defined task	Management style: adaptive approach, one size does not fit all. Perspective: organisational perspective. Project definition: a project is a temporary organisation established by its base organisation to carry out an assignment on its behalf. Main focus: value creation. Create a desirable development in another organisation
Lenfle and Loch (2010, p. 45)	Project type and target: routine execution, target given and defined from above. Examples of domain of relevance: • Known markets and customer reactions • Known performance drivers of developed systems • Known environmental parameters.	Project type and target: novel strategic project with a general vision and direction, but detailed goals not known and partially emergent. Examples of domain of relevance: • New markets and unknown customer reactions • Unknown technology • Complexity with unforeseeable interactions among drivers and variables.

Table 2-3 Classical Project Management versus Rethinking Project Management.

2.4.2.1 Actuality

Articles published recently in international project management journals state an urgent need to develop project management theory based on field experience. The actuality needs to be considered in developing the theory from the ground. There is a gap in project management research; the social aspect of projects is not fully explored yet.

Cicmil et al. consider a project as a social phenomenon, and the project manager as a socio-political actor: ‘the project management research should focus on practical action, lived experience, quality of social interaction and communicative relating, operations of power in context, identity, and the relationship between agency and structure in project environments’ (Cicmil et al. 2006, p. 684). In emphasising lived experience, tacit knowledge, enactment through reflection, systemic effects, flexibility and professional action, and agency between relationship and structure, they argue that the actuality of the project provides deep insights into how projects are executed in organisations (Cicmil 2006; Cicmil & Hodgson 2006; Cicmil & Hodgson 2007; Cicmil et al. 2006; Hodgson & Cicmil 2007a, 2008).

Project management research is gradually shifting to human relations and organisational behaviour (Kwak & Anbari 2009). Vermeulen points out the importance of a practitioner’s involvement in management research and proposes the addition of a second loop, which interacts with practitioners directly to share research insights and results (Vermeulen 2007). Walker et al. stress ‘the value of reflection in learning by understanding theory through challenging it and testing it in practical ways − both reflection *on* action and reflection *in* action’ (Walker et al. 2008, p. 170).

Reflective practice with emergent ontology is the basis for the ‘actuality’ school of thought. The reflexive nature of human interaction and co-construction of events through a process is seen as a primary theme in actuality research. The methodology is active interviewing and narrative analysis and the primary focus of investigation is the paradoxical tension between unpredictability, control and collaborative interaction.

According to Geraldi et al. (2008), gaining insights into project management practice is increased by focusing on the social processes in projects and the lived experience of the project stakeholders, including project managers, architects and sponsors (Geraldi et al. 2008).

As mentioned above, actuality research has an interest in what happens in the field − how project managers think in action. Cicmil et al. have stated that these alternative perspectives are inclusive and complementary; they are not competing with classical project management (Cicmil et al. 2006).

In summary, the actuality of project management has two important aspects: a) actors’ own experience of self and reaction to scenarios based on the context and the *‘lived experience’*, and b) what occurs in the project field.

2.4.2.2 Social process and Temporary Organisation

Jaafari (2003) argues that our society is very complex as rapid technological, social, and economic change is sweeping in. He posits that traditional project management assumes a world of order and a predictable environment. He classifies project management into four models: as Ad Hoc, Normative, Bureaucratic and Creative-Reflective. It is the Creative-Reflective model that he recommends as the best response to societal change.

Because treating projects as a social process requires consideration of the firm's organisational activity and must relate to the firm's philosophy, it would be beneficial, when classifying the project, to base it on certain individual characteristics. The typology of projects such as high-tech, complex and product development should be considered and the project management methodology should be tailored to suit the context of the projects. The 'task' itself can be considered as a social construction (So'derlund 2004).

Learning, participation, and commitment are main focal points in the 'Temporary Organisation' school of thought. The temporality in which the project participants engage through a process to achieve an outcome is one of the key areas of investigation. Even though the temporary organisations and social arrangements may have been adopted, importantly, the 'functionalist' approach remains unchanged (Lundin & Söderholm 1995).

2.4.2.3 Complexity in projects

Rethinking Project Management (RPM) research networks have published several articles and books on project complexity (Cicmil et al. 2006; Sauer & Reich 2009; Svejvig & Andersen 2015). This section attempts to identify the main postulates and realms of discussion in project complexity. The detailed treatment of existing complexity frameworks/models is presented in section 2.10 - Project Complexity Frameworks, following a discussion of the general concepts of complexity theory.

Industry reports acknowledge the increasing complexity of IT projects (Boston Consulting Report 2004). Research has suggested that the concepts of systems theory and the complex systems metaphor should encourage project managers to see projects as complex bounded entities. Drawing on an explanation of complex systems, the project execution can therefore be thought of as a process of constantly adjusting the project system to fit a confounding and emerging reality (Ivory & Alderman 2005).

Different types of projects demonstrate contingency characteristics that require different management approaches. Some researchers argue that one of the difficulties in advancing theory development on project complexity may stem from a conventional approach of developing ‘one-size-fits-all’ theories. However, since the conventional management tools that organisations usually apply do not cope with the uncertainty-based complexity, a contingency approach is required (Shenhar 2001).

Having presented the foundational concepts of complexity theory, Cooke-Davies et al. argue for the possibility of applying complexity theory to project management. ‘If even pure science is finding the need to become more flexible in its research methods while not relapsing into ‘anything goes,’ is it perhaps too much to hope that research into projects and their management will take account of these developments and incorporate methods they investigate both the objects (human beings) who work together in ways that are labelled ‘projects’, and the ideas that they find useful in doing so?’ (Cooke-Davies et al. 2007, p. 56)

Pich et al (2002), considering project management as a pay-off function that depends on the state of the world and choice in the sequence of the actions, illustrate how project environment is volatile, changes continuously, available information is inadequate and the outcome of the project is influenced by ‘how the project is framed’ at the initial stages (Pich, Loch & De Meyer 2002). The concept of second order cybernetics could be applied to project management as an extension of traditional project management focusing on multi-level feedbacks and emergence (Saynisch 2010).

Complexity theory in the form that has been applied to organisations may also be applied to projects (Vidal & Marle 2008). In applying the theoretical concepts of complexity theory principles, implications for practice and theory have been identified (Geraldi, Maylor & Williams 2011). The concepts of complex responsive processes have been used to explore the complexity of projects (Cicmil et al. 2009). Projects have been treated as both a human activity system (Small & Walker 2012) and a socio-cultural system (Sankaran 2012).

In new product development, product complexity and innovation can evolve into project complexity. Therefore, it is important to understand the product architecture, components (differentiation), interdependencies and associated uncertainties to manage the complexity of new product development projects (Lebcir 2006).

One of the dimensions of any project is complexity, emerging because of uncertainty. It is classified as organisational, technological and informational. It is measured in terms of differentiation and interdependencies. Project complexity warrants integration by coordination, communication and control (Baccarini 1996). Complexity assessment can help to manage the emergent situations and significant challenges. According to Geraldi (2009), complexity should be considered as continuous negotiation (Geraldi 2009).

Understanding uncertainty as a basis of complexity, project managers can then manage technical and structural complexity to control time and cost constraints (Macheridis & Nilsson 2003). There is strong evidence of a link between 'project management style' and complexity arising out of uncertainties. Management of technology and structural complexity are associated with an increased ability to adjust and adapt to emerging contexts (Camci & Kotnour 2006). Further, project management maturity models and project complexity have been explored in controlling the cost overruns and reaping business benefits (Christoph & Konrad 2014) .

On a contrary note, uncertainty itself is not complexity; it is one of the characteristics of complexity. Measuring complexity is not always possible as the interdependencies can be emergent. Nor can project complexity be simply defined and measured, as every project has some degree of uncertainty and thus possibly can exhibit complex behaviour at some stage of the project execution. At the same time, no additional tools are required to treat project complexity; a conceptual mapping of project complexity would suffice to deal with it (Whitty & Maylor 2009).

The uncertainties in projects stem from multiple sources; at times they cannot be traced until encountered as an issue; therefore, the complexity cannot be detected and managed. Alternatively, broader organisational perspectives such as learning and culture should be considered part of project management frameworks to deal with complex scenarios (Atkinson, Crawford & Ward 2006).

The complexity in project management is because of complex problem solving *(CPS)*; when the planning cannot be accomplished because of unknowns, the only option is to consider learning and knowledge distribution during the course of the project. Therefore, the project management complexity spectrum can be viewed in terms of knowledge and informational flows rather than systems complexity. In other words, a project should be treated as social entity rather than a technical object used for delivery (Ahern, Leavy & Byrne 2014).

Project managers should consider adaptive mechanisms using learning and selections. It is suggested that using projects as complex adaptive systems (CAS) would help us to understand the learning process happening in such a volatile environment (Pich, Loch & De Meyer 2002). The CAS constructs can be used to understand dynamic conceptualisation and execution of innovation projects and they will help to model these projects more efficiently. These projects reflect the dynamic nature of CAS as the project team members interact with each other in finding what is unknown by adaptive learning (Harkema 2003).

The complexity of IT projects has been mapped to complex adaptive systems (Benbya & McKelvey 2006a) and Kautz (2012) has shown that to deal with complexity, frequent feedback loops and periodic corrective measures are required (Kautz 2012). Treating projects as complex adaptive systems, it is noted that the success rate of the projects can increase when there is a higher degree of collaboration among the project teams. Soft skills, like empathy, influence, creativity and group facilitation are important factors that influence successful outcomes in complex socio-technical ventures. Meaning creation through orchestration is also an important process in dealing with complexity (Whitney & Daniels 2013).

Project complexity can be managed efficiently by inculcating ‘resilience’ in project managers and nurturing their ability to deal with emergent scenarios (Klein, Biesenthal & Dehlin 2015). Projects in such organisations where cultural diversity is high exhibit characteristics of complex adaptive systems. By treating projects as complex social processes, an emphasis is placed on human interaction (Small & Walker 2012). It is found that human perception and psychological effects are associated with the way complexity is perceived in project situations (Schöttl & Lindemann 2015).

Curlee et al. have suggested that complexity theory concepts can be applied to project management to resolve cultural conflict and improve a virtual team's performance in projects (Curlee & Gordon 2010). Most projects have complexity because of social and organisational factors − *socio-organic factors* that, if unattended, may lead to project failures. Understanding the complexity of interconnection is essential to cope with project complexity (Antoniadis, Edum-Fotwe & Thorpe 2011).

Improving governance in the program management of complex projects has also been recommended (Pitsis et al. 2014). Further, project governance should adapt to the specific project context and deal with emergent complexity and change as the project development process unfolds (Miller & Hobbs 2002).

2.5 Summary

In any field, find the strangest thing and then explore it.

- John Archibald Wheeler

From the above readings, I concluded that project complexity is a field ripe for exploration. The study of project complexity would provide deep insights into the interaction as a social process, which is pivotal to better project outcomes. In order to bridge the gap between theory and practice, it was preferable to build a framework through field research into the actuality of a project.

Table 2-4 shows some of the project characteristics from literature readings mapped to concepts of complexity theory. Figure 2-2 shows initial studies that classified project complexity into technological, people and structural groups based on uncertainty.

Table 2-4 Project characteristics mapped to complexity theory concepts

Project Characteristics	Use of Complexity theory frames mentioned
Ambiguity and uncertainty is experienced in a project	Explanation of adaptive behaviour, emergence and patterns as CAS
Technology innovation, unknowns	Explanation of initial conditions, interdependence, adaptive response
Structure – too many components in a project	Use of subnets, interconnectedness, evolving relationships
Social aspects are involved.	Conceptualisation, context sensitivity, collective mindset.
Intensive human interaction	Sense making, trust-based relationships, reflexivity, co-construction, cue collection, learning

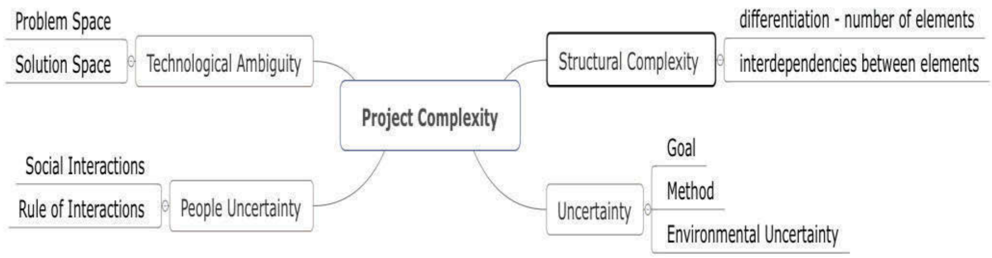


Figure 2-2 Project Complexity

Complexity science suggests that we would be better off with minimum specifications and a general sense of direction, and then allow appropriate autonomy for the individual agents to self-organise and adapt as time goes by.

This would suggest, for example, that intricate strategic plans be replaced by a simple document that describes the general direction that the organisation is pursuing and a few basic principles for how the organisation should get there. The rest is left to the flexibility, adaptability and creativity of the system as the context continually changes. This, of course, is a frightening thought for leaders classically trained in machine and military metaphors (especially in the project management arena). However, the key questions are:

- Are these traditional metaphors working for us today?
- Are we able today to lay out detailed plans and then 'just do it' with a guaranteed outcome?
- If not, do we really think that planning harder will be any better?

This literature review led me to formulate the high-level research question:

- ‘How can we develop some theoretical constructs, other than what have been noted, to formulate a framework for IT Projects in order to comprehend the project complexity?’

To do so, it is essential to have a conceptual understanding of various strands of complexity theories. The following section attempts to trace the history of various strands of complexity theory and their application.

2.6 Complexity Theory

> *Any physical theory is always provisional, in the sense that it is only a hypothesis: you can never prove it. No matter how many times the results of experiments agree with some theory, you can never be sure that the next time the result will not contradict the theory.*
>
> *− Stephen Hawking (A Brief History of Time)*

Complexity science was popularised by several books such as *The self-organizing universe* by Erich Jantsch (Jantsch 1980), *Order out of Chaos* by Ilya Prigogine and Isabelle Wily (Prigogine 1984), *Chaos* by James Gleick (Gleick 1997), *Tree of knowledge* by Maturana and Varela (Maturana & Varela 1987), *At home in the universe* by Kauffman (Kauffman 1995), *The web of life* by Capra (Capra 1996), *Emergence* by John Holland (Holland 2000), *Small world* by Duncan Watts (Watts 1999), *Linked* by Barabasi (Barabási 2002), *The hidden connections* by Capra (Capra 2004) and many more.

Chaos Theory, Dissipative Structure and Complex Adaptive Systems (CAS) are various strands of Complexity Theory. The science of complexity has now developed to the extent that it is applied to many fields such as natural and social sciences, management and the arts. This emerging science offers the promise of an alternative methodology capable of tackling the complex problems of the present day world (Waldrop 1992). When we attempt to see the challenges to the Newtonian Reductionism approach, we encounter the philosophers Bergson, Teilhard, Whitehead and, in particular, Smuts (1926), who coined the word holism, the tendency of the whole to be greater than the sum of its parts.

On philosophical grounds, complexity writers make reference to earlier thinkers: Kant, Hegel, Darwin and Mead. Kant introduced the theory of the 'united whole and parts' (Stacey 2000b, p. 21), which formed the foundation of system thinking. The scientific method involves a reductionism approach applying an 'if-then structure', eliciting a linear causal link and focusing on only part of the problem instead of considering the problem as a whole.

Kant noted a difference between mechanism and organism. Organisms need to be understood in a systemic way. Kant's assertion was that the parts of a system are functional and that the relationship between them functions to form the whole. There is an end state or final form that is enfolded in the sense the whole exists in some sense before the parts.

Michael Silberstein and John McGeever, in their editorial in *Philosophical Quarterly* entitled 'The Search for Ontological Emergence', draw upon the Quantum Mechanics to argue the failure of 'part-whole reductionism' and state that the existence of ontological emergence is a reality (Silberstein & McGeever 1999). They conclude that ontological emergence is the real feature of the world. Wismatt describes in an article titled 'Ontology of Complex Systems' how complex systems with multiple causal thickets functioning as an integrated whole are a reality in physical and social systems (Wimsatt 1994).

Complexity theory principles have been applied to organisational sciences in *Edge of Organisation* by P Marion (Marion 1999). If there is evidence of applying complexity theory in physics, biological sciences and sociology, it could be applied to explain the complex phenomenon that occurs in a project environment.

Complexity theory concerns itself with the emergent properties of systems with a large number of interacting parts. It states that 'critically interacting components self-organise to form potentially evolving structures, exhibiting a hierarchy of emergent system properties' (Lucas 2006).

As we have seen in project environments, there are too many components concurrently interacting with each other and displaying a variety of patterns. Complexity theory lays the foundational steps for emergence to be discussed. Thus, I assumed a framework could be developed to manage complex IT projects, based on the metaphors and principles of complexity theory, (Chaos Theory, Dissipative Structures, and Complex Adaptive Systems).

In the following section(s) I present brief descriptions of various strands of complexity theories.

2.6.1 Chaos Theory

Chaos theory describes the behaviour of certain dynamic systems that are highly sensitive to initial conditions. Chaos means not anarchic, absolute chaos, as in its literary meaning, but a pattern unpredictable beyond a certain threshold point. The principles of chaos theory state ‘a system is said to exhibit chaos when it is sensitive to initial conditions, at a given point of input the system displays unpredicted but unique patterns (attractors) by repeating the same (bifurcation)’. Examples such as ant colonies, bacterial growth, schools of fish and traffic patterns are found in nature.

Henry Poincaré (1900) reported dynamic systems with chaotic patterns. Birkhoff, Kolmogorov, Cartwright, Littlewoods (radio engineering) and Smale (physics) reported chaos in their respective fields. Some famous examples of systems with chaos properties are the Lorenz utterfly effect (so-called because of Lorenz's discovery that minute changes can have major and unpredictable consequences in non-linear systems) and Mandelbrot’s fractals. In any dynamic systems, states can be represented in ‘phase space’ diagrams. A repetitive pattern occurs at a given condition, which is attributed to strange attractors. Mandelbrot (1982) coined the term ‘fractal’ to describe irregular shapes that repeat themselves in nature (like ferns).

Chaos theory is a form of algebra dealing with features of self-similarity and it helps to explain how complex patterns are formed from simple guidelines. A familiar construct mentioned in chaos theory is edge of chaos. The studies of biological systems suggest that these systems are able to display behaviour of chaos and order at the same time. This momentary state in which a system resides between chaos and order is referred to as 'edge of chaos'.

The concepts of chaos have been discussed in several books such as James Gleick's famous *Chaos Making a New Science (Gleick 1997)* and *Chaos the Amazing Science of Unpredictable* (Gleick 1998).

2.6.2 Dissipative Structures

Ilya Prigogine in 1977 won the Nobel Prize for his study of dissipative structures in chemistry. A dissipative system is a thermodynamically open system that operates far from thermodynamic equilibrium in an environment with which it exchanges energy and matter. As an example of the dissipative structure, simple convection where phase transition occurs is cited. This study also leads to self-organisation (W Ross Ashby 1977; Nicolas and Prigogine, 1977; Jantsch, 1980; Prigogine and Stengers 1984). Self-organisation is one of the prime characteristics of complex dynamical systems; using feedback loops they adjust, when perturbation (stimuli) from their external environment (their boundary) occurs, in order to maintain ***equilibrium***. In doing so, they exhibit novel patterns, unique and unpredictable. The spontaneous behaviour that gives rise to unique patterns is referred as 'emergence'. The examples of such systems are living cells, and hurricanes.

In his book *Critical Mass*, where he quotes Prigogine's seminal work on non-equilibrium systems, Phillip Ball applies these principles to traffic jams, the market economy, social engineering and emerging cultures (Philip 2004).

In his discussion, Ball presents clear arguments how self-similarity and self-organisation occur in our society yet remain undiscovered by us.

2.6.3 Complex Adaptive Systems (CAS)

There is an increasing awareness in natural and social sciences that ecological and physical − as well as socio-economic − systems share the characteristics of CAS. A complex adaptive system (CAS) is a complex, self-similar collection of interacting adaptive agents.

In 1975, John H. Holland described complex adaptive systems' behaviour. A CAS is a dynamic network of many agents (which may represent cells, species, individuals, firms, nations) acting in parallel, constantly acting and reacting to what the other agents are doing, adjusting and aligning towards a mutual objective. The control of a CAS tends to be highly dispersed and decentralised. If there is to be any coherent behaviour in the system, it has to arise from competition and cooperation (recently the term co-opetition is used to refer to this) among the agents themselves. The overall behaviour of the system is the result of a huge number of decisions made every moment by many individual agents. The interaction of the agents, competing and cooperating with each other, over a period of time, exhibits a highly structured collective behaviour without centralised control.

Complex adaptive systems are different from complicated systems (Richardson, Cilliers & Lissack 2001). Dooley describes a CAS as an aggregate of interacting agents that behaves (Dooley 1996) and evolves according to three key principles:

- the order is emergent
- the system's history is irreversible
- the system's future is unpredictable.

The behaviour of the CAS emerges by interaction of the agents; they learn continuously during the process and change to an unpredictable state. CAS is a set of interacting parts, an assembly of elements producing an effect not inherent in any of them, the agency by which the net effect is produced: the 'whole is more than the sum of the parts' (Hernes 1998, p.74). According to Holland, the basic elements of CAS contain seven basic constructs: aggregation, tagging, non-linearity, flows, diversity, internal models (rules) and building blocks (Holland 1992).

CAS has memory and a feedback mechanism; it is an open system having qualities of emergence and self-organisation and, by diversifying its strategies, it adapts to the changing macro environment (Holland 1995).

2.6.4 Network Theory

A network is simply a collection of nodes and the links between the nodes. The links can be directed or undirected and weighted or unweighted. Barabasi reported three general models of networks, the Random, the Small World and the Scale-free (Barabási 2002; Barabási & Albert 2002). Random networks have a connected link with uniform probability. A Small World network has low probability, many local connections, and a few long-distance (many shortest paths) connections for every cluster (high clustering co-efficient) (Watts 2004). In a Small World network, even if the nodes are not connected as neighbours, the nodes can be reached with a few hops. Typical distance between randomly selected nodes L is proportional to the number of nodes N directly proportional to log N.

Small World network concepts have been applied to management to understand the group formation, and interactional dynamics. Uzzi et al. state that the 'network theory has caught on by showing how issues as wide ranging as creativity, supplier ties, referrals, collaboration, learning, trust, contracts, profits, diffusion, market signalling, entrepreneurship, externalities, price formation, imitation, and production markets can be understood using network theory, especially the small-world networks' (Uzzi, Amaral & Reed-Tsochas 2007).

Affiliation small-world (social) networks have been applied to study project organisation and emerging dynamics within project teams. A distinctive feature of affiliation networks is 'duality', meaning events can be described as collections of individuals affiliated with them, and actors can be described as collections of events with which they are affiliated (Wasserman & Faust 1994).

The proximity of two actors in a social network should be a strong indicator of interpersonal influence among the actors (Galaskiewicz & Wasserman 1993).

The primary interest in this research is to study the group behaviour and influences over the project decisions, rather than measuring factors (computational aspects) such as cluster co-efficients and centrality in the network of project participants. Complexity theory has been applied to sociology to analyse of various social phenomena including social media on the Internet (Byrne 1998a).

2.6.5 Systems Theory

There are several strands of system theory that have attempted to explain emergence and chaos. The General Systems Theory, System Dynamics, Cybernetics and Soft Systems Methodology (SSM) are based on system boundaries, feedback loops and possible human involvement as part of the interaction (Mitchell & Newman 2002). Kaufman's N_K model is a famous system model (Kauffman 1993). Extensive discussion on these theories, however, is beyond the scope of this research.

2.7 Complex Responsive Processes of Power Relating

Stacey and his associates introduced a set of conceptual constructs called Complex Responsive Process of Power Relating (CRPR) in a series of publications (Macintosh et al. 2006; Stacey 1993a; Stacey & Griffin 2005; Stacey 1991, 1993b, 1995, 1996a, 1996b, 1999, 2000a; Stacey 2000b; Stacey 2001, 2006, 2007, 2008). The essence of this conceptual framework is presented below.

Any organisation can be understood as interplay of stability and change. Teleology is a causal link, a movement to end a state − known or unknown − and a reason for the movement (Stacey 2000a). Stacey presents five teleological frames to understand causality, as shown below:

- In Natural Law teleology, the movement is towards a 'Known State'. The mechanism moves in a stable manner towards timeless stability. The movement is predictable; the interaction of parts is immaterial.
- In Formative teleology, the movement is toward a 'Known State'. The causality is of a functional formative process to reach a pre-given form.
- In Rationalistic teleology, the movement is towards a 'Known State'. The causality is due to autonomously chosen goals reflected by universal ethical principles.
- In Transformative teleology, the movement is towards an 'Un-Known State'. Here there is potential for transformation and continuity at the same time.
- In Adaptionist teleology, the movement is towards an 'Un-Known State'. The causality is based on chance-based competitive search.

Stacey argues that the existing management theories all propose a solution based on moving towards a known future, either via Formative teleology or Rationalistic teleology.

The complex responsive process of power relating is based on Transformative teleology (Stacey 2001, p. 60) (Box 3-1, p. 60), moving towards an unknown state, giving importance to conversation, dialogue, mutual construction and power relationship. The complex responsive process comprises:

- the process of action and interaction
- the action of relating
- bodily actions of communicating
- process of power relating, enabling and constraining action
- reflection upon human freedom and emergence
- varying interpretations
- bodily gestures and responses.

In process perspective, the causality is unitary and transformative. The emergence and transformation occur at the same time and the future is perpetually constructed. The process thinking focuses on relationship rather than individualistic psychology. The mind is the silent conversation and private role-play of an individual body (Mead's 'concept of mind'), based on reflexivity. The conversation can be classified as private, vocal and public.

Language and power relations play a key role in establishing and retaining social relationships. Ideology is a form of conversation as an aspect of the power relations in the group. The fundamental organising principle of conversation is turn taking. People use stories and narrative to create group realities.

Intention is a communication between people expressed in the form of symbols. Intentions emerge in relationships as a form of organising experience. An individual is free to respond to a gesture in a number of different ways. While people interact with each other, themes emerge; these consist of symbols, proto symbols and reifications, as well as propositional rules that organise the experience of being together (Stacey 1996, p. 356).

Human beings interact using symbols and symbols form themes. Themes interact with each other in a dynamic way; the organising theme of one moment emerges from the interacting theme of the previous moment. Themes are of the nature ‘both enabling and constraining’. Ideology is an organising theme that justifies or undermines the power relationship.

The organising themes can be classified as propositional/narrative, official/unofficial, formal/informal, legitimate/shadow and conscious/unconscious. Organising themes can take different forms, such as fantasies, myths, rituals, culture, gossip, rumour, speech genre, dialogues, discussions, meetings, presentations and debates.

Themes organise patterns of conversation and power relations and these patterns are analogues to attractors. Diversity of organisational themes engenders innovation and novelty and the interaction is self-organising in that meaningful patterns emerge in local interaction between people in the living present.

The main concept of CRPR is that the organisation is an emergent property of communicative interactions by power relating (Stacey 2001). The process of relating is complex and responsive in nature; the communicative interactions form and simultaneously are formed by power relationships. The future state known-unknown is perpetually constructed through these power relations.

Agency lies simultaneously within the individual as well as the group, implying the manager is an active participant supposed to be carrying out ‘emergent enquiry’ in the process of power relating, rather than standing outside as an external observer. Symbols, gestures and language play a key role in these interactions. A summary of complex responsive processes of power relating and its implications to management have been documented (Cicmil et al. 2009, pp. 80-7).

2.8 Complexity Theory applied to Management

Is there any evidence that complex adaptive systems principles are applied to management, and organisational issues?

In regards to Leadership, a framework has been presented as 'Complexity Leadership Theory' (Marion & Uhl-Bien 2001, 2007; Uhl-Bien & Marion 2009; Uhl-Bien, Marion & McKilvey 2007), highlighting a need for adaptive leadership. Marion et al. differentiate conventional leadership from complex leadership by stating that the complex leaders cultivate largely undirected interactions; they focus on global interactions rather than controlling local events, and they foster interaction to enable correlation; they enable people/work groups to work through conflicting constraints that inhibit their need preferences, and they develop skills that enable productive surprises (Marion & Uhl-Bien 2001, p. 395).

An important point noted in the above article is the mention of 'interactions', which is relevant to this research. Noting a situation in an organisation where an opportunity is presented, but the informational differences constrain participants from organising a cusp of change, Goldstein et al. recommend a framework to lead through emergence in the organisations (Goldstein, Hazy & Lichtenstein 2010, pp. 53-5).

Discussing stability, change and the participative nature of the business world, Wheatley demonstrates that the complexity theory principles such as strange attractors provide us with a mechanism to comprehend complexity in business (Wheatley et al. 2006). The organisational situations for leadership can be classified as Simple, Complex, Complicated, and Chaotic; the Cynefin framework encourages managerial experimentation and adaptive responses in complex situations (Snowden & Boone 2007).

In regards to Strategy, there are three important aspects involved: a strategy-making process, a strategy-implementation process, and performance. Though the conventional approach of strategy-making is static (done once a year by top executives), the application of complexity theory suggests that strategy making is a process of perpetual construction through engagement of the firms' stakeholders. The conventional approach to strategy is 'analyse and plan', 'reduce uncertainty' and 'minimise the variance'. However, the complexity perspective recommends that it is not necessary to focus on having an organisational equilibrium, creating open-ended choices, triggered by network activities, and marked by conflict and disagreement; rather, strategy should be a continuous process (Stacey 1995). Adaptive response is required for creating strategy in volatile business environments (Chaffee 1985).

In the conventional approach to strategy making, change of organisational environments, inaccuracy of environmental data and long-term and short-term focuses are all key challenges. The Complexity approach suggests that the strategy-making process should address these key challenges (Edmunds 2014; Frizelle & Woodcock 1995; Gregory & Ronan 2015; Hansen 2012; Hundsnes & Meyer 2006; Lane & Maxfield 1995; MacKechnie 1978; Mason 2007; McMillan & Carlisle 2007; Merry 1995; Quinn 1985).

In multi-business units, corporate strategy is about centralised control, coordination between the business units focusing on product development, marketing, and lifecycle management. Treating a multi-unit organisation as a CAS, the complexity perspective advises the use of flexibility, simple rules and context-based increased collaboration (Eisenhardt & Piezunka 2011).

In advocating simpler structures, minimal rules and increased collaboration, Cunha argues that the organisation CAS provides is a better approach to strategy-making (Cunha & Cunha 2006).

In regards to Organisation, the ever-growing size of today's modern corporation brings enormous complexity in terms of its functions and the inter-relationships between these functions. However, the response to organisational complexity could be from simple infrastructure (Cunha & Rego 2010). The process of organising can be through the perspectives of complexity science (Anderson 1999). As the organisational landscape is relentlessly shifting and evolving rapidly, the organising should have a paradigm that combines field insights with complexity theory.

Applying the complexity theory to organisational development warrants a discussion of the transitory nature of the organisation and its attempt to synchronise with continuously changing business environments. Such organisations depict a state of stability and instability at the same time, focusing on structure while being flexible to adapt to the changes around their operating environment.

Managers in these organisations demonstrate a balance between roles and responsibilities while emphasising communication and adaptability. Thus, learning is encouraged as a continuous process, keeping the feedback loops alive (Brown & Eisenhard 1997).

2.9 Critical view on application of complexity theory metaphors

I tend to concur with the opinion that, while the future is perpetually constructed by close interaction of agents with heterogeneous characteristics, agency is central to interaction. I also agree that the focus should be on relationship and on being 'both … and' at the same time. I agree with the fundamental shift from thinking as a system to thinking as a process.

In essence, the application of complexity science to management promotes agility, learning, reliance on tacit knowledge, intensive collaboration, thriving in instability and creativity.

It also indicates that there are organisational situations where extraordinary management is required and rationality, analysis and long-term planning lose their primacy. In the real world, organisations strive for stability, variance control and conformity to process. It is extremely difficult to distinguish a situation that requires rational analysis from a situation requiring extraordinary management responses such as self-organisation and sense making.

The complexity literature relies mostly on metaphors and analogy − drawing from natural sciences instead of empirical evidence; from a positivist's view, the validity of this evidence is weak. Transferring the metaphors from natural science to the social domain has its own limitations, as they differ from each other so markedly. Thus, scientific authority on using complexity theory in management is weakened. The plausible insights are balanced on unstable foundations (Rosenhead 1998).

Over-emphasis on emergence from power relations leads one to ask whether it is true that individuals do not have anything of their own 'mental frame' or possess experience, or tacit knowledge. Stacey suggests that these are free-flowing silent conversations or repetitive themes. 'Time' and 'Space' are considered in multi-dimensions of a higher degree, a difficult concept to understand.

2.10 Project Complexity Frameworks - an examination

The love of complexity without reductionism makes art; the love of complexity with reductionism makes science.

− Edward O. Wilson (Consilience: The Unity of Knowledge)

The general concepts and principles of complexity theory provided some relevance to project situations, but I was keen to see if any published literature discusses the complexity in or of projects as a framework using lenses or constructs. The discussions specific to complexity in/of projects will pave the way to developing a conceptual framework. Complexity frameworks or models are based on two distinct approaches:

a) Classification and typology based on a set of criteria and parameters,

b) Mapping certain characteristics of CAS, network behaviour and CRPR etc. to project situations as interpretive frames. Characteristics such as hierarchy, communication, control, evolutionary stages, emergence, phase transition, non-linearity, adaptiveness, sensitivity to initial conditions, and self-organisation are traced in project situations as *anecdotes*. No constructs to trace or acknowledge complexity and to cope with or respond to complexity have been proposed in these models.

2.10.1 NTCP or Diamond Model

This NTCP model (N: Novelty, T: Technology, C: Complexity, P: Pace) proposes a typology of projects based on uncertainty in terms of technology and scope. It recommends a project specific approach to project management (Shenhar & Dvir 2007a).

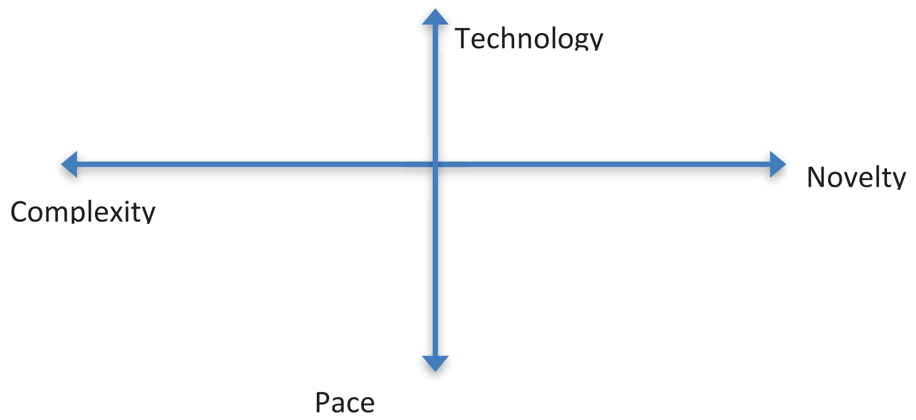


Figure 2-3 Diamond Model

Table 2-5 Diamond Model Classification

Aspects	Classifications			
Novelty	Derivative	Platform	Breakthrough	
Technology	Low	Medium	High	Super
Complexity	Array	System	Assembly	
Pace	Regular	Fast	Time Critical	Blitz

* *Coloured Columns show higher form of complexity*

This model has a hierarchical classification of systems based on uncertainty as shown in Table 2-5. There is a fundamental assumption that the uncertainty in areas of technology and system can be known at the beginning of the project. What happens if – due to changing business conditions or newfound knowledge or innovation in technology – a project changes its course and has to be classified into another category at a later stage, which then requires a change in the style of project management? This also implies that the classification of the projects needs to occur periodically at least.

The interaction, communication needs, tolerance for change, ambiguity, informational exchange and project control range from low to high, and formal to informal mechanisms, depending upon NTCP parameters as shown in Figure 2-3 Diamond Model (Shenhar & Dvir 1995; Shenhar 2001).

The diamond model does not attempt to explain the social process or emergence within project situations, nor does it examine the interaction at micro level. However, it does call for an initial classification and adaptation of a project management approach with a higher form of flexibility for projects that have achieved a breakthrough level of novelty, involve super technology, contain assembly-level integrated complex multi systems, and blitz-like fast pace. This model can be considered within the formative teleology, as the causal links are almost linear.

2.10.2 Remington & Pollack - Complexity Factors based Model

Project complexity could also be mapped into Structural Complexity, Technical Complexity, Directional Complexity and Temporal Complexity (Remington & Pollack 2007a). This model attempts to explain 'complexity' as an outcome of inherent factors *originating* in one of these four categories; it explicitly uses the word *'stems from'*. The model also suggests tools to comprehend/co-op with the complexity, though it is prescriptive. Table 2-6 captures the classification of complexity factors proposed by this model.

Table 2-6 Remington & Pollack Complexity Factors

Complexity	Origination (Remington & Pollack in their own words)	Characteristics
Technology	The complexity stems from interconnection between multiple interdependent solution options.	The project management challenges are usually associated with managing the

		critical design phases, managing contracts to deliver solutions to ill-defined design and technical problems, and managing the expectations of key stakeholders.
Direction	This kind of complexity stems from ambiguity related to multiple potential interpretations of goals and objectives.	The management challenges tend to be associated with the allocation of adequate time during the project definition (initiation of the project) to allow for sharing of meanings and revelation of hidden agendas. Managing relationships and organisational politics often become the keys to success. Political awareness and cultural sensitivity are two fundamental capabilities needed to manage these projects successfully.
Structure	The complexity in these projects stems from the difficulty in managing and keeping track of the huge number of different interconnected tasks and activities.	The major challenges come from project organisation, scheduling, interdependencies and contract management.
Temporal	This kind of complexity stems from uncertainty regarding future constraints, the expectation of change and possibly even concern regarding the future existence of the system. Temporal complexity can be found in projects, which are subjected to	Often associated with this kind of complexity are paranoia and anticipation on the part of the personnel within the organisation.

	unanticipated environmental impacts significant enough to seriously destabilise the project.	

This model is also based on uncertainty and interdependency factors, an improved version of the NTCP model; it differs in looking for complexity factors (stems from!) at micro level rather than simply classifying a project itself as one of the categories. The direction (or lack thereof) as a source of complexity has led to the inclusion of social aspects. The authors have demonstrated the model in practice, showing a project can have complexity factors from any one of these groups, and the combined effect can generate complexity in projects.

Applying this model provides an opportunity to trace 'what causes complexity in projects', and is therefore used in this research as a starting point.

2.10.3 TOE Model

In the TOE model, project complexity is traced using the classification of factors into Technical, Organisational and Environmental factors (TOE) (Bosch-Rekveldt et al. 2011). From empirical data (interviews) and literature review, 50 project factors, which are perceived to be causing complexity in projects, have been clustered into three major categories. In contrast to Remington & Pollack's model, here the factors have been grouped separately as organisational and environmental. This model does not attempt to explain the phenomenon of how these factors generate complexity in projects.

2.10.4 Goal-Method Model

In the Goal-Method model, based on the level of complexity, the projects could be classified into four types based on Direction and Methods:

- Known Goal and Known Method
- Known Goal and Unknown Method,
- Unknown Goal and Unknown Method,

- Unknown Goal and Known Method (Turner & Cochrane 1993).

The product and organisation have been mentioned, along with work breakdown structure; product breakdown structure and organisational breakdown structures have been included. When neither the goals nor the methods are well defined (ill defined), the milestone planning and configuration management have been shifted to summary level rather than detailed planning, as it is done in classical project management.

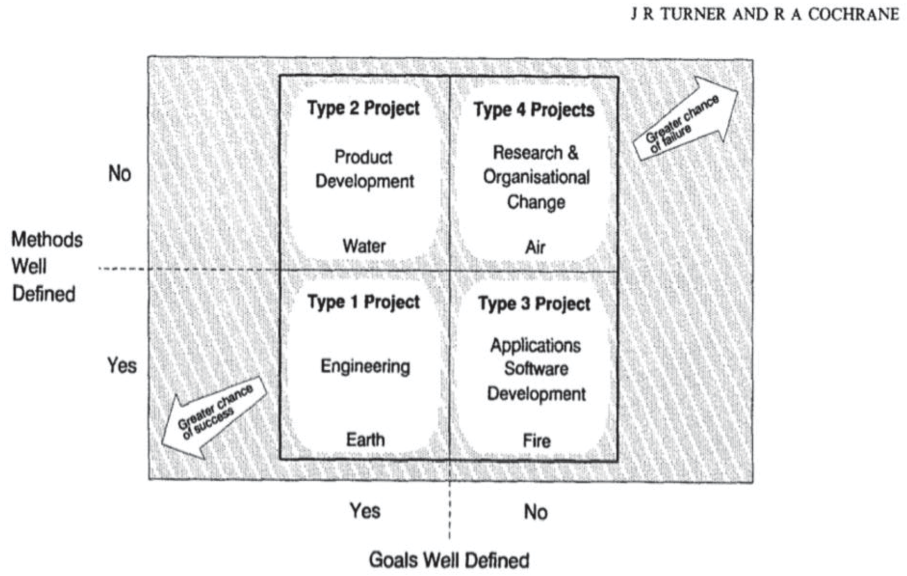


Figure 2-4 Goals & Methods – adapted from Turner et al.

It is important to note that the complexity is attributed to the process of building the product − the 'method'. In large enterprise organisations, in multi-project environments, not only the process of building the product − the method − is important but also the organisational process such as procurement, which plays a key role, and possibly can generate complexity. Again, the word 'goal' has different connotations to 'directions' as goals refer to deterministic description of the objectives, whereas direction refers to 'advised or recommended choice' within available options when a problem/impasse is encountered. In this research both perspectives are considered. Goal incongruity, goal ambiguity, goal articulation, lack of direction and concurrent multiple directions are higher granular attributes to be considered in this research.

2.10.5 Environment Classification Model

Considering synthesis as a necessary element of problem solving and availability of information in specification of the environment, the difficulties in synthesis are classified as Class I: Problem with complete description, Class II: Problem with incomplete environment description, and Class III: Problem with incomplete specification (Monostori & Ueda 2006). This is similar to the Goal-Method model of classifying the complexity, except here it is the 'problem space' that is classified instead of the 'solution space' − the method.

2.10.6 System Thinking for Project Complexity

When classifying projects as Simple, Dynamic, Complicated, and Complex, it is argued that system thinking concepts could be helpful to manage the complex projects as they involve multiple components with multiple interaction having uncertainty (Sheffield, Sankaran & Tim 2012). The classification is based on dynamic interactions and the number of components. The poject as an entity is treated as a system, with the project scope defining its boundary. The model calls for understanding the problem space defining the components, listing possible interactions and causal links, then developing responses and selecting viable options. This simplistic model, although useful for practitioners, does not depict the phenomenon by which complexity occurs in projects.

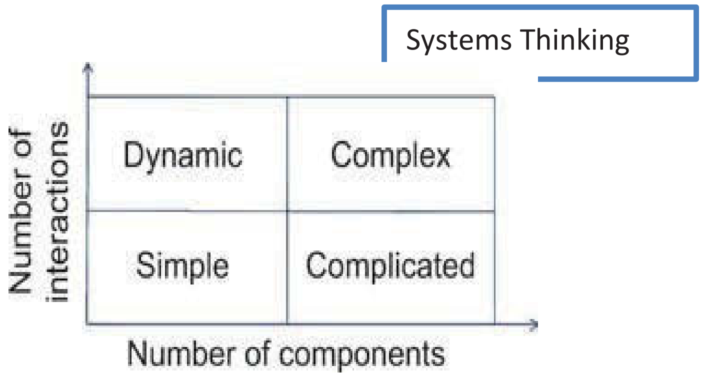


Figure 2-5 Systems Thinking-based classification adapted from Sheffield et al.

The system-thinking concepts have been applied to project concept, implementation and evaluation stages. Techniques such as rich pictures for concept stage and causal loop diagrams, behaviour over time (BOT), and system archetypes (recurring patterns) for the implementation stage are suggested to be useful. Policy analysis/scenario planning, and modelling/action learning techniques have been recommended as useful in the evaluation stage of the project. This technique is to help build viable responses to various scenarios conceived during an earlier stage.

2.10.7 MODeST Model

Maylor's view on project complexity is that simple tools should be adequate to understand project complexity and manage it through practical action (Maylor, Vidgen & Carver 2008). Project complexity factors are collected from a series of workshops and analysed in structural and dynamic dimensions. They are categorised into Mission, Organisation, Delivery, Stakeholder and Team. The projects are then treated as an organisational form. The approach is similar to the TOE model discussed earlier, however the dynamic perspectives are key differences. The classifications appear to be overlapping when comparing 'Goals' (Turner's Model), 'Directions' (Remington et .al) and the term 'Mission' used here.

This model, significantly expanded compared to earlier models, exposes the interactional criticality of Organisational issues, Process, Stakeholder Management, Manager and Team interaction as shown in Figure 2-6.

Maylor's research sets a future direction for project management practice as it advocates flexibility and dynamic dimensions to deal with complexity. The MODeST model could be applied to post-project situations, and an investigative approach. An attempt has been made to view the complexity using formative and transformative teleology as interactional/process aspects have been considered.

Adapted from Maylor et al. MODeST

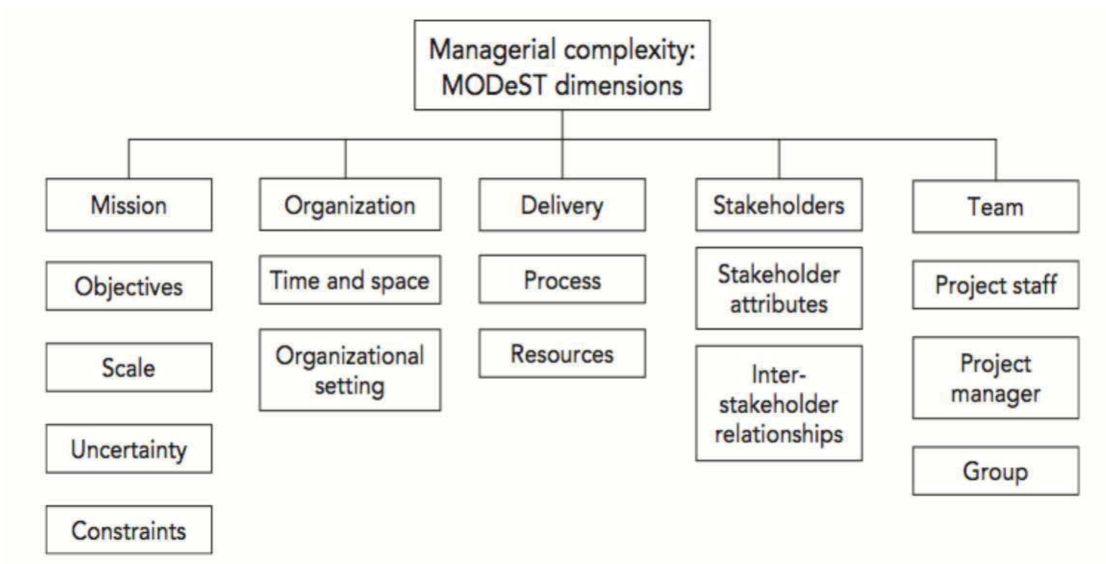


Figure 2-6 MoDeST

2.10.8 IS/IT Project Complexity

IT project complexity is classified as Dynamic and Structural, originating in IT and Organisational areas (Xia & Lee 2004, 2005). Xia et al. propose a conceptual framework, with Structural Organisational, Structural IT, Dynamic IT, and Dynamic Organisational Complexities in ISDP projects.

IS Project complexity is mapped to the co-evolutionary complex adaptive systems (CAS) model (Benbya & McKelvey 2006a, 2006b). In this model, the following constructs from CAS have been mapped into IT complexity:

- Adaptive Tension: Changing user requirements and changing stakeholder expectation. The adaptive tension between change and stability is characterised in IS projects.
- Requisite complexity: External complexity (perturbation) equates to internal complexity. It is essential to co-op with the external complexity. In IS, the more the external parameters such as business requirements change, the more the internal project (people experience) complexity increases in attempts to co-op.
- Change rate: The internal change rate, meaning flexibility and agility within the project management processes, of the project shows better co-opting mechanism with external changes when the processes are flexible. Observation, problem detection, decision-making and execution in a rapid fashion is the cycle of activities recommended.
- Modular change: the design of the project phases and products is modular so that interdependencies are managed through phases of the project.
- Positive feedback: Creating positive feedback within the IS project structures for mutual adjustments and bottom-up planning.
- Causal intricacy: Acknowledging multidirectional causal links in IT/IS projects including socio-technical, political and organisational influences.
- Coordination rhythms: top-down control and bottom-up autonomy duality found in IS/IT projects. It is entangled hierarchy that produces complexity.

Ribbers and Schoo propose three dimensions of system development complexity. The first dimension is variety, which is the multiplicity of project elements such as the number of sites affected by the system implementation. The second dimension is variability, which refers to changes in project scope and goal. The third dimension is integration and it refers to coordinating between project elements (Ribbers & Schoo 2002).

2.10.9 Project Complexity – Social Aspects

People-related issues have been noted as dominant factors in generating project complexity. Though people factors have been examined and studied in individual fashion in terms of power, politics and trust, there are only a few models that discuss these issues in collective form − the social. Here the focus should be increased to analysing and managing the stakeholder perception, communication and more engagement in comparison with task planning (Klein 2012). Referring to praxeology, 'the study of human action and conduct', Klein suggested the need to build resilience in project managers, education, knowledge management and practice development to deal with the emergent situations, calling for 'routine for non-routines' and improvisation (Klein, Biesenthal & Dehlin 2015).

Social systems are non-trivial systems, having contingency and complexity. The 'Social Other' is an essence of social design. Klein observes, *'the social can sensibly, only be thought of as an omnipresent inescapabilty' (Klein 2010).* Drawing upon the foundational concepts from Luhmanns' 'Theory of Social Systems' (TSS), Klein classifies the project organisation as temporary rather than permanent, thematically focused rather than generalist, unique rather than routine and horizontal rather than vertical. Taking practical examples of three projects, based on TSS, the following has been modelled by Klein.

Project Identity and Purpose: A project is defined by its borders, which are constructed, and subjected to variation through day-to-day operation in current and developing context (here and now). Thus, this theoretical construct encourages negotiating and co-constructing the project purpose with the stakeholders. Klein argues, 'Project has multiple identities; a project can be thought of as distinctions:

- in time, events that come before its deadline, and those that come afterwards
- thematically, those events that thematically belong to the project, and those that don't
- organisationally, those communications that are attributable to the project organisation and those that are not'.

This definition of a project shifts from one that is task-oriented deterministic to one that is interaction-based.

Decision-making: in Klein's model the focus is on the decision-making phenomenon in a project situation. The primary focus is on the process of decision-making much more than the factual rationality behind it.

People-related issues: Klein suggests that in project world, people-related issues are about perception. There is a tension between rationality and irrationality but, by drawing upon TSS, this decision is eliminated, as there is only a confirmed and a yet-to-be confirmed state. This is an initial pointer to use social theories for project interaction. It *is a critical* turning point in conceptualisation of project interaction and associated complexity, as this proposition departs from modelling complexity based on factors.

Use of CRPR

Cicmil et al. (2009) argue that CRPR provides an effective frame to analyse project complexity. The following aspects have been mapped to anecdotal project situations, to expose *'how project complexity occurs in projects':(Cicmil et al. 2009)*

- persistent ambiguity and equivocality of project goals, and contradictory and conflicting understanding of project success
- inherent unpredictability of future events
- complex multi-agency interfaces, social interaction and process of relating.

The researchers concluded that a project can be understood as follows:

a) it evolves around a particular kind of patterned conversational and power relating

b) it is a consequence of on-going communicative interaction

c) the process of power relating is responsive

d) novelty is because of diversity in projects

e) the project manager is a participant in the process of power relating.

2.11 Social Theories

Society does not consist of individuals but expresses the sum of interrelations, the relations within which these individuals stand.

-Karl Marx

It is essential to take this digression, as not only complexity science but also social theories can provide required theoretical constructs to develop an interpretive framework for project complexity. Since interaction is what engenders complexity in projects, the symbolic interactionism and sense-making theories at micro level can provide a meaningful interpretation to a project, thereby enabling us to comprehend complexity.

2.11.1 Symbolic Interactionism and other theories

In his famous book *Mind, Self and Society* (Mead & Morris 1967), Mead describes several perspectives to understand human interaction in our society. Mead argued that the worldview is created through interaction as a process − not because of structure. Consciousness is part of action and interaction. Mind is constructed through an individualised communication process.

Context of mind is only the development and product of social interaction. Humans learn to see themselves from the standpoint of their co-actors and humans take perspective of ‘others’. Mead argued further that the self and the mind could be part of a social process. The ‘me’ is the social self and the ‘I’ is the response to the ‘me’. In other words, the ‘I’ is the response of an individual to the attitudes of others, while the ‘me’ is the organised set of attitudes of others, which an individual assumes. The ‘me’ is the accumulated understanding of ‘the generalised other’; that is, how one thinks one's group perceives oneself.

The ‘I’ is the individual's impulses. The ‘I’ is self as subject; the ‘me’ is self as object. The ‘I’ is the knower; the ‘me’ is the known. The mind, or stream of thought, is the self-reflective movements of the interaction between the 'I' and the me'. These dynamics go beyond selfhood in a narrow sense, and form the basis of a theory of human cognition.

Symbolic Interactionism (Luhmann 1995a) implies that human interaction is 'the conversation' or 'exchange of gestures'. Gestures create meaning and arouse attitudes and response in others. A significant gesture is a conscious gesture, which only humans can make. Symbolic Interaction focuses on meaning; it is not only important what is said, but also such matters as how it is said and why it is said, who said it, their tone, their words and semantics. Communication connects the consciousness and the 'Social-Other' as a medium.

Luhmanns' theory of social system (TSS) provides a fundamental concept to understand the social unit − the organisation. *'An organisation is a series of specific distinctive operations processed in communication as decisions through which it distinguishes itself from its environment'*. The organisation operates through communication; the action of decision-making through conscious choice thus creates an identity for itself separate from that of the environment, while dynamically interacting with it. A specific instance of the organisation is project organisation, which is our primary focus.

Cooley's concept of 'looking-glass self' offers another perspective to the self-concept. Individuals perceive themselves in the way that others might perceive them. Mead referred to the attitude or stance others take in an interaction as 'generalised others'. Kant and Hegel also discussed in detail mind and social interaction as mutual construction (Gergen 2009). Language plays an integral part in interactions. If there is no interaction, there is no emergence of self, thus no existence of society. Sociologists use symbolic interactionism at the micro level and structural functionalism at the macro level to analyse social phenomena.

This research used concepts of 'symbolic interactionism' as philosophical grounds for discussing human interaction in projects. However, it is beyond the scope of this research to apply structural functionalism (Parsons 1951) to examine substructures such as steering committees, project governance boards, their consequent functions and associated complexity.

As a researcher, I believed that interconnectedness and interaction create complexity rather than the structures and their pre-evolved functions. Giddens' proposed theory of structuration (Jones & Karsten 2008) could have been considered, as it is relevant to analyse the social aspects in the project. My personal preference to focus on interaction led me to use concepts of symbolic interactionism as a basis for the lenses.

2.11.2 Sense Making in Organisations

Weick's famous book, *The Social Psychology of Organizing*, presented a process-oriented model based on human interaction as the central phenomenon of organising. He argued that organisations do not exist but are in the process of existing through continual streams of organised human activities. Communication is the crucial process performed by organisation members to enable ongoing organisation. Weick's model is built on three primary theoretical foundations: sociocultural evolutionary theory, information theory, and systems theory. In the communication process he postulates three constructs: enactment, selection and retention advocating equivocality (Weick 1979).

Further expanding on his model of sense making, Weick established a seven-step process of sense making as identity, construction, retrospection, enactment, socialisation, continuation, extracted cues, and plausibility. In organisational life, people who notice a cue pass through these stages and enact or trigger an action in a time-phased manner (Weick 1995). Key points taken from Weick's sense making are that organising is a continuous process achieved through interaction and the reflexivity in generating response to the noted cues.

2.12 Summary

Rational behaviour requires theory. Reactive behaviour requires only reflex action.
Deming

Project management is continuously evolving by exploring a gamut of sciences, including social science. Models represent only one spectrum, a researcher's view and a kaleidoscopic view of the project world. Project management has multiplicity; there is no single unique model to meet every project's context. New models being proposed do not replace the old models but complement and enrich them: they continue to be relevant to practicing industry (Bredillet, IRONP, 2006), (Bredillet 2009). Concepts from multiple theories, models can be adopted to suit the context.

The concepts from Complex Adaptive Systems (CAS), Complex Responsive process of power relating (CRPR), the Theory of Social Systems (TSS) and Sense Making can be considered when building a model for project complexity. As noted in the literature, classifying a project based on inherent complexity (NTCP, ISDP, Goal/Methods, TOE,) is still a normative approach. However, attributing the complexity to certain factors, and grouping the factors under a nomenclature, is an important aspect that can be considered for this research. The typology of factors as technological, directional, structural and temporal will at least provide an option to trace the complexity at its origin, even though only when complexity emanates in its static form.

I intend to use both perspectives, System and Process, while acknowledging the differentiation between them in terms of formative and transformative causal frameworks.

Pivotal concepts considered from a complex responsive process of power relating show that organisational activities are carried out through spontaneous interaction and a communicative process of power relating as a dynamic-perpetual construction, wherein a new state is co-created.

Networks and relationships − which are continuously forming − are critical aspects of how an organisation morphs into being. Affiliating networks (small-world network) will help the understanding of group behaviour in project interaction. In addition, organisational sense-making and noted reflexivity in the process of sense-making can be helpful in understanding project interactions.

There are not many project management frameworks found that connect three aspects, namely actuality, project complexity, and social process using constructs or lenses. Obviously, there is a research gap, as shown in Figure 2-7. The proposed interpretive framework attempts to fill this gap. Thus, the objective of this research can be defined as to develop frames/constructs for capturing the social complexity in IT projects, engendered because of human interaction, narrated by the research participants as their experience – ‘Actuality’. As research directions were pointing out the need to build theory from practice in the field, I started planning the field research.

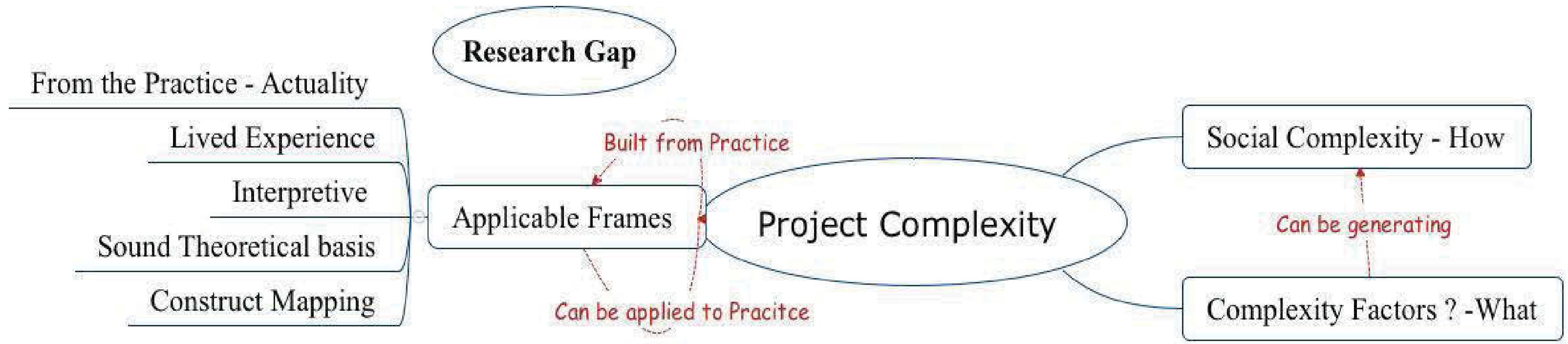


Figure 2-7 Research gap

Chapter 3 Research Design

3 Research Design

*All researchers interpret the world through some sort of conceptual lens formed by their beliefs, previous experiences, existing knowledge, and assumptions about the world and theories about knowledge and how it is accrued. The researcher's conceptual lens acts as a filter: the importance placed on the huge range of observations made in the field (choosing to record or note some observations and not others, for example) is partly determined by this filte*r.

(Carroll & Swatman 2000)

Chapter 3 presents the research paradigm, the chosen methodology and the processes used to ensure validity, minimise bias and address ethical considerations for this research.

3.1 Purpose and Question

In the literature review, a research gap was identified that highlights the need for a complementary approach to existing project management methodologies in order to deal with complexity in projects better. The application of complexity theory in project management is an emerging field. Several researchers have explored project complexity to some degree; however, the literature review did not find an interpretive framework that could explain the underpinning complexity because of human interactions in projects, through the lived experience of the practitioners (perception & experience) in IT projects.

As an emphasis had been on developing the project management theories from the experience of project participants, I intended to conduct a field study with the following research questions:

Q1: What are the factors believed to be causing complexity in IT Projects?

The objective of this research question was to list the complexity factors, as believed or perceived by the research participants. This primary aim of this explorative question was to understand how complexity is understood and defined by practitioners in the field.

An attempt was also made to apply selected theoretical constructs from literature and classify the complexity factors into these constructs. This was done to validate the findings against existing theory and look for new patterns that would contribute to new theory and understanding of complexity in projects.

Q2: How does human interaction engender social complexity in IT projects?

The objective of this research question was to capture the social interaction as it happened in a project world. The primary aim of this research question was to trace social complexity through proposed lenses from the lived experiences of the project stakeholders. The application of lenses in this research provided a window to look into what was transpiring in a project in terms of emergent events, and the dynamic constructions of various positions assumed by the project stakeholders during these events.

The lenses were applied as 'instrumental frames' to portray different worldviews created by intensive interaction of the people with diverse cultural and social backgrounds in a project context. The research participants assigned meaning in unique ways; they interpreted and made sense out of these events continuously.

The use of these lenses was expected to help the practitioners to trace and co-op with complex scenarios in projects; it also contributes to the body of project management knowledge.

3.2 The Company

This section describes the research plan, and how this research was carried out.

This research was conducted over a period of 3.5 years (mid-2009 to end 2013) in one of the largest telecommunication organisations in Australia, referred to as Xfone in this thesis, under the patronage of Program Management Office (PMO). The Chief Information Officer of Xfone permitted this research to be carried out in a formal letter sent through the company's Human Resources department. The researcher signed a Non-Disclosure Agreement stating no individuals would be referred to by name in any publications and the research participants would not be identified. Each research participant was therefore given a code name and the researcher maintains this data solely and exclusively.

Xfone is a dynamic, technology-driven organisation with approximately 7000 employees. It achieves business outcomes through projects and every year rolls out AUD $650M worth of projects. It has 16 vertical organisational units and its Singapore-based parent company has strong control over regional operations. The telecommunication industry is very competitive in Australia, as there are only three major players in the market.

The following characteristics of the organisation have significant impact on how business is conducted and projects are carried out. Xfone has virtual products, which demand simultaneous changes to organisational processes and multiple systems. Xfone has many market-customer segments, with a variety of billing processes. Customer experience is immediately reflected in revenue and churn, as a result of which the business is highly sensitive to customer experience. As new technology is frequently introduced, competitors can market with disruptive selling models. The projects experience uncertainty with resulting scope, time and cost impacts because of the inherent business characteristics.

Products are mainly packaged services and combinations of multiple services can generate numerous possibilities to create new products. Some of the products are communication equipment such as mobile telephone sets and when a product is released into the market, there is pressure to couple it with the services and reach out to the customers. The packaging of services in various forms leads to cannibalisation of existing products. The products are defined in numerous systems such as provisioning, rating, reporting and billing applications. Since the products are configured in multiple applications or systems, changing the software code can be very cumbersome.

The systems' architectural complexity stems from the high interdependency of these applications. Even though the software development takes place in separate hardware system platforms, integration testing and releasing the application (software code) into production environments requires adjustments to various events, such as application downtime, through dynamic release management. The line managers exercise control over their resources and pipeline of projects. However, when multiple projects are running in this organisation, they compete for the same resources at the same time.

The firm has different organisational units (CFUs) to cater to customer segments, based on size and product groups. The CFUs display a unique culture driven by key performance indices associated with the customer segments. Market segments are created based on factors such as customer age, topography, data and usage requirements.

The usage is captured through the telecommunications networks in real time. However, because the billing takes place in a periodical fashion, the billing period is different from the usage-collected period. This difference in transactions complicates various business processes of reconciliation and billing accuracy.

Competitors of Xfone create products and services to disrupt the market. Whenever such market disruption occurs, urgency is realised to respond to the competition. This urgency is transferred down to the system development effort. Thus, the system development projects, some of which are considered emergency responses to the market, take precedence in the priority of delivery. In the telecommunication industry, the quality of service in terms of the product and the level of billing accuracy, timeliness and reporting features are critical factors in measuring the customer experience. The Net Promoter Score (NPS), an indicator of customer satisfaction, is collected from customer surveys and reported every quarter.

Technological introduction in terms of new products creates a change in consumer behaviour. The organisation places vital importance on customer experience and relies on aggressive marketing. The products from every telecommunication service provider can be sold to only a finite number of populations in Australia. Government regulations impose certain mandatory conditions to customer engagement processes, such as billing and reporting.

Xfone has a PMO set-up primarily to focus on process improvements, governance, quality assurance, and improvement to project management methodology. Xfone often undergoes organisational restructure, which changes its work culture, promoting different sets of values, such as ‘innovation’, ‘agility’ etc. This organisation can be considered highly dynamic and operates in volatile market. At every facet of its operations, a paradoxical tension exists between stability and agility.

The research theme of exploring project complexity and forming a framework based on complexity theory principles was an appealing proposition to Xfone, as there was chaos and occasional failures, despite applying a tailored version of project management methodology based on PMBOK.

3.3 Stages

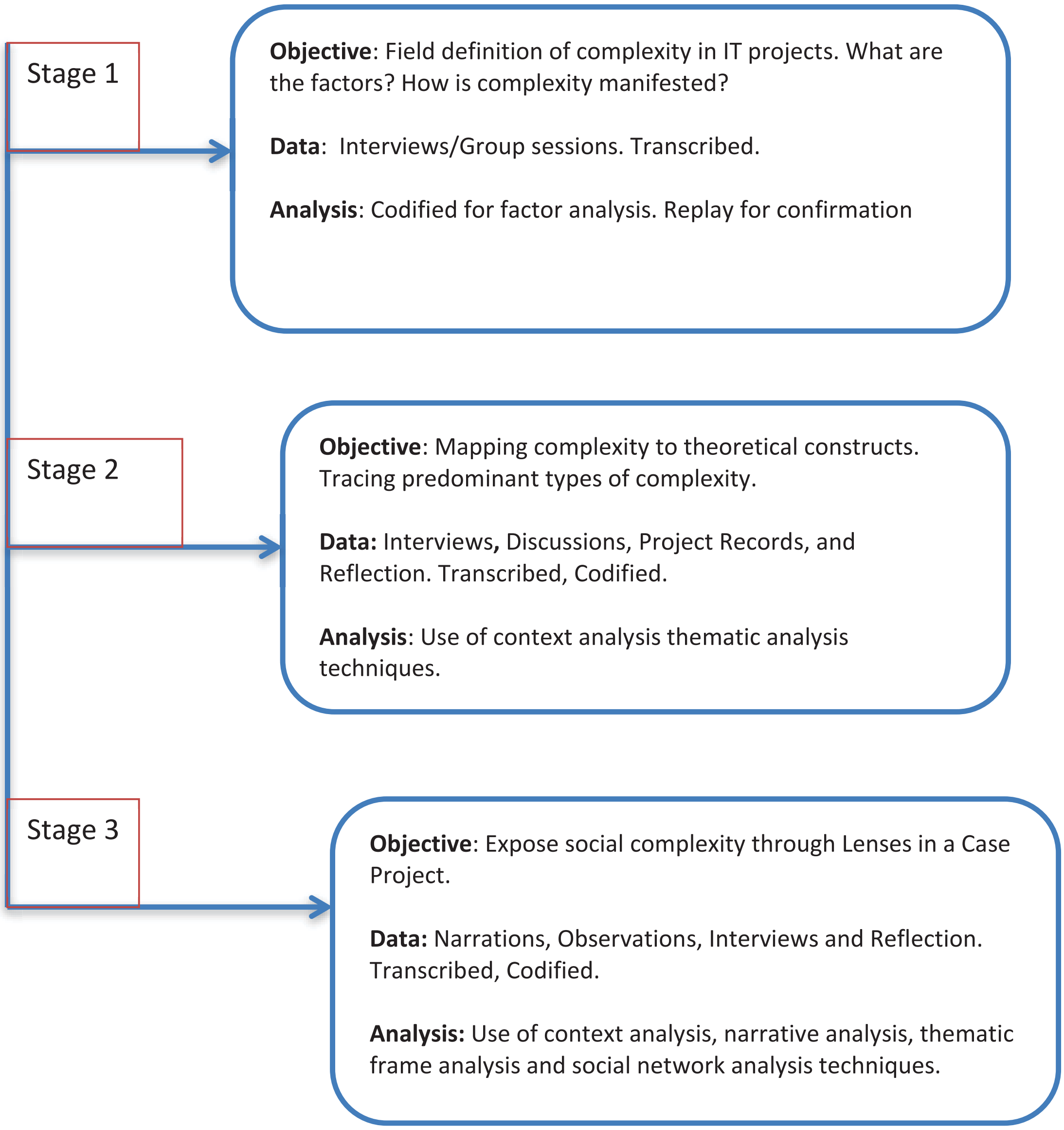


Figure 3-1 Research Stages

This research was carried out in three stages, as described in Figure 3-1. In the first stage, the definition of complexity as perceived or believed by the research participants was elicited through interviews. In the second stage, the interviews focussed on identifying the factors believed to be causing complexity and were classified using theoretical constructs. In the third stage, the narrations and event observations were captured in a case project and subjected to detailed analysis for developing the lenses.

3.4 Paradigm

3.4.1 Qualitative Research

The objective to capture the phenomena that transpire in the field and to build a theory from the practice requires a suitable research methodology. The research methodology without compromising the rigour should enable the researcher to be an active participant instead of a passive observer. The inquiry into 'how' social complexity is generated and experienced through various unfolding stages warrants qualitative approach. The research methodology should be compatible with the overall research objective and the phenomena under investigation, and with the ontological and epistemological perspectives suggested by the theories-in-use (Patton 1980)

The discipline of qualitative research provides many options to conduct this research with the appropriate rigour and validity. Qualitative research is multi-method research, uses a naturalistic approach, is highly descriptive, and emphasises the social construction of reality (Denzin & Lincoln 1994). By focusing on the human perspective, qualitative research addresses how social experience is created and meaning is given. It confronts everyday societal life and, above all, produces insights that quantitative research cannot produce (Guba & Lincoln 1994).

In qualitative research, the researcher should adopt a stance suggested by the characteristics of the naturalistic paradigm, should possess a level of skill and prepare the research design that utilises accepted strategies (Lincoln & Guba 1985). The researcher should have a *theoretical sensitivity* – an ability acquired through professional education and experience to interpret and assign meaning to the data collected through interviews and observations (Strauss & Corbin 1990b).

As a practicing project manager and having formal qualifications in project management, I have this theoretical sensitivity required to interpret the data in a meaningful fashion.

3.4.2 Selecting a paradigm

The research design needed to address three aspects of research: the research paradigm, the methodology, and the techniques to collect and process the data. A paradigm is a set of basic beliefs; it represents a world view (Guba & Lincoln 1994). Paradigms represent the researcher's view of reality and the philosophical stance adopted by the researcher (Easterby-Smith 1997).

The paradigm should address three basic questions:

- **Ontology:** What is the form and nature of reality is the ontological question, what is the nature of the relationship between the knower, the researcher, and the known? Ontology is the theory of being and refers to the approach connected to a particular social inquiry (Healy & Perry 2000).

- **Epistemology:** 'What can be known?' is the epistemological question. Epistemology is the theory of knowing, the way the knowledge can be gained about the reality.

- **Methodology:** 'How can the researcher go about finding this?' is the methodological question. Methodology is the way the theories are built and tested.

According to Guba and Lincoln (1985, 1994), a research can be placed, in general, within four well-established paradigms: Positivism, Post-Positivism, Critical Theory and Constructionism.

Positivism is concerned about proving and disproving hypotheses by hard facts, and Post-Positivism is concerned about the causes that influence the outcome. In both positivism and post-positivism, the researcher is an external observer separated from reality.

Positivism and post-positivism are suitable when the parameters are tangible to measure and for questions that ask 'What?' and 'How many?' The context of the research is masked. Quantitative methods are employed with discrete experiments. Empirical evidence is mainly collected with a view to proving or disproving the research hypotheses. Positivist and post-positivist paradigms with quantitative methods are unsuitable because of the fluid, explorative nature of this research.

Critical Theory believes in virtual reality and attempts to focus on political, cultural and ethnic factors. The researcher attempts to cause a change. This paradigm is suitable when the research has an action agenda attempting to influence the outcome (Fay 1987). Critical theory may not have been suitable for this research, as the research objective did not contain any action element; nor did it aim to cause a change in the phenomenon or process under study.

Constructionist or interpretive approaches state that reality is socially constructed through inter-subjective interaction. The meaning is attributed through the interaction. This paradigm defines the nature of the 'lived experience', the researcher's place in it, and the range of possible relationships the researcher has to that world and the phenomena that constitute it. This approach considers reality as an intangible mental construction, socially and experientially based. This paradigm posits that there are multiple realities, which cannot be easily deciphered by a rational process. The ontological basis of the constructionist paradigm is that the relationship between *anything known and the mind of the knower are intertwined*. In epistemological terms, *the investigator is linked to the object of investigation and is part of the investigative process*. In methodological terms, the constructivist prefers to *apply discussion- and interaction-based methodologies*. The primary focus of the constructivist is a) to develop interaction-based constructions between investigator and respondent, b) to apply hermeneutical techniques compared and contrasted in dialectic exchange and c) to trace consensus and distillation to build on previous knowledge.

The final aim of this paradigm is to elicit in-depth, sophisticated constructions, namely meta-level interpretations on the part of the researcher. (Guba & Lincoln 1994).

Interpretive research helps to understand the actual production of meanings, sense making and concepts used by social actors in real settings. In adopting a relativist stance, it assumes diverse meanings exist and it helps us understand how people respond to the objective world (Bleicher 1980). Knowledge is gained through transactional and subjective events analysis. The philosophical basis of interpretive research is hermeneutics and phenomenology (Schwandt 1994). Interpretive research does not predefine dependent and independent variables but focuses on the full complexity of human sense making as the situation emerges (Kaplan & Maxwell 1994). The act of inquiry in interpretivist research begins with the issues and/or concerns of participants; it unfolds through a dialectic of iteration, analysis, critique, reiteration, re-analysis, and so on, and leads eventually to a joint construction of a case.

Table 3-1 Key aspects of research paradigms (Guba and Lincoln 1994, p.106)

Item	Positivism	Post Positivism	Critical Theory	Constructionist
Ontology	Naïve realism – reality apprehensible.	Realism – imperfectly apprehensible	Historical realism – virtual reality shaped by social, political, cultural, economic, ethnic and gender values	Relativism – local and specific, constructed.
Epistemology	Dualist/objectivist findings are true	Modified dualist, objectivist, critical tradition/community findings probably true	Transactional / subjectivist / value-mediated findings.	Transactional/ subjectivist, created findings.
Methodology	Experimental, manipulative, verification of hypotheses	Modified experimental/manipulative critical multiplism. Falsification of hypotheses, may include qualitative methods	Dialogical/ dialectical	Hermeneutical / dialectical.

It is very important to check the relevance of a paradigm to the research question. IT projects are executed in a social context; therefore, capturing social events, and analysing them with a holistic view, is possible by selecting the *constructivist/ interpretivist* paradigm. The pluralistic, interpretivist research methods are congruent with IT/IS research due to the techno-social domains involved in it (Mingers 2001). This study is explorative as well as explanatory in nature and the findings are subjective. It can be considered as explorative, as an attempt is being made to increase the understanding of project complexity. This study can be considered as explanatory, as an attempt is being made to explain the phenomenon - the experience of complexity and build theory from the actuality of projects The researcher (myself) and the participants (project managers, architects and solution designers) are part and parcel of the research field; the way they interpret events, and the inferences they draw, contribute to the development of the theoretical frames. They cannot be isolated from this reality.

A constructionist-interpretivist paradigm with qualitative methods is suitable for this research due to its fluid context, spontaneous actions and emergent events under study.

3.5 Methodology

3.5.1 Ethnography

Ethnography is concerned with people's everyday behaviour in a social setting, with data collected from conversations and observation in unstructured raw form (Silverman 1993). Analysis involves its interpretation and assigning meanings (Hammersley & Atkinson 1995).

Table 3-2 Comparison of methodologies within each paradigm

Type of Research Question	Strategy	Paradigm	Method	Other Data Sources
Meaning questions	Phenomenology	Philosophy	Audio-taped conversations, written anecdotes, personal experience	Literature, reflections, poetry
Descriptive questions beliefs, practices, cultural groups	Ethnography	Anthropology	Unstructured interviews, participant observations, field notes	Documents, records, photography, maps, genealogy, social network diagram
Process questions, experience over time or change may have stages and phases.	Grounded theory	Sociology symbolic interactionism	Interviews	Participant observation
Behavioural questions	Participant observations	Anthropology	Observation, field notes	Interviews, photography

Source: *Handbook of Qualitative Research*, p. 224 Guba and Lincoln 1994 p. 112

As this research is placed in the constructionist-interpretivist paradigm, ethnography will provide an opportunity to obtain enriched data by studying the project management phenomenon, and observing the project managers, architects, developers and designers performing their tasks in real-world projects. Profiling and capturing the tacit knowledge through close interaction with the research participants about their interpretation of various events using the lenses can help to address the research theme better.

Ethnography has two paradoxes: the first is the gap between what people say and what they do. The second is participant observation because, when researchers immerse themselves in social reality and acquire a way of behaving that is like that of their subjects (going native!), it is difficult for them to grasp the differences. Here, the '*etic' (outsider)* and '*emic' (insider)* views are discussed. In 'etic view', the phenomenon and the people being observed are treated as the external to observation and the observation is purely objective.

In ‘emic’ view, the observer is familiar with the phenomenon, and reports the phenomenon as an insider. As a researcher, I propose to use an ‘emic’ view, using *‘participant-observer’ mode,* carrying out the research while being one of the project participants. Humphreys (1975) advocates using covert observation while participating and observing without informing the subjects so that their behaviour is not impacted by the observation. In this research, a covert approach may lead to suspicion. Therefore, it is not desirable.

Participant observation mode has a few disadvantages; once the researcher identifies him/herself with the group, it is difficult for him/her to separate from the rituals and special meanings assigned by the group. In some cases, the researcher digresses from the research objectives and attempts to advocate for the social cause of the problem being studied. In some extreme cases, participant-observer mode also exposes the researcher to ‘facts’ about the groups under study, which can lead to a conflict between confidentiality and the laws of the state. The behaviour of the researcher during observation is vital to have continued access to the group; once the group becomes cynical about the researcher, the researcher may be excluded or even exposed to some form of danger.

In this research, a cautious approach was taken when recording the events observed and in interpreting those events. Because this research was not focusing on any negative social phenomenon, such as juvenile crime or drug habits, the researcher was unlikely to be exposed to any danger.

The ethnographer may sample settings, context, time, people and events. In this research, the setting was organisations and the context was project complexity and emergence. In qualitative research, purposeful diverse samples can be used in order to capture rich divergent data from different categories. Sampling strategies suggested by the literature for qualitative studies include convenience, judgmental, maximum variation, deviant, key informant, snowball and confirming-disconfirming samples (Marshall 1996).

Multiple methods can be adopted for a research project to offset the bias and limitations in any one of the chosen methods. Triangulation is a technique when multiple methods are engaged to converge the findings (Creswell 1994).

3.5.2 Case Study

Yin (2009) defines the case study research method 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 evidences are used. A single case study is selected to code in-depth analysis of an unusual phenomenon where the access is possible (Yin 2004). A single case study can provide rich description and the opportunity to trace the intricacies; multiple case studies are better for theory building and generalisation. A single case study as a purposeful sample provides a continuum and depth to an account as a unit of research (Silverman 2000). The case study research method is particularly well suited to IS/IT projects as the objective is to study a real-time phenomenon that also involves social aspects (Benbasat, Goldstein & Mead 1987).

For this reason, a single case project was considered for studying the interaction among the project participants, other organisational members and wider stakeholder community.

3.5.3 Interviews

Qualitative interviews allow the researcher and respondent to move back and forth in time, to reconstruct the past, interpret the present and predict the future (Guba & Lincoln 1994). Informal conversation and an open-ended interviewing approach are suitable techniques for explorative research (Patton 1990). Both techniques were employed in this research to persuade the participants to share their experiences.

3.5.4 Events Observation

Observation is capturing events systematically and in detail, along with their context, enabling researchers to discover the here-and-now workings of an environment. The researcher can play possibly several roles, namely formal and/or informal, concealed and/or revealed, passive and/or active mode (Erlandson 1993; Patton 1990). For this research, the events in the case projects were observed in active and informal mode.

3.6 Data Analysis Process

The design approach for data analysis can be broadly arranged within four major inquiry types, namely, iterative (hermeneutic), subjective, investigative (semiotic), and enumerative. Ethnography is a form of iterative inquiry. This section focuses on data analysis. Silverman (2000) presents a pragmatic view by comparing traditional ethnography with recent modes of ethno-methodologies, advising the researcher to look for deeper meanings to events, rituals and language observed.

For this research, I chose a few data analysis techniques suggested by classical ethnography:

- event analysis
- social network analysis (SNA)
- context analysis
- narrative analysis
- grounded theory, using techniques such as open, axial and selective coding and memos as reflections.

SNA identifies the relationships between people in the groups under observation and looks for the structure of the group and the positions of its members. Event analysis focuses on special events detected during the thematic analysis by identifying the impacts of events on the culture being observed. I used a context diagram for text, transcribed interviews analysis.

3.6.1 Grounded Theory

Grounded Theory enables the researcher to develop a theory from practice by developing it in the course of debates and discourses with participants. Codifying and memo writing are widely-used tools in Grounded Theory (Strauss & Corbin 1990a). This research used grounded theory techniques like coding and memo writing, context analysis and thematic analysis.

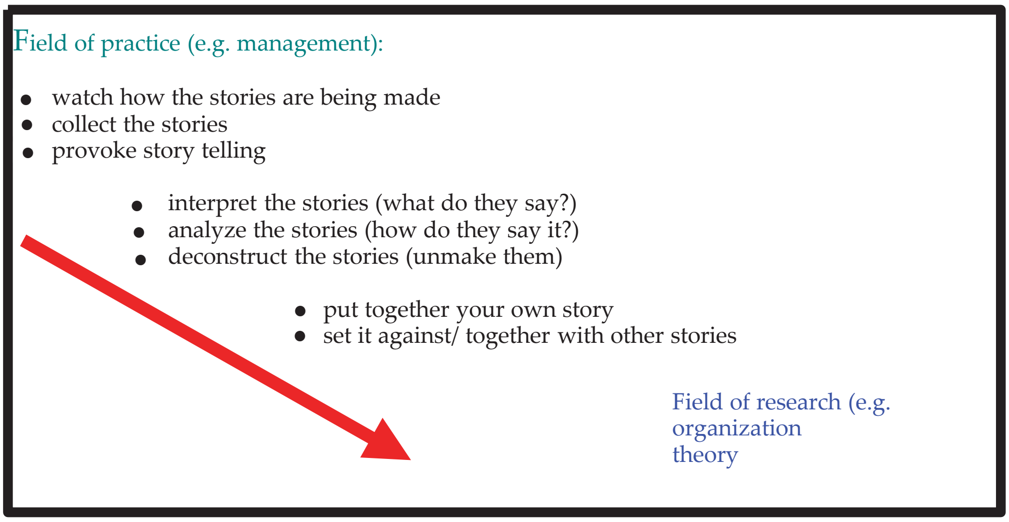
Open coding, that is, analysing the data line by line and word by word, and examining it carefully, generated emerging concepts and patterns. Axial coding and selective coding traced the predominant themes. Memos (my reflections) were records of indicators and categories developed through the collected data and my own experience. The memos helped to link the indicators to categories and generate theory.

A project itself is a macro event. Within the project that I observed there were a number of micro events, such as project milestone celebrations, team get-togethers and group lunches. Event analysis also provides insight into social interaction, power play and dominant sub-clan identifications within a project team. Events can be the culmination point for emergence and complexity, leading to unique patterns in the project caused by social construction.

3.6.2 Narrative Analysis

Narrative analysis provides a means to organise the emerging themes within the organisational context. Both physical and verbal actions in day-to-day organisational life can be organised through narratives using characters and plots (Czarniawska & Gagliardi 2003). Explication (what is being said here) and Explanation (how it is said and deconstruction of the story) are two viewpoints through which to analyse the story (Czarniawska 2000, p. 17). Narrative analysis is not only a way of finding out how people frame, remember and report their experiences but also allows a glimpse into the complexities of human lives, selves and endeavours (Seale et al. 2004, p. 117).

Figure 3-2 shows how narratives collected from practice can lead to theoretical constructs.



The uses of narrative in social science research (adapted from Czarniawska 1999a)

Figure 3-2 Narrative Analysis

Integration of data analysis is achieved through verifying the *emerging themes, the concepts and the metaphors across various techniques*. For example, if a theme is detected and tagged during the data analysis using a context diagram, the detected theme is verified and confirmed in data analysis using text analysis of the documents.

The data analysis process is described in flowchart Figure 3-3 shown below; the left side of the diagram depicts the data analysis process in Stage 1 and Stage 2. The data analysis process employed in the case project is depicted on the right side of the diagram. The research findings are combined into a final summary.

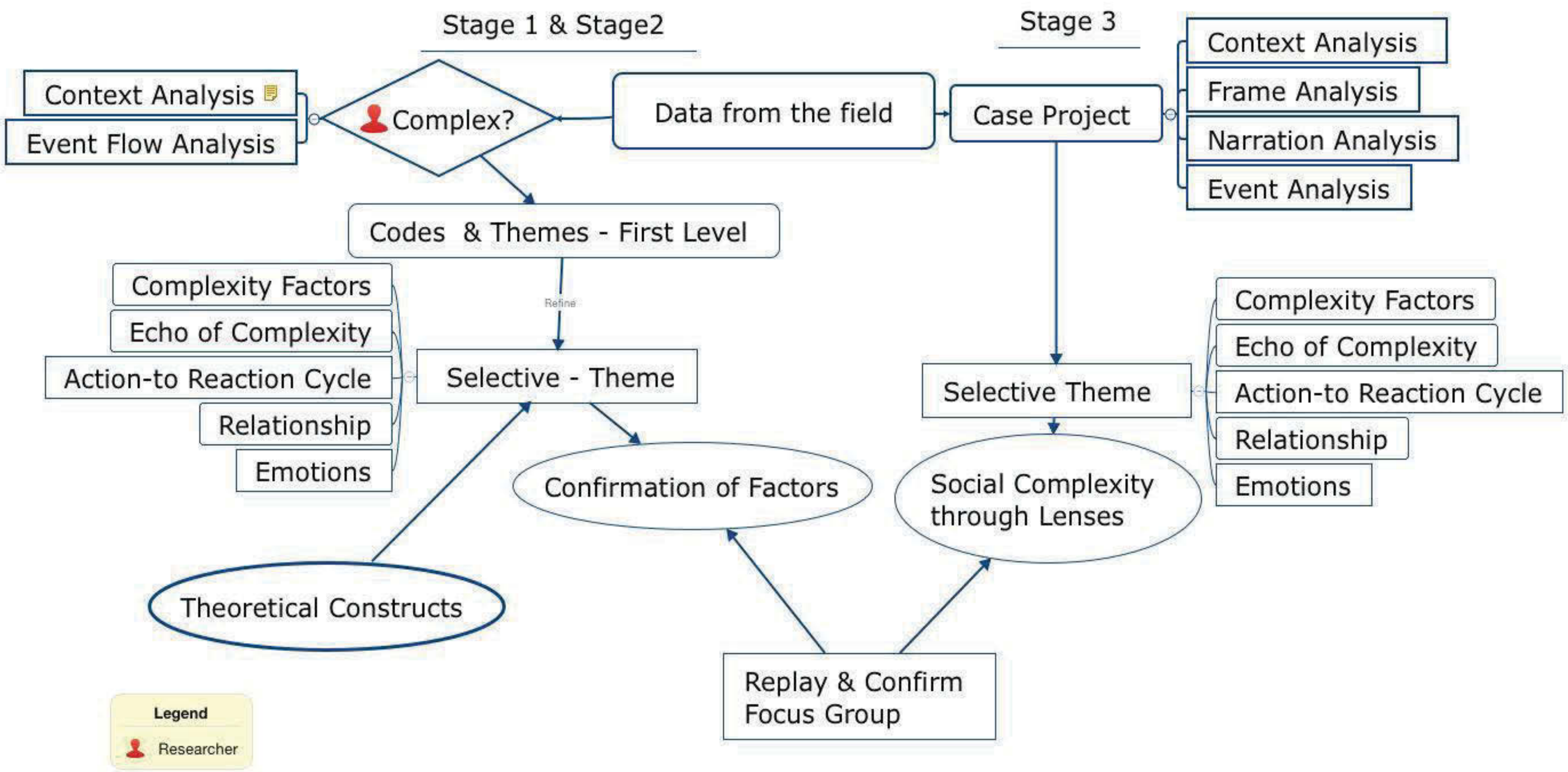


Figure 3-3 Data Analysis Process

3.7 Documentation (Captions)

The research question '*what* are the complexity factors?' led to analysis of the data according to the following categories:

- Complexity Factors (CF) - What are the factors believed to generate complexity?
- Echo of Complexity (EC) – Where does the complexity manifest itself?

The research question '*how* is complexity generated?' led to analysis of the data according to these categories:

- Action to Reaction (AR) – Action is triggered in complex scenarios. In turn there is reaction by the stakeholders.
- Relationship (R) – What type of relationship is in play during complex scenarios? Formal or informal relationships? Do these relationships bring complexity?
- Emotions (Fe) – What are the emotions experienced by the project team or stakeholders in complex scenarios?

3.8 Validity

For quantitative methods the validity criteria are defined by internal, construct and statistical validity (Bryman & Burgess 1994). The validity in qualitative research has been debated and various constructs have been proposed to demonstrate the credibility and relevance of the research. Validity is about the accuracy and reliability of an account. If an account describes a phenomenon intended to be observed within a specific field accurately, it would be considered valid (Hammersley 1992).

In qualitative research, validity stems from the *'trustworthiness'* of the source of narration – the person who is narrating the account (Guba & Lincoln 1994). Credibility, transferability, dependability and confirmability are all described as validity criteria in qualitative research (Guba & Lincoln 1994; Hammersley 1992; Healy & Perry 2000). The use of multiple approaches to check validity increases the credibility of the research (Creswell & Miller 2000).

Naturalistic research believes in multiple realities and its credibility depends upon the richness of the information gathered and structured, consistent and rigorous analysis applied. Credibility can be enhanced through triangulation of the data. Patton (1990) defines four types of triangulation: 1) methods 2) data 3) triangulation through multiple analyses and 4) theory. Theory triangulation enables a researcher to verify findings by adopting multiple perspectives (Yin 1994); this helps the researcher capture different perspectives of the same phenomenon (Denzin & Lincoln 1994; Yin 1994).

Regarding transferability in qualitative research, the researcher can provide only information that is relevant to the research; the reader determines its suitability to the context.

The use of an 'inquiry audit', in which reviewers examine both the process and the product of the research for consistency, can enhance conformability. The audit trail can consist of 1) raw data 2) analysis notes 3) reconstruction and synthesis products 4) process notes 5) personal notes and 6) preliminary developmental information (Guba & Lincoln 1994, pp. 317-21).

In order to enhance construct validity in case studies, there must be a clear chain of evidence to allow readers to reconstruct how the researcher went from the initial research questions to the final conclusions (Yin, 1994: 102).

In qualitative research, theoretical generalisation is possible, not by population but by applicability of the research findings to similar situations and context by another researcher. The characteristics of naturalistic inquiry differ from rationalistic inquiry; therefore it should have rigour and authenticity to be considered worthwhile. The standards and criteria applied at the end of the study to 'judge' the rigour does not guarantee quality; instead, steps to assure rigour must be applied consistently throughout the research project (Myers 1997).

'Pragmatic validation [of qualitative research] means that the perspective presented is judged by its relevance to and use by those to whom it is presented: their perspective and actions joined to the [researcher's] perspective and actions' (Patton 1990, p. 485)

The following lenses can be applied in showing the validity of a qualitative research project:

- Lens of the researcher: the researcher visits the data frequently to make sense, trace patterns. This lens is about the researcher's perception and development of multiple viewpoints through a sense making process. This lens is associated with credibility.

- Lens of the study participants: this lens focuses on participants' perceptions of constructed reality and how accurately their stories are represented.

- Lens of people external to the study (reviewers, readers): external reviewers can help to check the validity of the narrations and recounts.

The following validity checks were considered in this research:

Table 3-3 Validity check plan

Validity check Plan				
Paradigm	Lenses	Validity Check	Description	Plan for validity in this research
Constructionist paradigm (selected for this research)	Researcher	Disconfirming evidence	Forming preliminary themes and looking into data confirming or disconfirming the themes using the perception of the researcher.	Preliminary themes based on researcher's experience were formed. The research data was mapped onto these themes to check if they were valid themes.
	Study participants	Prolonged engagement in the field	Solidifies evidence and obtain pluralistic perspectives by remaining in the field	The data was collected during entire course of the case project

			for longer time.	typically spanning 8 to 28 calendar months' duration.
	People external to the study	Thick, rich description	Deep, detailed, dense accounts with background information and expressive language, so that a judgment could be made by the reader of its credibility.	Interviews were captured as voice recordings. Interview transcriptions, event descriptions were used as such in data analysis and discussions so that a reader could make their own reconstruction of the story according to their perception.
Critical paradigm (not selected for this research)	Researcher	Member checking	Taking the data back to the participants to check if the accounts made sense and the themes, inferences were meaningful to the context.	Focus group discussion was conducted. Verification through group presentation and confirmation by using questionnaire was carried out.
	Study participants	Researcher reflexivity	Using an interpretive commentary to capture researcher's reflection	In data analysis, the researcher's reflection has been noted explicitly.
	People external to the study	Peer debriefing	External person close to the research field, checks on meaningfulness of the accounts.	A research cohort (BXRe) reflected on the narratives and observations and commented upon them.

Lens of the researcher

I have twenty years' project management experience and therefore I comprehended the narratives of the research participants. Having studied project management at postgraduate level, and being familiar with IT and complexity, I am well versed in base theories due to my academic qualification, Masters in

Project Management, and my certifications, PMP and MSP. As a practicing project manager, I have tailored and applied multiple project management methodologies, such as Waterfall, Agile, PMBOK and PRINCE2 within PMO governance regimes. I also have adequate sensitivity. Through my professional memberships, I have access to the relevant project management professional bodies. Therefore, my perception of the events in this research was relevant and meaningful to the field being observed.

Lens of participants

The research participants had adequate base knowledge, extensive experience and professional integrity. Their voluntary participation demonstrated their commitment to the development of the project management profession. The organisational context and scope of this study could be delineated by a definition of the projects and individuals participating in the research. Therefore, the research participant's narratives and stories were a representation of their real-time experience.

Lens of external reviewer

It was agreed to have a research cohort within the organisation with whom the researcher would discuss the research themes. A focus group discussion was also planned to validate the inferences. The PMO manager acted as my research cohort and reflected upon my findings. A focus group session was held in final stage of the research in the Faculty of Design, Architecture and Building at UTS in 2015.

Data collection

I ensured that the data collection process and data analysis tools were designed to give the research adequate rigour. The data collection and analysis was carried out in three stages. The data was captured as voice recordings or handwritten notes and the text was carefully studied and codified.

The verification process was transparent to ensure the integrity of the findings, and these findings were presented to the participants for their comments. These comments helped to balance (offset) the bias and improve understanding of the data. Table 3-4 describes the validity checks planned in this research.

Table 3-4 Validity checks

Validity Criteria	Description	Plan for validity check in this research
Credibility	Prolonged engagement in the field, persistent observation, rechecking the preliminary themes in the data.	The researcher was engaged in collecting and recording the data, refining the themes and replaying the inferences to the participants for more than a year. As shown above, the researcher and participants were trustworthy because of their experience in the field and professional commitment.
Transferability	Evaluated by reader – the inferences were sufficiently similar to their own experience and made sense to them.	A focus group was conducted to obtain their view (verification) of the findings. Focus group observations on research themes are presented as part of the research.
Dependability	Established through a dependability audit	A form of dependability check was carried out through verification of the findings with three senior managers who were external to the research.
Confirmability	Assertions, constructions could be traced to their sources.	The research participants were identified through codes (IDs). The voice records were tagged and the narrations indexed.

3.9 Bias

Interpretive research begins and ends with the biography of the researcher (Denzin & Lincoln 1994). Bias in qualitative research can occur in many forms for various reasons. Bias is a systematic error introduced in research findings or reporting of the findings with an intention, conscious or unconscious, by either the participant or the researcher.

In this research, the samples were collected from multiple sources and the data was analysed using different techniques to reduce the effects of bias. The interviews focused on all aspects: neutrality, refutation and affirmation. The *informant bias* was balanced by including participants from multiple roles and organisational units. The *response bias* was minimised by providing a multi-dimensional, open-ended research theme to the participants, rather than focusing on one aspect of the theme. The *reporting bias* was balanced by focus group discussion, constructively criticising the findings and commenting upon the conclusions. Field notes classified the information/description of the events, such as observation, interpretation and participant statement, and the researcher's interpretation. Table 3-5 shows the bias mitigation plan applied in this research.

Table 3-5 Bias Mitigation Plan

Bias	Description	Mitigation Plan
Selection Bias	Selecting only samples or extreme cases to confirm the theory while ignoring anti-theory possibilities.	Even though the participants were selected through a letter of invitation, the interviews were conducted with the same set of prompting questions. In the case project, all narrations and observations were considered for data analysis without any filtering criteria.
Informant Bias	Informants may have had a certain degree of exaggeration or wishful thinking or stating what could have happened rather than what happened, as this research provided an opportunity to vent their feelings.	I do acknowledge this research may have a certain degree of informant bias. The data was analysed using multiple techniques so that any extreme, unrealistically opinionated and strong views could be tracked. An attempt was made to talk to people who had either participated or witnessed that event. Email trails regarding the same events were traced to ensure authenticity of reporting.

Response Bias	Prompting an expected response.	Open-ended questions were used so that the response could be natural rather than guided. A group session was held to confirm or refute the findings on complexity factors. In a focus group session held at UTS, the findings were collectively analysed.
Reporting Bias	Bias while reporting the observations in terms of articulation, structure and language.	I do acknowledge this research may have reporting bias, because of my language limitations. Additionally, as I am a project manager by profession, I could have misinterpreted or assigned meanings because of my own PM experience

3.10 Ethical Issues

In ethnographic research, many ethical issues have to be dealt with, including obtaining informed consent, avoiding deception, and ensuring the right to necessary information (Bryman 2001). Ethical clearance was obtained by applying to UTS' Human Research Ethics Committee prior to starting the research. The University Ethics Committee Approval was obtained. The ethics clearance number is UTS HREC REF NO. 2010-193A/June 2010

The research participants were enrolled with their consent after briefing about the objectives of the research. The consent was reconfirmed at different stages. The participants had the freedom to withdraw from the research at any time they wished without any obligation to the research project.

Trying to enter into the others' (research participants') world may have had an element of intrusion into their privacy. The research techniques used were carefully designed in consultation with my supervisor to ensure that they were not obtrusive. The discourses were free-flowing conversations. A certain degree of pervasiveness would exist in ethnographic research (Hammersley & Atkinson 1995).

Project participants' anonymity has been maintained in every report. The research participants were free to express their opinions. All research participants were treated equally and their comments were given due consideration. Organisational permission was sought and confidentiality and non-disclosure agreements were signed with individual participants about not disclosing any of their observation to the management. A non-disclosure agreement with the organisation ensured that no organisational information was revealed to any outside agency.

3.11 Summary

Design is not just what it looks like and feels like. Design is how it works.

- Steve Jobs

In summary, this research adopted qualitative methodology, as it was the most suitable option for the explorative nature of the research objectives. The research was carried out in the light of an interpretivist and constructionist paradigm, in participant observer mode. The discipline of ethnography was consistently applied. A single case study was chosen for close observation and to capture the rich narrations. The data was collected through persuasive interviews, narrations and recorded event observations and presented in a structured fashion, using the captions as discussed in section 3-7. Concepts of grounded theory and narrative analysis techniques were employed.

To ensure validity, verification of data and reporting were carried out, as shown in Table 3-4. Rigour in this study can be attributed to 'trustworthiness' and the consistent application of constructivist techniques throughout the research.

In this research, trustworthiness was established by ensuring that:

a) the findings were credible; the subject was correctly identified, described through detailed observation for a long time

b) the findings were transferable; a purposive sample was chosen and through thick description of the phenomenon, detailed documentation was carried out

c) the findings were reliable; an audit trail was provided through indexing and tagging of the voice records, event records etc.

d) the findings were confirmable; standard methods such as narrative analysis, and coding techniques as in grounded theory, were employed.

In conclusion, the qualitative research methodology described in this section is congruent to the research objective of exploring complexity and building a theory from the practice.

Chapter 4–Stage 1 Data Analysis

4 Stage 1 Field Definition of Complexity

4.1 Enrolment

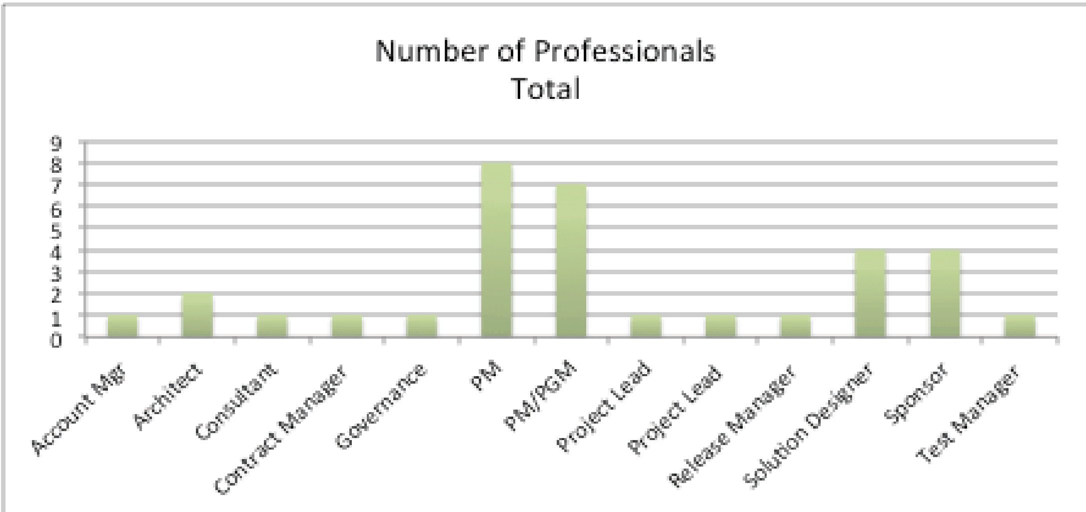
I approached selected professionals who had been involved in projects and had significant experience at Xfone (profile shown in Table 5-1) with an open invitation letter to participate in this research. The research participants had managed, participated in, and functioned in various capacities for more than 10 years in IT system development, remediation, and ERP implementation projects or had led technology transformation programs. Most of the PMs had professional qualifications such as Project Management Professional (PMP) certification from the Project Management Institute or professional registration in the Australian Institute of Project Management (AIPM) or PRINCE 2 from the UK OGC.

At Xfone, an average of 800 out of 7000 employee were involved in project activity; approximately 10% of these 800 employees were female. A short profile of project participants was developed; this helped me to understand their background and mainstream of thinking. Thirty-three employees consented to participate in this research, of whom only four were female. The total experience of the participants was 376 years; the average experience was 11.3 years. This provided some assurance that a sample with adequate experience had been chosen. A session was held to present the research objective and all the research participants signed a non-disclosure agreement (NDA).

The following table (Table 5.1) lists the number of research participants in each of the professional categories.

Years of Experience (e.g. 3 Years, 5 Years)									
	3	**5**	**6**	**8**	**10**	**12**	**15**	**20**	**No RP**
Account Manager						1			1
Architect				1			1		2
Consultant								1	1
Contract Manager					1				1
Governance					1				1
PM			1	1	4		2		8
PM/PGM	1				1	2	2	1	7
Project Lead		1							1
Project Lead					1				1
Release Manager					1				1
Solution Designer					2	1		1	4
Sponsor	1				1		2		4
Test Manager					1				1
Total Number of Professionals	**2**	**1**	**1**	**2**	**13**	**4**	**7**	**3**	**33**

Table 5.1: Research participants' professional categories and years of experience.



4.2 Data Collection

This section describes the data collection process adopted in Stage 1 of this research. A total of 97 interviews (repeated with the same participants on different occasions) were conducted; 40% were voice recorded. In 60% of the interviews, where an objection was raised, I took handwritten notes.

I listened to the narratives and stories and captured some of these interviews in voice recordings. The recordings were transcribed into text for analysis. I obtained the project records and PMO reports (relevant to the project being studied) for review and to take my understanding of the discussion point to the next level. I also recorded some of my own observations. The discussions were tagged and uploaded into a repository.

4.3 Tools

This stage focused on research Question 1 of this research to explore a definition of complexity as perceived by the research participants.

The following open-ended questions were repeatedly asked as prompts only:

- What is your view on complexity in IT systems projects, especially in Xfone?
- What are the reasons or factors for complexity in Xfone projects?
- Have you experienced complexity and can you describe it?
- From your experience, how does complexity manifest in our projects here?
- When a story was narrated or initial response was received, this *embedded question* was asked: ‘Do you believe it is because of technology, or a direction or size or time pressure?’
- How does interaction in projects lead to social complexity?

4.4 Timeline

Appointments were booked and recorded for the interviews, which were in a casual setup such as a café or in breakout zones. This gave the participants a relaxed atmosphere in which to share their experiences. Interviews started in August 2010 and were completed in Oct 2011.

4.5 Stage 1 Data – Sample snapshots

In this section, I present participants' responses to the prompt questions listed earlier about the definition of complexity. In this data, complexity factors ***(cf)***, echo of complexity ***(ec)***, action-to-reaction ***(ar)***, relations ***(r)*** and emotions ***(fe)*** are traced, using the codes defined in Section 3.7.

Snapshot 4-1 Definitions of complexity

S01 DXW observed: 'We can only plan to a certain degree and instil rigorous process to assure that we have counted all aspects. We got to acknowledge that there is uncertainty ***(cf01)*** always, as all required information was not available during the planning gate, we never had enough time to plan and the organisation and market undergoes continuous changes during the project.'

S02 DZH noted: 'For me, complexity is about unexpected events ***(cf02)*** and changing parts in a project, I would say not all the time, it happens in '*spurts*' and we go on doing our job again.'

S03 JZD observed: 'My feeling is that we can pin down a few factors upfront that they might lead to complex scenarios but once the project is on it is like a rolling ball and you will experience complexity in *sporadic fashion* ***(ec01).*** Take the case of Reitz 2; when we had to revamp the billing platform ***(L01)***, we knew it would be a complex project but nevertheless, we encountered scenarios from unexpected corners.

'Parallel but dependent tasks that require significant stakeholder management ***(cf03)*** Unknown dependencies and inflexible process ***(cf04)*** coming *like blinders.* I would claim this as a form of complexity. When a project team is spread across the globe and you are collaborating with ***(cf05)*** them when you don't know them an example would be Xtel Digital Portal Project done in Singapore.'

S04 BXR observed: 'We find caves as we progress so many assumptions **(*cf06*),** - is this not complex? Complexity at Xfone is about thick project processes ***(cf07),*** sometimes *blockers*. We change our course all the time (***ar01***), why the hell are we doing this project? ***(fe01)****.* The goal post was never clear or all the time it was moving ***(cf08*****).** This is complex!'

S05 JXT stated: 'Some *strange situation*s, don't know what to do next and when ***(ec02)***. We did not know what would be the outcome until we entered into this debate'.

S06 Mweb: 'For digital projects, on one side we face the fluidity in definition of the product ***(cf09)*** and on the other side, the product development is following agile methodology, in fact relatively new to the organisation, whilst all other enterprise applications follow standard waterfall methodology ***(cf10)***. The gate process ***(L02)*** becomes superficial, just a checklist to tick off, whilst we struggle to continuously communicate with our key partners ***(ec03)*** about our development cycles. We experience complexity not just because of the product but because of the way we develop it.'

Figure 4.1 shows the possible factors that may have caused complexity in a digital project based on the above narrative.

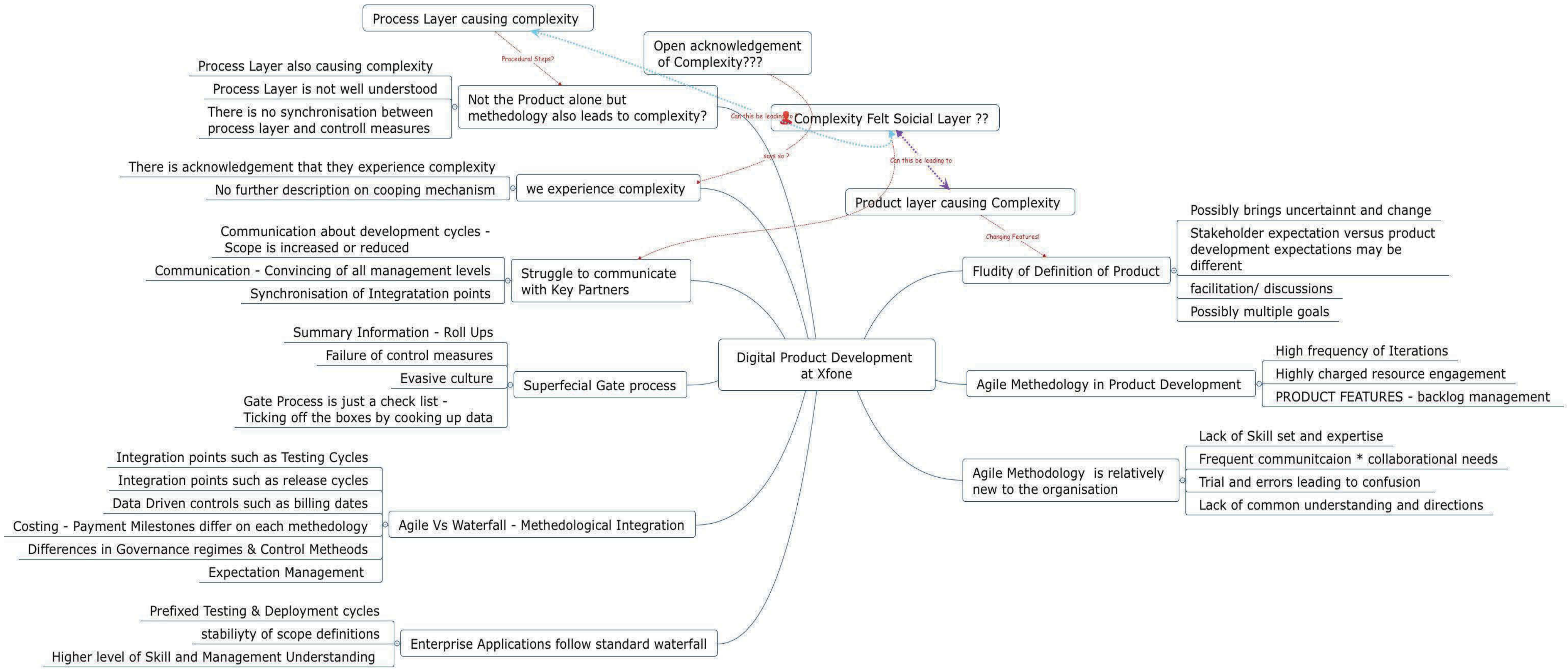


Figure 4-1 Thematic analysis of digital project narrative S05

S07 (MxB) on complexity: 'Complexity is felt when you attempt to resolve ***(ar01)*** an issue, not because the issue is there, though the symptoms ***(ec03)*** could be seen in earlier stages.'

S08 (JyK) commented: 'If complexity is about surprise and shocking situations, then it is about people ***(cf12)*** and their relationship gone pear shape ***(L03)***.'

S09 (KaSh) related: 'When a vendor was terminated (***t1***) in a bitter conflict with senior management, halfway through (***t2***) a customer-facing project (***t3***), I was struggling (***t4***) between contract termination, on-boarding a new vendor (***t5***), ensuring the knowledge transfer (***t6***) and avoiding potential delays (***t7***). For me it was about people engagement (***t8***) ***(cf11)*** not the process (***t9***) that is complex (***t10***) it was beyond my control (***t11***).' Refer to table 4-1 for text analysis.

S10 SxMc observed: 'As director, complexity means tying the project outcomes to business goals, profitability and customer experience. At times, I had to make decisions – caught in dilemmas ***(cf13)***. My view on complexity may be different to that of a project manager.

S11 BxR said: 'From PMO, my observation is that the perception of complexity may differ from person to person based on experience or influential power they have'. [Narrates a story about SXD and BXM as a comparison].

S12 DvS said: 'Sometimes small change, insignificant technical work in the product ***(L01)***, but we have to pass through management hoops, seek approvals from senior management and do all types of due diligence because of the impact ***(cf14)*** or we don't know how to do it ***(L02)***. These situations have their own complexity for our development team.'

Snapshot 4-1 Analysis

The following section presents the analysis of Snapshot 4-1 interview data. I have traced the factors, which are believed to be triggering complexity under the heading ‘Complexity Factors’. Instances and events where the complexity is manifested are captured as ‘Echo of Complexity’. The interrelationships between stakeholders are captured under the heading ‘Relationship’. Some of the emotional factors expressed by the interview participants while describing their experience on complexity are captured under the caption ‘Emotions’.

Complexity Factors

Uncertainty ***(cf01)*** on project events could trigger complexity, as the required information was not available at planning stage. When the organisation and market undergo changes during execution of the project, unexpected events occur ***(cf02),*** which brings complexity.

The project management process can be applied only to a certain degree. If the process is believed to reduce complexity, the limitation of the process can still lead to uncertainty, thus causing complexity. It is important to note some of the characteristics of complexity as being unexpected, uncertain, and unprecedented.

Complexity is generated when parallel and dependent tasks have unknown dependencies. Because of these unknown dependencies ***(cf08)***, which usually emerge only during the execution of the project, intensive collaboration between stakeholders ***(cf03)*** is required. This collaboration in itself may lead to complex scenarios. The complexity factor is the collaboration with the global teams (***cf05)***.

The assumptions ***(cf06)*** made in a project also may lead to complex scenarios, as may the project management process ***(cf04, cf07, cf10)*** because of its inflexibility.

Complexity is created when project team members have many assumptions ***(cf06)*** of tasks and/or timing, rather than a clear definition. There is a lack of knowledge, as they are collectively exploring and an impromptu response may be required. These atypical situations may lead them to experience complexity.

Echo of Complexity

Complexity is experienced unexpectedly ***(ec01, ec02, ec03***) described as 'coming like blinders' or 'we find caves.'

Table 4-1 shows the text analysis of the narration of Snapshot 4-1 S09.

Table 4-1 Text Analysis CRM Application Upgrade Snapshot 4-1 S09

Text Locator	Codes from Narration	Factors Analysis	Where is complexity?
T1	Vendor was ***terminated*** in bitter ***conflict!***	Administrative/legal tasks and relationship strains with the vendor – distrust in play.	Task complexity, relationship management. Focus to complete already started work. Unwilling interaction.
T2	***Half way*** through inflight project	Task continuity and delegation: associated confusion about directions for next steps within the teams.	Task complexity. Quality may suffer.
T3	The project is ***customer-*** facing	Business concern about customer experience. Loss of revenue and brand reputation.	Impact – fear – constraining outcomes.
T4	***Struggling***	Emotions	Helplessness. Outcome of social complexity?
T5	Contract termination ***versus*** bringing new vendor on board.	Conflict of interest between two vendors. Task allocation. Two opposing intents – bringing synergy though they in a conflict of interest.	Two different parties co-existing in same space for some time. Arbitration. Taking sides! Communication complexity? Task complexity leading to social complexity.

T6	***Ensuring*** knowledge transfer	Facilitation, prompting to share knowledge within contractual obligations	Facilitation, encouraging and enforcing – social complexity. Interactional complexity? Professionalism as constraining factor?
T7 3	***Avoiding*** potential delays	Time pressure – preventing delay, applying control measure	Time pressure of the project – temporal complexity.
T8	It is about ***people***	Human interaction, facilitation when interests are not aligned – differing goals	Directional complexity and social complexity.
T9	***Not*** process	People – communication, social aspects.	The process is not causing complexity – lower level of complexity felt in applying process
T10	Acknowledging she is in a ***complex*** situation –	Knows this is complex – an overwhelming feeling. Innate definition of complexity! Too	Acknowledgement is stated but not co-opting methods. Further exploration

	‘beyond my ***control’***	many things beyond one’s ability to control!	required to see what steps she took
Notes	KXC: Interview 16.03.2012, Note 1 >PM of 10 years’ experience, she was not involved in management decision to terminate the vendor. Data weight: scale of 8/10, second interview planned 22.06.2012		

Snapshot 4-2 Silverwater Narration from Program Manager MxL

‘An issue was encountered during testing; it appears to be on old issue with the system rule ***(cf01)***. I wanted to discuss this with the W, the business user. I went to meet him. C was with him. As soon as he heard this issue, he asked me whose head is going to roll ***(ar01)***. Then he said as per marketing policy this variance cannot be accepted ***(ar02)***. I can speak to B to stop the rollout.

‘Major is a very experienced project manager. Silverwater is a project with fluid scope ***(cf02)***. The billing director has a direct relationship (***r01***) with the vendor. Major is struggling with the challenge of holding the director from proposing and approving the change request ***(cf03)***. Major said to me, ‘My frustration is that my management should stop this behaviour ***(L03)***, otherwise it continues throughout the project and I am frustrated ***(fe01)*** with the ineffectiveness of the steering committee.

‘There are a few possible ways in which to respond to this situation. One is management intervention at the steering [committee] level to advise the director about the new changes (***ar03***). Definitely the chair of the steering committee is not going to be direct with ***(ar04)*** him, as he has much more at stake than this.

‘The second option is to create small wins for the director and be trustworthy while bundling the requested changes into a second release. This is a slow process, and it will take its own time. The current situation is not going to improve immediately. He can create a distance between the director and the vendor ***(r02)*** by establishing an authority with the vendor. Whatever step he takes, he has to put a conscious effort into ameliorating the situation otherwise the project objectives will not be met.’

Context Diagram for Snapshot 4-2, Silver Water

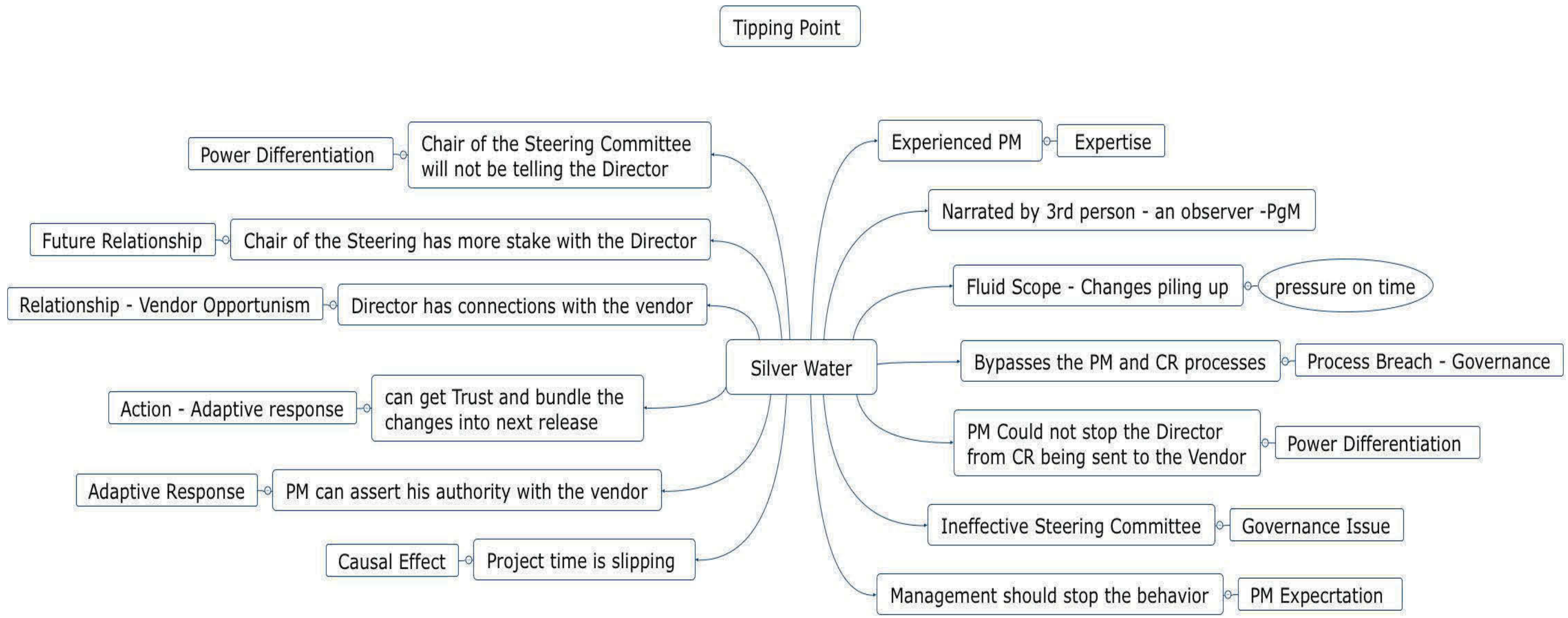


Figure 4-2 Silverwater Contexts

Snapshot 4-2: Silverwater Analysis

Complexity Factor

The Silverwater project had fluid scope ***(cf02)***; moreover, an old system rule ***(cf01)*** had surfaced as a defect. The project manager was struggling to control the director from putting through the change requests. The vendor was using this as an opportunity for growth. The steering committee could not control the director because of his official power. Thus, the complexity in the above scenario derived from the fluid scope, change control and the relationships ***(r01, r02)*** with the vendor, the sponsor and the PM's management.

Echo of Complexity

The PM's position on the steering committee to explain the potential delays due to additional scope and current technical hitches echoed the underpinning complexity.

The complexity was also echoed in meetings between PM and the vendors. The PM's discussions with his own management, in which he was attempting to control the director's behaviour, was another space where underpinning complexity would have manifested.

Relationships

There were several relationships in play in this scenario. The billing director had a relationship with the vendor. The SCM chair was expecting a future relationship with the billing director. The vendor relationship with the sponsor was crucial in getting business for them.

Action to Reaction

The billing director bypassed processes/channels. The steering committee was not being direct with the sponsor (ar02). There was a conscious effort to balance the vendor relationship and establish the powerbase with the vendor. The narrator listed several possible actions, such as assertion with the vendor, gaining trust with the director and invoking steering committee action through governance boards.

Emotions

Because there was a defect and some potential delay, a punitive measure was expressed: ‘Whose head is going to roll?’ The sponsor did not adhere to process and the PM felt helpless (fe01) due to his lack of formal authority.

Snapshot 4-3 Atlas 2: Narration from a PM SubXG:

‘Project Initiation for Mediation Application is in progress. Let me call this project Atlas 2. I am driven by various forces and face some form of confusion and lack of direction ***(cf01)***. With multiple vendors, very informal RFI process is going on without any commercial coverage.

Meanwhile, I have to listen to my boss's views, and the views of the architect, senior architect and vendor project managers, and internal skill group project managers ***(cf02)***.

‘Until I sort out a political map and a game plan, my anxiety level is very high ***(fe01)***; I have a few sleepless nights, as there are so many governance papers that need to be filled in.’

‘This is about proposing a project strategy for a DCS remediation project. The project typology is such that it has very high criticality ***(cf03)*** but well-established technology and no new requirements to be developed.

‘Therefore, the standard Xfone methodology is overkill ***(cf04)***. I proposed to follow the light version of Xfone methodology ***(L02)***. I need to sell this ***(ec01)*** idea and my proposition to the PMO and my management so that all other stakeholders can let me function.

I also have noticed that the stakeholders use the standard gates to their advantage whilst there is not so much work to be carried out at this gate for this project.

'I faced many challenges with the vendor, there were several gaps, and they were unable to decipher the code ***(cf05)*** inside this DCS platform. The vendor had a good relationship ***(r01)*** with the project sponsor. I was blamed ***(fe02)*** and DVX, a senior PM, joined just to manage the stakeholders, whilst I was supposed to focus on the technical delivery. Dave is good in communications, but I had to prepare the input for his reports.

'My relationship ***(r02)*** with the vendor manager soared over this period; despite escalations, no response was generated by the vendor. Dave had picked up the issue, battled with the director, as he used this project to settle a score ***(ar01)*** against IT in the Executive Forum. As customer impact was there for cutover, we had to seek outage; multiple skill groups rejected the outage request.

Since the outage went more than the required hours, an SMS was sent to Pos (CEO). I heard BAlv call the PM an idiot ***(fe03).***

'Next morning I was requested to appear in front of him and explain the situation ***(ar03).*** More than listening, he finished by shouting ***(ar04)*** in front of digital technical teams (who were sitting in that place).

'That night I had been awake throughout the cutover. Dave came to my support and requested me to go home to rest (**fe04**). Only PMs understand the struggle in this organisation.

'The project was delivered six months late, I thought of resigning several times, as I did not have any power over the vendor delivery ***(ar04)***.

Our architect KXK was very tired too, as the testing of the CDRs had to be done by manual comparison of the output data. The logic in binding the CDR records, no one in Xfone knew that it had to be reverse engineered out of the system. KXK left to join another telecom at the end of this project.'

Snapshot 4-3 Analysis

Complexity Factors

This project had business criticality ***(cf01)*** and lack of direction as complexity factors. There were multiple views on how to achieve the project goals ***(cf02)***. The methodology had some form of rigidity, which may have caused complexity. The vendor was unable to decipher the code ***(cf05)*** from the old technology platform. Thus, there was a certain degree of technical complexity in translating the code.

Echo of Complexity

The PM came up with a light version of the methodology ***(ec01)***, and he had to sell this to PMO, who in turn needed to endorse this tailored approach.

These discussions would have brought out the underpinning complexity in terms of applying standardised governance.

A form of communicational complexity was echoed in the PM's discussions with the Technology VP regarding delays and his attempts to explain the technical difficulties the vendor was facing. This complexity stemmed from the power differentiation between the PM and the VP.

Relationships

There were three key relationships in play: the PM and the vendor; the PM and the new PM joining to support the project, and the IT VP and the project sponsor. Each of these relationships brought complexity to the power balance equation.

Action to Reaction

It is interesting to note how the project sponsor used this project to settle a score against the IT VP. In turn, the PM suffers at the hands of the VP ***(ar01, fe03).*** The steering committee sessions did not have a full quorum as several senior managers were impacted by organisational restructure. Because of the absence of the senior managers in the steering committee sessions, the sponsor had full monopoly.

Emotions

The PM was frustrated that the vendor escalations were not effective and no resolution came out of the management escalations. A new PM showed humility in coming to support him in this project. The project managers displayed empathy for each other ***(fe02).***

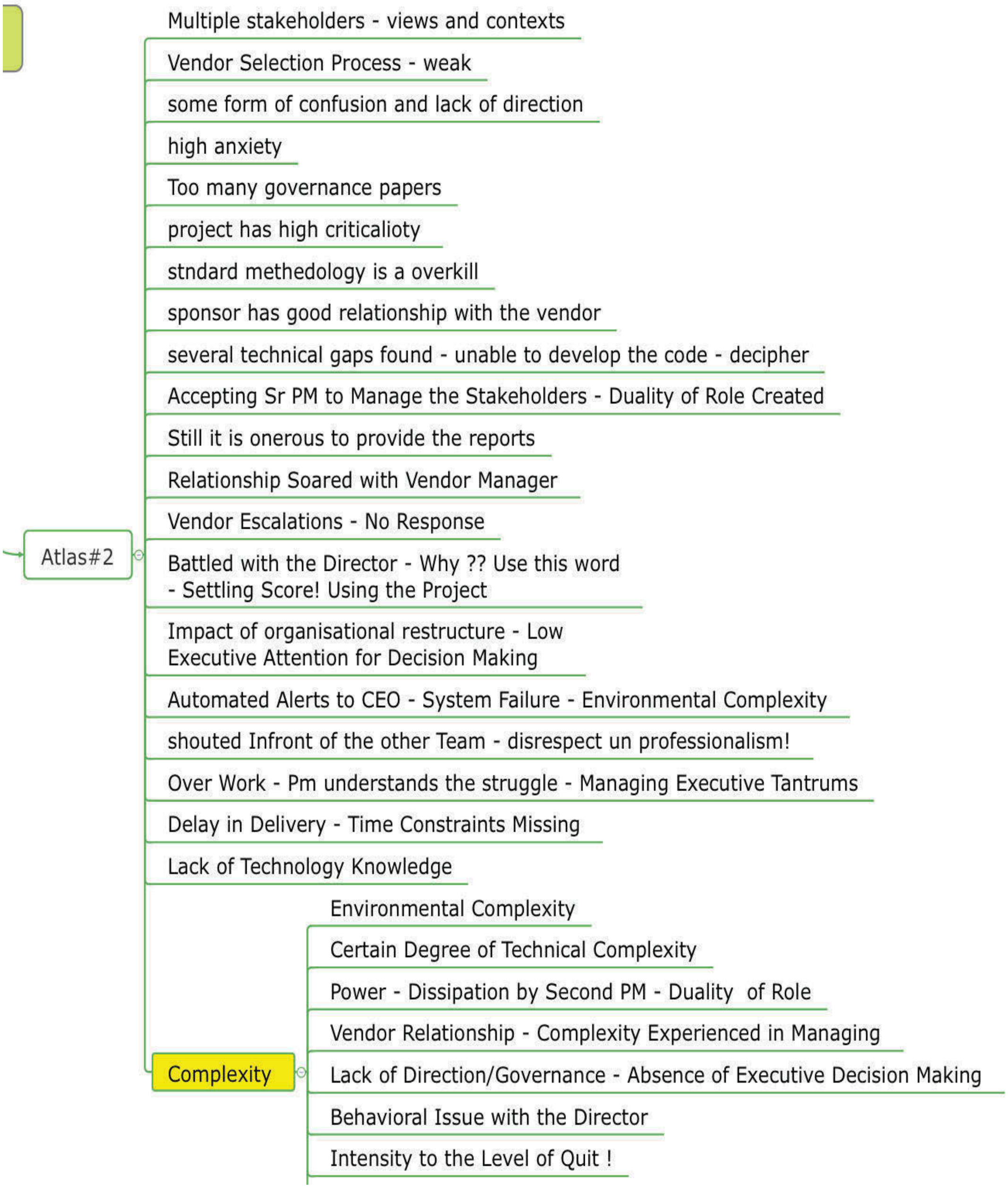


Figure 4-3 Atlas Contexts

Snapshot 4-4 ETL Project - PM DxH Narration

'The ETL project needs to obtain a quote from a vendor to build the VMs. The quote appeared to be exorbitant; the scope of work had some elements, which could not be estimated ***(cf01)***.

This led to assumptions ***(cf02)*** by the vendor and therefore the cost increase. The PM started the negotiations, since there were some unknowns ***(cf03)***; the simplistic option was to get a T&M (time and material) quote ***(ar01)*** for support services.

‘The quote went to the program manager, whose concerns were that once the PO is created the vendor will consume the value; this will set a precedent that for every other project they will start for a T&M quote ***(ar02)***. As part of the VM build, the vendor should provide the support services throughout the duration of the project; as a fixed-price quote, the vendor should take the risk. For the vendor, if it was a fixed price contract, the cost will be too high, the number of days effort needs to be capped. After a series of emails, a meeting was held.

‘The PGM simply stated that the service component should be part of the build and it is unacceptable to have a T&M for this service request ***(ar03).*** The vendor manager cited several examples where the effort exceeded their estimations; there were too many distractions from xxx during the project.

‘The PGM argued ***(ar04)*** that it was a different situation to this project. After 20 minutes of haggling ***(fe01)***, the vendor manager agreed that he would add five days of effort, distributed across the project’s duration. If any of the items that emerged during the project required the attention of his resources for more than a week, it will be considered a CR (change request); this is a gentleman’s agreement ***(ar05).***

‘At the end of the meeting, they arrived at an outcome. The project had urgency to be completed and a couple of days were lost in these discussions.’

Emails (extract):
‘If this is FP, then please ask for removal of all references to duration (e.g. 2 days, 10 weeks). TechM has the schedule and must stand by their deliverable and

support it for the duration of the project as long as any schedule deviation cannot be attributed to TechM.

'I was waiting for the quote yesterday late evening. Please send across the quote as soon as possible. I need to submit the E2E costs for Fund Approvals.'

> *Hi,*
> *Please note. If I don't get the final cost estimates from BI, we will be delayed until Tuesday or Wednesday for cost review. I had a quick chat with M and my understanding is that end points are too many. As you can note the ETL – Development Environment is required as immediately as possible to complete the ETL – Migration by TCS. It is not the risk factor we are minimising but rather addressing to minimum required effort – timeline. Suggestion is to provide PO to TechM for $39K to build the Servers – Within Available Budget*
>
> \- Obtained a hard copy from DxH

Follow up:

'I had to keep reminding the PGM and finance manager, and got really frustrated ***(fe02)*** with this impasse situation. I had to mark the delay in the baseline schedule and attribute it to indecisiveness. As a PM, held accountable for time-bound delivery. Decided to report in the PMO Report, moving the project to Amber.

'PGM was not happy about this, questioned me that a few days delay should be observed by the vendor ***(ar06)***. But my call is the vendor is already screaming about the commercial engagement. I know from vendor resource, the development is in progress, at their own risk ***(ar07)***. Whatever position I take, I have to balance the tensions and expectations of diverse groups here ***(L03)***.'

Figure 4-4 captures the different positions (viewpoints or perspectives) over a period of time constructed through interaction from the event described above.

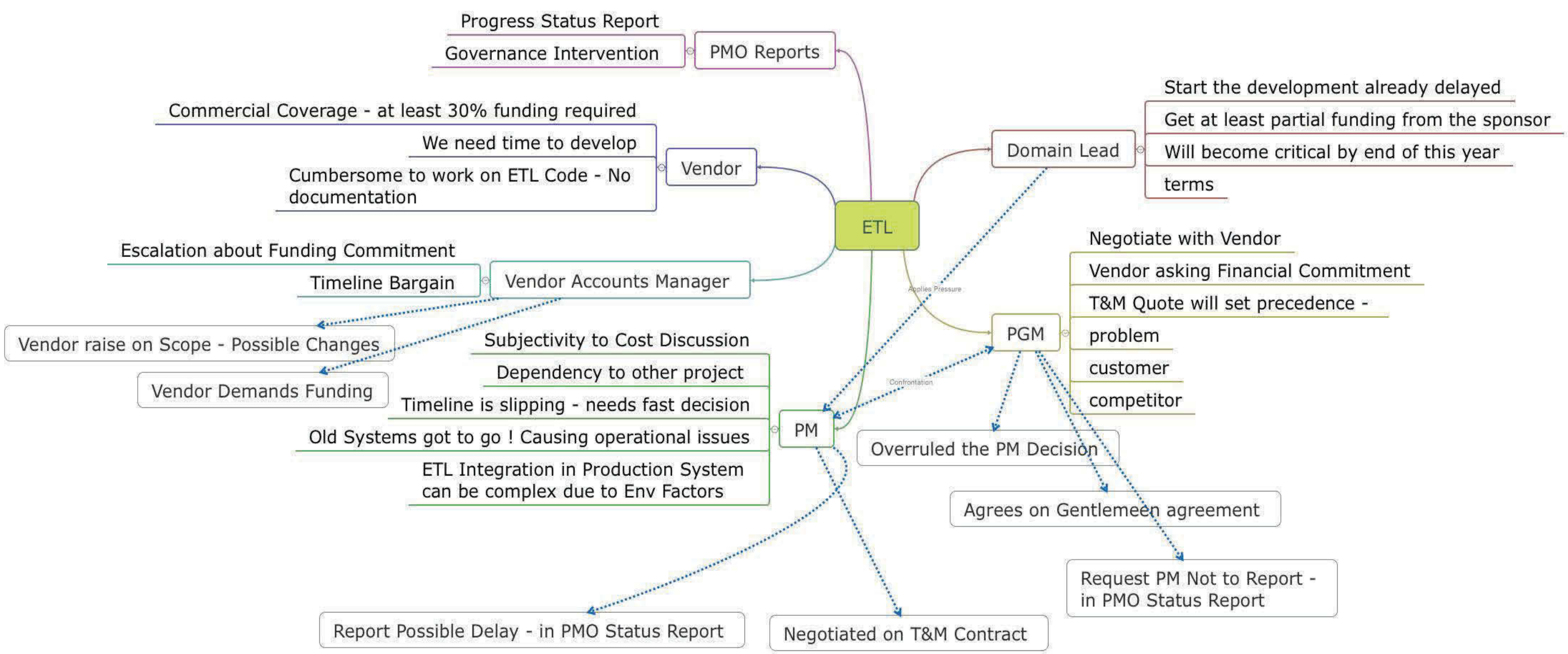


Figure 4-4 ETL Contexts in Play

Snapshot 4-4 Analysis

Complexity Factors

There were unknowns and assumptions around cost estimation and the PM attempted to isolate the uncertainty through a T&M contract clause ***(cf01, cf02)***. It is normally a simple negotiation with the vendor to reduce the price, but it was deliberately played out in a different way.

The PM adopted the process and wanted to control the cost through a T&M Contract for Support Services, whilst the PGM ended up agreeing to five days of effort with a 'gentleman's agreement' to apply PCR if the effort exceeded more than a week. Note the conflict of position and that the PGM's formal authority superseded the PM's option. The PGM had authority to overrule the PM's agreement with the vendor; here the power differentiation created complexity in the interaction. As noted, urgency was built into seeking the estimates, which may have led to inflated estimates. Time pressure can lead to complex scenarios.

Echo of Complexity

The complexity was echoed in the PM, PGM and vendor discussions on cost and time. Regarding the PM's discussion on the PMO report, the PGM requested the PM not to report any delay in the PMO report. The complexity was echoed in the PM's and vendor's discussions to absorb the delay, implicitly indicating the work should be done by the vendors at their own commercial risk. Expectations were evidently against the policy.

Relationships

The relationship between the vendor manager and PGM appeared to be positive as they arrived at a 'gentleman's agreement'. Here, trust played a key role.

Action-to-Reaction

In this narration, the action-to-reaction cycle was explicit and the adaptive response by the PM was noted. The vendor continued to develop the software, although the PM knew that, in order to apply time pressure, a formal position that the project had not started was maintained.

Emotions

The PGM overruling the agreements of the PM with the vendor caused anger. The vendor manager got frustrated about not having commercial coverage, as they were expected to absorb the delay.

Snapshot 4-5 Cluster Outage Project - PM XRob- Narration

'An outage had happened in a network cluster. TM Support groups advised that our business would be impacted. It was the fault of an engineer, when he was trying to update the DB server; he had copied the wrong configuration file.

The configuration corrupted the control files in the OS (Server Operating Systems -Software) ***(cf01)***. It was estimated that at least three days were required to recover the servers. ***(cf02)***

'We did a preliminary assessment of the impact on ongoing projects. Out of seven in-flight projects, three of them were impacted ***(cf03)***. One of the impacted projects was about to be rolled out to production the next day. Since the customer communication about the product launch had gone out already ***(cf04)***, customers ought to be notified about the delay. Business was not happy about notifying the delay to the customers. ***(ec01)***

'The issue was escalated to the technology GM. The GM called for a meeting with the vendor director, after a bit of a tense situation, the GM stated that the service credits would be applied as a punitive measure ***(ar01)*** to the vendor.

‘The Technology GM had to explain ***(ar02)*** the untoward situation to the Xfone business executives ***(ec02)***. He highlighted the volatility of our technology platforms, and sought additional fund for remediating the environment. Finally a call was made to notify the customers. Several meetings were convened with Branding, Commercial and Corporate PR to draft the delay notification ***(L03)***.

‘A question was raised: Why was there no system embargo imposed on these platforms as per normal standard operating procedure?’ As a PM, I had notified it in my rollout plan; unfortunately, the operations did not take this rollout seriously ***(ar03)*** and stated that the rollout did not warrant an embargo. As a project manager, I had to reallocate the resources around the rollout tasks. I had to control the budget, as no additional budget would be given because of this interruption. Our environments are unpredictable, and unstable frequently in recent past.’

Email...
The XXXX system is currently having some performance and latency issues, as a result you may be unable to connect to the mail server or you will have delays in sending or receiving email. Technicians are continually investigating the issue and working on a resolution to the server load issues.

We will provide an update in an hour. (Major Incident number: IM1004851956 \ INC000010599614)

Follow up: PM
‘The engineer went to his HR and cited he had worked 19 hours that day and due to overwork and fatigue that mistake had happened. Moreover, the Xfone support manager requested the vendor director to retain this engineer onsite. The vendor accounts director continued to influence the Technology GM to reduce the number of service credit days to minimise his loss ***(ec03)***.’

The PMO manager observed, 'We all know that our technology landscape is a mixture of old and new, it is unstable at times and we are not doing anything about it since it involves large-scale remediation. One point to observe is no one acknowledges the delays and impacts of outages on the projects, project managers chew up their contingencies, which is minimal, and struggle to explain to the sponsors for additional funds.' Figure 4-5 shows multiple contexts in play.

Snapshot 4-5 Analysis – Multiple Contexts

Complexity Factors

The complexity factors are associated with technology ***(cf01),*** time pressure to recover ***(cf02)*** and customer communication ***(cf03 – cf04)***. The environment is interdependent, and a mix of technology causes other applications in the network cluster to shut down.

Echo of Complexity

The tense meeting (swearing) between the Sales GM and the Technology GM was evident because their bottom-line KPI was affected. Vendor discussions on punitive measures echoed the complexity as it was a human error, but the decision in favour of service credits was not proportionate.

Relationship

Key players in this scenario were the Project Manager, the Technology GM, the Sales GM, Vendor Director, the culprit Engineer, the Support Manager and the PMO Manager.

Action-to-Reaction

It is to be noted that there was a frenzy of interaction due to the time pressure. Escalation to the general managers took place about the unexpected situation caused by human error. The Technology GM applied service credit notes as a punitive measure to the vendor. Decisions about customer communication were achieved through deliberation.

Emotions

The engineer who made this mistake because of over-work felt guilty. The Sales GM felt angry because of the delayed product launch. The vendor's accounts director experienced a predicament situation. The PM was questioned about the embargo process and underwent anxiety and frustration.

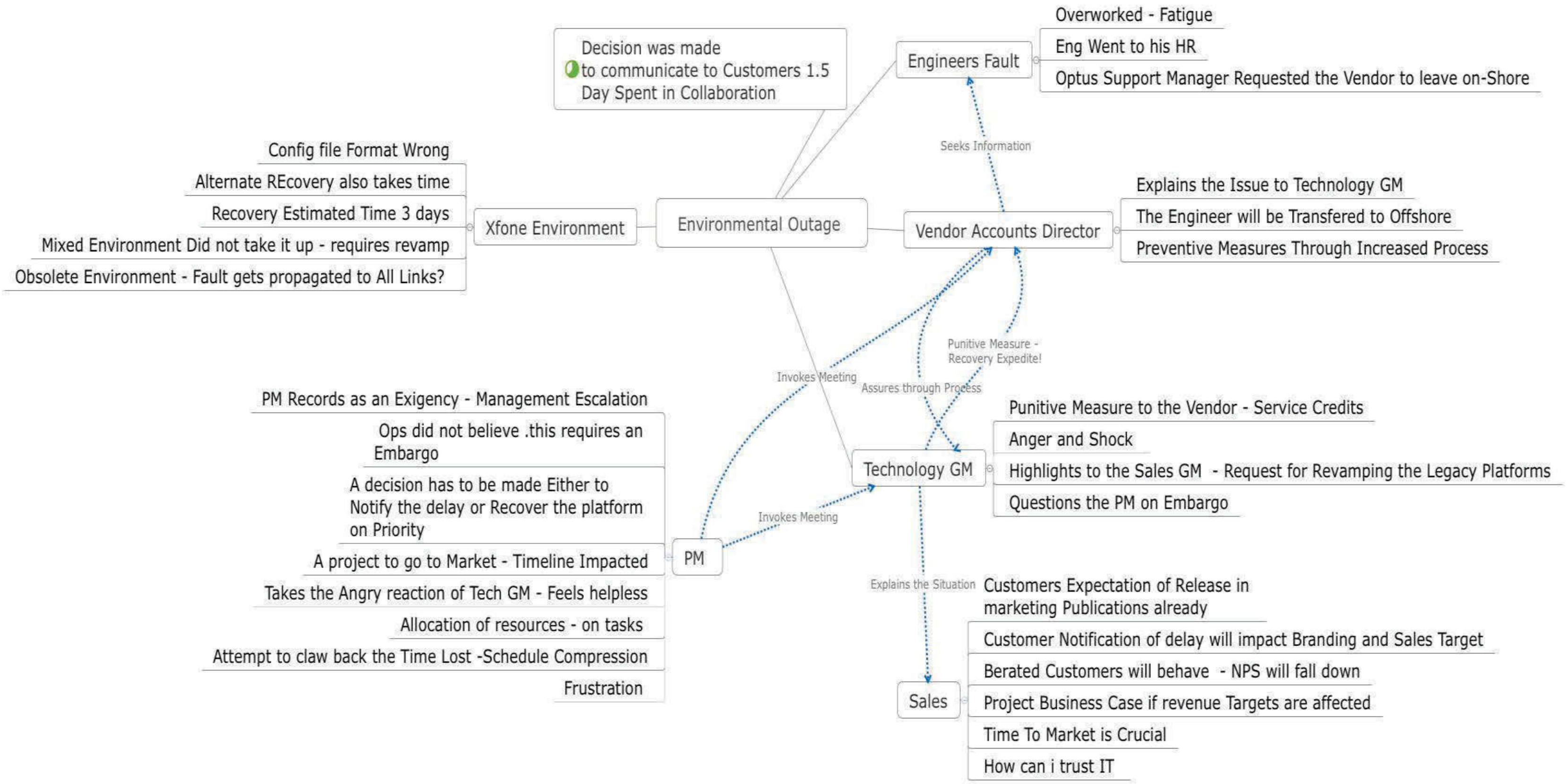


Figure 4-5 Contexts in Play

4.6 Risks and Issues Analysis

The PMO Manager suggested that I examine the risk and issue register to trace any pattern indicating complexity in our projects. The risks (uncertain events that may occur) were entered by the PMs. It is possible that they indicate complexity in an inherent form.

I obtained the risk register entries for projects relevant to this research. Table 4-2 presents the summary based on PMO risk categories:

Table 4-2 Categories of risks in age

RISK REGISTER - PMO INPUT

Count of Risk ID	Impact High 5, Low 1					
Category of Risks	**1**	**2**	**3**	**4**	**5**	**Grand Total**
Commercial	8	2	5	8	3	26
Communications	1			3		4
Contractual				2	2	4
Cultural			1			1
Environmental	1	2	9	17	7	36
Financial	2	6	13	12	8	41
Industrial Relations		1				1
Marketing			1			1
Organisational		2	11	3	3	19
Political			1	1	1	3
Process	2	1	5	3	5	16
Quality			3	6	5	14
Regulatory			1			1
Related Projects	2	3	11	12	8	36
Requirements Not Signed-Off		1	3	3		7
Resources		5	19	20	9	53
Scope Definition	3	4	18	17	5	47
Suppliers				4	2	6
Technical	1	7	25	30	10	73
Timing	2	3	31	45	10	91
Training			2			2
Grand Total	**22**	**37**	**160**	**188**	**78**	**485**

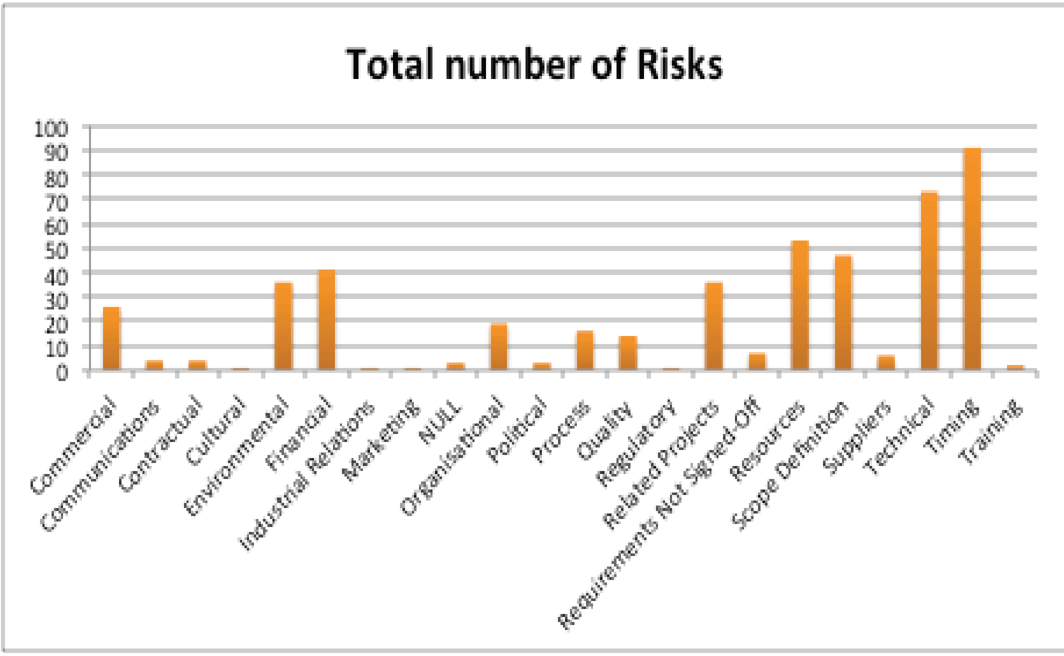


Figure 4-6 Risks Category

* Yellow Rows subjected to detailed analysis.

Indication of Complexity

Similarly, I obtained the issue register to check if I could find any pointers to complexity in this organisation.

Table 4-3 Categories of issues in open/closed state

Issue Categories	Cancelled	On Hold	Open	Resolved	TCM	Tfr	Grand Total
Commercial	1		17	11	12	2	43
Communications			4	2	3		9
Contractual				2	3		5
Cultural				1			1
Environment			2	12			14
Environmental			1	5			6
Financial	2		14	45	6		67
Hardware			1	4			5
Infrastructure		1	2	2	1		6

Legal					4		4
Organisational			1	15	1		17
Policy				2			2
Political				1			1
Process	3		5	14	4		26
Quality	3		3	14	1		21
Regulatory					1		1
Related Projects	1		2	9	4		16
Requirements Not Signed-Off				7	4		11
Resources	3		8	26	2		39
Safety			1				1
Scope Definition	2		6	35	41	1	85
Software			1	7	13		21
Suppliers				3	1		4
Technical	4		6	31	19		60
Timing	2		8	39	4		53
Grand Total	**21**	**1**	**82**	**287**	**124**	**3**	**518**

* Yellow Rows subjected to detailed analysis.

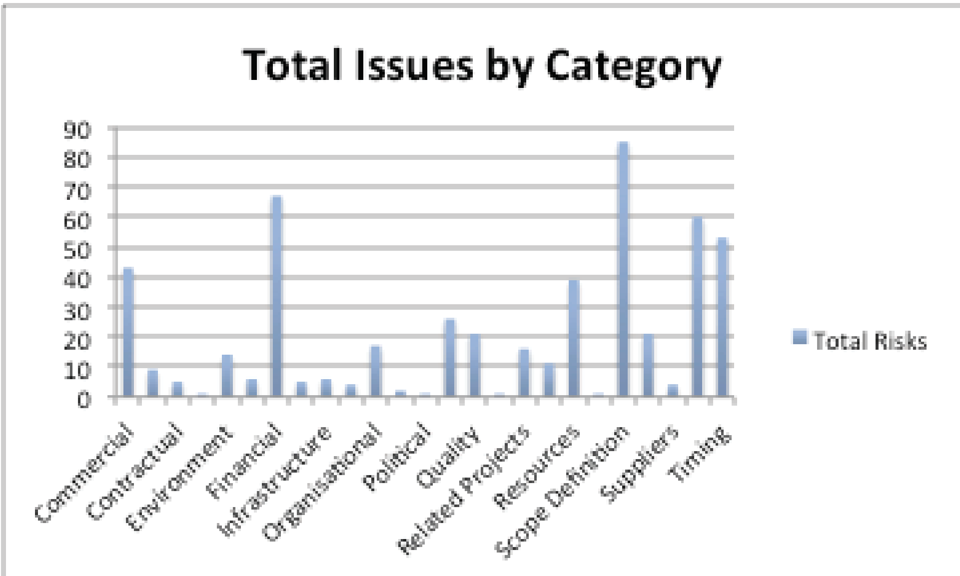


Figure 4-7 Issue Category – Indication of Complexity

I decided to examine most closely the projects with risks or issues in the Environmental, People, Process, Organisational and Political categories in order to trace complexity. I believed that the projects with these categories of risk or issues would have intensive interaction. Usually high intensity of interaction is symptomatic of inherent complexity. I did not consider risks or issues as a variable in relation to complexity, but simply as *indicators* from which to select the project data from the massive amounts of data made available for this study.

4.7 Complexity in Xfone

As research participant PXN (Director, Technology, OSS) said, 'Unless otherwise stated, complexity is taken as a felt experience, and perceived abstraction, you have no common ground on a definition.' The project stakeholders had an aggregate definition of complexity; at times it was intermingled with the definition of complication.

It is evident that the field definition of complexity contains attributes such as 'uncertainty', 'unexpectedness', 'unprecedented' and 'spontaneity'. In some cases, practitioners can conclude that there is complexity before even embarking upon a project; in other cases they come to feel trapped in complexity during the course of the project.

As described by the participants, the complexity factors could be present in a dormant state, and in certain situations the combination of these factors will bring out the inherent complexity. A clear delineation is made about complexity factors and the manifestation of complexity as separate themes.

Complexity is echoed in a sequence of continuous events (reference Snapshot 4-4). The manifestation of complexity occurs in 'spurts'. Static and dynamic complexities are echoed in different forms.

The number of stakeholders and the collaboration between diverse stakeholders located in different parts of the world can lead to complex scenarios in a project. Interdependencies between tasks and too many assumptions being made because of lack of information or too little time given to planning may also lead to complex scenarios in a project. Complexity factors mentioned frequently by the research participants are time pressure to accomplish a project faster than is reasonable, and lack of direction.

The dependencies between various tasks and stakeholders are emergent in nature. They can be found in a product component, between tasks or between other projects within an organisation. It is also evident that issues or risks are manifestations of complexity in a project at a particular point in time. Dependencies can also arise from external parameters such as changing market demand or suppliers. Some research participants observed how, in complex scenarios, decisions have to be made spontaneously as a reaction to these triggers.

Frenzied responses and impasse in progress have been noted in complex scenarios. The interaction between vendor and PMs around cost negotiations or time delivery brings out inherent complexity.

The sponsor, vendor or technology executive relationships pose a challenge for project managers, thus leading to complex behaviour. The power differentiation between sponsor and project manager was one of the complexity factors mentioned by the research participants.

An individual's experience and expertise is associated with the perception of complexity. However, the research participants did not mention any measurement or scale of strength for skills and experience in relation to the level of complexity experienced. The perception of complexity also depends upon the power and influence of an individual in the organisation (reference Snapshot 4-1 S10).

The research participants believed complexity created emotional states such as anger, frustration, anxiety and depression, and it adversely affected one's sense of accomplishment. My research noted these emotions whenever I saw them displayed in their narratives, but I did not analyse them in depth.

4.8 Layers of Complexity

I noticed that complexity was echoed in three layers; I have used the codes ***L01, L02*** and ***L03*** to denote these layers of complexity in the data set. They are described in greater detail below:

Product. Layer 1 – ***L01:*** reflections are due to inherent complexity in the product, the services or the platform the project is building and delivering.

Project. Layer 2 – ***L02:*** reflections are in the project management processes, methods or tasks – or organisational processes or management perspective in general – insofar as they refer to the project itself.

Social. Layer 3 – ***L03:*** reflections are in human interaction, collaboration and other social aspects. This type of complexity can be considered as socio-organisational complexity.

4.9 Notion of Tipping Point

The research participants attested to the fact that complexity is experienced only in certain project situations, and referred to them as spurts, floaters, an 'oops moment', an 'ah moment', blinders and caves. I was interested to differentiate these situations from typical project situations. These scenarios are tipping points in a project such that they alter the course of the project either for better or for worse.

One of the research participants, PYN, coined the term 'tipping point' while explaining the 'conflict-contest' nature of a project situation. Quoting an example from 'QToc' project, BXM, the PMO Manager, agreed that certain situations can completely change the direction of a project, and shake the foundations of an organisation. PXA observed, 'In a "seamless" project, because of multiple stakeholders' involvement and blurred accountability, these situations dragged on for several weeks and complexity in dealing with the stakeholders could be noted easily.'

I shall refer to such scenarios in this thesis as ‘tipping points’. In such situations, a decision has to be made, and a resolution to an impasse has to be arrived at and the project team seeks an exception to the process or seeks direction or approval. Complexity is manifested in these scenarios.

An example situation is presented (from my handwritten notes) below:

> PM: the network ports and subnet IPs are not available; they found this only when the network-patching request was submitted. In our design gate these shared resources were reserved. But another project has obtained the network ports on priority basis. The network division failed to inform us. Now we cannot progress on our connectivity for QA (quality assurance test) environment, the project timeline will be impacted.
>
> PGM: What alternatives do we have now?
>
> PM: To procure the network switches and install fibre-optical links, it will take at least three weeks. The procurement process itself will at least take one week unless otherwise we pull some favours with IBM or HP, the infrastructure vendors. In addition to this, we need at least $120K, my project cannot take on this cost, and I am running under a tight budget. We have to go to the steering committee for additional budget. Alternatively, you can speak to JJC GM Infrastructure, as these are shared resources, he should be able to fund it and expedite the work for us. Our project can take on a small percentage in overall cost for the network links.
>
> PGM: I will speak to JJC.
>
> PGM: In reflection… (Commented to this researcher)
>
> How can they allocate reserved material resources to another project? Why weren’t we informed about this? How come another project has higher priority? Our PM could have sensed a bit earlier?

> If I blame Networks for miscommunication, it would affect my relationship with SankD, the network engineers have helped us in similar situations before!
>
> Presenting this scenario to the business sponsor in the Steering Committee will not go well. Moreover, these are shared resources; the sponsor will be upset about IT.
>
> JJC is very slow, procurement will take a long time, and it is a pain to deal with IBM.

Researcher's observation: I started tracking this scenario for the next two weeks. I present my observations below:

The PGM took the position of putting the problem back to the networks in front of the GM in a subtle note, and called for an active communication process about shared technical resource allocation. The PGM spoke to the category manager to negotiate with HP for quick delivery of the switches.

The vendor delivered the material on a 'risk' basis with a signed-off procurement request by the Category Manager as an emergency item rather than waiting for a purchase order (PO).

The PM created a technical risk rather than creating an issue and did not communicate it to the Steering Committee. The PM set up a daily standing meeting with SankD and HP, the vendor. The project obtained the ports after 12 days, causing a delay to the project schedule. The PGM advised the PM of his displeasure, and ordered him to keep this delay within the contingency and manage it.

Analysis:

The scenario surfaced as a surprise. It was a 'floater' situation, even though it was a technical problem, but warranted interaction with key stakeholders. The project could not make any progress in testing and the project schedule was impacted. The communication and shared resource allocation process was overlooked. Seeking funds and informing the Steering Committee was not preferred by the PGM. A technical risk arose, in that the situation could blow out of proportion and the project be delayed beyond its contingency timeline. Subjectivity and managerial discretion could be noticed in the negotiations between the PGM and the GM Infrastructure to fund these switches from the technical domain budget. The PGM sought a personal favour from the Category Manager to treat this procurement request as an emergency request and bypass the lengthy procurement process. Demands from the vendors for urgent delivery were based on trust and future business expectations. The PGM's request to the PM to manage the delay within the schedule reserve was not palatable to the PM as it affected his performance indices for meeting the project timeline. The cycle of interaction lasted for 11 days.

The situation can be considered as a 'tipping point' because the outcome was indeterminate until it was reached. There were multiple options for the PM and PGM to choose from. Seeking priority had been noted as a common practice in Xfone.

The situation could have altered the course of the project in terms of time and cost. The social aspects, inter-subjectivity, management discretion, trust-based interactions noticed in this scenario, prompted the situation to be classified as a tipping point.

Table 4-4 shows a sub-set of Complexity Factors captured during Stage #1 Interviews.

Table 4-4 Voice Recordings sample data

Theme	Analysis	Stages of the Projec	Reflecting	Ranking of the Facto	Inference / Resarch outcome
Application Code / Embedded Technology	in this organisation all applications are Standard ERP Applications. We dont build large size Code The Detailed Design and Technical discussions usually trace this out. Not any emergence situations, conlficting event, scenarios that require review approvals occur just because of the nature of code like java, c++, SQl etc.	Build		0%	Technologicall Complexity is not evidenced
New Technology Introduction	This organisation introduces the technology very rarely	Concept	Project Process / Social	<5%	A rare incidence of New Technology Introdcution into this organisation leads to experiencing complexity in terms of trouble shooting, configuriong and perfroming required tests. Unknown factors emerged. Management decisions for Rollback and serious commercial implictions to technology vendor was evidenced.
Multi Node Infrastructure	All platforms in this porganisation are Multi Node. Technology Maturity and OSS - Support Systems Monitoring leads to	Deployment		0%	Multi Node - Infrastructure does not show any emergence just because it is multi sited/ multi noded. These are BAU - Project activities.
Access Management and Security Protocols	Standard Procedures and Existing Securty Tools fix this	Design		0%	Security Protocols dont bring any form of emergence complex scenarios.
Mix of Technology - Obsolecence to Recent Software	The base technology is Obsolete, unfortunately the new release does not integrate with Old technology.	Deployment	Project Process / Social	<5%	This has happened very rarely, and unpredicatble problems, which cannot be easiliy dtected has occurred leading to delays and issue resolution.
Project causing Major Impacts to Business	Most of the Projects are business impacting. Standard Engineering and Project Management Methedologies cover this as BAU.	Concept		<5%	Whene ever Business Impact is inherent in the project stakeholders view and new persepectives are brought, thus leading to changes.
Number of Modules in Application (Product)	Most of these Applications are standard Enterprise Applications. If a Project is impacting several modules then there is a few times to rare incidence of complexity. But Pre-Planning and design covers this.	Concept	Project Process / Social	<5%	

As a researcher, I noted clear evidence from the data that the reflection of complexity for Layer 3 were expressed more when the products were built under the nomenclature of, and clearly identified as, a ‘project’. I have come to believe that social complexity is engendered, or exacerbated, due to ‘projectisation’. Other organisational functions, such as Operations, Finance or Human Resources, do not experience similar type of complexity.

For example, when I inquired about the definition of complexity from the Operations Team, the Provisioning Team, the Customer Care Centre and the Billing Team, their definition was related to people, performance management, knowledge transfer, resource allocation, service level agreement and regulatory compliance rather than unexpected, unprecedented events causing a variance to pre-established state such as a project milestone. One of the reasons could be that the operational teams performed the same or similar tasks every day without any constraining time factor to complete.

> Op1: BrXA stated, ‘Complexity in Operations is about managing the Service Level agreements with the vendors and our operation teams’ problem management’.
>
> Op2: SXMc said, ‘Complexity in Billing Operations comes from mishandled customer communication and investigating lost revenue assurance through a rating process.’
>
> Op3: RXM observed, ‘In our area, complexity means unexpected outage and an attempt to fix it within the SLAs. It is about time, resource allocations and swift response to emergency. The complexity experienced here is short-lived. Tools, automation and process help us to regulate it.’

4.10 Summary

In summary, my understanding during this initial engagement with the research participants led me to believe that all project participants, in varying ways, understood the term ‘complexity’. The data analysis illustrated that the project management practitioners understood the concept of complexity well but with no clear delineation between complication and complexity. The practitioner’s definition was based on perception and experience, which differs from mathematical complexity. The ‘project’ had an imposing effect: the ‘temporality’ and rapid relationship building, and the virtual nature of the project team, were differentiating factors that could generate complexity in comparison to other organisational functions.

The sources of complexity factors were traced to product, process and social layers. A differentiation was noted between factors and echo of complexity, meaning the expression of complexity. Attributing the complexity factors to these three different layers bestowed an approach of looking for the originating points for complexity. The notion of a ‘tipping point’ differentiated the complex scenarios from normal project events.

Chapter 5–Stage 2 Data Analysis

5 Stage 2 Mapping Complexity to Theoretical Constructs

Having obtained in Stage 1 the rudimentary definitions of complexity as experienced at Xfone, the tipping point and the origination of complexity, in Stage 2, the interviews were targeted to classify the factors. Complexity in projects has been classified as 'technological, structural, directional, and temporal' in the literature (Remington & Pollack 2007a). In the following sections, the complexity factors are traced in various snapshots (event observation or interview data) of Xfone and categorised into four groups as defined by Remington et al (2007).

5.1 Technological Complexity

In some projects, the presence of technological factors can trigger complexity. The following section presents a set of snapshots containing narratives, observations and interview responses related to technological complexity in IT projects in Xfone.

Snapshot 5-1 Technological Complexity

S01: SgX wrote, 'In one of the projects, called CdAgIC, a new data extraction tool (CDC) ***(cf01)*** was introduced. A proof-of-concept exercise was carried out with limited volume of data in batch mode. Technical issues surfaced in the tool code when the project used a full set of enterprise data ***(ec01).*** These issues stem from the characteristics of the data set (***cf02***), which the vendor had never seen before. New types of technical problems surfaced in the testing phase for various test cases. The vendor had to apply innovative approaches ***(ar01)*** to provide a technical solution. In this instance, the assumption about [the] tool's capability to process majority of the data types had failed (***cf03***).'

S02: On another project, SgX observed, 'In my observation of XACCT to DCS transformation project, the software code designed in one application posed a technological challenge in translating the logic (***cf04***) into another application.

As unexpected and unpredictable issues arose, the project manager and technical specialist considered this scenario as complex ***(ec01)***.

The vendor has never carried out such translation in any other site, it was their first attempt, and despite knowledgeable engineers being involved, their technical assumptions (***cf05***) failed in many instances.'

S03: Kxk, Architect on DCS migration observed, 'Our effort to minimise delays due to introduction of new technology (***cf06***) in this project is defeated by unexpected scenarios ***(ec02)***. We were left to collaborate ***(ar01)*** with technology specialists in Germany and update the management about the risks involved in adopting options provided by these experts. The most difficult part was human interaction rather than technology itself ***(ec03)***.'

S04: The domain manager MXE stated, 'In order to experience the technological complexity, we should encounter problems which could not have been *predicted* ***(cf07),*** and for which no solution exists (***cf08***), despite applying available expertise. Eventually we may surmount the problem, but to do so we would need to embark upon innovation (***ar02***) and research through multiple iterations of solution development ***(ar03)*** *and race against time.'*

S05: JC stated, 'We observed that handholding of two different technologies or beta versions pose complications; however, such issues are expected at the initial stage itself. If *we know upfront* that the problem would occur, or we can improvise a technical work around it, but experience some level of difficulty in implementing it, then these problems are *complicated problems, not complex in nature* ***(ec04)****.'*

S06: MxE, in her note said, 'We don't do bleeding-edge technology here (***cf09***), our platforms are mature ERP applications with a few legacy platforms. As such, complexity in terms of technology surfaces only when we embark upon *state-of-the-art technology* and *have less in-house expertise.'*

S07: JXT observed, ‘The project managers and the architects participated in collaborative sessions with the vendors as technical issues surfaced, and project timelines and costs were impacted. It is sometimes frustrating ***(fe01)*** to get management approvals for technology discussions, as they don’t appreciate the gravity of the situation or quality recommendations.’ ***(ec06***)

S08: BXR observed, ‘In my experience here, most of the time, system implementation projects are in mature technology platforms (ERP packages & HW) with quality-tested implementation procedures and technology support processes.’ ***(ec05)***

S09: PXN commented, ‘My argument with John is, he should leave the technical decisions to us: we do this job day and night for a living and we are experts here. The cost discussions should be held in the next stage. I will take this up in SCM today for a decision.’ ***(ec07)***

S10: TXCar stated, ‘The software development vendors experienced technical complication in software code development. These scenarios are not of an emergent nature, as there was a known solution to the problem or that problem had been experienced elsewhere.’

S11: PMO Project Records: researcher observation:
Only three projects out of 27 projects have shown emergent behaviour due to technological factors. The other 24 projects have not exhibited any complex emergent behaviour due to technological factors, as the technology has been well understood and is mature.

S12**:** BXM stated, ‘Technological changes create a scenario, a floater situation, for which the solution has to be improvised almost immediately. Now the development of solution requires knowledge sharing and collaboration.

Moreover, I have to do some explaining to upper business management who cannot appreciate the gravity of the situation. I would say the complexity is in this collaboration and management updates.'

Technological Complexity - Analysis

Complexity Factors

The introduction of new technology ***(cf01***) caused emergent scenarios ***(ec01)***. The technology was functional in test mode, therefore, an assumption was made that it would work in production mode. The software code ***(cf04),*** when translated from a legacy application, brings out technological complexity. Lack of in-house expertise is quoted as one of the factors for technological complexity.

A few characteristics of complexity factors are described as 'no solution should exist' ***(cf07),*** 'face it first time' ***(cf08)***, 'happens unexpectedly,' 'state-of-the-art' and 'bleeding edge technology.' ***(cf09)***

Echo of Complexity

The complexity manifests itself in the discussions and debates between architects and PMs to develop innovative solutions and the solution evolves through their collaboration. The complexity is also traced in discussions (***ec01-ec04***) with the management ***(ec05)*** to explain the technical options and seek decisions, often involving additional funds.

Relationships

The key relationship in these scenarios is between the architect and the PM in terms of their collaboration and disagreements. The relationship between domain managers, the PMs and the Sponsor, also plays a key role in addressing the technical issues. If these relationships are strained (***ec06***) during the discussions, the decisions are slowed down, causing a direct impact to project timelines or costs. In turn, this delay triggers further repercussions at Steering Committee level.

Action-to-Reaction

In complex scenarios that were created because of technology, typical action-to-reaction cycles included delegation of technical decisions to SMEs ***(ar01)*** and architects, the project managers excluding technical SMEs or architects from decision-making, aggressive facilitation to resolve technical issues ***(ar02, ar03)***, and seeking management approvals through influence rather than presenting rationale in steering committees.

Emotions

The architects and SMEs expressed feeling overwhelmed feeling about conceptualising a technology solution in a swift manner. They stated during the interviews that they got frustrated **(fe01)** with the lack of decision-making by the management in the Steering Committee meetings **(ec06).**

5.2 Structural Complexity

In some projects, the sheer size and structure creates complexity. An application platform may have multiple sites and multiple instances. These types of projects have hundreds of tasks to be completed in a synchronised fashion. The following section presents a set of snapshots containing narratives, observations and interview responses related to structural complexity in IT projects at Xfone.

Snapshot 5-2 Structural complexity

S01: PMO Record: 'In project XXKing, the scope entails a new application to be installed on a new hardware platform with customisation ***(L02)***. As part of this project, there were changes to core functionality of 17 applications and 43 interfaces. A team of 76 people belonging to diverse skill groups worked during the peak time on this project.

The project XXKing was considered as a debacle (failure) in Xfone, and a PIR report acknowledged the complexity due to inter-dependencies between applications and involvement of too many people in this project led to failure in terms of increased budget and multiple delays.'

S02: JXM responded to my open-ended question on 'complexity of XXKing?' in a café: 'In Xfone, when a project size was too big, we ended up transferring the project to transformation program ***(ar01),*** or at least we organised it with several sub-projects ***(ar02).*** In XXKing, my approach was to have an individual timeline, when integration of the schedule ***(ar03)*** was done on key milestones. The communication became a bit complex as an issue in one sub-project affects the other sub-projects.

'An important point to note here is, we utterly failed in deploying these changes in our environment ***(cf07)***; that transition was never smooth. I would consider that as complex rather than the build effort involved in multiple systems. In an IT systems project, a functional change ***(cf08)*** in one application can directly or indirectly have an impact on another application causing unexpected cascading changes.

'A functional change in an application modifies the data structure, format, frequency, and control parameters, thus leading to concomitant changes in another application, which might have been overlooked ***(ar04)*** in the planning stage.

'The "functional complexity" addresses the characteristics and nature of the function in terms of qualitative measure, its criticality and interdependence to other applications.'

S03: Research participants JXM and NYP, in one of my joint discussions with them, agreed that the structure implies project size.

Project size is about quantification of impacted functional areas ***(cf01),*** number of applications to be integrated (***cf02)***, number of product components (***cf03)***, number of HW system installations (***cf04)*** and number of interfaces ***(cf05)***, etc. They believed that an increase in the number of elements might cause complex situations as time-bound coordination ***(cf06)*** exceeds a level of manageability. Emphasis had to be placed on 'nature and frequency of interaction' rather than the 'number of interaction'.

– Discussion Notes with JXM and NYP, roomE3

S04: In a lunch conversation GZD, MYE, PXN shared their experiences, citing the following as an example:

'"DMZ-Black adder" firewall was pulled down, it caused several applications to be restarted manually. The size of the firewall configuration code is very small, the technology is mature but its functionality (***cf09***) created a dependence on several applications.

'It was a bit of a mystery: when this firewall was down and brought up again, several applications required a restart and the network throughput and latency were behaving crazily.

'It took time to plot a graph tracking the peaks in the network performance, which was totally unexpected. Thus, a function can cause emergence and unexpected dependencies ***(ec01)***.

The application's interdependent behaviour was unpredictable until the testing cycles, thus causing change to the project parameters such as time, cost or resource model.'

Adding to this conversation, AXK pointed out: 'Functional change causes scenarios because of factors such as lack of expertise, shorter time duration spent in design stage, and in-depth analysis of functional dependency not listed throughout the application grid.'

MYE, however, defended this statement. 'Generally speaking, these scenarios cannot be considered as "complex" or "emergent", as there is a solution for these types of scenarios within the expected timeframe.

‘Functional interdependencies are comprehensible upfront. But, in a rare instance − as noted in the data − emergence is caused by some application functions such as network routes ***(cf10)***.’

GXP cited this example: ‘When a “bill aggregation” was implemented, we did not look into the indirect impact it would have on our data warehouse (DW) applications. The DW application was also undergoing changes concurrently. The DW PM failed to communicate with ongoing projects for interdependency checks ***(ec02)***.’

JVK stated, ‘Some application functionality contains too many parameters and contains complicated mathematical algorithms with “if-then-else” conditions. However, these algorithms are comprehensible and can be modelled. In this organisation, technical interdependencies were published in formal change control forums ***(ec03)***’

SYM observed, ‘Each domain wants to keep ***(ar05)*** any large projects within their portfolio, to gain control over budget and get a name within the organisation. They play games like subjecting the costs ***(ar06)*** to be below certain limits to avoid the governance scrutiny.’

S05: BXM, digital delivery head, said, ‘In my view the size of the project team, number of stakeholders ***(cf11)***, number of organisational units ***(cf12)***, geographies ***(cf13)***, and end-users ***(cf14)*** or size of customer base impacted ***(cf15)*** are primary factors for complexity, when we talk about project size. In project management planning we create a communication plan, but during the execution of the project, dynamically these relationships have to be managed and pro-active communication should occur.’

I asked for further elaboration with these groups, to which BXM responded. ‘People bring their agendas and *play games **(ar07)***, which can thwart the project’s objectives being achieved within a certain timeframe. We are talking about interdependency of human action ***(ec03)*** and their motive.’

S06: RXZ observed, ‘As a project manager, when you work on a large project, you are exhausted (***fe03***) and drained. When you hold a few balls in the air at the same time one or two will fall down. Definitely, you need administrative assistance to balance the coordination complexity you face.’

Structure as Complexity Factor - Analysis

Complexity Factors

The research participants acknowledge that complex scenarios might emerge because of the size of the project.

At Xfone, the PMO classifies a project as a ‘large project’ at their discretion, subjectively evaluating the impact, for example, number of applications and size of the application changes. Such large projects are moved under a transformation program or divided into sub-projects.

Though factors such as application functions, code size, scope elements, number of interfaces to other applications, number of installations/sites, instances and platforms are believed to cause complexity, emphasis is placed on factors such as the number of project team members, the number of impacted stakeholders and the geographic implications of having teams in multiple regions or countries working on a project at the same time. It is also important to note that the nature of interaction, such as concurrency, criticality and real-time functionality are mentioned as complexity factors.

Echo of Complexity

The complexity is echoed in discussions with large skill groups (coordinating the tasks or due to multiple positions), stakeholder expectations and communicational needs. It is also reflected ***(ec03)*** in gaining agreement over decisions and seeking priority on competing needs. Inherent complexity is also echoed in change control forums for interdependency checks.

Relationships

Key relationships in such complex scenarios are relationships between portfolio managers, program managers to project managers, domain managers and operations managers. At times, new relationships are formed between software coding teams, technical managers and vendor technical managers.

Action-to-Reaction

Domain managers attempt to get large projects into their portfolio for reasons of control, budget and domain or personal achievement. The domain managers or project managers make assumptions on costs and use persuasion and coercion to enforce agreement on costs ***(ar04-ar05).***

It is also noted that the project managers and domain manager evade approval authorities by splitting the project within domains to be under the fund approval limits in order to avoid scrutiny. Playing games to look after their interest was noted ***(ar07***).

Emotions

Project team members experience exhaustion, energy drain, a disconnected feeling and frustration (fe01) when a complex scenario occurs due to structure. They feel overwhelmed during these scenarios. Their feelings were expressed as ‘too much to hold.’

5.3 Environmental Complexity

Arising from my analysis of the interviews, I have coined the term 'environmental complexity' as a classification of complexity in my study. This term has not been used in the literature reviewed but it was an important classification in a context like Xfone. It is important to note that temporal complexity is mentioned in the literature (Remington & Pollack 2007a), pointing to the temporal, changing nature of the environments. However, I consider that the environments themselves generating complexity because of their connections (input/output/control data requirements) and interdependencies.

I define environmental complexity as the complexity that arises from a combination of technical and structural complexity; it is external to the product being built. I attempted to explore this category further and found it was easy to trace this type of complexity because of the availability of data about concurrent application releases, technological landscape and volatile environments. The following section presents a set of snapshots – containing narratives, observations and interview responses − related to environmental complexity in IT projects at Xfone.

Snapshot 5-3 Environmental Complexity

S01: AXK, the test manager, explained his experience in managing test environments: 'When a project has completed its development stage and is entering into stage of "system integration test" (SIT), the environmental contention ***(cf01)*** may lead to a complex situation. The environmental contention is caused by unexpected defects (***cf02***), or elongated timeframes ***(cf03)*** in defect fixing, (***cf04)*** and regression testing ***(cf05)*** in one application. A project may have many impacted applications. If one application has encountered a high severity defect, then that project *occupies the testing environment* for more than planned duration. This emergent scenario ***(ec01)*** leads to *prioritisation* of the projects. It is not possible to *predict these scenarios*; (***ec02***) therefore, building additional test environments is not cost effective.'

S02: RXZ observed, 'The PCI project encountered a strange scenario. When we were in the third cycle of the testing, a defect in interface caused a problem in EBPP application. The data preparation time is more than 36 hours; we cannot revert to the environment for another project. As I was attempting to negotiate ***(ar01)*** the time for the test environment with the test manager, he referred (***ar02)*** the issue to the General Manager. It took at least one day to get hold of the Steering Committee (SCM) and obtain the priority ***(ar03***) for the project. The vendor will be penalised ***(ar04)*** for the defect, but that is not going to resolve the issue, as we had to cooperate ***(ar05***) with each other. I had worked with J and C before ***(r01),*** so it became easy for me to ask for time extension.'

S03: AXK − again on testing − remarked, 'Failure of a critical test condition (***cf06)*** for a single project can lead to several emergent conditions, occupying the test environments, locking the hardware/software resources and tools. However, when an unexpected event occurs in one area it has an exponential effect on complete testing activity of the organisation ***(ec03)***. It will not be cost- effective to build too many test environments so we are left to dwell in uncertainty ***(ec04)***.'

S04: BYM commented on issuing priority judgments on the use of environments: 'A project has to adjust its timelines and resources and coexist ***(ar05)*** with other projects competing for priority.'

S05: BXR PMO Manager observed, 'Environmental complexity is also experienced when an organisational pipeline has several projects ***(cf07)*** in testing and delivery stage at the same time − *a clogged pipeline*.'

S06: SXG spoke about his project. 'As it happened in DCS cut-over, the window for downtime ***(cf08)*** data collection hubs is very small; we will lose usage and revenue if we have downtime of more than an hour.

‘We have to meticulously plan and carry out the sequence of tasks in synchronisation ***(ar06).*** A hitch in one step requires immediate intervention ***(ar07)*** and decisions to revert or proceed on the spot. No doubt, ordinary planning techniques are limited to help but completely rely on *intuitive* decision-making through *collaboration* ***(ar07)***.’

Table 5-1 PMO Records showing environmental contention by multiple projects

Period	Skill Group Report	Total Projects	Contention
June 2009 to Nov 2010	IVS, Release Management, Production Support, Portfolio Managers.	14	7/14
April 2010 to Sep 2011	IPG, Production Portfolio, IVS	36	19/ 36

S07: BYM said, ‘When an organisation has a pipeline of projects, obviously resource and environmental contention will occur. We cannot afford to use sophisticated tools to plan and re-plan (***ar08***) constantly, but to create a mechanism to interrupt ***(ar09)*** the system of delivery by control parameters.’

S08: JXK observed, ‘We are talking about the ‘inter’ factors rather than ‘intra’ factors of a project, which are causing a complex scenario. What I mean here is that the complexity is not due to lines of code that have to be written, a number of test cases that have to be executed, or a number of GUI that needs to be deployed. The complexity is due to a number of instances, and *roll-out demography* ***(cf08)***.’

S09: Projects and Environments: In a project, during ‘concept development’ session, I prompted the discussion by asking, ‘Why do we believe our environments are so complex, yet not do anything about it?' BXR, TZB, BYM, PXN, MYE participated in this session and PXN drew the following diagram on a white board attempting to trace the interdependencies in systems, process and people.

Figure 5-1 shows several projects in a pipeline, impacting multiple applications at once, causing changes in business process and people assignments. This diagram is a reflection of the environments in their current state − 'wobbling' through interaction and self-balance. The team concurred that the volatile nature brought inherent complexity to projects.

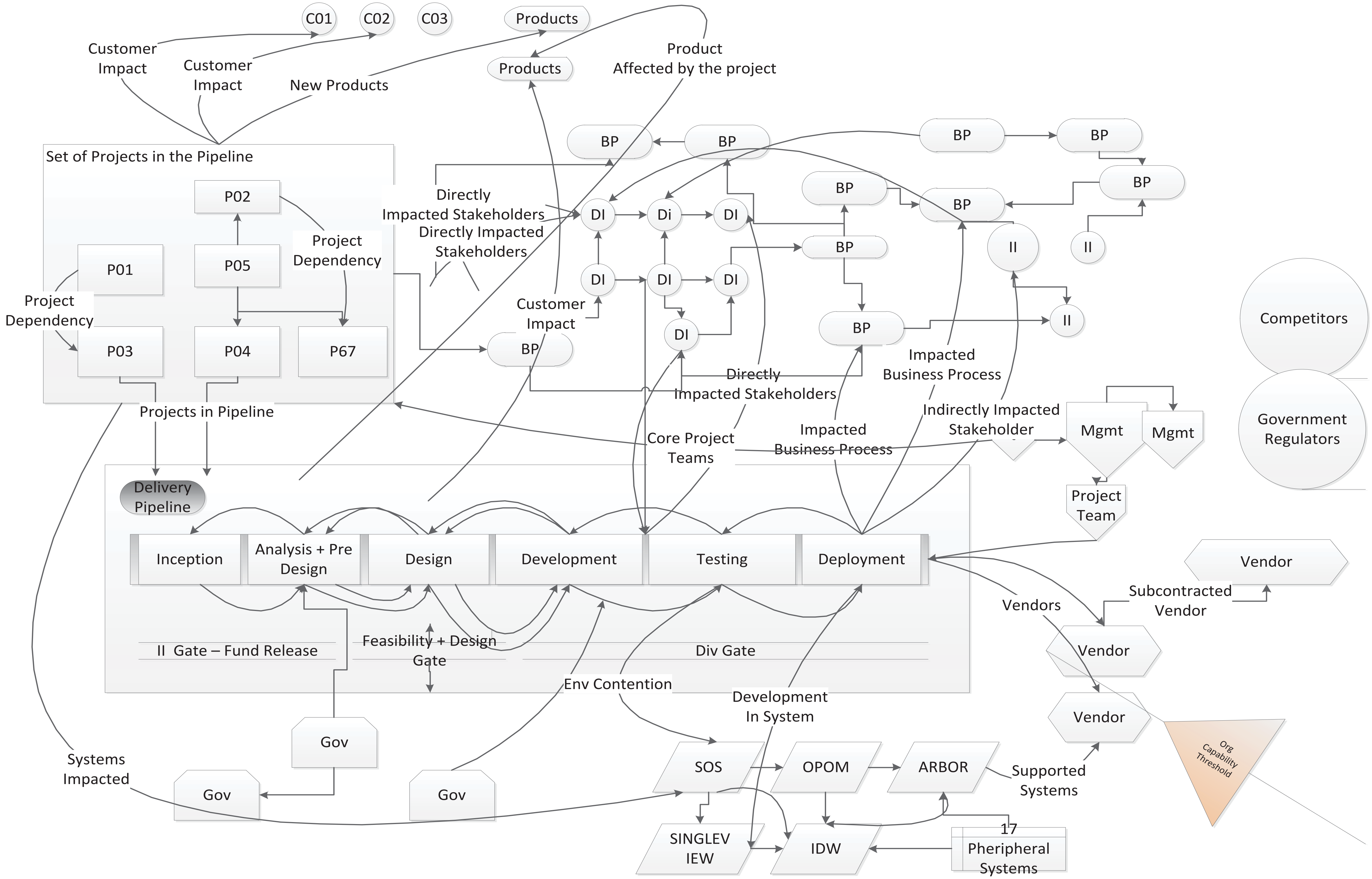


Figure 5-1 Interdependencies between Systems, Process and People

S10: In explaining the situation, PXN observed, 'It is like repairing a spaceship in orbit or a submarine in a deep ocean under tsunamis. There are too many factors, *continuously changing in the environment* ***(cf09).*** When an application is making changes to "real-time" systems or the release window is very small with potential impact to millions of customers or with severe impact to subsidiary systems, this complexity surfaces. Moreover, our "test" environments do not look like "production" environments ***(cf10)***. The test environments are a subset representation of production instances. Therefore discrepancies are found and data related complexity is encountered.'

S11: BYM added to this observation: 'Every organisation has a limit of capability to deliver a number of projects; if the project pipeline ***(cf11)*** is jammed by too many projects, then the environments in which these projects need to be delivered enter into freeze condition ***(ec05)***. Project managers feel angry and frustrated ***(fe01)*** as their projects are sidelined sometimes. But that's the way the environment triggers response and management intervention to prioritise ***(ar10)*** is required.'

S12: Researcher's observation: In order to show this type of complexity, first I obtained the number of projects in the pipeline and their dependencies recorded in initial technical assessments by the architects. There were 386 systems and 612 environments listed in the IT asset register. In one year of the Annual Operating Plan (AOP), 896 projects were in the pipeline delivering technological changes into the interconnected environment (PMO records).

I then obtained data from the release management function in order to see why there was frequent reference to the environment as complex in this organisation. The changes were shown in a management report. The environments became highly volatile because of the high volume and frequency of changes deployed in them.

Table 5-2 System changes (CRs) – application rollouts in different states at one point in time:

	Closed	Completed	Work in progress	Scheduled	Total
Oct'12	63	93	40	82	278
Nov'12	100	102	27	55	284
Dec'12	49	46	6	25	126
Jan'13	56	48	4	14	122
Feb'13	60	57	13	14	144
Mar'13	63	47	9	30	149
Apr'13	59	48	12	23	142
May'13	77	42	17	44	180
Jun'13	48	54	13	34	149
Jul'13	47	94	17	47	205
Aug'13	46	114	6	0	166
Sep'13	76	86	3	29	194

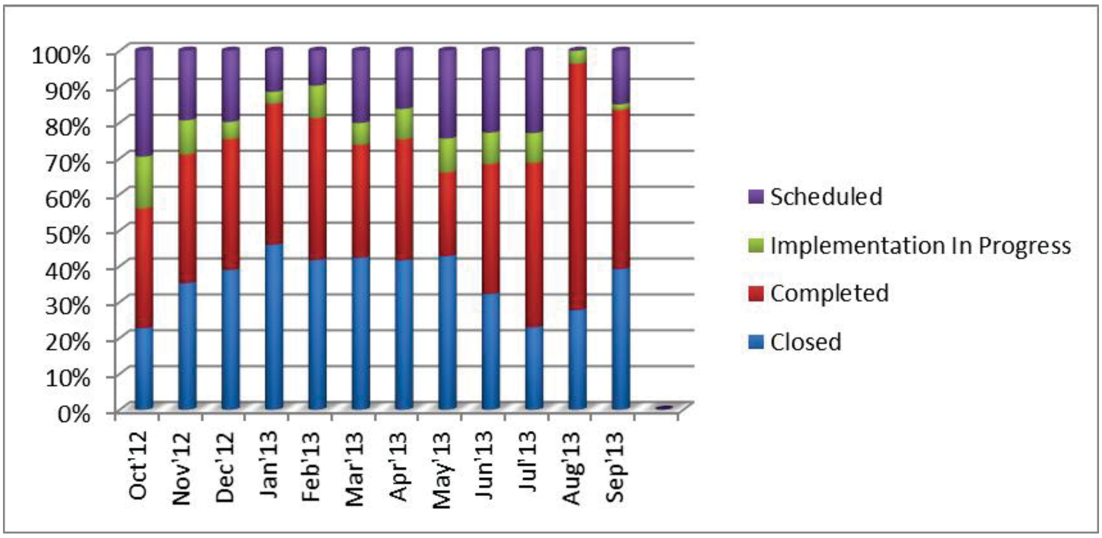


Figure 5-2 Systems undergoing change.

Table 5-2 shows the number of application releases going into the production environment in a year after completing development and testing. This shows the concurrent changes happening in Xfone's technology landscape. Complexity stems from the concurrent changes to applications, as shown in Figure 5-2, and the interdependencies between the environments, as shown in Figure 5-3.

A single project impacting several applications is shown in brown:

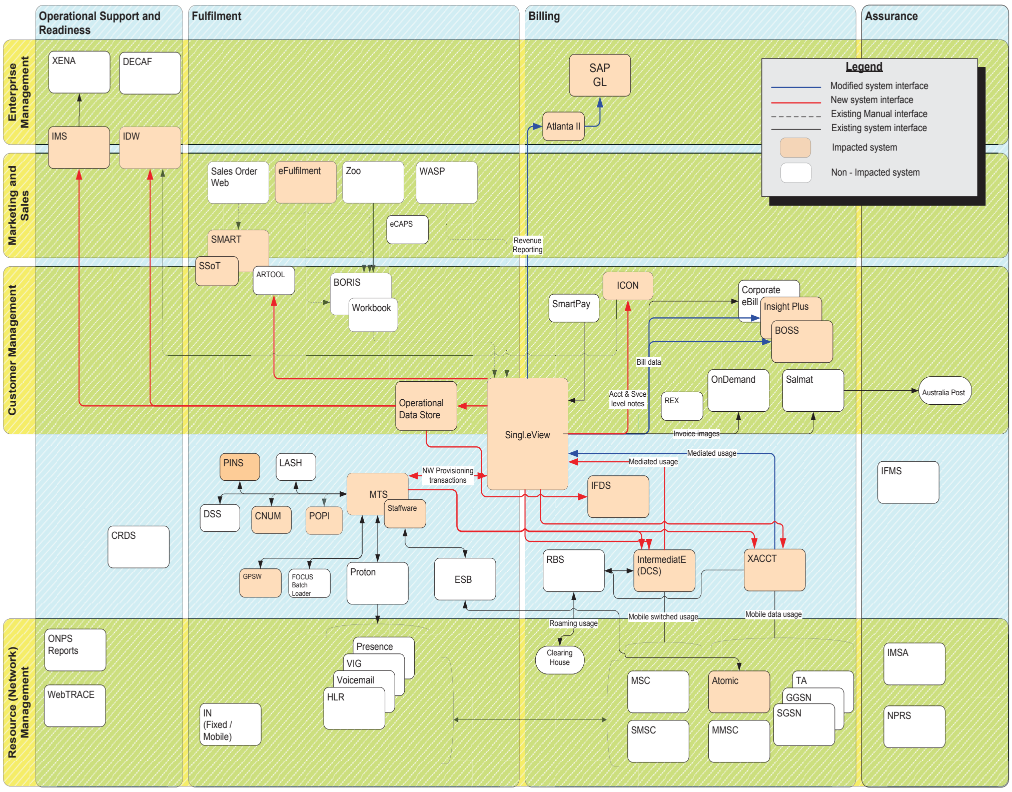


Figure 5-3 Interconnected Systems

S13: AVJ stated, 'As a business program managers, we are surprised by changing market conditions (***cf11)***, either by the introduction of a new business model or product configuration or commercial value adds ***(cf12)*** or disruptive products ***(cf13***) entering into market, for example, Viber coming into market dominance. The product managers pick these cues a bit late; it has a severe impact on inflight projects. We have to apply change requests upon change requests ***(ar11)*** with predictive models to meet market conditions.'

Environmental Complexity - Analysis

Complexity Factors

There is strong evidence that this organisation experiences complex scenario due to a technological landscape containing several systems interconnected in numerous ways, continuously undergoing changes ***(cf01-cf09).*** The environmental conflict is caused by defects and projects occupying the environments for more than the planned duration in order to complete the defect fix.

Differences in the build, test and production technical environments may also lead to complex emergent scenarios ***(cf10)***. Build and test environments are not an exact mirror of the production environment. Too many projects in the delivery pipeline ***(cf11)*** compete for the system resources, thus creating unpredicted demand on them. At the same time, IT service management tools are being used to coordinate hundreds of changes happening in interconnected applications/systems. The impact of these system changes contains a certain degree of unpredictability, which leads to complex scenarios.

Like any other organisation in a competitive market, Xfone also faces complex scenarios due to changing market conditions ***(cf11-cf13)***.

Echo of Complexity

The inherent complexity is echoed in management setting priorities when two projects are competing for the same environment. Such scenarios are unpredictable and emergent in nature ***(ec01-ec02)*** and when business conditions change, the corresponding change in the product demands collaboration at several levels. The complexity is echoed in this collaboration ***(ec05)***.

Relationships

The key relationship in play during these complex scenarios is the relationship between the environment managers and the project managers. Test managers, project managers, vendor delivery managers and release managers collaborate during these scenarios and we have noted the power play between senior executives is setting priorities for their projects to supersede others.

Action-to-Reaction

Environmental complexity triggers several action-to-reaction cycles, including lobbying for priority, negotiation for exceptions during releases, management intervention and escalation to higher management, coexisting with other projects through task synchronisation, planning and re-planning and interruptions to delivery systems ***(ar01 - ar11)***.

Emotions

Project managers experience anger and frustration ***(fe01)*** as their projects are given lower priority, which results in their missing target timelines.

5.4 Directional Complexity

This type of complexity surfaces when a) there is lack of direction to the project team from management, b) the project goals or objectives are not well defined and c) when project objectives are changed during the course of a project. Complex scenarios can also emerge because of multiple, concurrent and competing objectives. The following section presents a set of snapshots containing narratives, observations and interview responses related to directional complexity in IT projects at Xfone.

Snapshot 5-4 Directional Complexity

S01: JXM and PYA narrated this story when requested to describe their experience of complexity. ‘A legacy billing application has to be replaced with a new billing application. The domain managers recommended that we use See View Billing (SVB) application as it is already in use.

‘The functionality of the legacy billing application can be transferred to SVB. The billing domain manager initiated this project. During the investigation gate, a business executive was involved. As business has to fund this project, they questioned the validity of transferring the functionality without considering the current product strategy, as it would be wasteful to transfer unused functionality of the legacy application ***(cf01)***.

‘The project timeline to complete the initial costing and defining the scope was impeded by discussions of product strategy and its impact on the billing platform ***(cf02)***. A change in direction occurred ***(ec01)*** in an emotionally-charged Steering Committee. The domain manager claimed it was difficult to maintain the legacy application and support current demands from the business for additional features, while the business executive claimed it would be a waste of funds to transfer the legacy application functionality into new billing applications.

‘Two different standpoints prevailed (***cf02***): it was difficult to get all these executives in one place for a focused discussion. The Steering Committee requested that the project team analyse the product strategy and map it onto a technology road map. The project team carried out the planning activity again ***(ar01)***. After spending eight weeks, the project team recommended multiple options such as cannibalising non-performing products and offering the customers alternate options.

The project team was also engaged in rationalising ***(ar02)*** the rate plans, and mapping the technology to future products. ‘Flexibility’ became a parameter to determine the application platform. After three months’ duration, the project was merged with an ongoing program to deliver billing functionality for only a segment of customers.'

S02: NYP, on killing this project: 'Do they know what to do? They had an intent, but were never able to define the objectives ***(cf03)***, while the project still existed, spending funds, wasting resources and attempting to explore.'

My question to NYP, 'Where do we find complexity in this situation?' provoked this response:

'First of all, by justifying ***(ar03)*** the need for this project [i.e., even though the project objective is not well defined, we continue to run the project instead of closing it]. We are driving the teams crazy ***(fe01)***, causing more disruptions than reaching an outcome and value for the expenditure.'

I asked NYP if he found it difficult to stop. He responded, 'More difficult than starting, as I had to convince ***(ar04)*** several layers of management that it is not the right approach.'

S03: RZZ observed, 'The objective of the project "Insight Plus" was changed midway ***(cf04)*** as a different interpretation of the project objective was used in a later stage of the project execution. This project was started as a reporting platform for OB customers, wherein an end user from OB would be generating the reports to provide answers to customer queries and reconciliation for billing accuracy. Business realised that these reports could be distributed as a tool to the end customers, therefore changing the data content, accessibility, and GUI interfaces.

'This change was not that simple, as IT resisted changing the core components of this platform midway ***(cf05)***: several discussions and management decisions ***(ar05)*** had to be made.

‘When change is requested in functionality and features, it is managed through the change control process, but, as the objectives and goals are changed, it passes through intensive discussions and debate leading to political play and gamesmanship ***(fe02)***.’

S04: BYM noted, ‘We have funds, but we don’t have a clear view of operating in the market and we don’t know what to do ***(cf06)*** to capture the market. In this case, the formation of an initial goal itself went through hoops ***(ec02)***.’

S05: PMO: An external consultant’s investigative report on a project registered the following instance. ‘One example of a project in which the business direction was constantly shifting ***(cf07)*** and the project goal was *stated ambiguously* is QTOC. This initiative has seen many program and project managers and the organisation had spent at least $3 million in capital investment. The project was terminated due to lack of direction ***(cf08)*** and constantly changing business objectives ***(cf09)***.’

S06: MxC observed, ‘In projects, directional change can occur due to change of project sponsors or external market conditions. I observed another example in which a product manager defined the objective for a project called MVF. A new product manager, GK, replaced PF when the project was almost at its completion stage. On the basis of market insights, GK requested the project be terminated. The PM facilitated numerous sessions to redefine ***(ar06)*** the business benefits.
The project objectives were slightly changed as an outcome of these discussions ***(ec03)***.’

S07: BYM, on APO planning and locking in the portfolio, observed, ‘People come to these forums with hidden agendas, they manipulate ***(ar07)*** the project situation to their advantage by overstating ***(ar08)*** the project objectives and presenting a maximised view ***(ar09)*** of the benefits. When groups have lobbied their position outside of the project meetings, it is difficult to challenge these positions. But during the project execution, most of the time, these objectives are either altered to fit the level of real benefits or redefined completely.'

S08: TZB on setting the project goals: 'The project charter should clearly define the goals ***(cf10)***, and this is not the case. Otherwise, you are sending them on a death mission.'

S09: KXC on setting the project goals: 'When we are not on the same page the project will have fuzzy scenarios ***(ec04).***' After KXC explained the project goals in a project briefing session, one of the participants said, 'It seems this project is complex and politically motivated ***(ec05)***.'

S10: BYM talked about the 'One Portal' project. 'They don't see each other: one reports to the local COO, another reports to the Global CEO in Singapore. Let me call the first one Jack and the other one Jill, for you not to dig any more on this story!

Jack wants the project to deliver benefits to Australian operations and is keen on completing the project in shorter duration. Jill has global vision and wants the project to complete all of the outcomes for the global operations. Both of them are co-sponsors ***(cf11)*** for this project. The PM suffered ***(fe03)*** in every Steering Committee in attempting to balance the power base ***(ar10)*** of these corporate clowns rather than delivering an agreed outcome. Because the differences in objectives ***(cf12)*** led the project team into confusion ***(ec05),*** *core team sessions were chaotic,* and the time duration was still not altered.

'The project was delayed four months, it ended up spending $800K more and a governance enquiry was launched. I would consider this scenario as complex because of the interaction at higher-ups.'

S11: SYM spoke of a steering session: ‘It is my bloody money, my division had to burn their lamps to earn this revenue; the scope should *focus on my requirements* for this Bill Shock project; multiple stakeholder groups funded this project. It is an example of goal conflict.’

The Bill Shock project manager observed, ‘If you are talking about complexity, this is it! Balance the power equation ***(ar11)*** between three sponsors and be an arbitrator. Our architect is very angry ***(fe04)*** at this.’

S12: RXM commented on KXC, ‘She has to understand, I have good intention, the solution has got to be robust to be future proof; configurability is one of the main characteristics of a good solution. All she is worried about is the scope paper some idiot wrote in the beginning of the project.’

S13: JyZ’s comment was: ‘As an architect, I can only recommend ***(ar12)*** the decision is theirs; it’s better they settle their score soon so that the project can start.’

S14: TXB. ‘As a PM I am aware the vendor wants to make money ***(cf13)*** through the CRs; obviously, they’ve got to meet their bottom line. So what! The project is in the red and we are suffering from this delay.’

Directional Complexity - Analysis

Complexity Factors

The data analysis has shown that complexity is experienced as much because of a lack of goals as because of multiple goals. The project charter is supposed to articulate the project objectives. From the interview data, it is evident that when a project does not have clear objectives or direction, the project team is confused.

Factors such as ***(cf01-cf13)*** two different standpoints, inability to define the project objectives, change of direction midway, resistance to changing project objectives, constant shift in business, failing to define the mission, multiple sponsors pressing their views on the project objectives and vendor opportunism may all lead to complex scenarios.

Echo of Complexity

The echo of complexity is noted in charged Steering Committee sessions ***(ec01)*** and chaotic project core team sessions. In order to gain insights to form clear project objectives, the project stakeholders enter into deliberations or facilitated discussions ***(ec02-ec05)***. These discussions are politically motivated and the complexity is experienced in fuzzy scenarios.

Relationships

The key relationships in play during these scenarios are relationships between sponsors; delivery heads, business program managers and project managers.

Action-to-Reaction

The project stakeholders engage in activities such as planning and re-planning, rationalisation, and justification. They spend time convincing, manipulating the situation to their advantage, lobbying and balancing the power play ***(ar01-ar11)***

Emotions

In these complex scenarios, research participants reported that they underwent anger and suffered because of political game playing ***(fe01-fe03)***.

5.5 Time pressure as complexity

In the literature review, there was no mention of time pressure as a complexity factor. I have introduced this complexity factor because of the data analysis results. Time pressure due to compressed duration to complete the project was frequently mentioned by the participants I interviewed as one of the factors causing complexity. I recorded statements such as ‘time pressure in our projects’ or ‘the market does not give us a chance to wait’, pointing to complexity created because of time.

The following section presents a set of snapshots containing narratives, observations and interview responses related to time pressure as complexity in IT projects at Xfone.

Snapshot 5-5 Time Pressure

S01: BXR and BYM expressed their frustration. ‘In this organisation, every project exhibits “urgency” ***(cf01)***. This organisation cannot compromise on “speed to market” ***(cf02)***. Sometimes this urgency is “perceived urgency rather than the real urgency in the market”, as there is no empirical data behind this urgency. Every project attempts to compete ***(ar01)*** with an “urgent indicator and passes through the portfolio selection process.’

S02: JYT, shared his feelings on his experience with the Sentinel project: ‘Time pressure can lead to adverse behaviour ***(ec01)***. Once the time is committed, it is set in stone, signed by blood; it becomes extremely difficult to alter the expectations ***(ec02)***. When we missed the delivery timelines for this cursed project, it became clear that the blame game ***(ar02)*** and interrogation ***(ar03)*** by the SingTel Execs had started. A political fiasco! ***(ec03)***. First, there was no time to estimate the timeframe ***(cf03)*** for the entire project, and then the scope was never baselined to completeness ***(cf04)***. In addition to this, the vendor delay ***(cf05)*** was uncontrollable. I felt powerless ***(fe01)*** but had to receive this blame.

‘As part of project selling, either IT or IT vendors create a shorter time frame ***(cf06)*** in order to win the bid. The initial investigation or scoping gate duration is also short ***(cf07)*** in most of the projects, thus giving very limited time to carry out cost estimations. First level estimates are subjective assessments, and then political interests of the "delivery heads" skew them ***(ar04)***. The values are increased or decreased depending upon the context. Sometimes they are *not realistic* and project managers or technical experts *are forced to accept them* ***(ar05)***, even though it could be suicidal to their interest and career reputation ***(fe02)***. At the moment, I am the scapegoat ***(fe03)*** for this blunder.'

S03: BYM agreed. 'In this organisation, most of the projects had a compressed timeline of 8 to 10 weeks short of moderated timeline estimations ***(cf08).*** This was due to business expectations ***(cf09),*** technology reasons such as throughput ***(cf10)***, threshold fall and remediation ***(cf11).*** Entering into negotiations with the senior stakeholders means you have to be prepared for a dialogue ***(ar06),*** for several weeks to convince them about the timeline. When time pressure is applied, unrealistic compressed timeline expectations are set, and the project managers resorted to agile methods or staged delivery models ***(ar07)*** or reduced governance schemes ***(ar08)***. All of these approaches lead to increased collaboration ***(ar09)***, thus causing complex scenarios.'

Figure 5-4 explains a repeat situation in which projects get embroiled because of time urgency. – (BYM Drawing on Paper)

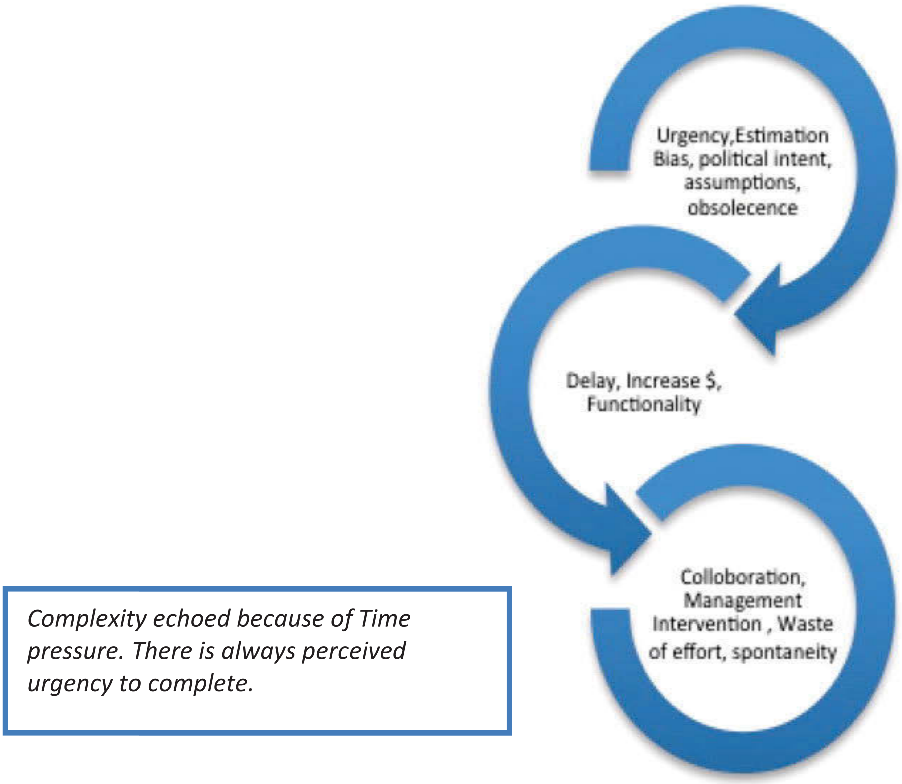


Figure 5-4 Time pressure the vicious cycle

S04: JXM stated, ‘It is a screaming fact that we need a better scientific approach ***(ar10)*** to estimate project timelines, and reduce the game playing ***(ar11)*** in estimations. But, unfortunately, this is the way we work here: “Squeeze trillion things in!” As an outcome of this time pressure, the interaction becomes too intense ***(ec04)***, sometimes inflammatory and abusive ***(fe04)***. To “When do you want this?” the response would be “Yesterday.”’

S05: MYE: ‘Because business wants everything urgently, we do tactical solutions ***(ar12)*** rather than strategic solutions to match the road map for the platform. In turn, the platform becomes much more intertwined ***(cf12)*** with several patches, resulting in a longer time for development subsequently. This cycle is never-ending.’

S06: RZX: 'Time pressure forces us to compromise on quality ***(ar13)*** and then we spend much effort in fixing defects.'

S07: PYA on the Seamless project noted: 'When you run on 100 miles an hour, you are too tired soon. Our culture of applying time pressure ***(cf13)*** leads to several complex scenarios during the execution stages of the project as constant negotiation and bargaining ***(ec05)*** with stakeholders and teams have to happen.'

Time Pressure as Complexity Factor - Analysis

Complexity Factors

Time as a complexity factor is well acknowledged by practitioners. Factors such as speed to market, perceived urgency, less time to estimate, not baselining the scope, shorter scoping gate, skewed time estimates, business expectations on time to release, throughput and interconnected platforms, lead to complex scenarios ***(cf01-cf12).*** In Xfone, there is a culture of compressing the time duration for projects as a means to get things done ***(cf13)***.

Echo of Complexity

The complexity is echoed in 'adverse behaviour' ***(ec01)*** and 'political fiasco' ***(ec02)***. Events associated with negotiating timeline and intense interaction ***(ec03)*** have echo of complexity. It is echoed in events associated with publishing the target dates for delivery with sponsors. As continuous negotiation and bargaining ***(ec05)*** for time occurs, as shown in Figure 5-4, the complexity is echoed in terms of adjusting positions to fit the context. To be convincing in their discussions with management about time delays, project managers apply enormous effort; complexity is echoed in these discussions.

Relationships

The key relationships in play during these scenarios are relationships between sponsors; delivery heads, business program managers and project managers.

Action-to-Reaction

The complex scenarios generated because of time pressure trigger several action-to-reaction cycles. The action-to-reaction cycles mentioned in the data are a) competing with an urgent indicator though it is a perceived urgency, b) blame game, c) treating time delay inquiry as if it is interrogation, d) skewing the estimates to befit the context though they might be unrealistic, e) being forced to accept delivery timelines, f) engaging in dialogues, g) staging delivery models, h) reduced governance, i) increased collaboration, j) providing temporary tactical solutions and k) compromising on quality ***(ar01-ar13)***.

Emotions

The project managers expressed their powerlessness ***(fe01)*** during these situations and were very much aware that they were unlikely to be able to meet such timeline expectations. They considered the time mandates as suicidal to career aspirations ***(fe04)***.

5.6 Social Complexity

The results of my data analysis have led me to believe that there should be a separate category for social complexity, even though the literature does not have a separate classification for social complexity, attempting rather to trace it in projects. My research at Xfone showed that factors such as organisational identity, cultures were in play because of outsourcing contracts and the geographically distributed multi-vendor environment. In order to understand social complexity in IT projects, a set of tipping point scenarios were analysed using perspective diagrams. ‘Human conditions’ such as anger, frustration, and ‘trapped-in’/helpless feelings are depicted in these narratives. The following section presents a set of snapshots containing narratives, observations and interview responses related to social complexity in IT projects at Xfone.

Snapshot 5-6 Social Complexity

I followed JYT working on project 'Select' over a period of three months, collecting the events and developments as the project progressed.

Ranch, Macquarie Park, August 2011.
S01: JYT joins us. BXR and I were sitting at a corner table; we usually sit here to relax after work on Fridays.

JYT: 'They are blaming ***(fe01)*** me for this project, I am just a contractor PM, I took this project from another idiot who had messed up. The timeline was never reasonable ***(cf01)*** or even meaningful to accomplish this project. Singapore ***(ec01)*** never understands ***(cf02)*** the volume of work, the BA did not pin down the requirements, the scope is continuously changing ***(cf03)*** and no one had taken an account even to record the scope ***(ar01)***, but instead argued that they were design changes, as the vendor had not understood ***(ar02)*** the original requirements, and the vendor is operating from Manila ***(ec02)***, running out of the budget for the past three months as no additional funding has been approved.

'Why is BZA nodding his head and condescendingly listen (swearing) to them? ***(ar03).*** You cannot intervene ***(ar04)***, where is your process and governance BXR? All I can do is miserably fail, when everyone watches.

'I feel like committing suicide, my contract will not be renewed, I need this job at the moment ***(fe02)***. My relationship with JMS has [soured] soared over this period; we don't see each other anymore. My future reference for the next job is difficult now. Since the industry is small, people talk about this project to everyone.'

I asked what happened to his conversation the other day with NXP.

‘NXP is a chameleon **(fe03)**, he works for himself, he needs his position, he lacks guts (***fe04)*** to speak to Singaporeans. BXA should absorb ***(ar05)*** the overspend and allocate funds from some other project, but then the lost time cannot be recovered. The Steering Committee is doing a post-mortem, already asking for investigative ***(ar06)*** reports. We are preparing the reports rather than doing the project work. The other day she (sponsor from Singapore) threw the phone on the table.’

I nodded my head, and said to JYT, ‘Relax, my friend, this is after all work.’

BRW said to me, ‘Don’t edge him; he is right. As an organisation we have failed ***(ec03)*** here. If he does harm himself we will be witness to that.’

JYT continued, ‘It is not about leaving the project to fail. It is about my integrity, the unfair treatment I am getting ***(fe05)***, and I am helpless to do anything about it. My family suffers ***(fe06)***.’

I followed up with NXP, he curtly said, ‘This project is very sensitive, no one could influence the situation ***(ar07)***, only time will lead to a solution, but JYT should stop leaving corpses around ***(ar08)***.’

After three months, the employment contracts of the architect, a permanent long-time staffer, and of JYT with this organisation were terminated.

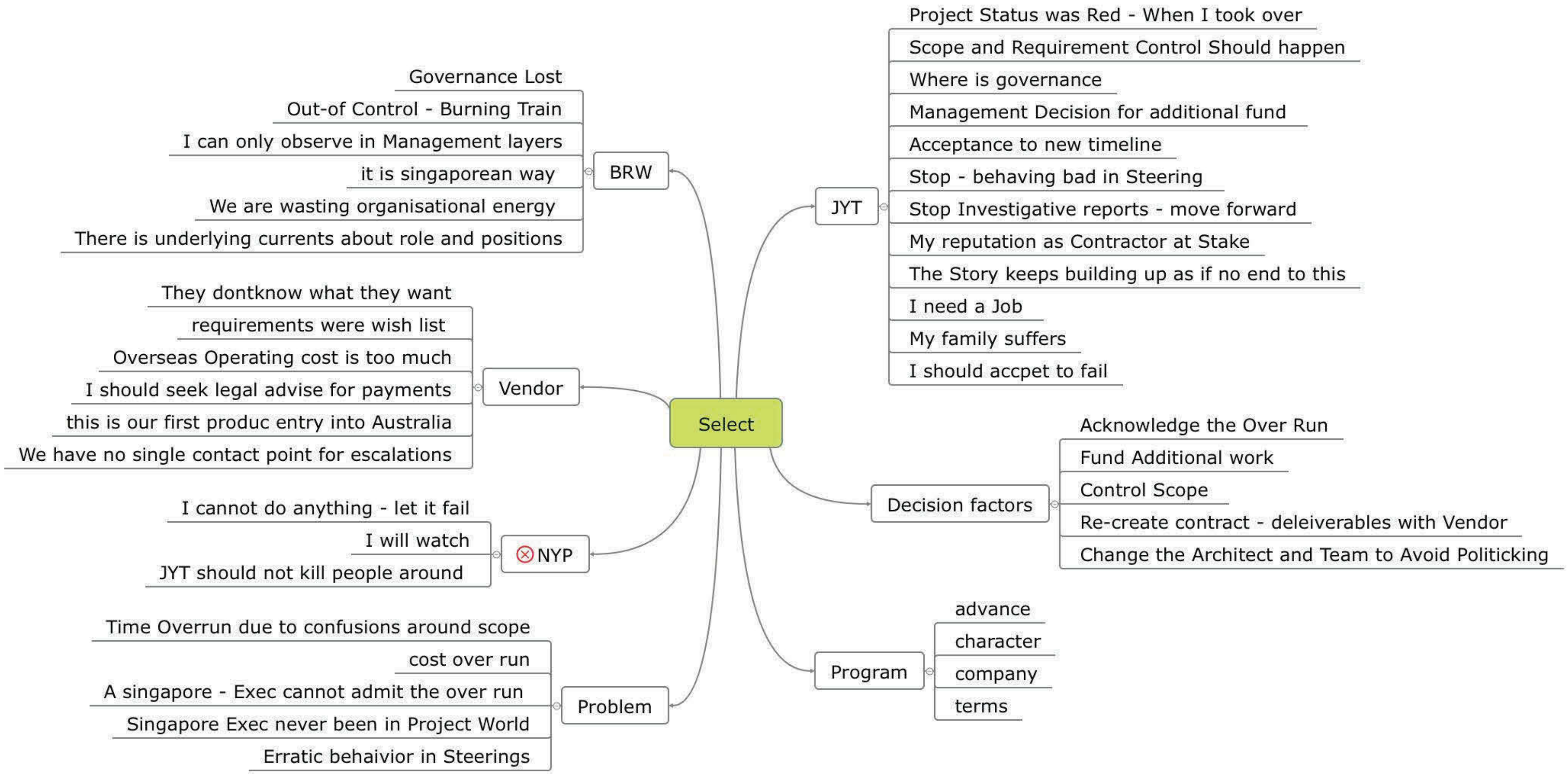


Figure 5-5 Social Complexity

Complexity Factors

The project timeline was not achievable as the time estimates were compressed. The Singaporean management did not have complete understanding of the situation. They applied too much pressure on the PM to deliver the project on time. The governance process had failed and Xfone local managers could not intervene. In addition, the vendor's inability to deliver the project on time caused further delay. Figure 5-5 captures several social themes, emotional experiences and contradicting perspectives from this narrative.

Echo of Complexity

The complexity is echoed in terms of interaction with the Singapore sponsor in Steering Committee sessions **(ec01)**. The vendor's interaction to bring them under control for time bound delivery also echoes complexity of social nature **(ec02)**. As an organisation, collectively, they have failed to support the PM on a rational basis; instead Xfone management has sidelined the project through deliberate inaction.

Relationship

The PM and management at different levels were involved in this scenario.

Action-to-Reaction

Inaction from the senior manager at Xfone appeared to be deliberate ***(ar03)***. The governance also failed to point out and correct the sponsor's behaviour ***(ar04)***. Time spent requesting investigative reports did nothing to resolve the impasse. It appeared that JYT, in an attempt to control the situation, ruffled the project stakeholders ***(ar08)***. There were multiple perspectives created simultaneously during different events. The project team members and stakeholders built and defended their position. The project team had several choices, but what was suitable was determined at the time, in a dynamic fashion. The choices differed from event to event, person to person. The interactions had individual and collective characteristics as the players acted and reacted to various project scenarios. Rituals and emotions were involved.

Emotions

JYT − obviously suffering in this predicament and situation − expressed helplessness, being blamed, and fear for future job references. Undergoing unfair treatment he felt betrayed. The social complexity was echoed in losing an important connection because of this project.

5.7 Links between Complexity Factors

The research participants believed that the experience of complexity was dependent on variables such as gender, professional experience, expertise, subject knowledge, power level and formal role in the organisation.

This research did not focus on gender difference to differentiate the experience and perception of complexity. However, there is a clear correlation between the formal role, power and stake of a person and the view they had on complexity in the same project. I came across a few instances when SXM and JYD talked about their involvement and experience of complexity, from their perspective as senior executives. They focused on business benefits, revenue growth and assurance while the project architects focused on time-bound delivery and working solutions in terms of quality. The project managers, on the other hand, focused on managing stakeholders' expectations and delivering on time. From these samples, my understanding is that the perception of complexity has a link to experience, formal role, power base and *'own stake'*.

It is inferred that professional experience can increase the ability to co-op with the complexities and respond to tipping point scenarios in a better fashion. A project stakeholder's skill sets provide a wider spectrum in 'options search' for optimal choices. Professional experience is also associated with an individual's ability to be in, steer through and deal with ambiguity. Since the perception of complexity and the type of experience differs from person to person, it is difficult to trace the correlation between complexity and these variables.

It was observed that when the research participants described complexity, they pointed to the 'whole project' or mentioned the existence of certain factors. However, when they described their 'experience of complexity', they narrated a project event, an unfolding situation that they had passed through.

In governance forums, such as a capital review board, a project review board, an architectural review board, change control forum or a production readiness assessment forum, etc., there is the echo of social complexity. In these governance forums, whenever an exception is sought, it requires preparation of the information, executive briefings and position development. It is noted that in these forums, the political play is too strong.

In candidate projects (projects from PMO), the data shows that there is inherent complexity with outsourcing vendors in terms of their master service agreements, service level agreement (SLA) definitions, statement of work (SOW) and contract definitions. In several instances, vendor opportunism was mentioned as a factor for complex engagement. However, I had limited access to these articles and did not examine closely the legal, contract clauses and inherent complexity in vendor engagements.

5.8 Summary

In summary, technological and structural complexity at Xfone were not experienced as much as directional, environmental and temporal complexities. The data analysis has illustrated that 'time pressure' is also a dominant complexity factor. The social complexity stems mainly from interaction and political power plays. The research also indicated that there are connections between complexity and variables such as expertise, professional experience and power. Environmental, time-pressure and social complexity as new complexity factors have been introduced because of the Stage 2 Xfone data analysis.

Chapter 6–Stage 3 Data Analysis

6 Stage 3: Tracing Social Complexity

The case project was selected because it was a community project. It was one of the largest projects Xfone had embarked upon using innovative technology and it had to be delivered quickly so that the facility could help the community through the SMS alerts during the next fire season. (In Australia, during December, raging bush fires cause severe damage.) The Australian Government and all the telecommunication carriers in Australia (including Xfone's competitors) were also involved in this project. This project had involved a collaborative approach, often seeking exemptions to standard project management methodology, yet achieved its outcome and was considered as a great success both by the Xfone management and the Government. I was given an opportunity to work as an advisor to the project manager because of the government expectations that two project management professionals would be involved in the project.

6.1 Research Set-up: Case Project

Saturday, 7 February 2009, dawned bright and sunny in a Victorian village, people were busy undertaking their usual chores as usual. Unfortunately there was a bush fire; initially the thought was that it could be controlled and news was spreading that the fire fighters were already there. However, it did not end up as a simple incident; people, properties and animals were charred to death (see https://en.wikipedia.org/wiki/Black_Saturday_bushfires). In another part of Australia, and with a very different landscape, the Toowoomba, Queensland, floods of 2010/2011 killed more than 30 people and displaced hundreds of thousands (see https://en.wikipedia.org/wiki/2010%E2%80%9311_Queensland_floods).

In order to manage these natural calamities, a time- and place-sensitive, robust system of emergency alert was required so that early warnings could be sent to affected areas, to help with every aspect of rapid response. In short, the Federal

Government wanted to strengthen the backbone of its emergency warning systems across the country.

In late 2009, an initiative was launched whereby all telecommunication carriers participated in a consortium to provide solutions for a location-based SMS alert system (LBS). Each carrier chose its own technology solution and proposed it to the Government. Xfone proposed a solution in partnership with technology vendor NZN.

At Xfone, the project was codenamed ‘Zeus’. It was estimated to cost around $12M, including the cost of internal resources, firmware, integration, hardware system installation, configuration and vendor cost. Based on engineering estimates, the project could be commissioned to public service in 27 months.

After several simulations of the schedule with vendors and a government agency (Banjara-GA), it was concluded that the project could be executed in 22 months by assigning additional resources to the project (increased resource load model).

The Australian Government nominated a program director (commissioner of emergency services) to oversee the project and the minister involved formed an executive governance board including a representative from each telecommunications carrier.

The project did not commence immediately; GA was attempting to define the scope and Xfone was involved in lengthy negotiations with the vendor. Although time was ticking away and informal project-planning sessions were conducted, there was no official start date and resources were not allocated for some time because of these lengthy discussions.

It became an image issue for Xfone, as other carriers were well ahead of the game. The media was also watching all three carriers for the service to start on time, as promised by the Minister.

6.1.1 Suitability of the case project for this research:

This project officially started in June 2012 with an objective to commence the emergency alert system facility prior to the next fire season. The solution was built upon innovative technology, having never been implemented anywhere else in the world. In this project, a large number of stakeholders from diverse groups were involved.

This project was the 'best fit' to explore complexity, as it had the known characteristics of a complex project such as new technology, large number of stakeholders, diverse groups (as shown in Figures 6-1 and 6-2), multiple vendors, time urgency with a compressed schedule (as shown in Figure 6-3) and a community purpose.

I was nominated as 'Advisory Project Manager' for this project and therefore had complete access to project data and witnessed many project events.

6.1.2 Types of Stakeholders – Role ambiguity a reason for complexity

Count of Initial Row Labels	Column Labels Client	Core	Domain	Executive	Vendor-Subcontract	Grand Total
Governance	2		3	1		6
PM		5				5
Scope		1				1
Steering	2		6	5		13
Technology	3	7	10	1	2	23
Test	2	4				6
Grand Total	**9**	**17**	**19**	**7**	**2**	**54**

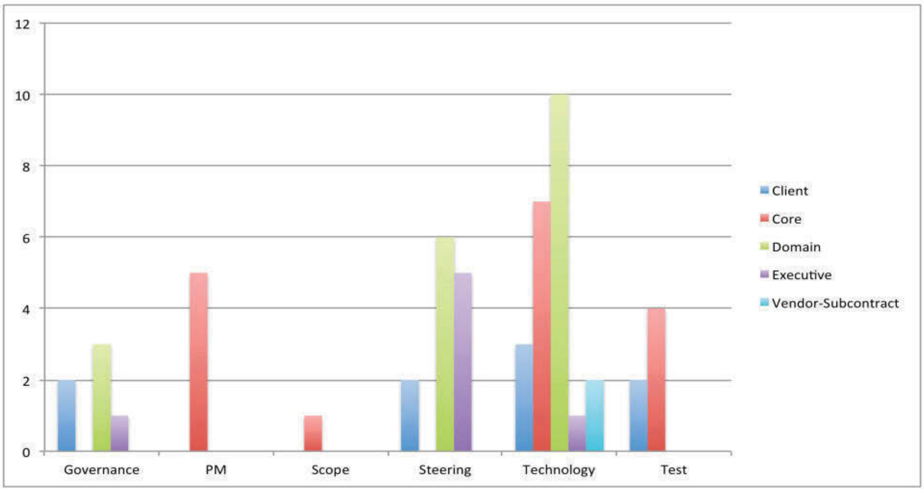


Figure 6-1 Types of stakeholders according to their role in the case project

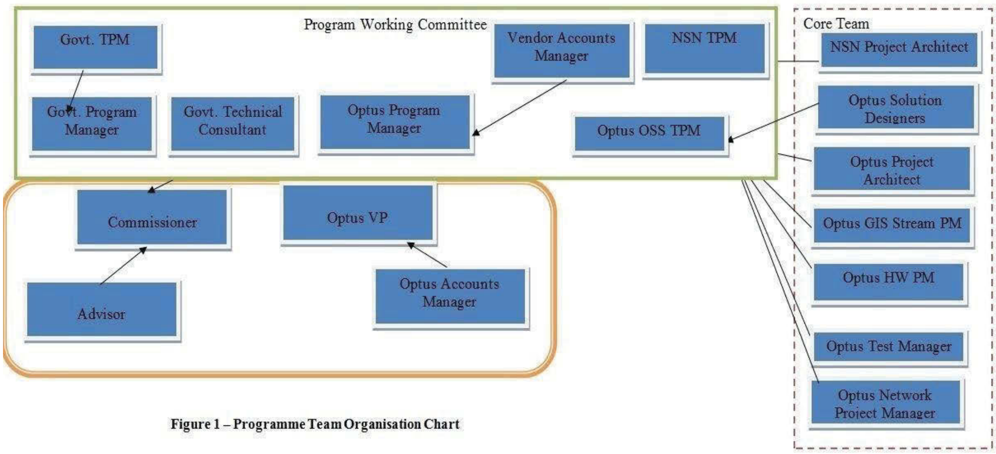


Figure 6-2 Project Organisation – Case Project

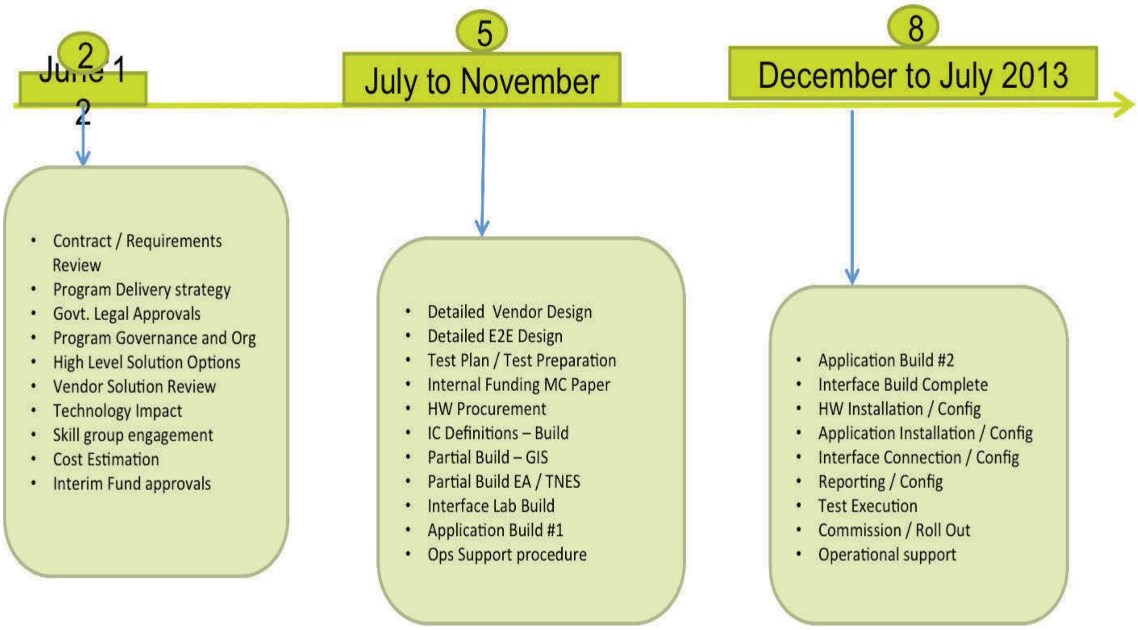


Figure 6-3 Case Project Timeline – Compression of Estimates

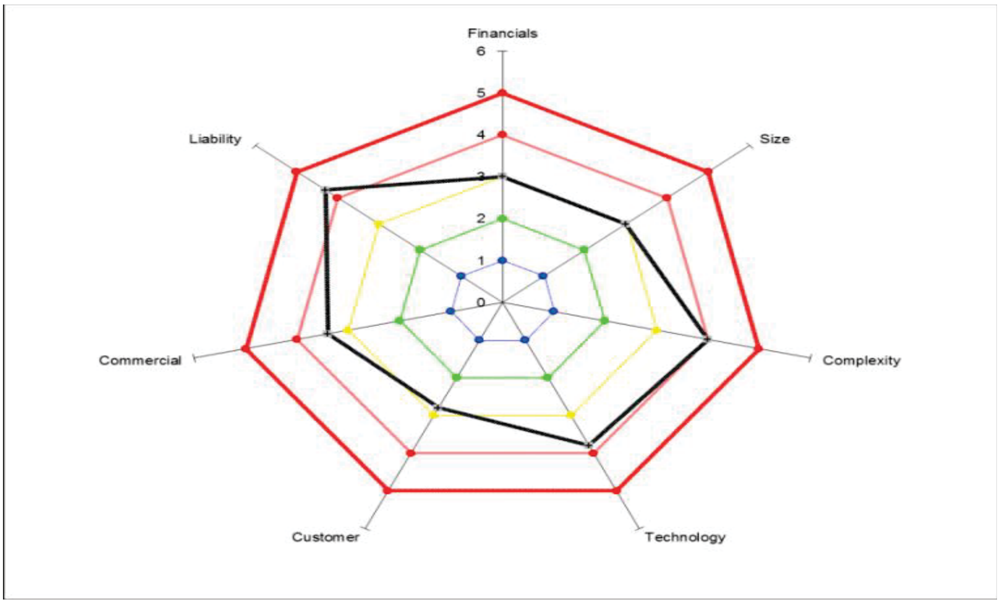


Figure 6-4 Case project risk map – Classified as complex by PMO risk scale.

The PMO developed a tool to understand the risks and complexity of this project. Figure 6-4 shows the high-risk levels as assessed by the PMO. The combination of time urgency, diversity of stakeholders and new technology made this project a good candidate project for studying complexity.

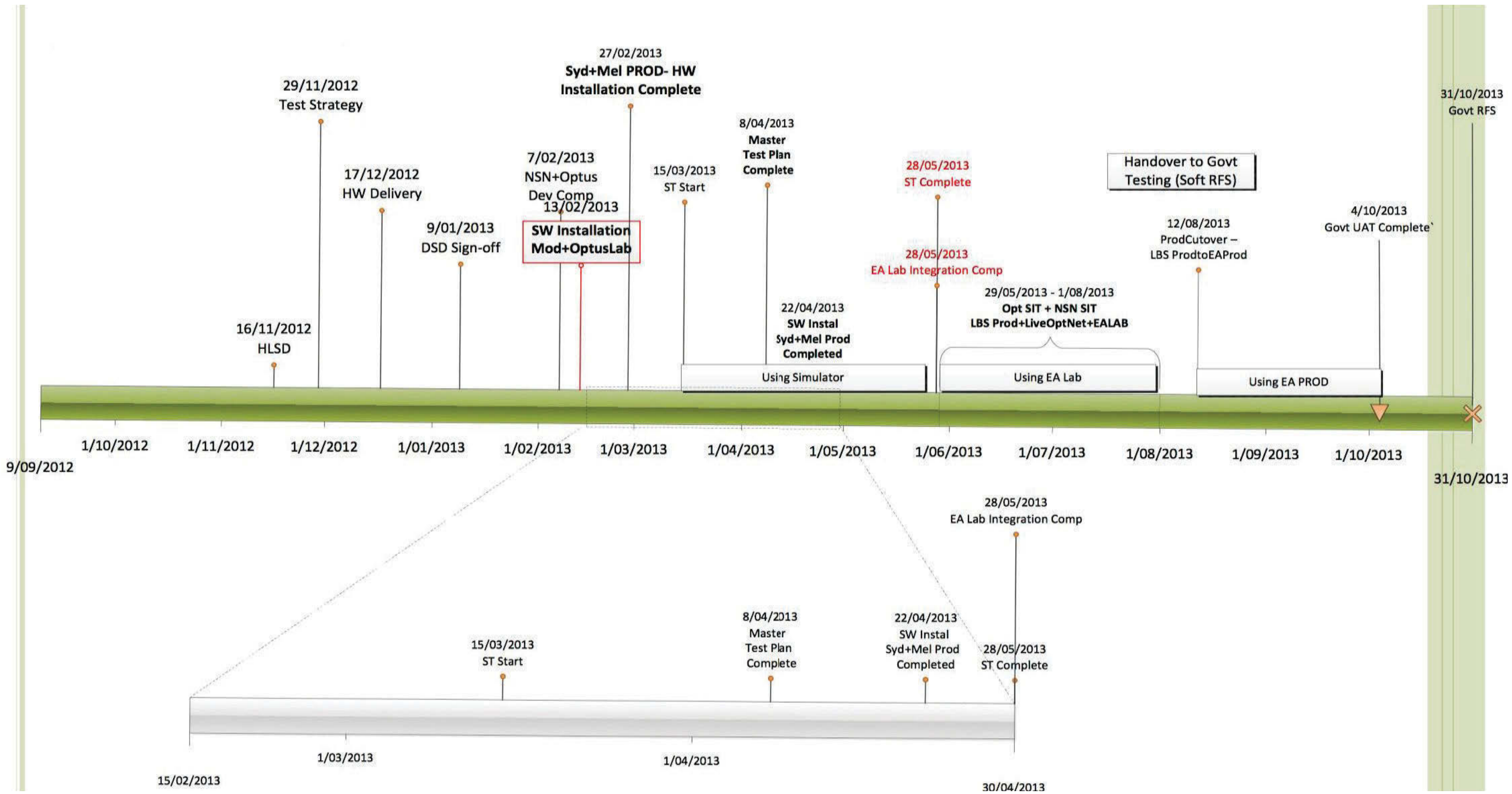


Figure 6-5 Case project timeline

6.2 Data collection

I worked with the Project Manager and recorded his description of events. As I had access to the project's document repository, I was able to collect data including emails, status reports and management presentations. I was also able to collect narratives from project stakeholders in a casual setting.

I excluded transactional data such as emails seeking clarifications or timesheet approvals etc. However, I carefully included 'themes' or 'open issues' and the tipping points associated with chains of events for analysis. For every central theme collected, there had to be hard evidence in the form of emails or meeting minutes to confirm that it had occurred. Voice recordings of meetings and interviews could not be made due to confidentiality issues and governmental sensitivity, but handwritten notes were taken.

The data collection was carried out as part of the project's gates, namely,

Gate 1. Feasibility & Design, Proof of Concept
Gate 2. Development, Testing and Deployment

6.3 Data – Narrations & Event Observations

In the following sections, the voice of the researcher is noted as 'Voice of AdPM' and spoken of in terms of 'I', whereas the voice of others is shown within quotation marks ('…') and tagged as the 'Voice of the Narrator'.

Actors Table

PM	Project Manager	Project Manager for this large project
BgPM	Business Program Manager	Representation to Government and

		commercial P&L responsibility
QQ	Architect	Overall responsibility for technology
MK	Business Analyst	Requirements management
AdPM	Advisory Project Manager (Researcher)	Advisory Role. Process and overall governance.
Pi	E2E Solution Designer	Detailed technology design
Vendor PM	Prime Vendor Project Manager	Technology delivery
Network PM	PM from Networks Division	Manage network component delivery

Snapshot 6-1 PM Narration

(A journey collected at different occasions through the voice of the PM)

'Networks division was assigned to carry out this megaproject 'ZEUS'. OSS division had a joint responsibility to deliver this project. A-west division managed the communication and customer relationship with the government. Each division nominated an executive as sponsor for this project ***(cf01)***.

The government had mandated the dates for service of this capability as "Prior to Fire Season ***(cf02)***."

The Networks Program Manager (MP) carried out initial discussions with the vendors. The vendor selection process was muddied ***(cf03)*** and NZN was selected over another vendor because the NZN solution was believed to be robust and resilient. The cost negotiation went on for three weeks ***(ec01)***. I was not privy to the discussions the program manager and others had in the pub or elsewhere outside these formal meetings. The vendor accounts manager was too close to MS (my manager). MS and the Network Program Manager MP, negotiated the final costs with the vendor. I was not involved in these discussions ***(fe01)***. I did not even attend any initial sessions held by the government agency GA ***(cf04 – initial involvement of PM)***.

On the first day of my assignment to the project, I spent time studying the background and technology scope of the project. I met with the architect and discussed the solution options. I felt this was a good project to be involved with ***(fe02)***, as it would serve the community. A bottom-up resource cost was requested with a high-level schedule ***(cf05)***. We made lots of assumptions ***(cf06)*** about the solution and resource requirements and the resource cost went above $7.2M, even though I was told that the vendor cost was negotiated to $6M. The total project cost was reduced from $13.2M to $10.5M after a series of discussions and *browbeating* ***(fe03)*** with internal stakeholders.

The project team's schedule spanned 2.4 years to deploy the platform after thorough testing. Since these time estimates did not match the government-mandated timeline, our schedule was adjusted to deliver the project within the government-mandated timeline, within 16 months ***(cf08)***.

I was involved with the vendor only in the final stages, to close out the contract along with my manager MS. Unfortunately, the government had too many liability clauses ***(cf09)***, in case the solution failed to sound the alert on time and someone lost their life because they had not been notified. Xfone's commercial and legal department expected these government liability contract clauses to be embedded into the vendor contract so that the vendor carried these risks, not Xfone. However, the vendor declined to have these liability clauses included in its contract ***(cf10)***. The project's commercial risk profile (document available in repository) was shown as ‘highly risky’, the business case had to be adjusted and the contracts were finalised only after seven weeks of discussions ***(ec02)*** with the vendor and the government.

I had assembled a team, found a project room, and co-located ***(ar01)*** the team, including the vendor team. The timeline was still up in the air but the team commenced the technical design, led by the Xfone architect, who had good experience in implementing this type of technology solution. I also employed a business analyst to work on the government requirements and produce a requirement traceability matrix document (RTM) so that at any point in time we could trace the requirements for government.

On the Thursday of the first week, I invited the team, including the vendor team, to go for a coffee as a team building exercise ***(ec03)***. Some of the team members were from Indonesia, India and Japan. NZN had subcontracted the geographic map components to a small innovative company in Spain ***(cf11).***

I wanted to be as detailed as possible in my planning session, but we didn’t have a clear view on the solution integration option until then and knew this detailed planning approach would not work ***(cf12).*** We agreed with NZN that we would use a high-level schedule on a weekly basis, plan out the tasks and close out the open issues by working collaboratively ***(ar02).***

The problem was the GA, as they expected a detailed schedule and expected us to report on micro level tasks. I called a meeting with DxD who, after a thorough analysis of the schedule, chose only a few interim milestones to report to the government agency ***(ec04).*** This helped me a lot and we developed a mutual respect for each other **(R01).** I created a project management plan (PMP), created a simple stakeholder map, and classified them as approvers, support workers and core workers.

I identified a political group ***(cf13)*** who would seek information constantly, just to complicate the situation. I grouped the stakeholders as supporters or detractors, that is, those who were difficult to deal with ***(ar03)***. I attempted to speak to others in the organisation to know about their past history.

I had a *bitter argument* with the PMO, seeking autonomy (***ec05***) to operate and attempted to avoid their frequent interference ***(ar04).*** I was a bit nervous ***(fe04)*** about the timeframe as we had to attempt some unconventional methods ***(cf14)*** here and form a very strong team.

I also created huge *noise* in the management meeting for losing the first few weeks in contract negotiation (***ar05)***. DD helped me to raise the priority of this project throughout the entire organisation ***(ar06);*** this meant I would have to *fight* ***(ec06)*** less for approvals. The result of creating the image as an 'important project' worked like magic. An official memorandum from the PMO stated: 'The organisation is committed to treat this project with high priority and to allocate resources and additional funds to reach the target date.'

It was a challenge to create a unified team ***(cf15)*** from internal resources, the vendor and the government agency. I decided to create a sense of purpose and meaning ***(cf16)*** for this project and coined the motto 'Save Lives Through Your Work.' I put this poster with black smoke graphics in a corner of the project room ***(ar07)***.

The vendor team started loosening up their reservations, sharing information and building bonds with our team. That was a good sign. The vendor project manager was not a people person; he had difficulty in leading his own team and they did not like his style of operating. I took him aside and encouraged him to work like one team, rather than emphasising boundaries ***(ar08)***. His fear ***(fe05)*** was that I would get some information and use it against him in the Steering Committee ***(ec07)***.

In team sessions, I would go through each action item tracking, assigning or requesting status on past actions ***(ar09)***. These sessions were fun-filled ***(fe06)***, as some of the team members would have a go at me, or comment on my mannerisms. It was difficult to walk the power line, whilst letting them understand I meant business ***(cf17)*** and I constantly repeated: 'We are one team, our objective is to deliver this solution before the next fire season' ***(ar10)***.

The Steering Committee sessions were like interrogations ***(ec08)*** and I felt very stressed by them. DD would give a helping hand now and then but my own manager caused some of the pain ***(fe03)***. My view was to keep her off ***(ar11)*** this project as much as possible, as she ruffled the team members when I was not present in the project room ***(cf18)***.

I was not going to bow down and give every bit of information to these crooks ***(ar12)*** (the SCM executives); already each one of them was fighting for their chairs. The boys appeared to be very genuine, knowledgeable and committed to what they were about to do. When I mentioned the difficult situations, my ranting did not discourage them.

The BPgM is a nice person, as long as we give him adequate control and information to manage the government's expectations, we should be fine. The vendor had to be hand-held, guided; we've got to pull the vendor executives in to a Steering Committee session and make them accountable ***(ar13)***.

Presenting information for specific stakeholder groups such as the Government Steering Committee and Internal Steering Committee was an onerous task. I took leave for three days, having over-worked, was not coping with the load ***(ec09)***, and made small mistakes in communications like emails.

Requested QQ to run the detailed design workshops before I returned. The personal conflict between ***(R11)*** Paul and Jim had faded and turned into 'talking-term relations.'

Snapshot 6-2 MA Narration - project set up:

'It is amazing to watch how he (PM) tackled ***(ar14)*** the issues; he listened to others and was available to every one of us. He allowed us to come up with a solution through respectful discussions that we all agreed at the end ***(ar15)***. The MPa's behaviour towards him was hostile ***(R03)*** all the time. It was told that this project was supposed to be led by Networks division and managed by MPa ***(cf19).*** For sure, if MPa would have managed this project it would have sunk long back.'

Snapshot 6-3 Event Record Case Project Kick Off: AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

'Government project kick-off was held in a hotel, at Sydney, 2012. The commissioner of emergency department and director for this program spoke with clarity. He showed the television pictures of Black Saturday. There was an eerie silence ***(fe07)***; I felt for a moment that somehow everyone wanted to give it a try.

'His speech attempted to create a context and meaning ***(ar16)***. He emphasised: "You all are competitors to each other in the market ***(cf20)***, but this program has a holy purpose, it is now 'WE' and WE will 'Collaborate' with each other to deliver it on time. While I am cognisant that already some time has passed in contract negotiations, it is absolutely critical to deliver this capability before this fire season ***(cf21)***.'

In a briefing note to Xfone management about the government kick-off session, the BPgM observed: 'All parties made the right noises around the areas of collaboration and teamwork ***(ar17)***.' As the GA wanted to have more control over the carriers through workshops, the BPgM noted: 'The planned government workshops and schedule are at odds with the contracted schedule.' ***(cf22)***: *Source email copied to AdPM.*

The PM echoed similar thoughts on government engagement: ‘If and when issues on scope or time would arise, we would be required to justify and negotiate ***(ar18)*** these through GA.’ The PM wrote: ‘We need to calculate the time and cost associated with the additional reporting and governance for GA. Balanced governance, and minimal interventions from the government agency would help the project.’ ***(ec10)***: *Source email copied to AdPM.*

Snapshot 6-4 First Steering Committee – Event Observation ***AdPM***

(AdPM: Voice of Researcher, recording the event as an observer)

‘At the first meeting with the Steering Committee, the PM demanded that he would pick up the project resources of his choice. A dedicated project room was required. There was silence for a minute, the PR from the engineering domain muttered: “QQ was the right person as he had done POC and was very versatile with the technology.” The PM said, “That would be fine, but given the context of time compression − even for planning − Mi and Mk are required.”

‘The requested resources were allocated after some heated discussion ***(ar19)***. Some members of the SCM did not like the way the demands were presented.’ ***(ec11)***

Snapshot 6-5 First Team Meeting – Event Observation *AdPM*

(AdPM: Voice of Researcher, recording the event as an observer)

The PM located himself in a corner of the room facing his table while all other tables were facing the wall ***(ar20)***. A communication was sent to all project staff to attend a meeting in the project room at E3Egg. I recorded the event in my notes. For me it appeared a bit strange that the PM was silent as if lost in thought. A vendor PM, an engineer by profession, came to meet with us. A full day event was held in the project room. I took a back seat as everyone was focusing on the white board.

The PM opened his speech: 'We are on a deadly journey, or at least it appears so. Have you looked into some form of briefing?' ***(ec12)***. Mk laughed, and said, 'The requirement is a dossier ***(cf23)*** from the GA.'

The PM continued: 'Let us work backward from the target date − written in stone ***(cf24)***. Today's workshop would define the game plan; apart from the usual stuff, there are high-risk areas ***(cf25)*** in this project − landmines we got to focus on this.'

After this meeting, the PM called the BPgM and asked what his planning expectations were. Both agreed ***(ar21)*** it would be good to have lots of flexibility (macro control, micro flexibility) while controlling and reporting on major milestones only. BPgM was tasked to manage ***(ec13)*** the government expectations ***(cf26)*** and would continuously argue for not applying stringent reporting requirements on the project.

The PMO or Steering Committee did not accept this approach of high level planning; a bitter argument broke out in the SCM session held on the following Tuesday at level A3, chaired by a technology vice-president (VP), senior to the director. After a few minutes of thumb rolling, the VP said he had complete trust in the PM, and was happy to take this approach. The PMO would take a back seat.

The PMO left with contempt and anger. The VP curtly observed looking at the PM: 'We are together in this; you better do something, and give me an SOS/mayday call if required at any time.' ***(R02)***

Snapshot 6-6 QQ Narration - Google Map use

'It looks like we are on the Titanic, but we've got to save it ***(ec14)***. I am the ship engineer; I got to work closely with the PM. He is funny at times, sometimes very abstract. The vendor engineers are good; I have worked with them in the past. The solution contained three major components, one of the components was the most difficult ***(cf27)***: it was the new software to match Google maps and the handset in near real-time.

'The Google Map work was outsourced to a Spanish company. It would be a challenge ***(ec15)***: wait and watch. On our side, we've got to engage many other skill groups ***(cf28)*** so that we can seek required priorities. This project's going to be different; the PM would have to put up several fights for the approvals ***(ar22)*** with the PMO.

'I think he has diplomacy and the right connections in the field. He does not have any hesitation to demand ***(ar23)*** his own management does not like him, but they know he will get it to the borderline. As long as I get support and direction ***(ar24)*** from him, I am happy to work with him. From outside it looks as though he is abstract. I am worried other team members need to work at his speed. We cannot spend too much time in detailed planning at this stage, but we have to take a risk and get into work as we don't know many parameters even around technology itself.'

Snapshot 6-7 Pi and MK Narration:

'We are bit confused and worried about the workload, PM is funny, hopefully we can enjoy a bit while putting in the hard yards. MK is an introvert, a shy person. He has to manage eccentric personalities here, being himself one of them!' ***(cf29)***.

Snapshot 6-8 Government Schedule Session - Event Observation *AdPM*

(AdPM: Voice of Researcher, recording the event as an observer)

In the third week of October 2012, I obtained the project management plan, the project charter, the scope statement and the communication plan, which was developed after the planning sessions. During this period I participated in several face-to-face and teleconference meetings along ***(ec16)*** with the PM and other team members and created notes. I had collected several email threads and recorded voice recordings with the PM and QQ, as both agreed to be in the research. A government meeting was held in Sydney at VXHXA office to integrate and build a multicarrier schedule, which the PM and BPgM attended. A heated debate with the GA took place for forcing the carrier, not giving adequate time for testing. The GA, PM and BPgM did not agree about the frequency of the governance reports to be submitted to the government.

Snapshot 6-9 Financial Figures - Event Observation *AdPM*

(AdPM: Voice of Researcher, recording the event as an observer)

The financial figures were misrepresented to management and an inquiry had to be conducted. The VP Finance had been told that the total project budget did not include the operational expenses (Opex) expenditure for the early stages of scoping activity that had taken place in 2011. As he had allocated only $10.5M, this issue resulted in a $500K shortfall of the total estimated value ***(cf30)***.

The PM presented this case and stated that given the context of high resource loading, he would not be able to complete the project within the tolerance level.

It was the responsibility of the GM Engineering to submit the final budget to the management. He stated: ‘The project team should attempt to control the cost.’ The VP Finance wanted this in writing with a condition that the business case be re-evaluated mid-term through the project, but the PM and the GM were not aligned to this approach ***(R03)***.

The GM was very hesitant to put any such claim in writing. They were nudging for their position, and the GM said he would come back again within a day. The PM curtly observed: ‘Funds got to be available for the vendor to commence work, otherwise I have to mark a delay.’

A follow-up meeting was held on Level A2. The GM (Eng) had written a memo stating that the Engineering Division would not spend any funds on the Cell-Id construction, as that would be covered under some other program. Therefore, the project cost estimate would be reduced approximately by $500K.

Snapshot 6-10 Narration from Network PM on Financial Figure:

‘The GM and MPag went to meet the Networks VP. When they informed the $500K short situation to him it was *bloodshed* ***(ec17)***. Unfortunately, it would have been an issue at CEO level looking bad for the division itself. To avoid further escalations, they have made some internal arrangements. When both returned to desk, they were not on talking terms ***(fe08)***. The implicit message given to me was to control the resource cost ***(cf31)*** and if possible use funds from this project to cover part of the cost for cell-id work without making a hue and cry. I will place a few odd POs in this project. The PM understands this, though he is in fits, he also has no other choice, and otherwise he will ruffle ***(ar25)*** the Network VP.’

Snapshot 6-11 Cost Control - PM & *AdPM conversation*

(AdPM: Voice of Researcher, recording the event as an observer)

I just mentioned once to the PM: 'How are we tracking to the cost?' The PM retorted: 'Since we could not do real-field estimates for lack of time and clarity of scope, I would squeeze as much as possible to be on track − worst case scenario, I would definitely pose some CRs for Operations, so the cost increase can be covered. I cannot confront ***(ar26)*** the VP, I need his support for my own life here. It is better to have a few buddies in the Operations.' ***(R03)***

Snapshot 6-12 PM: Narration Govt. Stakeholders

'Finally, momentum had picked up; we were about to complete the design phase and present the design to the Government. I flew with my architect and solution designers to Melbourne for government review. I got introduced to Stephen from GA. He reviewed the design. There were a few feedback questions. The relationship ***(R04)*** and friendly conversation with SXG will be helpful throughout the project. I started discussing with Stephen about the project status prior to any formal government meeting ***(ar27)***. I kept DxD in the loop.

'As design for various components have progressed well, the Government agency was busy in reviewing and approving the design documents and requirement traceability matrix. The vendor was building the infrastructure capability and the application design was being reviewed at the same time. It was a risky approach, as any change in HW capacity parameters would have caused a rework. Though there were several iterations of walkthrough ***(ec18)***, surprisingly no major comments were coming from the GA. I have built a good relationship with Steve and GG, even if any issue comes out of the design reviews, we would manage it.

Snapshot 6-13 PM: Narration Spain Systems connections

The connectivity to Spain for the NZN remote vendor had become a challenge ***(cf32)***. InfoSec did not permit the remote connectivity due to a security threat. The discussions were not heading anywhere with NadX, I decided to call for a help ***(ar28)*** from SiveZ. As usual, with a big gesture and scolding the designers for not considering the security requirements upfront, he granted permission to connect through a jump-host.

I came and said this to QQ, I thought he would be happy about it. Pi was listening to the story. Then Pi said, 'You have brought a bigger demon by selling a small devil.' I did not understand, but now realised that I have to run around to get the jump-host set up. Obviously, we are trailing two days behind to provide connectivity to NZN-Spain vendor. Albert would call this as a delay in vendor meeting in front of Network VP to my embarrassment.'

Snapshot 6-14 Pi: Narration Spain Systems connections

'Well, I can reach out my old colleagues in Network Connections Team ***(R05)***; I have approached Marcus to set up the jump-host. Fortunately, the boys are on late shift, they worked throughout the night, as there is time difference to Spain.

'In order to test the connections, I needed Spain staff to work on it. I could not find anyone. Just for 'LOLs' sake, I called our hero, the PM, and asked him to mobilise the resources. It was 1.00 am. Midnight. PM picked the call, even in that time with funny comments: "Have we come on current affairs yet, Pi?"

'I explained the story. A few minutes later, AaX called me from Spain confirming that the connections have been established. I left home in early morning hours with a note on my table that I would be late.'

Snapshot 6-15 Vendor PM: Narration Spain Systems connections

'He (PM) has no right to be so nasty ***(ar29)*** with Spain engineers, it was midnight here so they did not expect anyone to call. Hopefully he does not do this again and ruin their spirit. This time I will not mention this to Con ***(ec19)***; if it repeats, I will document this high-handed behaviour ***(fe10)***.'

Snapshot 6-16 PM: Narration – Funny QA Auditor

'As design was about to be completed, I got a bad cop, ***(ar30)*** a funny man, who could use humour to tackle issues, "SIM". He took a role of quality auditor. He would not compromise quality, at the same time, would leave the issue to be managed by me. Four technical leads worked on specific technology zones; that way I could easily make them accountable for their work ***(ar31)***. Late evenings were unavoidable. I brought food and drinks for the team and shared my lunches with them (***ar32)***.

'We did one thing well; as design was coming up, we started planning for testing. Our 'test lead had clear vision of how to approach system integration testing after several discussions with the vendor. Defect meetings had to be organised, the test manager wanted daily meetings ***(ec20*)**, in my view that would be too frequent, but I left this to his convenience ***(ar33)***.

'As the detail design was started, we encountered a whole set of operational requirements not considered in any of the discussions with the vendor ***(cf33)***. Internal support teams had not been involved in scope discussions. I hate MS ***(fe01)***, half cooked and thrown at me. I initiated these discussions, QQ is aggressive and Paul had some connections ***(ar34)*** in the Ops, as he had worked there in the past. We would resolve this before the cutover.'

Snapshot 6-17 Project Room LAN Event Observation - *AdPM*

(AdPM: Voice of Researcher, recording the event as an observer)

The Architect printed the email and showed it to the PM, stating the system testing could not be commenced as per plan since testers don't have access to the test platform.

The PM looked at him and vanished from the project room, but was asked to look into the port detail as he walked out of the project room. A few minutes later he was pulling a trolley with 6 PCs and requested the team members to go to floor f2 store and pick up the terminals ***(cf32-a)***. They looked at each other, and spent the next hour connecting and configuring the PCs as if nothing had happened. Once the PCs were connected, the PM took the printed email and tore it up in front of the team ***(fe11)***.

Snapshot 6-18 PM: Narration – External Ports

'There were a few issues on network connectivity (ports in the sharing pit) ***(cf34)*** with other carrier ports, our Network Architect is a detail person but cannot stick to the timeframes: constant follow up required. I had to seek some intervention ***(ar35)*** from GA; it was their responsibility to organise the port connections from other carrier. I was dragged into this technical discussion; not happy about it ***(fe12)***. I had to support our architect in external communications ***(cf35)***, otherwise things would not have moved.'

Snapshot 6-19 First Milestone Design completion Event Observation - *AdPM*

(AdPM: Voice of Researcher, recording the event as an observer)

It was first milestone for this major project. The component design activity has not been concluded yet; there were some minor gaps. The PM showed his disappointment about not completing the design document with adequate detail. Tomorrow is government design presentation.

The PM requested some enhancements on the design document and stated he will run the show, and left the project room.

After perfunctory welcome and self-introduction of the team, a context to the meeting was set by the PM; he used the word ‘compendium’ to describe the e2e design document. While the architect presented the design, and component designs were presented by the SMEs, the PM intervened now and then to provide additional comments.

The meeting was concluded as the delegates left, the PM and delivery managers met at a café. They reflected upon the event, the conversation turned into informal assessment ***(ar36)*** of vendor behaviour and upcoming uncertainties.

After having a couple of beers, the business manager subtly observed that the spend needed to be controlled as business unit was undergoing financial pressures due to organisational changes ***(cf36)***. They parted. It was an informal meeting for acknowledgement ***(ar37)*** and chilling out after the hectic activities of the event.

Next day an email followed from the director, an extract of which is presented below:

> *“By all accounts today was a successful day; we have presented our detailed solution to the government representatives. I want to extend my thanks and appreciation for the hard work and time spent in achieving this outcome. Whilst there is a long way to go to deliver this program it is important to take the time to reflect on our achievements to date. Please extend this feedback to the broader team.”*

Snapshot 6-20 PM: Narration – Government Visitors

‘It is crucial to manage the perception of these Government visitors ***(ec21)***; it is my responsibility that they return satisfied with good responses. Even though we find gaps, they should view it as actions to close rather than blaming us ***(cf36)***. I felt stressful in the beginning but, as the session progressed, I felt confident and satisfied ***(fe12)*** with our work.’

Snapshot 6-21 Testing Resource Event Observation - *AdPM*

(AdPM: Voice of Researcher, recording the event as an observer)

They were haggling over ***(ec22)*** an issue at Bluestone Cafe on 4 February at 2.30 pm. A testing line manager had given a resource load profile for this critical project, the project manager was not agreeing to this resource load and requested a resource activity plan for this period.

The resources engaged were by an outsourcing organisation, which worked for the line manager in testing division.

It was evident that the resource load is 'bumped'. Emotions flared up, the project manager, being accountable for the project and budget, asserted his position ***(cf37)***.

The line manager replied: 'I am not challenging your position; I believe we need to have a different conversation. JV has approached CS and JS spoke to me about that, we have difficulty in OPEX, got to balance here.'

The project manager responded: 'How can I permit the resource load when there is no actual work at all? I have to deliver the project within the budget.'

The line manager replied: 'Our spend will not exceed submitted budget. Well, we have worked for years now, I trust you on this. I will speak to CS to see what we can do.'

The PM called the BPgM and said, 'I am trying to control the cost but require your help to set this expectation in my land; my landlord does not get this, mate! It would be better if you mention this in our steering committee session SCM. We did not have this conversation – delete button please.' ***(ar38)***

The BPgM did observe in a sharp but subtle fashion ***(ar39)***, at the steering committee session in that afternoon that the burn rate was a bit exorbitant for this stage of the project. As a result of this comment, CS asked the PM what financial reports were going to the BPgM.

The PM responded: 'BPgM has access to the time sheet system and obtains the reports directly.'

Now CS advised the PM to carefully balance the resource burn rate with testing and he would speak to the testing line manager again. The PM achieved his outcome by cross connecting and playing with power equation ***(R06)***.

Snapshot 6-22 Support Process Event Observation - *AdPM*

(AdPM: Voice of Researcher, recording the event as an observer)

Thirteen participants were there in that meeting representing various support groups. The agenda was to develop the support process for this new platform ***(cf38)***. The meeting went awry ***(ec23)*** as tier 1 support groups were vocal about various checklist items to be completed by the project and declined to write the process, demanding a process analyst be engaged by the project. The meeting ended up without an outcome.

The network project manager MP observed: 'This is their attitude; they cannot be blamed for this. In their past they have been left by other projects without being given required support structure such as processes and assistance.'

The PM noted: 'Unfortunately, I don't have time. Got to use some influence. BrenA is director of NMC now, and I will have a coffee session.' ***(R07)***

Snapshot 6-23 Coffee Session Event Observation - *AdPM*

(AdPM: Voice of Researcher, recording the event as an observer)

I attended this coffee session and recorded the conversation as follows:

'Conversation start -

> *BrenA: How are you, mate, have not seen you for some time? Is everything OK?*
>
> *PM: Not bad, How about you? The company is changing continuously?*
>
> *BrenA: I heard you are managing one of the large projects. Be careful with Pi. You cannot expect support from him, better to document his decisions.*
>
> *PM: Yep, I am experiencing his fickle mindedness **(fe13)** in the SCMs. About this same project, I need your support. As we have stringent SLA by the government, we got to develop our support process, I had an initial meeting, and Tier #1 has echoed their concerns. Instead of pushing through at the end, I would like them to participate from the beginning so that we work together to put a sound process in place.*
>
> *BrenA: Who was there from Tier#1?*
>
> *PM: Yuand and Ben D.*
>
> *Bren A: Ok, I will request Di to take leadership on this. Do you have clarity code for her?*
>
> *PM: 30% allocation per week is possible.*
>
> *BrenA: Keep me posted, I will speak to the boys.*

- Conversation End'

Snapshot 6-24 PM's frustration - conversation with AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

I ***(AdPM)*** continued my conversation with PM to gain more insight into the issue the PM was alluding to in the morning. My guess was that the PM had taken a position for a project outcome. When the sponsor was questioning it, his manager, Y, did not come to his support; ***(ec24)*** being silent he had not taken any sides. The PM expected Y to support him.

PM said: 'He (Y) knows I am right in taking the position. Ethically speaking I could have involved the HR, but in that meeting, where blood is drawn, he was silent; he did not echo, just for fear of losing on X's good books ***(cf38)***. When I approached him, he simply mumbled away without explaining his silence. The project did not achieve any outcome; at a personal level I have suffered ***(fe16)***.'

I *(AdPM)* inquired Y casually about the incident, and Y said, 'PM is right but I had no choice but to be silent.'

(*AdPM Observation)* At a core level, Y felt what the PM had done was right, but Y 'enacted' ***(ar40)*** to the context for preserving his future interests or maybe he was contemplating an action after this heated session with the project sponsor in a separate session.

I observed the project participant continuously enact a position rather than giving an immediate response. When an enactment suits the context it does bring an expected outcome to the project.

MK held several sessions with support groups, it was to form a centralised command centre for Severity 1 incident management.

Snapshot 6-25 Support Process meeting Event Observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

The PM entered the meeting room after arriving late. He looked at each person and demanded an explanation of their respective roles and the skill groups they represented. Two of the participants had dialed in from Melbourne support centre.

PM started the conversation. 'We are here today to "finally agree" on one approach and list the challenges and constraints in implementing that approach. We have met in our earlier sessions and done the brainstorming I believe, as the team has highlighted. If the command centre leverages on its capacity and leads the Severity #1 incident management as soon as Tier #1 invokes the call, we will have better control and meet the stringent SLAs. I also understand there are resource constraints and time of support hours.' He paused and created a silence ***(fe17)***. Daisy − sitting next to him − nodded and said, 'It is a community project, but to assign high priority for support, a management mandate is required apart from supplying support resources.'

The PM acknowledged Daisy's supportive voice by leaning towards her. Daisy agreed to list out Severity#1 events. Pete X explained how difficult it is as such to receive calls for all priority platforms and it would be impossible to meet the SLAs.

The PM intervened, and observed, speaking for all: 'We are saying that the SLA is next to impossible.' Everyone nodded and agreed. The PM promised the team to go back to Government for the SLA revision, again bringing the focus and stated command centre would assume the responsibility for collaborating with the Severity #1 incident management event. The PM concluded the meeting abruptly ***(ec25)***.

However, as people left the room he requested MK to update the documents with a 'to-be' process and said these skill groups will be told what to do; that we would meet our target date of submission to the government ***(cf39)***.

The PM said to me, 'I have spoken to Pexer's boss this morning. He was very receptive' ***(R08)***.

Snapshot 6-26 ELAN Discussions Event Observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

The HW needs to be deployed, network traffic throughput analysis has been completed, the ELAN is not strong enough to take up this load, we cannot move the production servers to PLAN, as TMDs need also be moved. It is a technically complex scenario ***(cf40)*** with trade-offs for both options. However, a management meeting ***(ec25)*** was held to document the risk to the project and request top management decision to create a separate initiative for LAN-Network cleanups.

StepX to PM: 'Every time a major project like this comes and touches our complex network, we face problems. All of these projects try to find a temporary solution and add to the network, instead of resolving through a permanent, stable solution ***(cf41)***.

'As a PM, I understand you have an urgency to deliver, but if you see the operational requirements in your own project, the Government demands 24/7 availability. If you are putting the PROD in Corporate LAN, there is less security and support. If you put through Enterprise LAN, this requires upgrade and this project has to fund it. However, we can accomplish the Network upgrade in a short time. This is not between you and me, our management had to decide ***(ar41)*** and fund this urgently.'

The PM escalated this issue and organized a meeting ***(ec26)***. The PM briefed DD and requested him to expedite the decision. BrenA chaired this meeting. A paper was presented by QQ.

After analysing the pros and cons, BrenA made a decision to upgrade the firewall as part of this project and still install the PROD servers in Corporate LAN as the Enterprise LAN would require a minimum eight weeks of work and the project time would be impacted ***(cf42)***. This decision was captured in the Steering Committee Decision Log.

The PM had discussed the project urgency and firewall problem with each domain manager in order to create a context beforehand. As soon as the stakeholders assembled in one place, each one presented their point of view and available options as if the meeting was held to tie a final knot to their agreements. The director was continuously looking at the PM and they were communicating through SMS as the meeting progressed ***(ar43)***. The director concluded by stating the project could not fund this mega project (meaning it was not a simple change) as it had neither the time nor the funds for it, but would definitely lodge a change request (CR) and consult the executive steering committee for senior management directions.

ME noted: 'Now I am into this hotspot, the PM will harass ***(ar44)*** me every day until I complete the firewall upgrade, though he is funny; B … never leaves until the work is done. I am 200% loaded already' ***(cf43)***.

PM said: 'These are typical situations, as long as we are able to convince with proper rationale, we should be able to resolve. It also depends upon whom you are dealing with. SC is a reasonable person to deal with and I believe he achieved the outcome he wanted.'

CS noted to the PM: 'I was bit worried, JE and CS don't get along; they had bad dealings in the past. It is good that you had created a view on the project priorities beforehand.'

Snapshot 6-27 MT Narration on WSDL (a technical software component)

'As we discussed on the WSDL, DV from GA provided a template; all carriers had applied this template to develop the Google map interfaces. As we were about to carry out a testing, a few lines were not bringing the HTML layout as expected. Later we came to know that the version DV shared with us was not the right version and Emergency System in Production environment is using a different version. DV had used in his email, along with the WSDL template as Sample Template, QQ had not followed up with him to get the final version and relay it to the development vendor. The development vendor requested a change request and additional cost for rework ***(cf44)***. It was a small amount. Sometimes, these types of CRs can lead to prolonged discussions; in this case, the PM spoke to DD and DV. The PM called the NZN Accounts Director, without going through NZN PM, and stating it would be embarrassing for NZN to put forth $3K CR, NZN is working on this megaproject in millions.

The NZN account director did not accept this; his fear was that this would set a precedent as we are still in design stage. DD agreed to take this on his budget, thus a CR was placed, the rework was carried out, though Alvaro, development vendor, lamented about his resources being overworked to meet the rework target time.' ***(ec27)***

Snapshot 6-28 PM Narration WSDL

PM said, 'We are working on very high speed; despite very close interactions a few mistakes are bound to occur. We got to manage the situation ***(ar45)***. I would call this as complexity within the project. Formal processes are there, we have to apply it to get better outcome for the project. The balancing ***(cf45)*** act is achieved through discussions with stakeholders.'

Snapshot 6-29 JW Narration on Lab Equipment

JW (Network Engineer reporting to MP), 'I told many times, our lab is not sophisticated enough to test loads and volumes on SMSC. We have to trigger the SMSC transactions manually triggering within the lab premises. In project design document this limitation is captured in a single line.

'But it does not tell what alternate mechanism ***(cf46)*** is there for us to test the expected loads. As we were testing the connectivity to the lab, we encountered a strange situation. We were checking the TT hub connections; it was done in off peak time. Six of us joined in our project room. We initiated transactions; all other ports were working except one, port 143. We were puzzled by the behaviour, collected all routing data and start analysing, by this time it was 9.00 pm. Unable to find out root cause, when PI was glancing through the log, he jumped up and down, swearing on Network Admin. The root cause for the failure of port 143 is the firmware license ***(cf47)*** for the server had expired on that day by 5.00 pm. What a co-incidence! The team in all their jokes ***(fe18)*** would remember Port 143! Next day morning the PM escalated this issue to VP Networks, and obtained the license on urgent basis from the vendor within a day. We continued our testing again on the following night.'

Snapshot 6-30 PM Narration EA Connectivity

'EA connectivity was recognised as a technical risk. If we don't have end-to-end connection to test bed, we would not be able to ascertain whether the application is responding correctly to EA system events. As soon as I received the PIT – floor plan, I spoke to data centre manager RamiX. He agreed to establish the port connections through existing PITs. Unfortunately, the duct could not be laid through existing PIT ***(cf48)***. The alternate route requires permission from a private property owner to dig and cover a conduit in his property. The company, which manages the ducts, is a private company. I met with the manager of this private company, 'Goldman', and explained the importance ***(ec28)*** of this project and critical importance to the community.

'After three days, Goldman came back and stated that the owner has approved this duct. It was great news; JoelS worked with them and connected the EA interface through the secure ports. InfoSec and our network architect reviewed the layout on site. Finally we were able to test the end-to-end connections.

‘The project team celebrated this test by shouting and clapping. Did it end there? I should have engaged commercial department ***(cf49)***, as we usually charge other carriers a rent to connect through the POI. A GM reprimanded me. ***(ar46)*** I felt bad, called DD and said, ‘Where were these f… buffoons before? ***(fe19)*** It was the MP’s responsibility to manage all these connection issues but I jumped in to get this going’. DD promised me to speak to the Network VP about this.

‘Thursday, when VP visited, he acknowledged our internal struggle. Network commercial wrote to TT with a quote for rent’.

Snapshot 6-31 MK Narration - Test Manager

‘I cannot blame this person (Desmond, NZN Test Manager), he is not having time ***(cf50)***, does not even eat on time and go home late every day. This is the case with everyone. I am really worried ***(fe20)*** and concerned about the RTM and test plan review by the Government. DV appears to be very detailed and pedantic.

‘Our test leads were having trouble to work with DX ***(cf51)***, a subcontracted company for testing. Our PM is also busy with upper management; they keep dragging him into discussions on progress status every day.

‘PM wrote to us informing DX will not be in the project anymore and a new test manager will be substituting DX. On Friday, Rem spoke to the PM, she was in tears ***(fe20)***, and I supported her. Good outcome, but I don’t know how he did it.

‘Wow, our PM is like Magic Jackson, on Friday, when we met we explained the highhanded approach by DX on our project resources. He consoled ***(fe21)*** Rem and said, “Monday will be a good day.” As usual, he cracked jokes and made us feel better. But I never knew he could get rid of that rascal so easily.’

Snapshot 6-32 PM Narration Test Manager

The PM said, 'Negative behaviour should not be tolerated. If my team is demotivated, they will not sacrifice for this project as they are doing. I had to make a few calls ***(cf52)***, without going through the formal channel ***(R09).*** Oh I got rid of the clown indeed.'

Snapshot 6-33 MK Narration - Test Servers

'As we were about to do the shake-up testing, one of the test servers was dead ***(cf53)*** showing no connections. The PM called the JR and asked to inspect on urgent basis. JR came back and said, "There are no physical connections." The PM asked him to visit the data centre immediately by taking a cab.

'We came to know that a contractor responsible for wiring had taken the cable out. It was very strange that a subcontractor doing wirings would unplug the cable going to this server. You should have seen the PM's anger ***(fe21)***. He requested AlfiX the DC manager to inspect the infrastructure with him in preparation [for the government visit]. In reality there was no such visit planned by the government.

'The PM called Steve (Government) and said, 'When you are in Sydney next time we will show you our infrastructure, as per the contract scope specification, they are all in secure cage.'

'AlfiX requested the engineers to tag the infrastructure components and tendered profuse apologies for cutting off the cables. Three days later, the PM and JR went to the DC with Sim to inspect the infrastructure. After returning from the site inspection he said, "They are in secure cage now. Sometimes small incidents cause commotion."'

Snapshot 6-34 CPU Failure - Event Observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

Mel recorded, prompting the project manager to look into the email thread.

"It's an ISSUE!!! It's shocking, they did not bring this up earlier ... you need to catch up with NZN tomorrow. Regards."

On the Sunshine server, the CPU had failed and testing is about to happen. Vendor project manager did not reveal this in any of the project meetings.

PM to Vendor PM: 'You … ***(fe22)*** cannot give me a clear picture of Sunshine, I need the fix immediately or I have to cancel the next milestone payment and escalate.'

Vendor PM: 'Hey, I thought this will be minor defect in the CPU integration ***(cf54)***, our vendor HP was addressing, only late last night, I came to know the part has to be replaced. It will require two hours outrage for testing; we will manage it and get it done over this Sunday. You don't need to panic, man! A test was done after the CPU was replaced.'

Snapshot 6-35 PM Narration - Summit Point

'This meeting is a summit point celebration. We have achieved the first two major milestones. Completed the design and Government approved it. We have built the infrastructure and commenced shake out testing using the stubs. Let us celebrate this, and prepare for the next peak completing the system integration test.'

Snapshot 6-36 Milestone Success - Event Observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

‘The directors came to our project room and had drinks with the team. Some of the team members went and watched a movie *Fast and Furious* at Macquarie Centre that evening after a couple of drinks.’

Snapshot 6-37 Stage Closure Report - Event Observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

A stage closure report was prepared by the PM; it stated that the major milestones were met on time under budget. However, it identified risks on resource availability ***(cf55)*** for testing and deployment. The MP had a few negative comments ***(fe22)*** on the expectations from networks, pointing out that there should have been planned activity rather than seeking immediate responses and avoiding undue escalations.

Snapshot 6-38 Blackadder Firewall - event observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

The Blackadder firewall construction could not be completed on time, since shutting down the firewall would cause several applications to have an outage. PMs for different projects were preventing ***(cf55)*** this change to proceed as their projects were impacted.

The PM presented the case to change the control board, and sought escalation through the Networks GM. This meeting went well and an official embargo was applied for the change window ***(ec29)***. Even though the system was brought back on time, some automatic system alarms were triggered during the outage, leaving the technical teams to resolve. The communication with these stakeholders was firm and demanding as if it were a ‘do-or-die’ situation.

Snapshot 6-39 PM Narration - Black adder Firewall

‘Only when we say it is a “deadly” situation, the organisation is responding. This firewall is a single point of failure ***(cf56)*** and no system can pause; this bottleneck should have been removed. This is one example of our intricate system topology.’ ***(cf57)***

Snapshot 6-40 Billing Architect - Event Observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

GXD is a veteran in the billing domain, a walking encyclopaedia of billing systems. He was offended that such an important project in this organisation had not involved billing and considered the billing mechanisms to the government.

The PM had worked in the billing domain for six years. He knew GXD very well. The PM called DD and requested him to submit a change request for billing system changes so that the government could be billed based on the number of SMS messages generated for each campaign.

He engaged the commercial department and government for billing mechanism. Unfortunately, they could not arrive at an arrangement ***(cf58)***. Meanwhile, the system had been built and ready for service. The commercial department had agreed with an annual contracted value rather than billing it by campaign. There were no billing changes.

GXD commented on this incident: ‘How can an important function be ignored? What would have happened if the government demanded to bill by campaign and requested reports on our delivery? Why did senior stakeholders and architects ignore such a critical function?’ ***(cf58)***

The PM commented: ‘Getting GXD on board is not that easy, since there were no billing requirements stated in government BRS, consciously we left him off. Since in the final stages the government started playing up with commercial detail, these discussions have surfaced.'

Snapshot 6-41 Defect Analysis - event observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

On an everyday basis, the defect statistics were published by the test manager DXT; it would be reviewed by the internal team FYP and SXC. At times, the internal team would challenge the vendor and demand the fix over night for retest ***(cf59)***. At that point in time, it was clear that DXT and SXC were fighting for their interest by passing the 'frolic friendship' ***(fe22)*** they had shown a few moments ago prior to that meeting.

I asked SXC why he was aggressive in that session. SXC replied, 'They can't play curly balls ***(cf60)***. I can be tough if I have to be, the release can't pass through this defect. DXT would not take this personally, he knows my intent, though Al would not take it like this. Watch tomorrow, there will be a complaint ***(fe22)*** against me to the PM.'

QXD observed: 'SXC is acting as a bad cop, he is good at it, and tomorrow he will repair the relations ***(fe23)*** as if nothing had happened.'

Snapshot 6-42 Production Readiness - Event Observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

It was clear who was in power; the meeting room was crowded with people from different domains ***(ec30)***. BXA was chairing the meeting with RYF as a production coordinator leading the discussion.

BXA said, 'The approval cannot be given as the project has failed to address the operation's resource requirements.' ***(cf61)***

The PM said, ‘We all know that we have raised this to executive management, and no decision can be made at this juncture when the organisation is going through the changes. However, we can highlight that it is crucial to have these resources on deck to support the platform.’

RXF said, ‘The project should have predicted these requirements when it was started. The system is nearly ready, and still we are struggling to have the logistics set right. Every project worries about delivery, then operation struggles coping ***(cf62)*** with the pressures.’

QQ intervened and said, ‘The project duration shortened so much that the planning could not be carried out ***(cf63)***; rather, all our teams have given urgent response to this request.’

The PM observed: ‘Instead of tying the resource issue to the project, we can look at the other operational support features we have built in here ***(cf64)***. We will minute that the approval is conditional and let us progress with the deployment.’

Every one concurred, as there was no other choice; the forum had agreed to proceed with the deployment. BXA still blamed the PM for not demanding a resource grant from the sponsors.

Snapshot 6-43 Production Launch Plan - Event Observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

QQ spoke at the briefing session. ‘Launching the platform into production has to be planned carefully ***(cf65)***. As soon as we open the connections to production networks and EA test systems (Government Emergency Alert Systems), if anything goes wrong then alarms will be triggered. The launch is being done in normal outage window at 11.00 pm tonight.'

The PM said, 'It will be great to assemble in the project room; I can get some pizzas and drinks. We can request EA to send some test campaigns so that we can simulate the response.'

The launch took place that night, and sample campaigns were successful in chosen geographies.

DXD was informed that the production systems were all working and campaign results in chosen areas were successful. SYG confirmed that the tests show that the test handsets were placed in those areas.

A Steering Committee session was held to present the launch status to management. Prior to this meeting, the PgM and PM went into an argument. At the end of this argument PgM said, 'Let us also get some credit in this success!' It was obvious throughout the project how confronting they had been to each other (R).

Snapshot 6-44 Soft Launch Plan - Event Observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

Given the context of a successful soft launch, the commissioner wanted to visit the site for a demonstration and a date was organised. The project team was very excited ***(fe24)*** about this event. The live data coverage for Victoria needed to be available in the system. The system generated SMS as expected except at a place near Geelong. It was a bit of an embarrassment for Xfone senior management.

As usual, the PM jumped out of the seat and tried to buy in some time for a quick investigation. QQ and PXM ran to the project room to check if the data load statistics was appearing correctly ***(ec31)***.

In the next 20 minutes, they concluded that the traffic data in Geelong was not being captured at that time, as some transmissions cells were inactive ***(cf57-a)***.

The Xfone VP promised the commissioner that the demo would be conducted again. The Commissioner stated, 'We should build the quality as it involves lives.'

Though the session was closed with mild disappointment ***(fe25)***, the project team worked throughout the session collaboratively and all of them shared the same feeling of sadness ***(fe26)***. The PgM was having a hearty laugh, which the PM took as personal hurt.

The next day, in the level E3 corridor, the PM was harassed and mocked ***(fe27)*** by his peers about the failure of the demo. It was a rough time for the project team to work to get over those hurdles.

Snapshot 6-45 Soft Launch Plan - event observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

As all three carriers were implementing the systems and commencing the service at the same time ***(cf66)***, the integration between carriers had to be planned in detail, meticulously. The GA took responsibility to set forth an integration plan. The engineers were involved in technical discussions, whilst the managers were planning for media release and risk analysis ***(cf67)***. The GA attempted to create a project perspective and community perspective to supersede the organisational and individual perspectives ***(cf68)***. This synergy is noted in DXD's comments to Xfone director CYS.

The inter-carrier meeting went well, it is important to note all carriers are collaborating well to deliver this facility for our community. Our project is progressing well to meet target dates. However, given organisational changes happening now, the resources working on this project should not be changed ***(cf69)*** at any cost. Since there is a good relationship with other carrier representatives and GA program coordinators ***(R10)***, it is crucial to maintain these relationships for success of this mega project.

Snapshot 6-46 Soft Launch Plan - event observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

The government published the date for a community trial. A small community near Geelong and a suburb in Melbourne were chosen to conduct the live community-based testing (CBT) of this facility. A conference call was set to coordinate the community trial.

The project team was huddling towards the phone, tracking campaigns on the monitor. A change in group dynamic was noted.

I observed these aspects in the way the team functioned. The team operated in high alert mode, a team member can approach any one at any time. Any type of interruption is acknowledged immediately. Help to succeed means the formal roles and responsibilities and organisational boundaries were effaced. The team showed empathy for the personnel on the frontline who were working on the monitors.

Snapshot 6-47 Soft Launch Plan - event observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

The facility was launched successfully; the project team was on alert for the next three days; a major campaign was initiated for the fire at Katoomba in the Blue Mountains, NSW; and 17,000 SMS were sent to Xfone customers alerting them of the fire hazard. The project team felt happy, though watching the fire burning gave them a mixed feeling.

The PM observed: ‘Strangers would be standing to take the credit; as usual, the team would be soon forgotten. This organisation fails to recognise the contribution this team had done to make this project a success. The Obelix would go on to get rid of me. He had no role in this project, but injected himself and tarnished my image when I was in trouble. But he is the one to review my performance records.’

The project team was disbanded: QQ and PM were returning to their desk in their office locations. The whole team assembled and planned a trip to the Hunter Valley. QQ, PM and PXM attended the Government PIR session. As the team assembled for the last time (24 People) in the project room, MYK’s eyes misted ***(fe27)***.

RXS, HYM and MXS were sitting in one corner. The PM sat with them and took pictures. In all of these celebrations MXP was missing as if he never participated in the project but merely did his job.

Snapshot 6-48 Post Implementation Review - event observation AdPM

(AdPM: Voice of Researcher, recording the event as an observer)

As part of the post-implementation review (PIR), three weeks after completion of the project, all management team members were invited to reflect upon the success of the project. A template framework was given for discussion and a professional facilitator was nominated to steer the conversation. This event provided valuable data, covering all aspects of the research inquiry in a nutshell. I have captured the excerpts from this conversation as the management team members presented it.

MXH: I think it was too difficult in the initial stages for our government legal team to digest a few gray areas like support service level agreements. Since multiple partners were involved, the negotiation had taken too long, chewing up the time *leading to time pressure for the project teams. ← p1. Time Pressure as Complexity factor*

DXD: The support contract could have been separated, as there were multiple failure points in technological landscape to which different partners had to respond for alarming and fixing. ← p2. Task complexity

Syd: The methodology had been tailored to fit the context; flexibility was brought into it by close interaction and mutual trust.

QXD: Agree, there was nervousness in internal management layer. This project had to work within the typical waterfall governance of the organisation for reporting. We cannot deny that the collaboration and close interaction had introduced its own complexity. At time we did not know what outcome we were driving to achieve. ← p3. Adaptive Response

OPM: When we talk about interaction, it was always guided by the context that this project helps to save lives. Thus the commercial motives of each partner were subdued by the purpose. ← p4. Context

TPM: This collaboration is exemplary; we have seen all types of characters emerge out of real people during this journey. ← p4. Adaptive Response

DvD: This project had time pressure but each team had created openness in their dealings, the focus was to fix the issue rather than finger pointing or punitive measures. ← p5. Cohesion – Concurrence of thought and agreement

TPM: Coming to this point, people were adaptive, understood their interdependence on others' outcome. I believe this was one of the key reasons we could resolve the issues. ←p6. Coupling – appreciation of interdependence

NSPM: It would have been better if we had used communication tools such as 'Goto Meeting'; at times we were struggling to have good voice from Spain and India.

OPM: Agree, a collaborative tool would have helped to organise the discussion threads in better was, because of email communications we had some breakdowns. MxH: How did the community receive this facility and what were their feelings?

DVS: I believe this has given some level confidence in remote communities; some of the public was surprised as the SMS alert had been used in Katoomba.

I interviewed QxQ after the completion of the case project;

Table 6-1 QQ Interview Post-Implementation

QxQ – Reflection: File: 131011_001.mp3	
Time	Transcript
0:53	What is your definition of complexity?
1:14	Impacting multiple areas, often conflicting
	Pressure of timeline (***cf70)***, pressure of financial (***cf71)***, defining requirements not only customer also the vendor (***cf72)***. The organisation causing the change ***(cf73)*** – the leader is swapped frequently losing momentum, no leadership and change of leadership.
2:20	Pressure of delivery, project handover to delivery team, with all specs, but this project had more delay in handing over from the presales to delivery with compress timeline. It is based on fire season, compressed to 13 months instead of running for 2 years (cf73-a). We were in a project room; with high collaboration we exceeded the expectations.

3:30	About government requirements and solution design - how was your view on the project in solving the uncertainty.
4:21	It was proof of concept, I was not involved at that state, I started again from the vendor a proposal stage, and it required input from multiple departments. It is kind of a complexity where the requirements were spreading across the organisation. From the scope, Xfone had to undergo all these departments to align ***(cf74)***, whereas for the government it is one spec.
5:53	Different departments' involvement and getting agreement led to complex scenarios. Yes, It is correct. Breaking the requirements and design for individual departments requires continuous coordination ***(cf75)***. For example, the requirement 'SMS delivery' is interpreted by Network as sending SMS from point A to Point B, whereas for billing and customer team it is implicit requirements. I guess, we pulled all these SMEs into a project room and worked through to get common understanding.
7:31	Vendor Negotiation – Discussions with the Vendor. How did you feel about those negotiations? It is about aligning Xfone financial positions. Again, here intensive interaction is required. Multiple discussions ***(cf76)*** dragging through different periods of time. Once revisited it become irrelevant. It had to start from the beginning again, the more it is dragged the time is wasted ***(cf77)*** – the deadline does not move. Two or three days to resolve everything, by sitting all of them into a room and thrashing the details of schedule and payments etc.
8:58	Size of the project: Experiencing complex scenarios in this project. It is one of the biggest projects Xfone had done; I had worked in this company, not only from financial terms but also cross-functional side ***(cf78)***. Going to OB, Networks etc.
10:30	Relationships in the project room? Any recount. There were

	perceptions on who will lead – that need to be sorted out. But due to restructure we lost the leadership. Mentioning the Role and Responsibility and attitude, etc. But for this project we did not have this opportunity ***(cf79)***, we straight launched into delivery. We had R&R due to misconceptions – IT or Network? Upper management decided it. When we went to project room, we were playing multiple roles ***(cf80)***. We collaborated more than the roles defined by our jobs – trying to understand where the person is coming from – technical problem or scheduling problem – sometimes the discussion is heated - but we were coming out happy ***(fe28)*** as we found solutions through this interaction. Sometime Architect playing release manager's role, platform owner playing network designer role – it is very collaborative effort.
13:26	How did we achieve this collaborative mood? – We knew we were working this project for community and ability to save life – it was coming to our mind always, it is a community project – we were putting extra effort – not asking for anything. We know that the project is going to save lives. Social context is key factor for all of us that drive this outcome? Another thing is that through the organisational change, the project team become isolated and focused only on the project. Unnecessary management intervention was avoided (R), not influenced by the reporting line. There was freedom. Especially big restructure affecting the IT and networks – people were impacted ***(cf81)***. If there was not this project they would have been worrying about the job, etc. but in the project room we had great support. Even the commissioner coming down to be with us – it all created momentum.
16:51	Government Relationship: Lot with Dav, StXG – Complexity we faced with the government? The government needs to follow certain standards and strict

	procedures ***(cf82)***. It is true that when G produce a set of requirements, given that this is first on deployed in Au, the requirements are based on thinking that what it should do but through the project, regular meetings and collaboration other aspects of the life, brought both sides to concurrence – it is common thing we are trying to achieve. Then it became much easier, the discussions and negotiations came to compromising positions.
19:17	Let us shift the focus to Vendor. NZN team were assimilated with us, they thought we are their team. How did we achieve this collaboration? 20:04. When we think about this it is almost magic. It is not something that we could put in paper as a method; you know, we should build for any project. When people work very closely, the vendor, the government, they can also see why we are doing. It is social aspect that helped us. When we had issues with testing or design – let us have a look at that – sitting together – true credit to these people they are great people to work together
21:33	Let us explore the events: Commissioner's visit and taking pictures, etc. The demo could have been better, unfortunately the demo failed as we were showing more than we could achieve at that time. PIR would have killed this. But we focused on those scenarios and worked on it. The thing is when that happened, @23.07 we got support from external party rather than the internal management. ***(cf83)***
23:07	At that time we could have come up with better support from our management level.
23:33	Community Testing – what was your feeling? That was exciting

	time. Everyone was ready. We were nearly there. When I went down to Melbourne I took pictures how that village was burnt down. It was playing back in my mind. Something you spent 10 months on− without any encouragement from our own management just to help a family in community − everyone was excited. We were running through all the scenario − we established a command centre − testers looking at the campaign − another one watching the report.
25:48	Group Dynamic − X vs Y. What were your thoughts? 2 or 3 Categories, 1. Completely opposing the project − Purely challenged the project − whatever it is without putting into any contribution in it. 2. Clash of R&R − People do not care about the project they will let it go. So much collaboration ***(cf84)*** to get it through − we need to have that outcome − given period of time − shorten timeframe − holidays coming up. Heat of discussions and arguments, etc. At the end, people understand it is only to achieve the outcome for the project.
30:47	Celebration − Hunter Valley. The chemistry between the groups. Recount on this? It is amount of time people spending together and working through common issues, we manage to break down the problem and aligning it towards from social perspective, peer-to-peer relationship was great. People going on paternity leave, family issues, etc. in a team that might be discussed, but in this place we got together and discussed and supported each other − human aspect of playing ***(cf85)*** a great role to success of the project. In their mind one-of-a-kind project. They will treasure that memory down the line for 10 years.
	Thank you for sharing these recounts.

6.4 Case Project Analysis

As part of the case study analysis, the tipping points were subjected to concept diagrams and event analysis techniques, as shown in Figure 6-6.

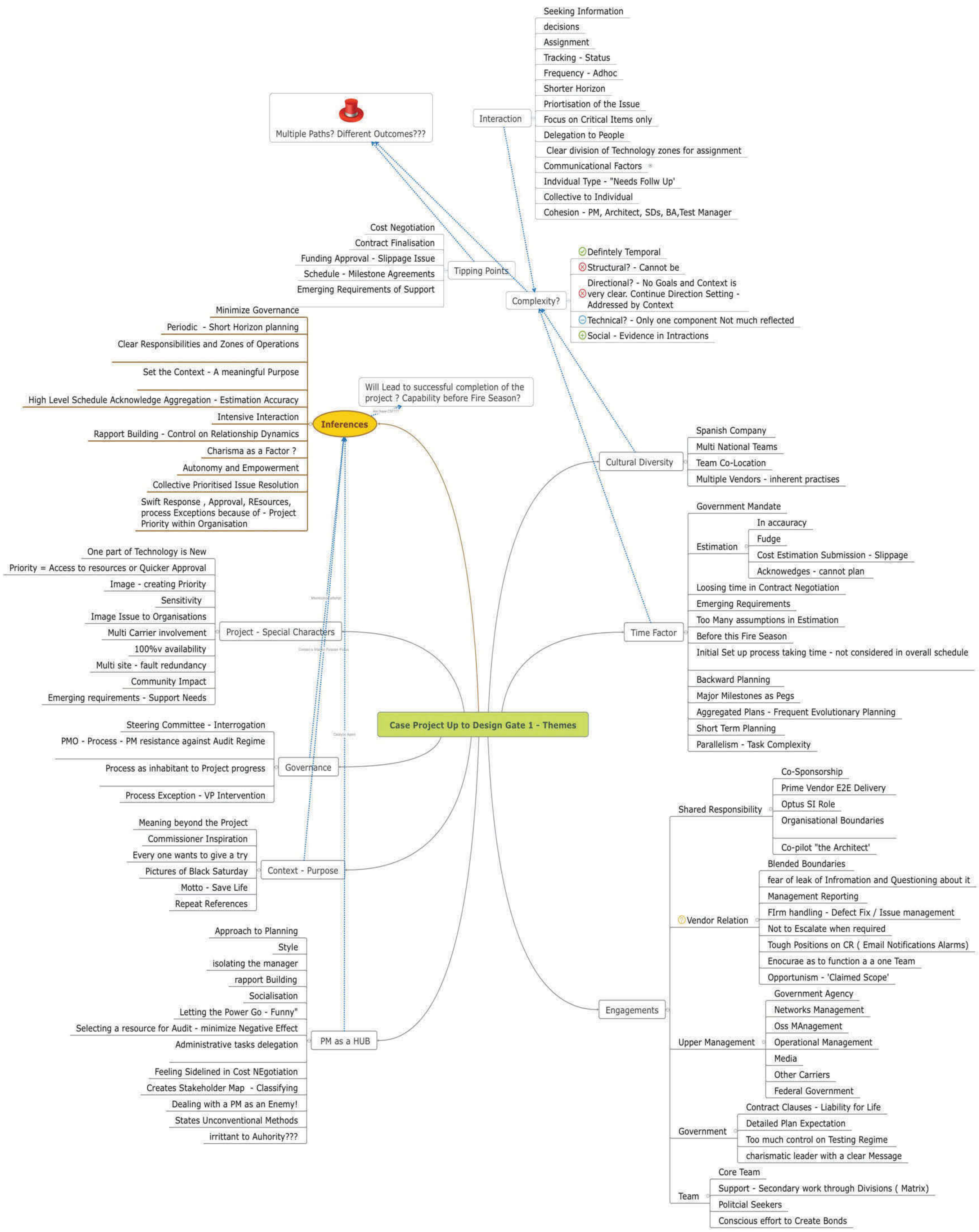


Figure 6-6 Case Project Analysis

Complexity Factors

In Xfone, multiple divisions shared responsibility to deliver this project ***(cf01).*** Technical teams, especially architects, experienced a certain degree of coordination complexity ***(cf74), (cf75), (cf28) (cf75)***. As noted in earlier analysis, the size and structure, and the wider impact to the community, brought out some complex scenarios. Constraint posed by the government on 'time' was one of the primary factors for complex scenarios ***(cf02, cf21, cf24).***

The vendor selections, cost estimation, and fund approval by the organisation underwent some complex scenarios that could be attributed to process complexity (***cf03-cf07, cf30)***. This is a level 2 reflection of complexity. The project had reduced time duration; the schedule was constrained with several parallel tasks, thus giving way to task complexity ***(cf08, cf14, cf22, cf23).***

The liability clauses and support conditions triggered complexity in finalising the contracts. The cultural diversity of the team, co-location and creating a unified vision for the team with strong bonds produced social complexity, which was well balanced by the project manager as catalytic agent ***(cf11, cf15, cf16, cf17)***. Lack of planning time ***(cf12),*** tailoring the methodology ***(cf14)***, and agreement to report only on high-level milestones ***(cf26)*** caused some complex scenarios. The carrier participation, even though they are competitors in the market, also generated some form of social complexity ***(cf20)***.

Technology as a factor is traced in only one place ***(cf27)***. This is Layer 1 reflection − complexity in the product being built. Cost control measures and associated discussions showed interaction and power play that could be considered as complex scenarios ***(cf31)***. The emergent situations in technological landscape were traced throughout the data ***(cf32, cf32-a, cf34, cf40, cf41, cf42, cf47, cf48, cf54, cf55, cf56, cf57, cf57-a, cf66)***.

In the initial stages of the interviews, the research participants clearly mentioned that there was complexity in our technological environment in which the product would be integrated after development.

Resource allocation ***(cf37, cf69)*** and organisational restructure posed some challenges leading to complex negotiation. Vendor opportunism was also noted as a factor of complexity ***(cf44, cf60)***. The discussions around support process led to complex scenarios in terms of political power play ***(cf61-64)***.

Echo of Complexity

The factors noted above triggered several complex scenarios. The complex scenarios traced in the data were discussions over cost estimation and fund allocation, contract negotiation with the vendor and government agency, team building efforts, arguments with PMO for change in methodology, seeking approvals for exceptions, Steering Committee sessions and interaction with GA for balanced governance ***(e01 to e10)***. For example, the liability clauses ***(cf10)*** and support conditions ***(cf38)*** were factors triggering complexity in the discussions for finalising the contract ***(ec02)***. Specific resources were requested, resulting in heated interaction in SCM ***(ec11)***. The volume of requirements triggered an overwhelming feeling within the project team; this is a symptom of complexity ***(ec12, 14)***. Managing government expectations over schedules and governance echoed complexity, as these interactions were marked by tact and diplomacy ***(ec13)***. A technically complex component was outsourced to a smaller company in Spain ***(cf32)***, leading to complex scenarios in terms of language, culture and time zone ***(ec15)***. As design was carried out in parallel to build activity, the design walkthrough events were complex in terms of agreement on technical aspects ***(ec18)***. The PM taking overt control and direction to vendor resources brought out complexity in terms of vendor relationship ***(ec19)***. Daily defect meetings were marked with complex interaction, as there was pressure to fix the defects and disagreement over the severity of the defects ***(ec20)***. A form of complexity was echoed in the interactions arising from the technological landscape and emergent issues ***(ec25, 26, 27, 28)***.

The discussions with Operations displayed complex interactions due to the support process mandated by the Government and the allocation of support resources. The presentation to the commissioner and the technical hitch therein led to managing the expectations within the organisation and with the customer. These actions, marked by diplomacy and commitment, had inherent complexity.

Relationship

As seen in these narrations and episodes, it is evident that there were formal and informal relationships in play, exploiting each other for their positions. Statements such as '*good rapport with the PM'* ***(R01)***, *'buddies in operations'* ***(R02)***, *'give me a May Day call'* ***(R03)***, *'PM and GM not aligned'* ***(R04)***, *'developed relationships with'* ***(R04)***, *and 'old colleagues in networks team'* ***(R05)***, *'Power connections* ***(R06)***, *'got to use some influence'* ***(R07)***, *'I have spoken to him, he was receptive'* ***(R08)***, *'without going through the formal channel'* ***(R09)***, *'good relationship with government coordinators'* ***(R10)*** were all pointed to how relationships are key for generating delivery outcomes in a project world. The data has revealed the following:

- Project participants had developed relationships gradually from simple acquaintance to a strong bond as personal friends.
- Project participants attempted to continue these relationships even after the project had been completed and the team had been disbanded.
- Project participants carried memories of personal accomplishment. They displayed satisfaction with the life period they spent together in achieving this mission.

An attempt was made to trace both formal and shadow relationships between stakeholders through connection diagrams. These diagrams were updated periodically whenever a significant difference in a relationship was noticed. In Figure 6-7, the red connection shows opposing or constraining relationships. The dotted lines show informal (outside the project charter) relationships. The influence of these relationships was noted. These networks (shadow lines) in this research are called Private Influencing Networks (PINs).

In Figure 6-8, an instance of cohesion within the project core team was recorded by marking '1' in the cell. Different patterns of cohesion emerged over a period of the project, showing how the project team was adjusting itself by preferring other agents.

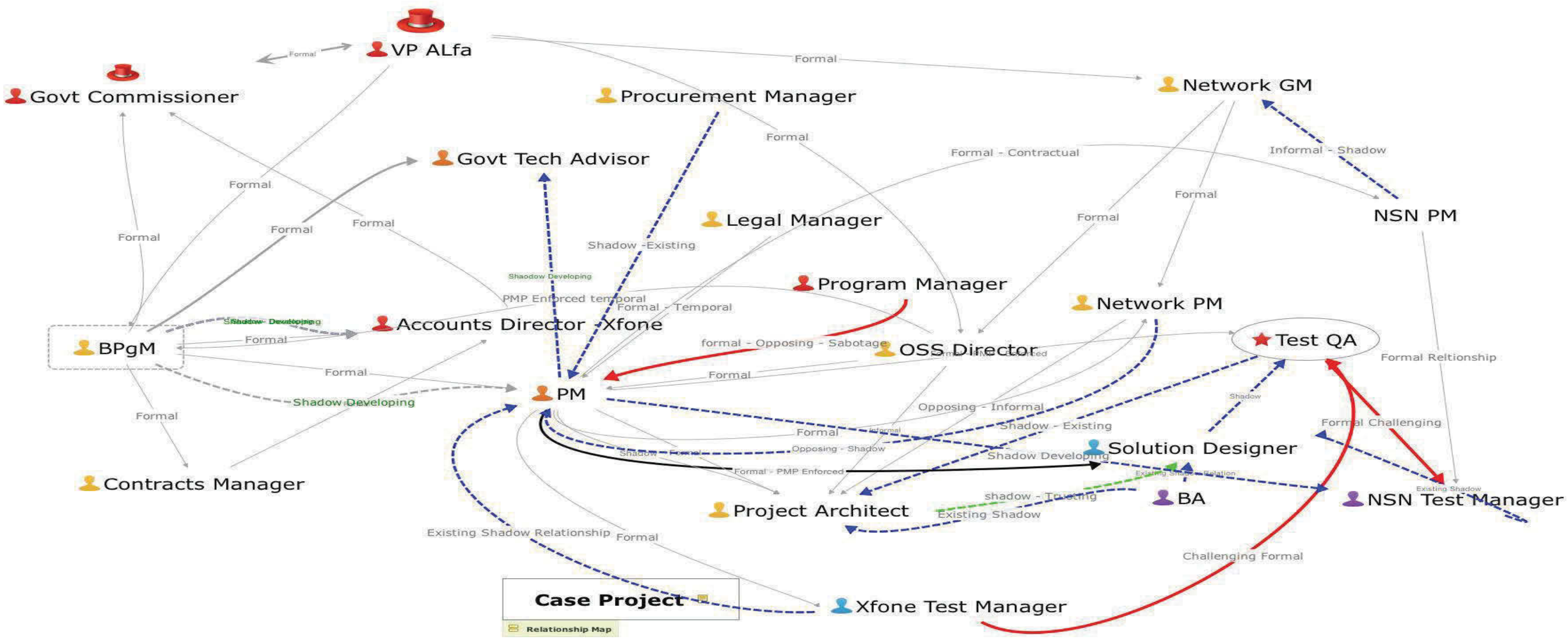
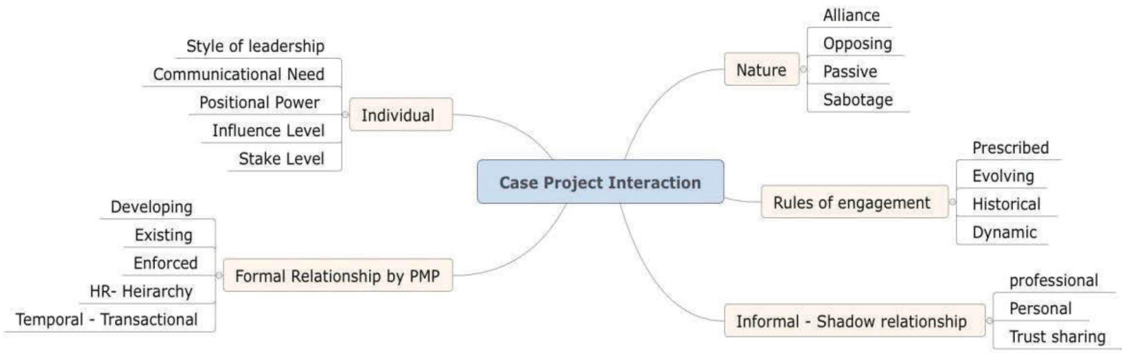


Figure 6-7(PIN) Private Influencing Networks.

Network connections and shadow connections across the organisation. Note: Blue dotted Lines – Shadow relationship, Red lines – Opposing relationship, black lines – Formal relationship



XX	T01	T02	T03	T04	T05	T06	T07	T08	T09
T01	0	0	0	0	1	0	0	1	1
T02	1	0	1	1	0	0	0	1	0
T03	1	0	0	0	1	0	0	1	1
T04	1	1	0	0	1	0	0	0	1
T05	1	0	0	1	0	0	0	1	1
T06	1	0	0	1	1	0	0	1	0
T07	1	1	0	1	0	0	0	1	1
T08	1	0	0	0	1	0	0	0	1
T09	1	0	0	1	1	0	0	1	0

NEWS Project Initial Stage

XX	T01	T02	T03	T04	T05	T06	T07	T08	T09
T01	0	0	0	1	1	0	0	1	1
T02	1	0	1	1	1	0	0	1	0
T03	1	0	0	1	1	1	1	1	1
T04	1	1	0	0	1	1	1	0	1
T05	1	0	0	1	0	0	0	1	1
T06	1	0	1	1	0	0	0	1	0
T07	1	1	0	1	1	0	0	1	1
T08	1	0	0	1	1	1	0	0	1
T09	1	0	0	1	1	1	0	1	0

NEWS Project - Build Stage

XX	T01	T02	T03	T04	T05	T06	T07	T08	T09
T01	0	0	0	1	1	0	0	1	1
T02	1	0	1	1	1	0	1	1	0
T03	1	1	0	1	1	1	1	1	1
T04	1	1	0	0	1	1	1	0	1
T05	0	0	0	1	0	0	0	1	1
T06	1	0	1	1	1	0	0	1	0
T07	1	1	0	1	1	0	0	1	1
T08	1	0	1	1	1	1	0	0	1
T09	1	0	0	1	1	1	0	1	0

NEWS Project Closure Stage

Figure 6-8 Cohesion between project team members

Action-to-Reaction Cycles

There were many noticeable action-to-reaction cycles in the data. For example, co-location **(ar01)**, working collaboratively **(ar02)**, creating political maps, classifying stakeholders **(ar03)**, frequent interference **(ar04)**, continuous negotiation **(ar05)**, raising the priority **(ar06)**, creating noise, prioritisation (**ar07)**, effacing organisational boundaries (**ar08)**, status seeking **(ar09)**, goal reminding **(ar10)**, exclusion (**ar11)**, withholding information or distorting it to suit the context and audience ***(ar12)***, pin them down and make accountable for action ***(ar13)***, tackling ***(ar14)***, concurrence and agreement ***(ar15)***, creating meaning and purpose ***(ar16)***, making right noises ***(ar17)***, justifying ***(ar18)***, heated discussion–contention ***(ar19)***, power display by seating/physical positions or objects ***(ar20)***, mutual agreement ***(ar21)***, fight for approvals ***(ar22)***, demand ***(ar23)***, support and direction ***(ar24)**,* confrontation, ruffling ***(ar25-ar26)**,* cross connecting, informal engagement and communications ***(ar27)***, and favor seeking ***(ar28)***, threatening, playing bad-cop, ***(ar29-30)***, social chats/hanging around ***(ar32)***, delegation and giving freedom of decision-making ***(ar33)***, being aggressive ***(ar34)***, supporting a position, appearing in session for power weight, intervention ***(ar35)***, informal assessment ***(ar36)***, acknowledgement ***(ar37)***, de-identification and covert action ***(ar38)***, subtle observation ***(ar39)*** *and* enactment ***(ar40)***.

Table 6-2 Number of tipping points with impact classification in different stages of the case project:

Row Labels	High	Medium	Low	Total
Concept Gate	24	16		40
Feasibility & Design Gate	130	56	19	205
Total	**154**	**72**	**19**	**245**

Table 6-3 Sample - Tipping Points captured:

TIPPING POINTS IN CASE PROJECT						
TP ID	Short Description	Why	Durat	Intens	Category	Project Gate
TP01	Cost Negotiation NSN - $$$ -Confrontation and Trust Play	Agreemen	1	High	Contract	Concept
TP02	Legal Clause Contract - NSN to Optus Lawers	Agreemen	1	High	Contract	Concept
TP03	Contract Liabaility - Penalty Clauses	Agreemen	2	Medium	Contract	Concept
TP04	Support SLA - Timing	Agreemen	2.5	Medium	Contract	Concept
TP05	Budget - Expense Missed in Governance Papers	Agreemen	3	High	Processual	FD
TP06	Government Timeline Expectaions - VP Discussions	Agreemen	1	High	Contract	FD
TP07	PM Allocation - Org Unit Ownership Who will do it - Discussions	Direction	1	Medium	Organisatio	FD
TP08	Reporting and Government Control - Process definition using the	Direction	1	Medium	Client	FD
TP09	Vendor-Govt Project Schedule Representation	Agreemen	2	High	Time	FD
TP10	Inter-carrier - design Audit and review sessions with the Agency	Agreemen	2	High	Client	FD
TP11	Spain - Subcontractor Connectivity - Firewall Rule	Approval	0.5	Medium	Processual	FD
TP12	Project Room - PCs and Connections	Approval	0.5	Low	Logistics	FD
TP13	Traffica - Servers as a Sub Project - Fund	Decision	0.5	Low	Financial	FD
TP14	Wire Unplugged by the Engineer	Decision	0.5	Low	Financial	FD
TP15	Sunshine - Server CPU - Faulty	Decision	0.5	High	Vendor	FD
TP16	Character Set Argument with MP	Direction	0.5	Low	Scope	FD

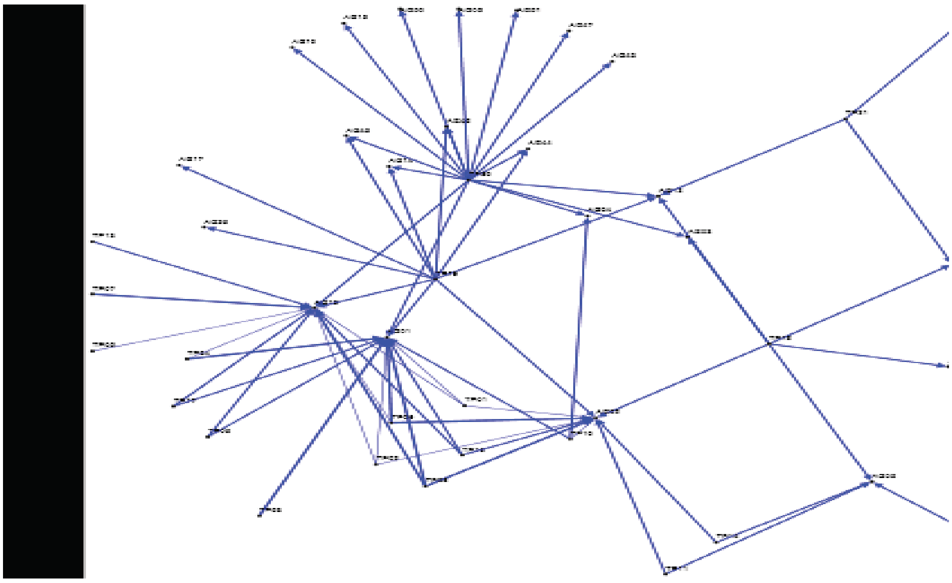


Figure 6-9 Agents attending to tipping points at the same time. (NODEXL)

Table 6-4 Agents in action on several tipping points scenarios

AGENTS INTERACTION IN TIPPING POINTS									
TP ID	Agent I	Duration of Engagement	Action Category	Duratio	Intensit	Categor	Project G	Power Level	Group
TP01	AG01	1	Leads	1	High	Contract	Concept	Provision End to En	High
TP01	AG02	1	Contributes	1	High	Contract	Concept	Ened to Solution - C	Medium
TP01	AG24	0.3	Decides	1	High	Contract	Concept	Legal Advisory	High
TP01	AG22	1	Distracts	1	High	Contract	Concept	Contract Creation	Low
TP01	AG23	1	Contributes	1	High	Contract	Concept	Contract Review Ap	High
TP01	AG26	1	Contributes	1	High	Contract	Concept	Initiation and Sales	High
TP01	AG27	1	Contributes	1	High	Contract	Concept	Line Manager to PM	Medium
TP01	AG12	1	Contributes	1	High	Contract	Concept	Advisor to Program,	Executive Level
TP01	AG29	1	Decides	1	High	Contract	Concept	Decisions on Delive	Executive Level
TP01	AG26	1	Decides	1	High	Contract	Concept	Initiation and Sales	High
TP02	AG01	1	Contributes	1	High	Contract	Concept	Provision End to En	High
TP02	AG02	1	Contributes	1	High	Contract	Concept	Ened to Solution - C	Medium
TP02	AG24	1	Contributes	1	High	Contract	Concept	Legal Advisory	High
TP02	AG22	1	Contributes	1	High	Contract	Concept	Contract Creation	Low
TP02	AG23	1	Contributes	1	High	Contract	Concept	Contract Review Ap	High
TP02	AG26	1	Contributes	1	High	Contract	Concept	Initiation and Sales	High
TP02	AG27	1	Contributes	1	High	Contract	Concept	Line Manager to PM	Medium
TP02	AG29	1	Decides	1	High	Contract	Concept	Decisions on Delive	Executive Level
TP02	AG53	1	Decides	1	High	Contract	Concept	Rown Corker - Gove	Executive Level
TP02	AG47	1	Contributes	1	High	Contract	Concept	OB - Business Progr	Executive Level
TP02	AG43	1	Decides	1	High	Contract	Concept	Commissioner Repr	Executive Level

The number of agents participating in each tipping point was captured using Social Network Analysis technique (NODEXL) (see Figure 6-9). If there were too many tipping points and the agents were involved too frequently in these tipping points (threads of discussions, chain of sub-events) then it was evident that the level of complexity was increasing in the project.

The project would experience a disruption and possibly become defunct unless there were interventions through radical, forceful, often unpalatable decisions.

Emotions

The project team passed through a rollercoaster ride of emotional experience throughout this journey, from the beginning to completion of this project. An attempt was made to trace the feelings experienced by project participants but detailed analysis was beyond the scope of this research. An observation is made here that complexity in projects brings out a variety of emotions. Emotions range from isolation, happiness, feeling good about something ***(fe02, fe12)***, browbeating, fun-filled ***(fe06)***, fear ***(fe05)***, high-handedness, disappointment, shared feeling of sadness ***(fe26)***, tears ***(fe20)***, anger ***(fe19)***, disrespect, commotion, despair, excitement and a sense of accomplishment.

6.5 Lenses

Lenses are like knots; when they are untied, it should be possible to look at the threads and the way the social fabric is woven. Lenses are conceptual abstractions or encapsulation of a phenomenon. I listed many such encapsulations mentioned by the research participants during the interviews. To name a few: agility, transience, power, trust, animosity, internalisation and resonance. Since the researcher had made a conscious decision not to focus on communication styles, temperaments, ethical, linguistic or individual psychological aspects, the lenses had to be within the individual to collective interactional (social) domain.

I presented some of my sample (lengthy) narratives collected in the case project to Visiting Professor Dr Barbara Czarniawska, from Gothenberg University and expressed my difficulty in defining a few social lenses to study social complexity in projects. She suggested that I revisit the narratives (data) and query them with an open mind to check 'what is happening in this narrative that can be considered as complex, if the pattern is repetitive, can we use it to comprehend complexity?' rather than approaching the narratives with preconceived theoretical notions. After reading on narrative analysis (Czarniawska 2000), I undertook another in-depth analysis of the case project data.

At first I found that the narratives contained hidden background to transpiring events. It was not discernible from the outset. The participants attempted to paint a picture collectively, while they were having a conversation, a *silent soliloquy,* to themselves during the events.

For example, the narration from the project manager about the system demonstration to the government commissioner read, 'When the demo failed, I was thinking….(slang), … my intent is to show that the team has put enormous effort to meet this tight target timeline, I could not agree with MxR, he does not have to act as he did….(slang - meaning condescend), as long as we meet the contracted milestone we are doing ok….I committed just because of QQ's interest, we will do the demo again…. I know, CxS will use this failure of the demo event to crucify me!'

Subjecting this narrative to analysis, it appears that there are two different contexts in play. The PM was residing in 'hard work' and 'commitment to complete' as communicational anchors and a context in his mind, whilst MxR was acting from the realm of 'customer engagement', another context. The common theme was to assure the customer of success. Another context crossing the mind of the PM was about criticism he would face from his manager.

In another instance, QQ warned AdPM and PM about the network support group's approval during governance gate submission (NOCR Gate), 'If you fail to understand their context you will be defeated … they are corporate gorillas.'

The background to events or interaction brings complexity because it is not transparent and is still forming. Behind the veil of transpiring events, several themes from the past and future are shared. I called these collective schemata context. Sometime, the pictures are contrasting, dissonant from each other's vision. Sometimes the contexts are created. At the Novotel Hotel, the Commissioner's speech, 'The purpose of this session is to set a scene, create a context that we need to save lives by delivering this project before next fire season,' was nothing but an open invitation to paint a collective picture of purpose for this project. Thus, sometimes the contexts are consciously created and openly stated. Two key pivotal aspects are the individual's picture (self) and his co-creation of the collective picture involving the 'other'. The tipping points demand immediacy of action. These two aspects are definite sources of complexity in terms of social.

The 'connectedness' lens surfaced by itself. I drew connection diagrams for each tipping point (56 in total), inquiring who was interacting, what type of inter-relationships they had and how these relationships were influencing the project outcomes. First, the connections were not only between the project team and stakeholders but expanded beyond this formal enforced relationship across the organisation and included some vendors.

I found that there were two types of connections: a) a transactional connection, and b) a 'stick-to' bond, 'affinity', 'belongingness' or 'hang-around' connection.

In the first type of connection, even though the agents did not like each other, they still acted to support each other, purely in the expectation of having the favour returned either immediately or in the future. I refer to this in this research as 'coupling'.

Since some of the connections were not formed through formal initiation, were not enforced through a project charter, I classified them as shadow connections.

In the second type of connection, people were showing an affinity among themselves, a bond by preference, 'liking' factors. However, their banter in cafés and pubs were indicative of their attempted influence on several projects in which they were involved. I refer to this type of relationship as 'cohesion', and started tracking it throughout the case project in a simple matrix to see what type of patterns could be detected.

As I captured the interactions among the participants in tipping point situations, the positions were recorded in time-phased bubble-charts. I noted that sometimes the positions were altered during the cycle of interaction, because of the exchange of ideas and thoughts. The social-collective response that was produced by the project stakeholders depended upon an ability to adapt to emerging contexts. When this adaptive ability was deterred, like MXP, the network PM was unable to cope with the changes and the momentum of the project team, and disengagement settled in.

In narrating the event about a test manager's behaviour, MxK said, 'I noticed for past two days RxS is not feeling alright about something, today took time to talk to her, then found that it was because of the test manager, I promised her I would speak to John about it, she is very good at her job, there is no place for any type of harassment in this project, I am sure John would listen to us.'

Note the reflective nature in this narration; 'I noticed', after two days 'I talked to her', after that 'I promised to speak to'; all pointing to a reflection in thought, creating an action. This type of conversation led to termination of the test manager in the case project. Such time-phased reflective action is unpredictable, because the action takes place after a period in time because of the cues collected in the recent past.

In tipping point situations, when the reflexive actions occur, they induce further complexity, as previously noted.

The Connectedness lens attempted to demonstrate the influence of private networks beyond formal organisational boundaries and interconnectedness in project decision-making. The Adaptive Response lens traced the dynamic creation of positions through deliberations in project tipping point situations. The Reflexive Response lens depicted time-phased reflexivity in a project team member's interaction.

In Figure 6-10, the lenses are shown applied to tipping-point situations; the actors and their positions were recorded. Simply stated, the diagram portrays a consolidated view by applying the lenses to a) the play of multiple contexts, b) shadow networks (PINs) that are influencing the outcome in this tipping point, c) interdependencies that are active for this tipping point, and d) adaptive and reflexive responses in a state of progression.

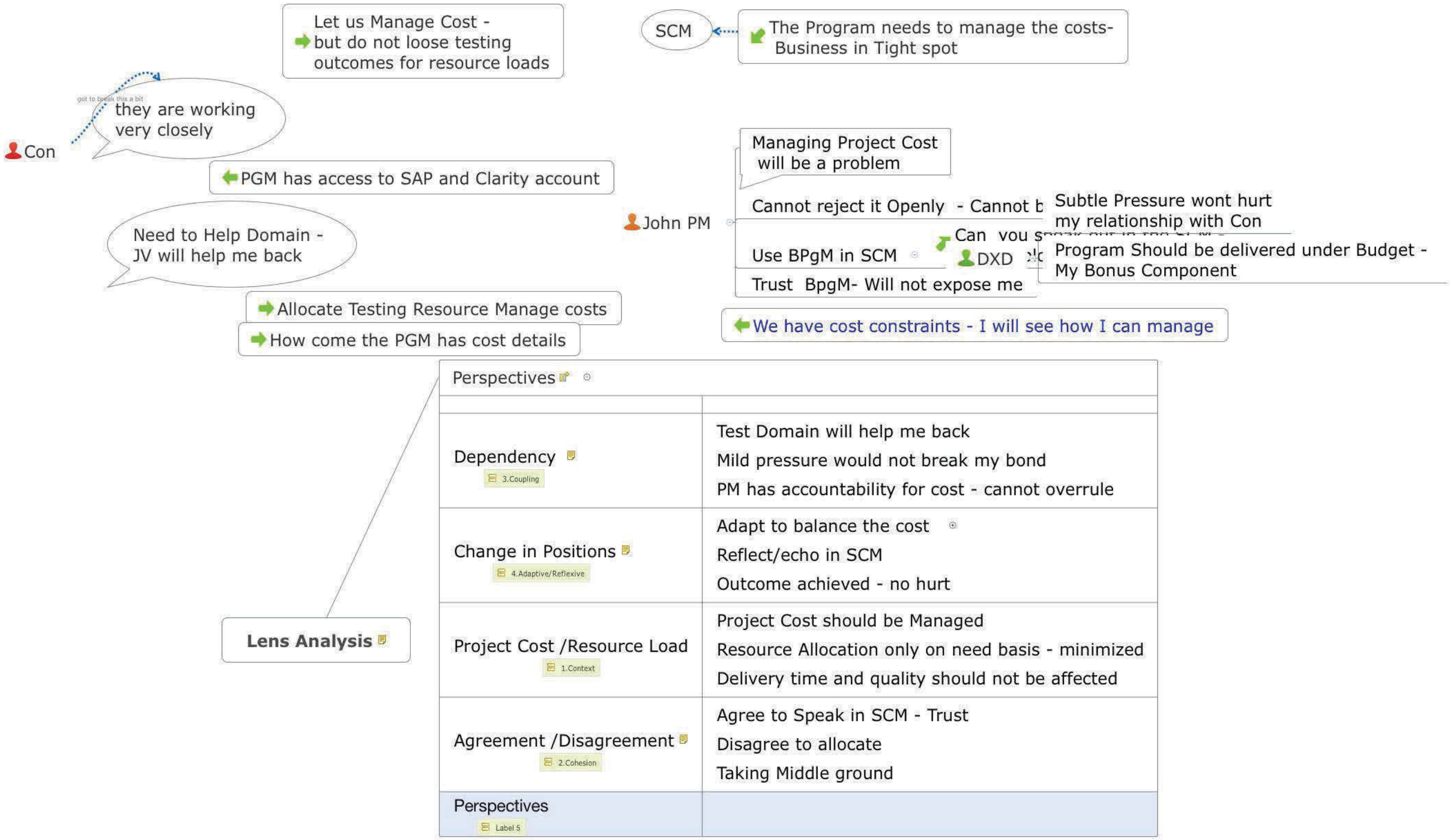


Figure 6-10 Lenses to analyse the tipping-point scenario

6.6 Summary

This analysis of data from the case project contributed further to my investigation by showing that the Context, Connectedness and Adaptive-Reflexive Response lenses can be used to comprehend inherent complexity in IT systems implementation projects. The lenses can help to expose and reveal underpinning social complexity. The Cohesion lens attempts to trace the 'stick to', an unspoken social bond, and the Coupling lens looks for transactional relationships. The Adaptive Response lens exposes changing mindset of the project members and co-creating the position through dialogue. Reflexive Response traces the action triggered by cues collected in the past. There is a need for deeper examination of these lenses through available theories.

Chapter 7 Triangulation

7 Triangulation

7.1 Complexity Factors Triangulation

The objective of this triangulation attempt was to rank the complexity factors identified in this research in terms of their relevance and the frequency with which the project stakeholders encountered them. As part of the triangulation exercise, two focus group sessions were held at Xfone, in which 11 participants responded to 213 prompts/questions.

Table 7-1 shows the questions grouped to elicit responses according to the complexity factors, that is, Directional, Environmental, Social, Structural, Technical and Temporal. The questions were posed as situation: a short description of a situation was presented to provoke a response based on the research participants' experience. The responses 'rare', 'a few times', 'frequently' or 'agree' were chosen from a list. Table 7-2 shows a sample of the questions used in the triangulation sessions. They provoked discussion among the participants and excerpts of these discussions are also presented in this section.

Table 7-1 Complexity Traced in category

Question Group	Number of prompting questions
Directional	23
Environmental	7
Interactional	30
Process	12
Social	60
Structural	28
Technical	40
Temporal	13
Total Questions	213
11 Participants	2343 Responses

Table 7-2 Sample Triangulation Questionnaire

Can this lead to a complex scenario? Did you experience this in Xfone?	Rp#01	Rp#02	Rp#03	VP#1
Lobbying is done outside of the steering meeting	agree	agree	agree	agree
The exceptions are given to people of preference	frequently	frequently	frequently	frequently
You can trace the clan he belongs to	agree	agree	agree	agree
It looks like the department wants an outcome against their own project	few times	few times	few times	few times
People cite past projects during meetings for taking a position	frequently	frequently	frequently	frequently
He is well connected, so fund request will pass through	frequently	frequently	frequently	frequently
The anger he shows out of the meeting will be changed to apologetic request in the meeting	frequently	frequently	frequently	frequently
Due to personal stake she will take a compromised position	agree	agree	agree	agree
Due to different organisations - there is a communication barrier	frequently	frequently	frequently	frequently
The Project Team will not take risks, unless otherwise authorised by the higher-ups	agree	agree	agree	agree
He (architect) spies on the team to update the program manager	frequently	frequently	frequently	frequently
They have worked on several projects together in the past	frequently	frequently	frequently	frequently

The responses were analysed and the results are shown as the percentage of responses in each answer category in Table 7-3 below. The percentage for each category was calculated as Percentage = type of response/total number of responses for that category.

Table 7-3 Summary of Response for the Triangulation Questionnaire

Complexity	Rare	Few times	Frequently	Agree	Disagree	Total %	Agree + Frequently
Directional	0%	7%	51%	27%	14%	79%	Evidence of Directional Complexity
Environmental	0%	14%	29%	55%	3%	83%	Environmental: Combination of Technology + Structure
Interactional	0%	2%	50%	45%	3%	95%	Social
Process	0%	0%	33%	42%	25%	75%	
Social	0%	7%	44%	47%	2%	91%	Social
Structural	16%	13%	47%	20%	4%	67%	
Technical	18%	46%	33%	0%	3%	34%	
Temporal	0%	1%	23%	76%	0%	99%	Temporal

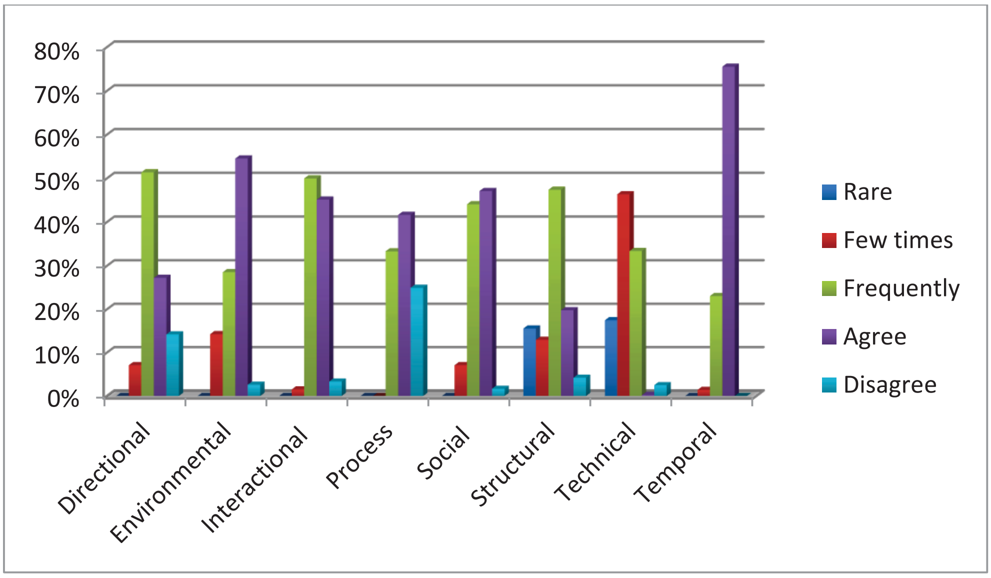


Figure 7-1 Triangulation - Participants' Responses

At Xfone, the research participants agreed that while temporal and environmental complexity were experienced, they believed that directional and social complexity were experienced more frequently, particularly social complexity. The triangulation shows that structural complexity was also experienced frequently. When asked to clarify their understanding of 'structural complexity', the research participants confirmed that it implied the level of impact in terms of number of users and customers, rather than the number of project components or the size of application code.

7.2 Focus Group – Reflections

A focus group session was organised on 5th of June 2015 at UTS, facilitated by Dr Elisabeth Leigh of the Faculty of Design, Architecture and Building (DAB). At this event, eight project management professionals (three construction PMs, three IT PMs and two academics) and myself actively discussed the complexity of projects based on the following prompts/questions:

- How do you define complexity? What do you mean when you say you experience complexity or that a project is complex?

- Would you agree that complexity factors could be classified? If so, can they be grouped in the following groups of complexity factors used in my research
  - Technological (technology and architecture)
  - Structural (size of the project)
  - Environmental (infrastructure, application and business environments)
  - Temporal (changing nature, volatility)
  - Time pressure (compressed duration)
  - Directional (goal ambiguity, multiple goals, lack of direction)

- Given this particular list, which factors in your experience would be dominant, that is, more prevalent?
- Context (language, symbols, background). By asking what contexts are in play in a project situation, are we able to expose complexity? Can you narrate a scenario in which 'context' has been a vital component of the complexity?
- In the project management world people operate through close connections and/or networks. How do these connections/networks contribute to social complexity?
- In the project management world, people develop positions (or points of view) and make decisions to adapt to situations. They form opinions and reflexively change their views due to interactions. Does this adaptive-reflexive nature of these interactions contribute to social complexity?

Reflecting upon their own personal experiences, the focus group participants acknowledged that there were a few situations that could be considered as complex and that 'tipping points' was an acceptable term to refer to these situations. The experience of complexity depended upon their professional experience, training and knowledge in the subject domain.

However, beyond a certain point, training or upskilling may not have made a significant difference in enabling the project manager to deal with complex scenarios, as the experience of complexity was time dependent.

In terms of complexity factors relevant to structure, size ranked higher in the construction industry than in the telecom/IT industry, while IT PM professionals believed that a lack of direction or multiple direction played a key role in generating complexity. The focus group participants narrated personal stories, in which ***contexts*** were misunderstood, politically manufactured and led to disastrous project failures.

Emphasising communication, the influence of networks (referred to as Private Influence Networks or PINS in this research) over project decisions was acknowledged; however they pointed out that planning for communication and flexible governance should be instilled from the initial stages of a project to maintain transparency and balance the political influences of these networks. They said that a paradoxical tension could exist between the project teams seeking flexibility and management's expectation of consistent reporting and stability.

All focus group members concurred on the use of the complexity framework developed in this research, and they suggested that further research could be done to improve the auxiliary lenses for context, cohesion and adaptive-reflexive responses.

7.3 Interviews

After I finished my study at Xfone, I joined another telecom organisation, which I refer to here as Yfone. In June 2014, I invited Yfone's head of PMO, head of strategy, head of vendor delivery and a program manager to reflect upon my findings. I captured these reflections through a series of discussions, excerpts of which are listed below:

- Int01: ZxMinto, Head of Strategy: (Source: 140705_001_zubair)

  Definition of Complexity: a project can be considered as a complex project depending upon the change it will bring to staff, systems, processes, customers and in general to the organisation itself. The uncertainty is definitely one of the complexity factors but there are other factors too.

  Structure: Building multiple network nodes where repeat process is involved cannot be considered as complex, even though it is large. If a project has significant impact to large customer base then it will be a complex project.

  Direction: Talking about direction, the planning should be in place, an organisation should have a clear objective defined upfront for a project. In Yfone, five projects per year may be considered as complex. We don't have any classification but at portfolio level we examine the projects based on the impact and advise our technology and business stakeholder to carefully track the dependencies.

Int02: DaKS, Vendor Head of Delivery, Yfone: (Source: 140711_001_daks)

Definition of Complexity: Complexity differs from project to project. Complexity is manifested in different forms within stages of a project. Complexity is relative and depends upon the perception of a person being in that situation. True, it occurs in spurts (to my question, confirms). Initial assessment of a project as complex or simple becomes irrelevant and can change from simple to complex because of emerging scenarios.

Technology: When we say technology is complex, it means we have a low skill set in that particular technology, and do not have enough expertise.

Direction: Business goals or business outcomes are key parameters to determine complexity. Vendor eco system and client eco system − the organisational landscapes may not be aligned, which leads to complexity. The misalignment in process is transparent but in organisational culture, business practice and ethics is invisible. These invisible factors cause complexity rather than transparent factors.

Context and Connectedness: The identity as 'vendor' remains only until the sales cycle. After that formal process is completed, a 'mutual trust-based, beneficial' relationship emerges. Client relationships are achieved through prolonged engagement, by adapting to client's eco system, it is a journey. Trust is developed as an outcome of this interaction. The relationship is pivotal to successful delivery of a project. Project success is also subjective, in some cases we could have adopted all processes but if the outcome is not realised by the client organisation, then we cannot consider this project as a success. Multiple perspectives should be considered.

Int03: DxHump: Program manager Yfone: [Source: 140815_003]

Definition of Complexity: Complexity is not about technology, but getting concurrence from different parties who have a major stake in a project's outcome. Recollecting my experience in one organisation, when outsourcing of application development was done without proper planning, as a project manager, I had to deal with lack of management direction, indecisiveness, lack of commitment and lack of governance. The complexity comes from integrating diverse stakeholders.

Context and Connectedness:

In another instance, I had to manage a project where the technology and solution was explorative. In AI for NRMA, we created internal competition by assigning another architect to come up with an alternate solution. The rivalry grew out of proportion to personal level, the proposition was good as risk mitigation – not to rely on a single person, but managing the relationship for effective outcome was complex. Structure is not an issue for IT projects, as we have multiple vendors looking into different components most of the time. In another instance at a large bank, a structurally large project, I felt the complexity was experienced because of interpersonal relationship with the core teams, management teams and sponsors. Yes, connectedness and the networks of relationship are important aspects for a project success. In essence a project is complex because of lots of people, different agendas and timidity of the vendor, customers' aggressive stance, and personality mismatches. The interactions show complexity in different forms of arguments and politics.

Int04: BxMehtha: Director, Technology Delivery. [Source: 141013_001_BhMeth]
Definition of Complexity: Complexity comes from different angles, for example time to deliver a project and relationship with the stakeholders.

Time pressure: Time obviously a factor for complexity. It is because business spends time in strategizing. When they make up their mind they expect IT to accomplish in shorter time. Force PMs to crash the schedule. When the relationship with the stakeholders is good the complexity is reduced; when it is bad because of past project failures, the complexity increases.

Direction: The clarity in people's mind about project objectives reduces complexity; when it is blurred with high-level view of this intention the complexity increases. Complexity also comes because of distributed locations. The relationship between IT, business and vendor was fractured in one of the project. During that time, the organisation was undergoing changes and the project was managed by head office. This introduced brand new characteristics. The whole group never bonded and started off with friction. So getting right direction, getting everyone on same page was the most difficult task and led to various complex scenarios.

Social Complexity: Lot of the times, the team has worked before – generated previous helps make things smoother. If it is a brand new team who have never worked together before and suddenly put into time pressure, that's when the relationship gets tested.

Everyone is looking for a reason why things cannot be done and blame other parties. That's why the relationships breakdown. Not getting enough attention from the sponsor or people may have other priorities, then the relationship gets broken. People look for direction and it is missing. Social engagement opportunities need to be created for the new teams.

Collaboration: What ingredient is required? They need to have some attitudes towards each other. Mediocre developer with social context can produce more. The project I mentioned earlier will remain in my mind for a long time, as I consider this as a character-building project. The lenses make strong sense to me, for practical purposes, they need to have some indicators, though it would be subjective measure. The level of collaboration, escalations and other social aspects involved in that project would showcase your research.

Int05: CRac Head of PM Practice Bank [150910_001- Carl Raccani .mp3]

I invited the head of PM Practice in one of the major banks to reflect upon my research findings; excerpts from this interview are presented below:

‘The complexity in projects is experienced when there are unsettling and conflicting views about what the project is trying to achieve. There are diametrical [opposing] purposes, the Build organisation attempts to introduce change, governed by project management practice, however the Run organisation (Operations) resists the change and has purpose of stability. PMs are caught in this dilemma. They have to inject change while keeping the project trajectory intact by manoeuvering changing organisational elements. PMs are integrators, like conductors of an orchestra. The bank does not acknowledge complexity of delivery; the bank has no model to classify the projects.

‘Technology is a factor of complexity; particularly the stability of technology platforms is challenged by ongoing changes. Environments generate complexity because there is no one vested with decision-making power regarding the environments, even the sponsors. Large projects, like the bank’s digital project, have many stakeholders and impacts large customer base therefore can be considered as complex. Time pressure is not a complexity factor in the bank as banks are not competitive; we are more concerned about stability and risks.’

On Context: ‘Yes, Social Complexity contributes to success or failure of a project. The project teams have to constantly negotiate and build consensus. “One maverick can turn upside the apple cart.” PM’s have no power, no accountability for the decisions but act like facilitators. Context is important in reaching the outcomes. We manufacture them on the fly.

On Connectedness: ‘Since there is no formal power vested in PMs, a form of tribalism is promoted. Coffee sessions and networking is essential to succeed as a PM here. You got to be part of the clan!'

On Adaptive-Reflexive Response: 'The good PMs don't have egocentric view but place themselves in others' context. Adaptive behaviour is an explicitly recognised skill in this organisation. On future direction for PM practice, because of outsourcing trends, the PMs will act as integrators. The organisation is looking for shorter and quicker delivery cycles.'

7.4 Summary

The complexity factors pertaining to direction and time pressure were clearly confirmed by the triangulation data as more prevalent factors than technology and structure. In general, uncertainty is associated with complexity. The experience of complexity can be in mid-course of a project due to emergent situations, thus its dynamic form of complexity is acknowledged. Skill sets and competency are considered as critical factors in enabling project managers to deal with complexity; however, beyond a certain point, training or further developing expertise in the subject matter does not make a big difference in project managers' ability to cope with complex situations.

The professionals, who participated in the focus group, and those who were interviewed at Yfone, reflecting upon my findings, confirmed that stakeholder relationships play a pivotal role in generating complexity in projects.

Chapter 8 Discussion

8 Discussion

There are not more than five musical notes, yet the combinations of these five give rise to more melodies than can ever be heard.

There are not more than five primary colours, yet in combination they produce more hues than can ever be seen.

There are not more than five cardinal tastes, yet combinations of them yield more flavors than can ever be tasted.'

― *Sun Tzu, The Art of War*

8.1 Introduction

From my investigations, I found that social factors such as culture, power, politics, group interactions, covet alliances, collective behaviour, relationship dynamics and power play were some of the key factors leading to project failures in Xfone (Biggs 2000; Whitney & Daniels 2013; Yeo 2002). As noted in the literature review, Chapter 2, prominent project management journals have confirmed that the project management methodologies have failed to emphasise the importance of social dimensions in projects and there is an urgent need to develop complementary theories from practice (Cicmil 2006; Cicmil & Hodgson 2006; Cicmil et al. 2006; Floricel et al. 2014; G Saunders 1992; Hodgson & Cicmil 2007b; Jaafari 2003; Kwak & Anbari 2009; Lalonde, Bourgault & Findeli 2012; Packendorff 1995; Smyth J. & Morris 2007; So'derlund 2004; Williams 1999 ; Winter, Smith, Cooke-Davies, et al. 2006; Winter, Smith, Morris, et al. 2006).

Stakeholder relationship and group behaviour were common themes of discussions in professional forums such as PM practice development sessions. As noted in data analysis, chapter 4.7, 'complexity' is a frequently used word, subconsciously applied to project scenarios by a community of project participants. Thus complexity is likely to be socially constructed.

As a keen observer, I noted the metaphors, language, symbols and parables in narratives told by the research participants. Stage 1 data analysis revealed that the metrics to measure the success of projects were too simplistic, focusing mainly on the scope, time, cost and quality parameters (Nelson 2006; Standing et al. 2006).

In recent times, business benefits (Lijima 2015) and organisational change aspects have become more prominent in evaluating project success (McAfee 2006). Often the success of a project manager or project architect in the researched context is measured by stakeholder satisfaction created during the execution of the project.

Project stakeholders implicitly and continuously judge the project team. As noted in the data analysis, the stakeholder's behaviour is determined by the expectations of 'others', and governed by 'collective social acceptance'. Undoubtedly, it is difficult to measure stakeholder satisfaction and perception about success is important for a project (Doherty 2014; Frey 2013).

Given the context of systemic organisational issues such as restructures or divisional conflicts, it was not always possible for any project manager in Xfone to meet the expectations of a large stakeholder base without being in conflict or taking sides ('turf battles') with conflicting groups (Pinto 1997).

As social factors have significant influence on project success, the objective of this research was to explore complexity factors, particularly social complexity, engendered by human interaction. The field definition of complexity, the originating layers of complexity, the notion of the tipping point, the echo of complexity and complexity factors based on Xfone data analysis were all presented in the first part of this discussion chapter. A detailed discussion of the proposed lenses was presented in second part of the discussion chapter. The framework and its constructs were then discussed in the light of well-established theories such as theory of social systems, theory of sense making and complex responsive process of power relating.

8.2 Field Definition of Complexity

A point I want to reiterate here is that 'complexity' is a way of interpreting the world. There is no agreed common definition (Cilliers 2002). In its simplest form, complexity is defined as S = (T, R), T=Thinghood, R=Relationhood, and a complex system, S, emerges when a set of things, T, interact with a set of relationships, R (Klir 1991).

A project as an entity interacting with other entities within an organisation and outside of the organisation can produce emergent situations. This emergence in IT projects can be represented in this research as:

Emergence in Project = {Project, (Process, People, IT Systems), Rules, Meta Rules }

The participants in this research expressed a fair understanding of complexity since they deal with various types of business systems in their work. When asked, therefore, 'How do you define complexity? What is your definition of complexity?' their immediate response focused on a set of attributes they had experienced in their project world. They believed that these attributes could be helpful in defining complexity in the project world.

Their definition exposed a few attributes worth noting, namely:

- A situation happens unexpectedly that requires intense collaboration.
- A situation brings out an unexpected outcome.
- This situation is unprecedented in this organisation; we have never seen it before!
- Choices are there; the selection of choice is yet unknown.
- There are too many changing elements of tasks and scope items.
- There are constraining parameters, changing variables and too many assumptions in the design and plans.
- Unknown elements come into play at a later stage of a project − at the post planning stage.

- Rules of engagement have first to be discussed and agreed to but they often develop over a period of time and are based on mutual understanding of the problem at hand.
- From the beginning, due to certain observed characteristics of a project, we can assume there will be certain degree of complexity such as multiple applications, and multiple vendors.

From the data analysed, the symptoms of complexity are as follows:

- Concurrency and parallelism of tasks with new dependencies are detected
- Swift decision-making frequently occurs
- Impromptu interactions are spontaneously triggered
- There is less time to respond, resulting in spontaneity of responses
- Frenzied action or temporary pauses in project progress are evident.

The research participants attempted to factor in the reasons for complex scenarios, what their reactions to such situation were, and how they felt when they were caught up in complex scenarios. This implies there are four elements to complexity:

- factors of complexity
- coping mechanisms/individual and collective actions
- relationships
- the emotional side of it.

The data analysis shows that the project participants do experience complexity because of lack of factual information (complexity of faith) or an inability to infer from the data (complexity of fact), or the interaction displays patterns that are complex to predict and comprehend (complexity by interaction) (Geraldi & Adlbrecht 2007).

The causal links between project events and the factors are non-linear and the system is sensitive to initial conditions. The project takes place in an historical context, with a set of initial conditions that cannot be replicated and any reliable outcomes cannot be predicted (Maylor, Vidgen & Carver 2008, p. 17).

It is noted in section 4-7, that according to practitioners' definition, *'Complexity is felt, experienced, and a perceived abstraction;* otherwise, we have no common ground.' This feeling and experience are subjective. In this thesis, *the complexity is conceptualised to be what is experienced by project stakeholders* (Geraldi, Maylor & Williams 2011). The attributed factor could be a perception − 'believed to be causing' or could even have some concrete evidence to show that a factor causes complexity (Geraldi 2009).

The research participants acknowledged both aspects of complexity, that is, the dynamic and the static forms (Baccarini 1996; Shenhar & Dvir 2007a; Williams 1999). The factors could be static, dormant and traceable at the concept stage of the project, or the factors could be dynamic, that is, found or developed during the project execution stage.

In their interview responses, the research participants sometimes referred to a project as complex, and at other times to specific scenarios as complex. From the description of factors revealed during the interviews in stages 1 and 2, it is noted that the combined effect of the factors also generated complexity (Whitty & Maylor 2009).

From the narrations shared by the research participants, we can infer that there was a correlation between professional experience, age, gender and the formal role of an individual to the way the complexity was perceived or experienced.

8.3 Source of Complexity - Layers

The data analysis also showed a clear pattern about source or origin of complexity. The source of complexity can be classified from the research data (using codes as L1, L2 and L3) in three layers: (refer to section 4.8)

- Layer 1: Product Layer
- Layer 2: Organisational Process – Project Management Layer
- Layer 3: Social Layer.

8.3.1 Layer 1: Product Layer

In Layer 1, the complexity is attributed to the product delivered by the project. Since telecommunication products are a bundle of services, the service configuration, such as network provisioning, usage rating, billing and reporting associated with the product, may all create complex scenarios. The product configurations are implemented through software application code in multiple software applications, leading to task complexity. The complexity factor associated with the product itself is technology- related. Task complexity and the associated team interaction have been discussed in research papers (Chae, Seo & Lee 2015). As noted in Xfone's data aggregation product development project, factors such as software version incompatibility, mix of technology, scarcity of resources with specific knowledge and skill, could trigger complexity during product development. Product scope can also be a factor when it is iteratively developed based on newfound knowledge.

8.3.2 Layer 2: Organisational Process – Project Management Layer

In Layer 2, the complexity emanates from process. IT projects have to incorporate non-functional, operational and compliance requirements, all of which are deeply embedded into business processes. The solution also has to cater to process changes in the business domain.

Complexity in the Organisational Process – Project Management Layer is about representing the project in governance forums, change control boards, capital funding requests, release management requests and procurement processes. In general, complexity at this layer stems from the process adopted in conducting the project in relation to the enterprise process framework of the organisation, mostly advocated by the PMO (as observed at Xfone).

The approval cycles involved in these processes demand continuous engagement by the stakeholders to convince and cajole other stakeholders to approve the artefacts within a stipulated timeframe. The projects are *executed through organisational processes*, such as a procurement process; thus the complexity stems not only from the method (how to) of *developing a product or technology solution* (Turner & Cochrane 1993) but also from the *organisational processes of implementing a project*. This is an additional perspective to the existing complexity models discussed in section 2-10.

8.3.3 Layer 3: Social Layer

The complexity experienced in Layer 3 is due to multiple factors such as cultural diversity, communication, language, personality styles, group behaviour, political connections and associations. This type of complexity emerges because of the human interaction occurring in projects. It is also important to note that the complexity generated out of the product and process layers permeates into the social layer.

NXP stated in this research, *'Watch the events, you can trace complexity in what is happening there, though … underlying factors could be numerous.'* The complexity factors, whatever they are, in combination or in isolation, can trigger project events such as meetings, discussions and arguments.

These events involve intense interaction. The social complexity manifests itself through these events and invokes further interaction. An important point to be noted here is that there is *clear demarcation between complexity factors and manifestation of complexity.* The manifestation of complexity is referred to in this research as 'echo of complexity'.

Figure 8-1 shows how complexity factors trigger events, which involve formal and informal interactions.

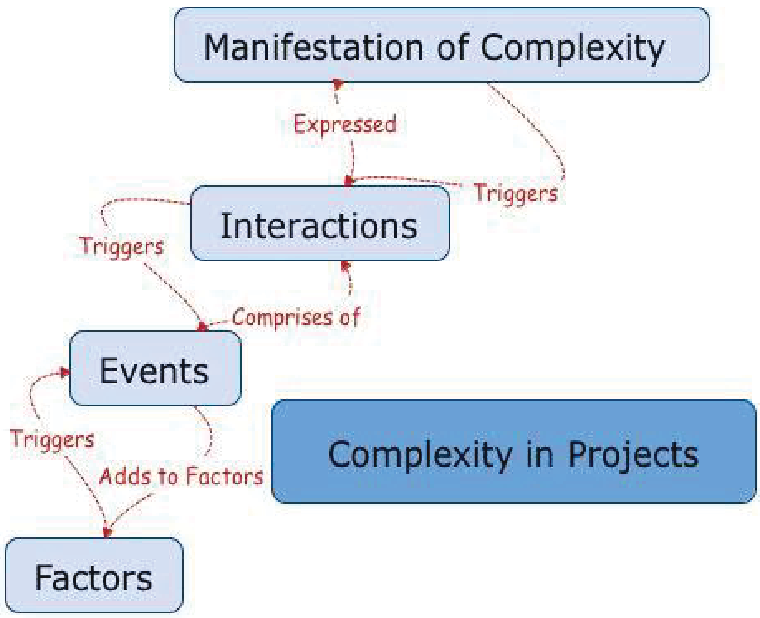


Figure 8-1 Complexity manifests in project events

This demarcation is not explained clearly in the literature; the factors are intermittently considered as 'complexity itself'. Observation shows that the echo of complexity occurs while resolving the problem through stakeholder interactions.

Table 8-1 shows for each class of complexity the origins.

Table 8-1 Complexity originates in Layers

Complexity Type	Layer 1 Product	Layer 2 Process	Layer3 Social	In Xfone
Technical	O	S	S	Not much, All mature technology
Structural	O	O	S	Rarely experienced
Environmental / Temporal	O	S	S	Frequently experienced
Time pressure as complexity factor		O	S	Frequently experienced
Directional	O	O	O	Frequently experienced
O: Originates	S: Spreads			

8.4 Notion of Tipping Point

The tipping point is that magic moment when an idea, trend, or social behaviour crosses a threshold, tips, and spreads like wildfire.

− Malcolm Gladwell (The Tipping Point: How Little Things Can Make a Big Difference)

Since the research participants mentioned words such as ‘spurt’, ‘blinder’ and ‘floaters’, it was essential for this research to define a term for this situation and tag it while registering it for research.

As noted in data analysis, complexity is experienced in random outbursts. The term *‘Tipping Point’* refers to atypical, non-transactional interaction, triggering decision-making, conflict and/or impasse. This situation warrants management interventions and collaboration. During the data analysis, the tipping point situations were considered more important than the project transactional interaction, which could be referred to as project-as-usual situations *(PAU).*

The punctuated equilibrium model (Gersick 1991) provides an explanation for Tipping Point. In this model, inertia maintains a system (project) in equilibrium (tracking to plan), until a major event occurs that requires a change. Once that event has passed, the state of equilibrium returns, possibly at a different equilibrium point. Lindahl and Rehn (2007) note that projects ‘... despite being generally seen as the most action-oriented way of organizing are usually conducted under a bureaucratic superstructure based on foundations of stability, predictability and success' (Lindahl & Rehn 2007). They introduce the term 'yield point' to describe the point at which a project goes into crisis to an extent that established protocols and routines can no longer deal with it.

In this research, the tipping point is detected as a sudden change, causing dramatic interactions (Buchanan 2002; Gladwell 2006). The action required to turn the project back on track (to the base line plan) would require a step out of the institutionalised web of intra- and inter-organisational rules, or the rules themselves would have to be reformulated and renegotiated.

In tipping-point situations, there is a strong possibility that the cognitive disagreement (difference of opinion on a problem) can be considered as personal conflict (known as affective conflict – emotional side) (Amason 1996) and change the focus from resolving the problem into relational strain.

In tipping point situations, there are conflicts, numerous choices and options as to how to respond, often without concrete factual data with which to make an informed decision. Thus there is insurmountable subjectivity and the situation can therefore be considered a wicked problem (March 1994). Immediacy of the resolution also creates complexity. Positions are taken, contested, negotiated for some time in circles and based on relationship and trust one of the options may be selected as a response (Rittel & Webber 1973).

Treating projects as CAS, the system (project) is destabilised because of these external perturbations and seeks to return to an elevated state as a balancing act. In terms of time and space, an event (tipping point) may be small, and many events in the background could have led to formation of the event. The tipping point is however significant because of the impact it has on project outcomes.

The tipping point is a basic block of complexity framework for projects (CFP). This is because, at tipping point situations, the echo of complexity can be easily traced in transpiring interactions.

8.5 Complexity factors and classification

In the literature, complexity factors are classified as Technological, Structural, Directional and Temporal factors (Qureshi & Kang 2015; Remington & Pollack 2007a). The classification of complexity factors has been noted in several frameworks during the literature review, such as TMO framework (Bosch-Rekveldt et al. 2011; Clift & Vandenbosch 1999; Watts Sussman & Guinan 1999; Xia & Lee 2004, 2005). In this research, Remington & Pollack's classification of complexity model was adopted as the basis for analysis. Section 8.5 discusses in detail the complexity factors derived from the data analysis.

This section confirms the presence of these complexity factors at Xfone. The system perspective is used to define complexity and categorise the factors.

8.5.1 Technological Complexity

'*In a technically complex project, areas of uncertainty and ambiguity relate to issues of how we will find solutions to problems.*' (Remington & Pollack 2007a)

Uncertainty in the solution space creates a complex scenario when implementing technology. This ambiguity generates additional complex scenarios in spontaneously selecting an option or trying out what could fix the problem on the fly. Eventually, we may surmount the problem, but to do so we need to embark upon innovation and research through multiple iterations of solution development.

The following factors appeared frequently in the interview data while exploring the technological factors:

- introduction of new technology
- changing critical technology components
- technological integration with legacy platforms
- limited technological expertise/knowledge
- functionality with too many interdependencies
- too many nested logic loops
- mediation and integration layers; having circular dependency
- time-bound transaction volume in the application
- distributed deployment, multiple demographics
- time zone sensitivity
- real-time references
- embedded legacy code/routines
- impact on larger user base and user access management.

The uncertainty was attributed to the method of accomplishing or executing the technical tasks even if a solution was available at times. As noted in the case project, the technology problem itself could not be defined/predicted until the real-time integration with all other components had taken place. This complexity stemmed from Layer 1, the product layer.

The interview data analysis and the triangulation data confirm that complexity can stem from technology and novelty (Shenhar & Dvir 2007b), ill-defined design and technical problems (Remington & Pollack 2007a), lack of experience and expertise in a specific technology space (Bosch-Rekveldt et al. 2011), and stakeholder expectations about the services and the operational capabilities of the technology (Geraldi & Adlbrecht 2007).

As noted at Xfone (see snapshot 5-1 S12), because of the strained IT-business relationship, complexity was experienced (Coughlan, Lycett & Macredie 2005). Because of technological issues, the case project encountered several conflicts. Conflict resolution and collaboration brought a better outcome and swift response to resolve the technology issues (Watts Sussman & Guinan 1999).

At Xfone, product complexity was minimal, thanks to mature application platforms such as Oracle ERPs. Even legacy applications (e.g., the ARBOR billing application) showed stability. A certain level of complexity occurred Xfone when several patches (software code changes) were applied to legacy application, and documentation was poor (Munson & Khoshgoftaar 1990). One of the crucial reasons for complexity at Xfone was the top-down (Benbya & McKelvey 2006a) waterfall software development lifecycle (SDLC) in conjunction with the governance regime (funding gates) through gated approach in a linear fashion. .

The research participants did not consider technology factors to be top of the list for triggering complex scenarios in this organisation. As stated in Snapshot 5-1 S06, '*We don't do bleeding edge technology here… usually complexity is associated with introduction of new technology'*. Only 33% of the responses confirmed that complexity was experienced 'frequently', while 46% of responses indicated complexity occurred only a 'few times' because of technological changes (refer Table 7-3).

Since the technology applications at Xfone were mature, technological complexity was not something experienced frequently by the project stakeholders. In fact, from the research data, I concluded that complexity due to technology was both rare and manageable at Xfone.

8.5.2 Structural Complexity

Structural complexity generally stems from the sheer size of a project because of uncertainties, interdependencies, task co-ordination and stakeholder communication (Remington & Pollack 2007a, p. 28).

From the interview data, the structural complexity factors related to size at Xfone can be summarised as follows:

- Complexity is experienced if a project is impacting a large user or customer base (* >1500. For example, consumer mobile products can impact millions of customers. The complexity arises because of extensive communication, training and knowledge sharing.
- An incident in a large project can have an adverse impact, causing loss of revenue, damage to the brand and to customer experience (criticality of impact and volume)

- If a project has changes to its application code in core modules (* > 50) or a new code development involves too many applications (* >15) and number of interfaces, then a type of complexity is experienced in terms of technology integration and task coordination.
- If a project involves many stakeholders, multiple vendors with prime and sub-contractor relationship (as in the case project) and/or has a large project team (*average project team size > 32, still operating in matrix structure), then a type of complexity is experienced in terms of task delegation, coordination, communication and management of deliverables. The team's geo-location, orientation and cultural diversity can also lead to social complexity.
- If a project has changes to applications with real-time transactions, or high volume/high frequency transactions (* >25000 Tp/s), or multi-site deployment (* >50 locations), then a type of complexity is experienced in terms of site coordination and control mechanism.

* *The numbers are proposed based on the researcher's review of PMO records;*

There were no distinct PMO criteria to determine a project as 'large' at Xfone; rather, a simplistic measurement was applied by counting the number of applications, interfaces, deployment sites and customer/users impacted relatively. My interviews with the senior stakeholders and program and project managers revealed that there was no agreed consensus on a definition of a large project, but all of them agreed that project size was definitely a trigger for complex scenarios, as specified in Snapshot 5-2 S03.

Structural complexity can be viewed from two aspects:

- product structure
- project structure.

Xfone has a matrix organisational structure whereby multiple projects are being executed at the same time.

In a matrix organisation, the project organisation is a sub-unit, deeply embedded in the hierarchy of large entity the organisation itself. Since Xfone has a multi-project environment, the interdependencies between projects generates complexity in terms of coordination and resource sharing (Macheridis & Nilsson 2003). At Xfone, because of matrix organisation, the project structure itself generates complexity (Williams 1999 p. 272) and the project organisation can also lead to complex scenarios (Danilovic & Browning 2007). Structural complexity (Lu et al. 2015) is experienced to a certain degree in project management processes due to the need to coordinate several tasks among large diversified functional departments and divisions in Xfone.

As mentioned in Snapshot 5-2 S05, 'size' also refers to *criticality and degree of impact* an application has on the number of business stakeholders, business users within the organisation and customers. Structural complexity is manifested in Layer 1 (Product) and Layer 2 (Process) but also permeates into Layer 3 the Social layer.

However, Xfone does not embark upon large projects too frequently. From 27 projects in the PMO records, we found only six projects that could be considered as 'structurally complex. It was confirmed in the triangulation exercise (Section 7-3) with interview respondent ZxMinto that large projects were seldom executed in telecommunication organisations. If a project is considered large then it is carried out under a transformation program with a 'projectised' organisational structure, as in the case study for this research.

From the research data, I concluded that complexity due to structure at Xfone was both rare and manageable.

8.5.3 Environmental Complexity

A combination of technology and structure generates complex scenarios. The applications residing in infrastructure platforms interconnected through interfaces are called 'grids'. A set of platforms and application grids are referred to as an 'environment'. The three types of ICT environments in most organisations are 'Dev', 'Test' and 'Prod'. The application code development is done in 'Dev'; testing is carried out in 'Test'; and the live application operates in 'Prod'. A set of environments and associated business processes are referred as 'System Ecology'. There are multiple ecologies at Xfone. Once the development is completed and tested, the code is transported through automatic tools into 'Prod', where an outage of the production environment is requested for the implementation.

Environmental complexity can stem from a range of causes. These include:

- a lack of environmental availability because several projects may be in the pipeline, competing for the same resources at the same time. Such resource conflict has to be managed through management intervention and at times, project timelines are impacted due to unexpected delays in sanctioning the requested environments.
- A consistent data set, a mirror image from the production environment, is required for testing purposes. Sometimes, it is not possible to obtain this data because of technical complexity.
- Business conditions can prevent an outage of the production environment. There are freeze points and change embargos in place to give this volatile 'system ecology' a temporary 'pause' so that projects can deploy the software code into 'Prod' for production function.
- Multiple projects may be changing the configuration of these environments at the same time; occasionally, the application and hardware systems exhibit inexplicable, unpredictable behaviour, such as degradation in performance and network latency.

From my data analysis, it was evident that the volatility of the system ecology generated complex scenarios. The complexity stemmed from dynamic resource sharing and input, process and control variables of the environments, not only the changing and temporary nature of these environments. Senior management intervention was required to define priorities for projects when competition for resources was experienced. All this interaction set the stage for complex scenarios, described in Snapshot 5-3 S10 as 'repairing the spaceship when it is in flight.'

The environment in which projects deliver an outcome, a product and a service has multiple interconnections and is *bombarded by change*. The fitness landscape is unstable and sporadic, and the projects have to navigate through change while still delivering their outcomes (Ivory & Alderman 2005). These system changes also trigger process and training requirements, as well as human resource allocations with organisational units, as shown in Figure 5-1. The complexity stems *from the environment into which the product or application is developed, released into, integrated with and operationalised*.

In this research, 'environment' refers to recipient ecology comprising operational procedures, hardware systems, network hubs, data centres and existing application platforms.

Environmental complexity can be experienced in the build, test or deployment stages of a project lifecycle. At Xfone, most of the projects exhibited this type of complexity, because the company's technological landscape was very large and interconnected, had concurrent changes taking place, and yet had an inaccurate knowledge repository. Xfone did have several forums to check continuously on the current status of environments and advise the project manager about changes happening. It's ITSM, service management (change and configuration) tools did capture the changes being deployed to the environments.

However, the configuration management data did not give an accurate reflection of the system ecology.

Remington et al. discuss this type of environmental complexity, in which the environment is time-dependent and ever changing as ‘temporal complexity’ (Remington & Pollack 2007b). In my research, the environments themselves were considered in terms of which could generate complexity because of their connections and interdependencies (as shown in Figure 5-3); temporality is only one aspect of the environment.

Xfone suffers continuously because of its environmental complexity. This complexity arises out of product configuration, planning and scheduling of the environments, as well as project management process. Since management intervention is required, social complexity surfaces as each manager attempts to argue for his/her position. System engineering concepts are challenged by the emergence and complexity of operational domains; therefore new methodological frames should attempt to include social aspects (Sommerville et al. 2012).

8.5.4 Directional Complexity

Directional complexity can occur at the macro level because the project goals and objectives have not been set forth, articulated and communicated to the stakeholders. Directional complexity can also be experienced because multiple goals conflict with each other and lead to confusion in project teams.

Directional complexity can also be experienced at the micro level, in tipping point situations, because critical decisions have to be made in conditions of uncertainty that also demand instantaneous and autonomous decision-making.

Project stakeholders at Xfone experienced complex scenarios due to lack of direction or because multiple directions were given to the project team at the same time, causing confusion and leading to the project sponsor or project manager being blamed for lack of direction.

As noted in the data analysis, complexity can arise from one of these possibilities:

1. Project goals were defined and objectives were expressed in the initial stages but were changed during the course of execution, late in the project life cycle.
2. Project goals were not defined and not expressed. These types of projects are explorative projects. The PMO did not acknowledge it as an explorative project and standard governance schemes were applied.
3. The project goals were too ambitious; they could not be accomplished within the time or with the technical expertise available.
4. Key stakeholders, powerful in the organisational hierarchy, had defined multiple goals and the project team had multiple interpretations for the project goal.
5. Ownership of the project objectives was missing and indecisiveness was apparent in respect of these project objectives.

'Goal incongruity' (misalignment of goals) (factors 1-3) is definitely a factor for complexity. 'Goal ambiguity' is about the lack of clarity in a goal's definition, in the understanding and articulation of a project's objectives (factors 4-5). Project goal definition is key to successful delivery of the project (Bilassi & Tukel 1996). For directional complexity, projects will have unshared goals and goal paths, unclear meanings and hidden agendas (Saynisch 2010). This kind of complexity stems from ambiguity related to multiple possible interpretations of goals and objectives.

It is not only about lack of goals but also multiplicity of goals. *'Polytely'* means the existence of multiple objectives at the same time, often conflicting in purpose. Table 8-2 shows various possibilities about goal definition and the associated complexity experienced.

Table 8-2 Goals classified

Defined	Expressed	Complexity
Yes	Yes	Low complexity experienced
No	No	High complexity, in a process of developing the goals
Yes	No	Moderate complexity, in a process of confirming the goals
Too ambitious goals	Lack of ownership	High complexity is experienced.
Too many goals	Standpoint over decisions on project objectives	High complexity is experienced as balancing of power play is seen.

Crawford et al. argue that projects can be classified according to the degree of definition of their goals, using dimensions such as goal/objective clarity, goal/objective tangibility and project permeability (Crawford & Pollack 2004, p. 645). In the case project for this research, the goals were well defined and articulated. The project goals were continually reiterated by the PM and the Program Manager, which increased their clarity. In fact, a project can be classified based on the clarity of the goals and a strong link exists between the degree of definition of goals and their tangibility (McElroy 1996). The clarity of goal definition in the case project was one of the contributing factors to its success.

The project goals were developed, altered and continuously explored in a project mentioned in Snapshot S5-4 S01. At one stage, the organisation had to terminate (close-out) the project, as it was not able to finalise the objectives. After subjecting this project to a 'goals/methods matrix' (Turner & Cochrane 1993) to determine if goals or methods had engendered the project's complexity, I did find that the complexity could have been experienced because of a lack of goals and, consequently, a lack of articulation and communication of goals.

If project goals are tied to strategy, since strategy is all about macro-level business parameters, ambiguity increases, thus leading to complex scenarios. The classification of these types of projects can be based on goals and methods (Turner & Cochrane 1993); the Type 4 projects mentioned by Turner et al., where neither goals nor methods can be defined, are tagged as causing a higher level of complexity. Xfone uses projects as a vehicle to deliver its business strategy and engages intensively in innovation. The success of its projects has direct impact on business strategy, as noted in the Annual Operating Plans of 2010, 2011, 2012 and the Project Pipelines PMO records of 2012.

Strategy-making through transactional mode is about interaction, ongoing dialogue and learning (Fiol & Lyles 1985). The difficulty of organisational goal setting is it can lead to politically-motivated behaviour among actors (Hart 1992, p. 328). In Snapshot 5-4 S05, the political struggle in defining the project goals for the QTOC project, which was directly connected to organisational strategy, led to the failure of the project and its abrupt termination.

Building consensus is a time-consuming and costly activity and goal setting is an interactional process with diverse stakeholders. Complexity stems from a difficulty in obtaining concurrence of thought (Remington & Pollack 2007a) and clarifying the incongruity. Often, the project manager has to act as a facilitator with very little positional power and has to rely on a sponsor or users to champion the cause and obtain convergence.

At Xfone, project managers are not rewarded for conceptualising goals; rather, they can be criticised at a later stage for not getting the goals defined correctly, as noted in the digital project mentioned in Snapshot 5-4 S04.

Sponsors blame the PMs for going wrong but never accept accountability for their decisions. Dysfunctional steering committees, (as noted by MYJ in the SAP

Upgrade Project) can also lead to complex scenarios. The head of the PMO at Xfone observed, 'Our steering committees are ineffective, we suffer from indecisiveness and project managers lack power to make decision autonomously in the field. … Management is equally accountable for the delay in delivery of major projects here.'

Software development projects demand several hard decisions, and decision-makers undergo emotional states such as anxiety and loss of will to participate any further in projects. (Mullaly 2014). In the case project, the PM expressed his frustration over vendor selection decisions and suspected behind-the-scene influences in those decisions. As noted in the case project, multiple stakeholders such as Networks, OSS, Core Engineering and Billing were influencing the goal setting, skewing the objectives towards their divisional advantage. There was a certain degree of agency (Williams & Samset 2010).

In tipping point situations, decision-making is critical for the success of the project. The following snapshot is such an illustration.

Snapshot:

In the case project, a decision had to be made to install additional network nodes. The SMS alerts were not reaching customers' mobile handsets when they were inside big shopping centres, because of a failure on the part of internal signal boosters in those shopping centres. The government SLA mandates that an SMS should reach at least 97% of the population in an impacted area. However, it is not possible to predict the number of people in shopping centres during an emergency situation in an impacted area. This scenario was revealed during a later stage of system integration testing.

The following questions were debated during the steering committee meeting:

- Do we still claim we meet the government Service Level Agreement (SLA)? It was difficult to prove with any statistics.
- Do we tell the government about the scenario and explain this as an additional work that need to be managed through a change request? How will the customer react?
- Do we have moral obligations to the public to cover the SMS for people in shopping centres?
- Do we install additional network nodes, causing some delay to the project as testing had to be repeated. There is no technology proof that the problem will be solved, and still the SMS may not reach the boosters.

In stating the problems, project stakeholders bring not only the facts but also their own beliefs and ideas (Colomo-Palacios et al. 2013). Experienced project managers at Xfone believe that it would be a waste of time to focus on definition, but get to an aggregated definition of the objective − a 'satisficing index' (Simon 1969) − and go through the options that are good enough one by one and then choose one after close discussions (Fernandes & Simon 1999). There were several meetings and discussions (outside of the formal meeting sessions) to resolve the tipping-point situations. In these meetings and discussions, the concept was generated after several iterations.

The research participants expressed anxiety and frustration about the tipping point situations, which were captured and presented in the data analysis and showed that the decision-makers experienced organisational complexity, cognitive complexity and inter-relational complexity *(Boschetti et al. 2011)*.

The manifestation of complexity due to either the lack of goals or the presence of multiple goals ultimately ends up in the social side of engaging the stakeholders. Decision-making in a tipping-point situation demands an increased level of collaboration and in the case project's post-implementation review report, the government sponsor observed, '… success of this mega- project is due to its *meaningful objective, vivid articulation and frequent communication.*'

My analysis revealed that at Xfone, the projects experienced complexity due to directional factors. In the Triangulation, section 7-3, Int04 confirmed that directional complexity exists at Yfone as well.

8.5.5 Time as a factor of complexity

The project stakeholders at Xfone experienced complexity because of a sense of urgency. The urgency could have been real or perceived, but perceived urgency on projects leading to compressed timelines is noted as a predominant factor causing complex scenarios. Vendors bid for shorter time, but attempt to extend it during the execution of the project. This is Layer 1 Product complexity. It ends up in dense interaction and social complexity, echoed in Layer 3 Reflection of complexity, a category that I did not find in my literature review.

BYM agreed: 'In Xfone, most of the projects had compressed timeline, 8 to 10 weeks short of moderated timeline estimations because of business expectations. In this company, every project exhibits 'urgency'. This organisation cannot compromise on 'speed to market'. Sometimes this urgency is 'perceived urgency' rather than the real urgency in the market, as there is no empirical data behind this market urgency. Every project attempts to compete with 'urgent' indicator and passes through the portfolio selection resulting in clogged delivery pipeline.'

My data analysis revealed that projects at Xfone have perceived urgency, and create 'undue noise' to gain attention or resource allocation. The organisational value is lost because of this superficial urgency, as projects with genuine urgency could be sidelined with lower priority.

Time pressure can lead to adverse behaviour by participating agents. Once the 'time set in stone', - as mentioned in Snapshot 5-5 S02, is committed, it becomes very difficult to alter expectations. When time variances do occur, explanations have to be provided at different forums, such as steering committees and management boards, and managing expectations creates complexity.

At Xfone, the time factors leading to complex scenarios can be summarised as follows:

- The estimation process is fraught with political play. The estimates are skewed and inaccurate. Therefore, time pressure builds up on development teams resulting in task complexity.
- As part of project selling, either by the vendor or by internal divisions, the time estimates have been shorter than what is a reasonable time to deliver the project, giving management wrong expectations. Once the project execution commences, extensions to project timeframes are attempted through change requests to the project scope. These timeframe extensions pass through a governance board and are negotiated with the management, thus creating social complexity in terms of debate and discussion.
- The project scope and purpose are changed during the project execution, and time pressure is applied to attain the changed goals. Market events, such as an iPhone launch or the case project of this research could have

genuine urgency. However, this urgency creates increased coordination and communicational needs, leading to complex scenarios.

Figure 8-2, which follows, shows a repeat situation in which projects get embroiled in situations that demand management intervention, thus leading to social complexity because of time urgency.

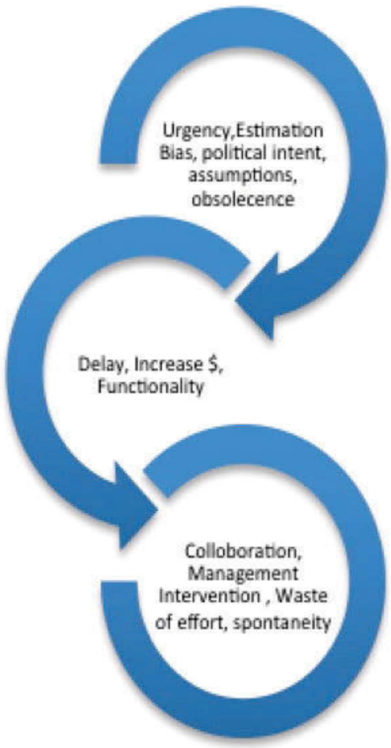


Figure 8-2 Time urgency – vicious cycle

Especially in product development projects, time pressure can lead to disastrous outcomes in terms of customer experience and regulatory outcomes (Crawford & Pollack 2004; Sheffield, Sankaran & Tim 2012).

At Xfone, product launch dates were dictated by external market conditions, thus imposing shorter development cycles (Clift & Vandenbosch 1999). To meet their performance targets, the management (marketing) applies time pressure to projects, which creates complex scenarios (Maaninen-Olsson & Müllern 2009).

In summary, at Xfone, project stakeholders have experienced complexity predominantly because of environmental (temporal), time-related and directional factors.

8.5.6 Social Complexity

The science of sociology from its initial days has always had an interest in human interaction in the society. Complexity science, especially the Complex Adaptive System concepts and metaphors, have been applied to social studies (Byrne 1998b). Modern-day enterprises have labyrinthine connections internal and external to their boundaries. As these enterprises have significant impact on our society, they have become forceful social units by themselves (Jaafari 2003).

In Snapshot 5-6, a genuine issue of scope, design and technology triggered an intensive, continued interaction and led to an impasse. This is complexity reflection in Layer 3 - Social Complexity. The approach was to ‘acknowledge the cost overruns and move forward’, but this approach was not taken; instead, at least three months of haggling and arguing took place. The players involved in this situation had their own stake and were looking after that stake. The complexity was experienced in terms of relationship with the sponsor, project manager and project teams.

The situation crossed the boundaries of ‘professional’ to ‘personal’ in the case of JYT. The people who were supposed to support the decision-making and to take ownership were silent. BXR observed, ‘Selective Participation − purposely they don’t act at times.’ The parent company’s culture of showing power and authority rather than following process, governance and listening were noted. Not only were process and governance not adopted, no one was vocal about this.

This analysis points to the existence of shadow structures in organisations, subjectively applied. Thus, the Layer 1 ‘Product’ or Layer 2 ‘Process’ reflections of complexity enter into Layer 3 ‘Social’ complexities.

The communication patterns traced as part of this research in the case project reflected the cultural diversity of the project team. When discussing tasks with the Asian teams, the PM had to be more directive and instructional in his style of communication; when communicating with the Australian teams, he had to simply set the task objectives, otherwise they would consider his approach 'instructional' and resented it. . The Asian teams were uncomfortable with the casual approach taken by the Australian teams in some of the technical discussions, as they believed the decisions had to be announced by the authority figure, rather than the facilitator. The shift in modality led to complex scenarios in project communication (Biggs 2000).

The vendor team members were aloof, and did not mingle with other team members, because they were located at the client site. However, the PM attempted to create a unified identity of the 'Zeus Project team' through several social events. There was a fine line between calling the vendor part of one team while leaving the delivery accountability to them unchanged. Because of these cultural factors, that is, perceptions about power (Pinto 1997) and politics (Wilson & Howcroft 2005), there were varying communicational needs, leading to complexity (Lacayo 2013; Marly Monteiro de 2014; Pinto & Pinto 1990).

The interactions with the government agency's team members were cautiously rehearsed, and project status updates for Xfone senior management were revised several times. Organisational culture and identity (Turner & Müller 2003) has been noted as one of the key factors in causing complexity in project interaction (Dubinskas 1993; Killen & Kjaer 2012; Latonio 2007; Marrewijk Van 2007; Seel 2000; Wilfong 2014).

In tipping point situations, if the interaction is not within the expected social norm, a digression in communication was taken; the communication issues became a dominant theme in these conversations more than the problem itself, as noted in Snapshot 6-31. Klein observes 'the internal differentiation of groups, organisations or companies implies different degrees of social performance' (Klein 2012, p. 8). The interaction generates complexity, because the social factors such as culture, identity and language constitute it (Small & Walker 2012). Social complexity manifests itself in these interactions.

Social complexity has a very large spectrum of attributes. The lenses provide a *window to peep into* social complexity as it happens. The following section discusses social complexity in detail through the application of the proposed lenses of Context, Connectedness (Coupling and Cohesion) and Adaptive-Reflexive Response.

8.6 Complexity revealed through lenses

There was a door to which I found no key: There was the veil through which I might not see.

- Omar Khayyam

The proposed framework, Complexity Framework for Projects (CFP), consists of three social lenses: 1) Context, 2) Connectedness and 3) Adaptive-Reflexive Response, plus a typology of complexity factors named as technical, structural, directional, environmental, temporal, time-pressure, and a construct called tipping point. The lenses were developed as an outcome of the data analysis of the case project (section 6.5). This section presents the main argument for the suitability of these lenses *(fit for purpose)* to comprehend inherent complexity in projects.

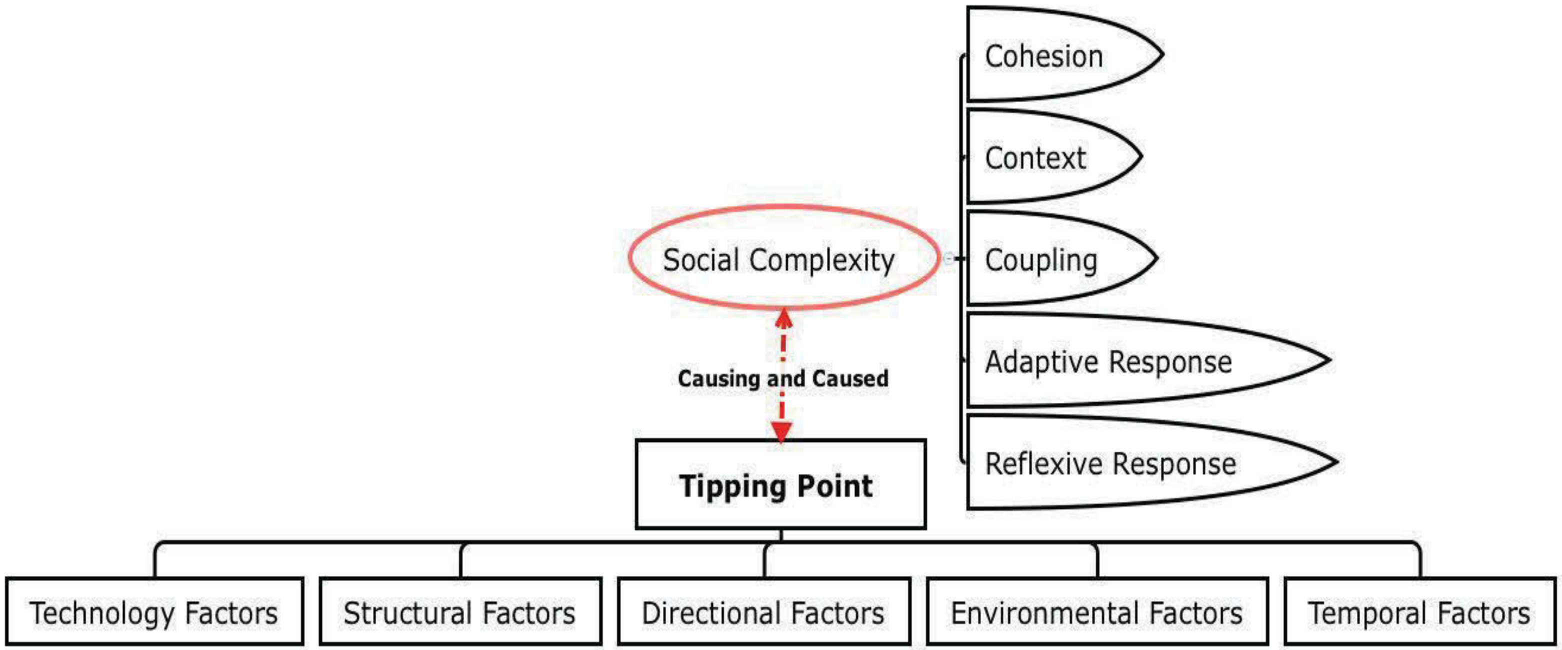


Figure 8-3 Complexity Factors leading to Social Complexity

8.6.1 Interaction as pivotal aspects of a project

Project outcomes are derived through interaction, whatever the underpinning complexity factors are. Figure 8-3 shows that the underlying complexity factors culminate in social complexity. Therefore a project management framework should consider the interactions as a pivotal construct (Klein 2010). To categorise *interactions we have to understand their boundaries*. The boundary for a project is a virtual boundary within an organisation because, for example, Xfone has a matrix organisational structure. This boundary enables us to classify the interaction within its environment. Interaction in projects has three elements: purpose, relationship and action. Since the project boundary is 'virtual', the demarcation in purpose, relationship and action is often fudged, meaning blurred and vague.

The purpose is not only the project purpose that was set at the initial stages of the project, but, at micro level, the project participants continue to define the purpose during the interaction. The action is not only about the task of doing; the project participants carry out specific actions in light of their own purpose. Relationship is not only the formal relationship defined by the roles mentioned in the project charter; there is strong evidence of existing and developing relationships among the project participants themselves. Therefore, project interaction engenders complexity (Garrety & Badham 2000; Jensen, Johansson & Löfström 2006; Roberts et al. 2004)

Therefore, a project interaction has a primary purpose to create an outcome to meet the project objectives and it can be classified within an organisation. This classified interaction sets a boundary for a project. The proposed lenses of Context, Connectedness (Cohesion and Coupling) and Adaptive-Reflexive Response should provide a meaningful interpretation of the complexity in project interactions.

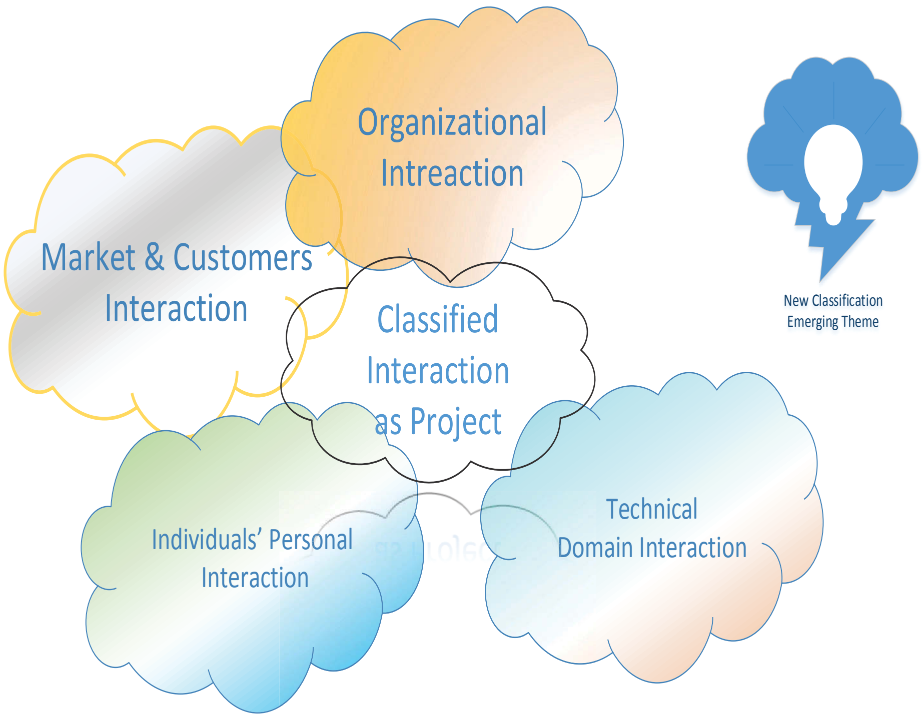


Figure 8-4 Interaction as pivotal aspect of project

8.6.2 Recursion in Project Interaction

Recursive communication in tipping points generates complexity. The concept of autopoiesis (Maturana 1980; Varela 1974) is that a systems' components generate their own elements through interaction in a recursive cycle. Language plays a role in recursive communication *(Graham & McKenna 2000)*.

Social systems use communications as their particular mode of autopoietic reproduction. Their elements are communications that are recursively produced and reproduced by a network of communications and that cannot exist outside of such a network (Luhmann 1995b).

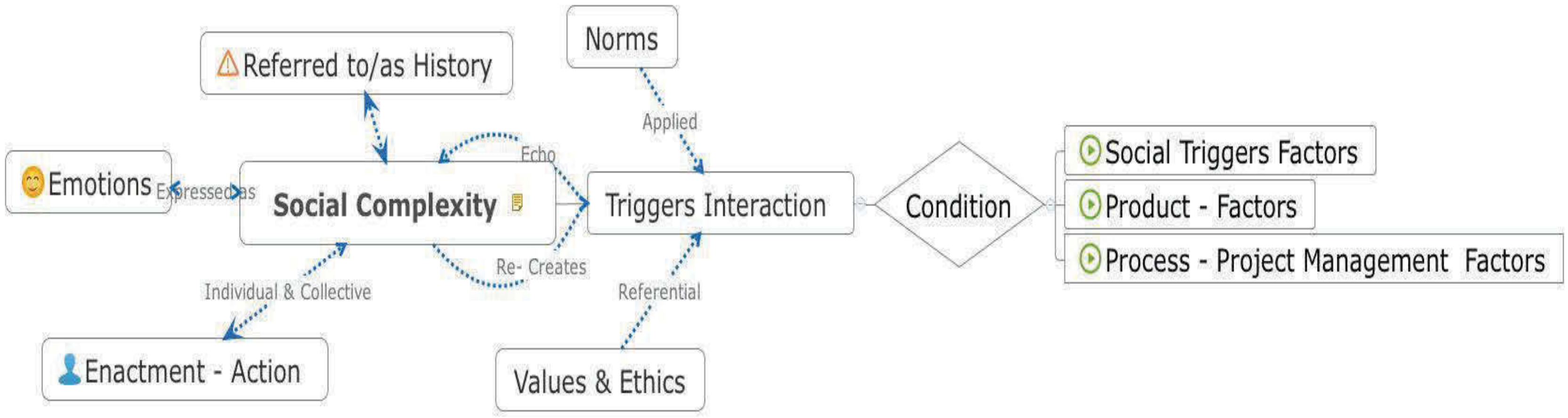


Figure 8-5 Recursion

The above diagram Figure 8-5 shows how complexity factors create a condition, a tipping point situation, which invokes intensive interaction. The interactions refer to norms, organisational policies, values and ethics. As noted in this research, the project interaction generates a cycle of action and reaction recursively.

At the tipping point, the recursive cycle is visible. The duration of the tipping point is based on the criticality of the impact and its urgency in relation to achieving the outcome and reaching closure of the recursion. The recursive cycles of interaction transpiring in a tipping point can be short or long. The end of a recursive cycle is achieved when an outcome has been agreed through collaboration and mutuality. While recording the tipping points in the case project, an attempt was made to measure how long the recursive cycle lasts before it settles to normalcy *(PAU)*.

For example, in the case project, a request was placed by the Finance General Manager for an explanation as to why the program budget had not considered past expenditure on the project. This request at steering committee level triggered several sessions of financial analysis, memo preparation, meetings, written communication and ruffled relationships within the team. The cycle of communication was closed when the Networks General Manager acknowledged the error, stated the commitment to absorb the increase in cost and issued a formal memo. As noted, the sense of urgency created high frequency of recursions and instantaneous interaction and autonomy of the agents in making the choices were key contributors to project complexity.

The CRPR refers to this as ‘the process of action and interaction’ whereby the project outcomes are achieved through a loop of recursion, there is uncertainty associated with this loop, which causes complexity.

8.6.3 Teleology for this framework

The proposed framework has a strong philosophical leaning towards Kant and Mead in terms of looking at a ‘whole’ and constructionism. It has a basis in the well-founded theoretical concepts of Complex Adaptive Systems (CAS), Social System Theory (Luhmann), Complex Responsive Process of Power Relating Theory (CRPR) (Stacey), and Theory of Sense Making (Weick).

The framework has adopted both *System* and *Process* perspectives**.** System perspective is applied to classify the complexity factors. In this perspective, a project is treated as a Complex Adaptive System (CAS) with interacting elements comprising information, infrastructure, software applications and human beings; the interaction is a form of techno-socio interaction.

Some components have system boundaries, whilst humans involved in these system interactions do not have definitive boundaries. The possible system states for inanimate objects can be defined and pre-formulated but for the humans involved in the interaction, a definitive state cannot be formulated or listed exhaustively. Therefore, the prediction of techno-socio interaction can never be accurate when using system perspective.

By contrast, with the process approach, the focus is on the flow of stimulus and the dynamic stages of meaning creation, sense making, purpose, intent, response generation, relay and organisation of communication. It provides an opportunity to trace multi-dimensional, differential states over the trajectory of a project. The process perspective is applied to develop the social lenses.

In order to understand the human interaction, a clear definition of causal frameworks (teleology) is required. As noted in the literature review, Stacey has listed five teleological definitions:

- Natural law Teleology
- Rationalistic Teleology
- Formative Teleology
- Adaptionist Teleology and
- Transformative Teleology (Stacey 2000a, p. 15).

The difference between each teleological definition is about the argument as to whether the ‘state in transition’ is known or unknown, or is a co-created state. In formative teleology, an external super-agent is defining the elements, boundaries and interaction patterns with hidden states being unfolded due to interaction. In transformative teleology, spontaneous, autonomous interaction co-creates a new state without an external agent imposing the rules of interaction.

This research has a view of formative teleology in treating the project as self-regulative, autopoietic complex adaptive social systems, and leaning towards transformative teleology in treating the project as a process of classified interaction.

The following sections discuss the lenses and the effect of applying them to a tipping point situation in the case project.

8.6.4 Context

Gossiping is essential for survival because the complex mechanics of social interactions are constantly changing, so we have to make sense of this ever-shifting social terrain.

- Michio Kaku (The Future of the Mind)

A simple dictionary definition of context is 'backdrop', 'panoramic view of the surroundings', 'giving meaning to the event through language', and 'a picture collectively painted'. Chambers Dictionary defines contexture as 'the process or manner of weaving together, structure and fabric.' In cognitive psychology the concept of constructive cognition describes context as 'the influence of environmental factors on one's perception of a stimulus.'

Context is also about individual and collective perspectives. It is about a 'social world' collectively created through pathways generated by interactions (Garrety & Badham 2000). Context is a narrative painted together, the underpinning complexity can be understood by going through these narratives (Browning & Boude's 2005). Context refers to language, symbols, metaphors and notions used in project interaction.

Context connects the history and sets the preface to a current event in progress as a continuously developing extension of the interaction in time and space. Context when applied at macro level, for the whole project, depicts a panoramic picture; connecting the past history of individuals, organisational units and current state. Context when applied at micro level exposes the backdrop for a transpiring event. The way a project deals with contextual, relational, and interactional uncertainty determines the probability of its success (Jensen, Johansson & Löfström 2006) .

When 'context' as a lens is applied to a tipping point situation in a project, it unveils that there are multi-dimensional, multi-threaded themes in play. The cast of multiple themes is what brings complexity to the project situations. The multiple perspectives, whether transparent or hidden in its characteristics, create complexity in terms of uncertainty and choice of decisions.

8.6.4.1 Multiple Contexts

The case project Snapshot 6-1 had multiple contexts: a) network division owning the project, b) exclusion of the project manager, c) conflict with the network division project manager purely because of professional jealousy, d) time constraints set by the government 'prior to next fire season', and e) a muddied vendor selection process.

In the case project, contexts helped to bind and bring together all the participants by creating shared meaning and values to a central theme, namely, 'this is a community project to save life', even though diverse organisations involved had their own vested interests. The context that this project was 'a community project' superseded the differences of individual project team members. Even though there were arguments and debate, most of the time it was because of their intent to improve the quality of the solution.

In the case project, the context that organisational branding (reputation) was at stake led to increased attention from the Xfone management. The past history of projects leaving loose ends for Operations at Xfone led to several arguments, setting a context of ensuring operational requirements to meet government expectations on SLAs.

There were contexts consciously created, induced and propagated, like ‘community project’, which become anchoring themes over a period of time. There were contexts that were manufactured by a domineering group for their own advantage, for example to justify a project and request funding. As noted, there were some contexts that were created dynamically over an interaction, and deposited for future reference as a ‘memory’ with the group or the individual.

When MxP had an argument with QxQ about the character set in the network configuration, it was a clash of two power bases, the formal power of the Network PM versus the power of knowledge of the technology expert. This incident created a contextual decision for the project that all technology decisions had to be made only by the technology experts. Taking advantage of this conflict, the PM created a virtual identity – a *‘shadow context’* − for the Network PM as an ‘enemy within’, deflecting all negative feelings at all times, and unjustifiably, towards the Network PM.

This context was deposited in group memory, to be re-used again and again in all interactions as a continuum of the past. The project managers assumed a responsibility to create a fusion between contradicting contexts through deliberation and facilitation.

In order to comprehend social complexity, it is important to understand why and how a position is taken, a point of view is created, a theme is echoed, and a move is corroborated individually or collectively during project interactions.

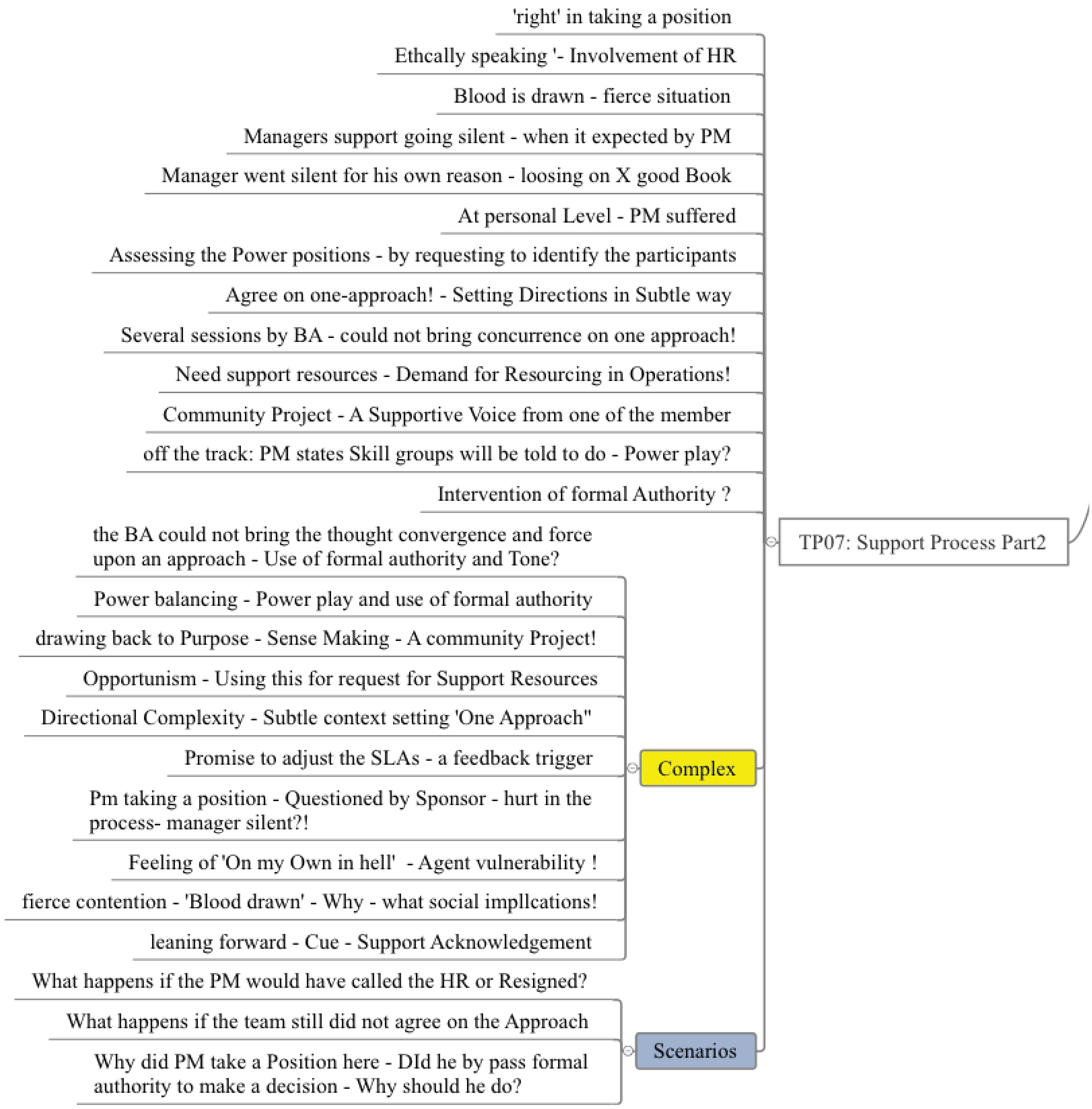


Figure 8-6 Analysis of Snapshot 6-22: Support process – multiple contexts

In Snapshot 6-22, a meeting to discuss the support process was captured as a tipping point and analysed. The above diagram (Figure 8-6) shows several themes emerged out of the discussion *that created context for further interaction*. The themes trace the context in which the decisions around SLA were being made. It also shows the metaphorical language in use ‘on my own in hell, blood is drawn…’ etc. The PM was facing an onslaught from another manager for exceeding the measures and penetrating into the ‘personal’ space from the ‘work-role’ space. The PM lost the support of his manager in that session (enactment). The context of impractical government SLAs and the expectations of the support division for additional resources all contributed to this emotionally charged situation.

The unpredictability of the outcomes were easily noticed. The power relationship between the PM’s manager and the support manager was constraining, at least to the outcome expected by the PM.

The interaction between the project participants passed through a process of relating; for example, the power relating in the above snapshot analysis is shown by the words, ‘the support groups will be told to do’, which itself is a process of choosing, intending and acting. In Stacey’s own words, ‘No one steps out of it, arranges it and operates onto it or use it, for there is no simply objectified it’ (Stacey 2000a, p. 187).

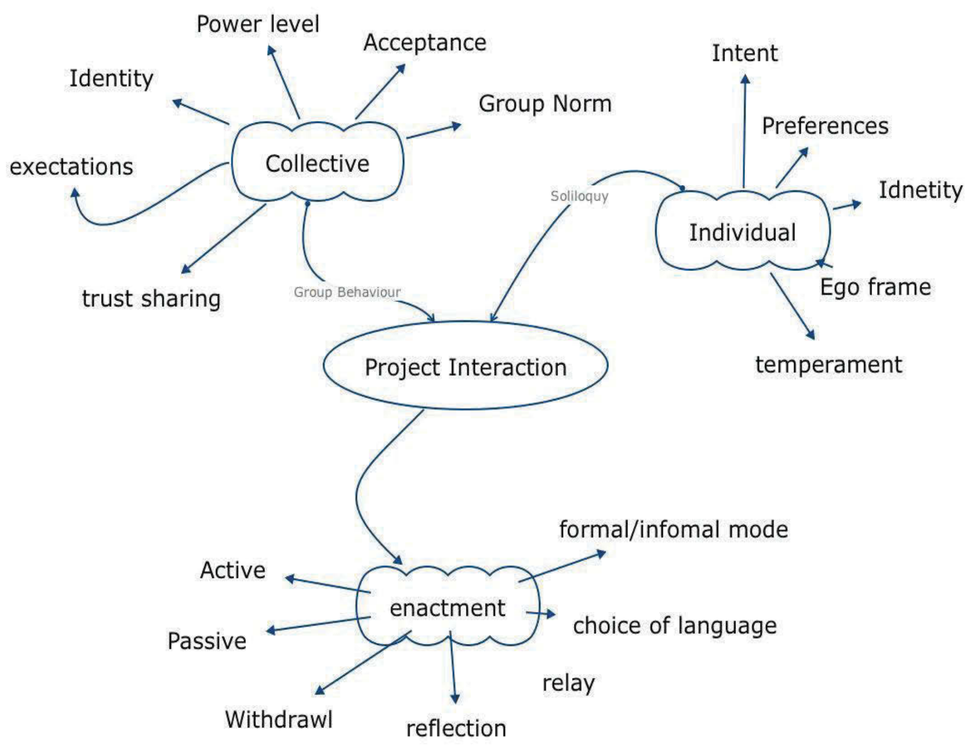


Figure 8-7 Perspectives

There are at least three realms (Figure 8-7) that an individual traverses during the interaction - individual, collective and enactment. The organisational context is the foundation for building shared meaning (Daft & Weick 1984.). Shared meaning is the frame of reference for the taken-for-granted knowledge, which enables participants to act and interpret others' actions (Bjørn & Ngwenyama 2009). Multiple contexts are created because of the differentiation in individual and collective realms or misinterpretation of the enactment.

In private conversation and public conversation as explained by CRPR (Stacey 1996), individuals hold a conversation in their mind, and then they have another version of the conversation with 'others'; while holding this public conversation they 'enact' what they think would be suitable for the context. For example, in the case project Snapshot_6_24, the manager remained silent rather than react to the situation. People have a clear conception of the appropriateness of communicating specific messages in different social situations; that is, the nature of the communication to be made determines the choice of situation in which to communicate (Furnham 1982, p. 44).

By simple inquiry of what contexts are in play, what themes are emerging and identifying the tipping point situations, we can discern the underpinning complexity. Project stakeholders cannot be involved in the coordination process until and unless they build the *common ground moment by moment*, thereby– co-creating a context (Clark & Brennan 1991).

8.6.4.2 Symbols and Cues

Symbolic interaction is underpinned by the insight that in a conversation of gestures and symbols, a person responds not only to what another person says or does but also to the meaning or the significance of what the other says or does (Argyle, Furnham & Graham 1981). Anecdotes (snapshots) I have captured and analysed as parts of this research, show how important is the use of symbols, objects, and gestures in human interaction as they occur during a project.

For example, a picture of 'mountaineers on a peak' was hanging in the project war room, giving an impression that the team was focusing on work at peak. Satirical notes, hints, cues (beer currency, paddling on the Narrebeen) and metaphors used during project interaction bear evidence to this perspective.

8.6.4.3 Self and Social

In the project world, the interaction is characterised by 'I', 'Me' and 'Self'. The narrations use the notions of I, Me and Self in statements such as 'I attempted to do', 'It happened to me', 'This is myself', 'I could not do anything other than suffering'.

For Mead, the ‘self’ is an outcome of the interaction. It is evident from the narrations of research participants, for example, JXT’s suicide attempt, at least mentioning it metaphorically, over a project situation because of his inability to change an imposed human condition. It is evident that the project stakeholders related to themselves and defined their identity through the interactions taking place in that project.

The narrations show that the project stakeholders often jumped from one perspective to another. It is also evident that they assign great importance to how others, such as the project team, the sponsor, their manager and their colleagues, perceived their contribution at a given point in time. This continued interaction defined who they were, what they stood for and what their stake was in that situation.

It is through the interaction that an individual concept about his ‘Self’ arises. For example, QXQ commented, ‘After every meeting I go to with the PM, I feel we have achieved something, professionally it is satisfying, it is because of the respect and engaged conversations.’

This concept in turn guides and influences the behaviour of this person. The role definition in a project charter is a simplified version of formality, but as the project progresses, each individual’s behaviour is based on the acceptance of, and their perception about, what others think of/about them.

Social systems are about processing meaning; self-referential systems and decisions are a special type of communication and the essence of the organisation. Social systems are a network of communication that produces further communication. If a project is to be considered as a social system then decision-making as a special type of communication is the essence of a project.

According to Luhmann (1995), the social order is created between action and experience. Meaning is produced by the differences between actuality and possibility; it cannot be simply comprehended by language alone.

Communication is not a simple transfer of information but shared actualisation of meaning. Meaning generates 'reciprocal coordination of expectations among participants'. Meaning provides an option for choice and is a variation from the current system state. Action is attributed to the network level, mutually constructed as a result of meaning.

Luhmann emphasised society was a network of interactions between the carriers who perform the respective cycles. The individual is left outside of the social system.

The isolation of the individual has been critiqued by (Habermas 1987) Evolving of the self in relation to 'others', and placing 'others' in front for acceptance in tipping point situations engenders social complexity.

If the self is eclipsed by the belief of an individual about how 'others' view them, my next question was, how do these so called connections contribute to complexity in projects?

8.6.5 Connectedness – Cohesion & Coupling

The more complex the network is, the more complex its pattern of interconnections, the more resilient it will be.

– Capra

In this research, the research participants pointed to stakeholder relationships as one of the areas in which they frequently experienced complexity. The data analysis of project events confirmed that the relationships among the stakeholders − whether pre-existing, developing, formal and/or informal − were pivotal to the interactions as they brought out societal complexity.

The term ‘stakeholder management’ and ‘team management’ are didactic, mechanistic approaches originating in formative teleology. In the real field, there is neither a formal control power vested in the role of a project manager, nor a centralised power vested in the role of a project sponsor to rule over all stakeholders to receive an expected outcome. The Project Manager or Project Sponsor or Architect is not a super-agent, externally located, and moving the sources through a ‘code or script’ (moronic!). A project manager, sponsor or architect is part of the project stakeholders’ community, an evolving tribe. Through interaction they influence the stakeholders for an outcome. During this interaction he/she also undergoes change by himself/herself.

In tipping-point situations, only lobbying and influence through discussion and debate is possible. Thus, the power of decision-making rests with the networks. Therefore it is important to understand these aspects of networks.

The relationships among the stakeholders can be mapped and analysed over the period of the project using the social network analysis and graphs theory (Butts 2001; Tichy, Tushman & Fombrun 1979) in conjunction with Complex Adaptive Systems (CAS) concepts (Lansing 2003; Monostori & Ueda 2006).

The relationship between stakeholders should have specific characteristics. By using these characteristics, it should be possible to expose the underpinning complexity in a project (Miller 2008). Cohesion and Coupling are two such unique characteristics of the stakeholder relationship.

8.6.5.1 Cohesion

In social psychology, intensive research focusing on the factors of cohesion or the effect of cohesion has been carried out; however, there is no agreed single definition of cohesion. Perceived cohesion is defined as 'the extent to which individual group members feel "stuck to" as part of a particular social group' (Bollen & Hoyl 1990).

Mullen and Copper (1994) examined the long-held notion that cohesion is composed of interpersonal attraction, group pride and task commitment (Mullen & Copper 1994). A definition of team cohesiveness is a group's tendency to stay united under a common goal (Carron 1982). Cohesion is considered as one of the small group phenomena, related to task performance (Bakeman & Robert 1975). A critical group variable is attributed to interpersonal communication performance, maintenance of the group solidarity and expected conformance. Cohesion has also been studied in relation to job complexity and performance (Man & Simon 2003).

One simple measurement technique for cohesion is to note concurrence of thought or action in a tipping point situation. By tracking who sides with whom or who supports whom in these tipping point situations, an instance of cohesion can be recorded. These instances are a representation of a type of bond and togetherness, and an endorsement of each other's position.

Individual cohesion to one another forms a group identity, which can be noticed as a pattern over a period of time, as shown in Figure 6-8. The project relationship is an interaction that exists between two project actors and transmits resources (e.g. information, knowledge) between project actors to achieve the project's goals. The relationship can have a number of attributes (e.g. levels of trust, respect associated with it) and is directional (Brookes et al. 2006).

This research showed that a clan-like, territorial bond is exhibited because of the informal rather than formal relationship defined by the project charter. Such a relationship is beyond the boundaries of formal teams. The social capital refers to 'the aggregate of resources embedded within, available through, and derived from, the network of relationships possessed by an individual or organisation (Inkpen & Tsang 2004).

In the case project, the social capital exploited by the PM to gain the network resources and computers, manage government schedule expectations and change requests were evidence to this effect. 'Social ties are a leading parameter for high performance in information systems development project (Lee, Park & Lee 2015). Such relationships are influential in decision-making, diverting the course of the project, and creating an image for the project.

When the cohesion lens was applied to tipping point situations., patterns were traced in cohesion graphs. These patterns indicated the emergence of a temporal structure, an 'affiliate group', volatile in nature, changing from time to time and created because of the power relations.

The pattern clearly indicated multiple groups were either working together collaboratively or not cooperating with each other, intrinsically causing restraint. The agency created the temporal structure, not enforced by any formal mandate of the organisation, and it was not permanent in nature. This temporal cohesive force caused complex project interaction, which was social in nature.

8.6.5.2 Coupling

Coupling is about interdependence, a trust-sharing connection not necessarily only for the project in the current situation but also possibly for a future situation. Unique patterns of group dynamics among the stakeholders emerge over the period of the project. Coupling is a transactional relationship - a favour-seeking, favour- granting relationship. Trust is bartered with futuristic expectations. The project organisation simply creates a formal relationship based on task dependency, but that task dependency is only one aspect.

Coupling in this research refers to the 'organically developed implicit dependency' traced among the stakeholders, not necessarily formal dependency created by the projects team's role and responsibility matrix (RACI) or project charter. Several connections of this type (implicit dependencies) form a network. These networks are called private influencing networks (PINS) in this research. These network connections are referred to as shadow networks as they are informal and beyond the boundaries of formal definition of project stakeholders. Flexibility and project complexity have been studied in respect to team coupling (McComb, Green & Dale 2007). For example, in this case project, when Pi said, 'I will use my connections to get this done,' he is banking upon the PIN (see coupling diagram Figure 6-7). Collective feedback and cue sharing takes place.

The narration from MxK read:

> *'Every day at 5.30 they close the door, it is their rendezvous, starting from lunch plan to next day meeting preparation and all types of stories are shared there. It is their way of reflecting upon the day as well as telling the PM what can be done next. Occasionally they get pizzas and beer, swear at each other, crack sexy jokes, even the girls are joining in this…. It is good that they work together like this but, if you don't belong to them, they will hound you'.*

In reflecting upon this narrative, I recorded in my memo, 'How is this not a tryst resembling a ritual in hunter-gatherer society, joining to share their experiences of the hunt and as well as passing the cue for the next one. Is this not social? How come this bond cannot be deciphered at the beginning of the project? It is because the relationships have evolved over a period of time and still forming.'

In recording the coupling instances within the case project team, it was evident that shadow relationships were influencing the decision-making, as shown in Figure 6-7. It was critical for the agents to understand the shadow connections in order to provide an apt response and achieve a better outcome. At times, the shadow connections could not be traced. They were temporarily built, as noted in the relationship between the business program manager and the project manager on fund management.

The inability to trace the shadow connections is one of the reasons for dynamic construction/deconstruction of various positions; they need to test each other's viewpoint for acceptance and acknowledgement, endorsement and enablement leading to emergent scenarios wherein complexity is experienced.

The statements below collected from different participants show the logic of these statements: ‘I can’t act solo,’ ‘I don’t know who’s who in the zoo yet,’ (Xfone used animal images for advertisements, therefore derogatorily referred to as a zoo), ‘I can do a litmus test of my thoughts; if we get onto the same page, well and good, otherwise got to adjust.’

It was evident that failure to understand the cohesion and coupling among the stakeholders meant isolation or an undesirable outcome, as noted in the case of MxP’s social exclusion by the project team. These relationships are time-bound, relevant to the context and they reflect mutuality, they can also extend into future transactions in expectation of reciprocity. The agents therefore can experience complexity due to connectedness in terms of cohesion and coupling among the stakeholders.

Power is an aspect of human relations and a pattern emerges among people due to their power relations (Elias & Scottson 1994) (Elias refers to this as figuration). Power favours some and not others and groups are formed and sustained in the process of inclusion and exclusion. The power relationship is constraining and enabling at the same time. The group identity ‘We’ is inseparable from individual identity ‘I’ (Stacey & Griffin 2005, p. 17).

The formal power base is dissipated and due to continuous interaction a new power base emerges that is outside of the project organisation and to which decisions are referred. Higher degrees of coupling and cohesion are ingredients of this power base. In the case project, the power base, shown below, is different from the formal power base of the project organisation as drawn up in the project charter.

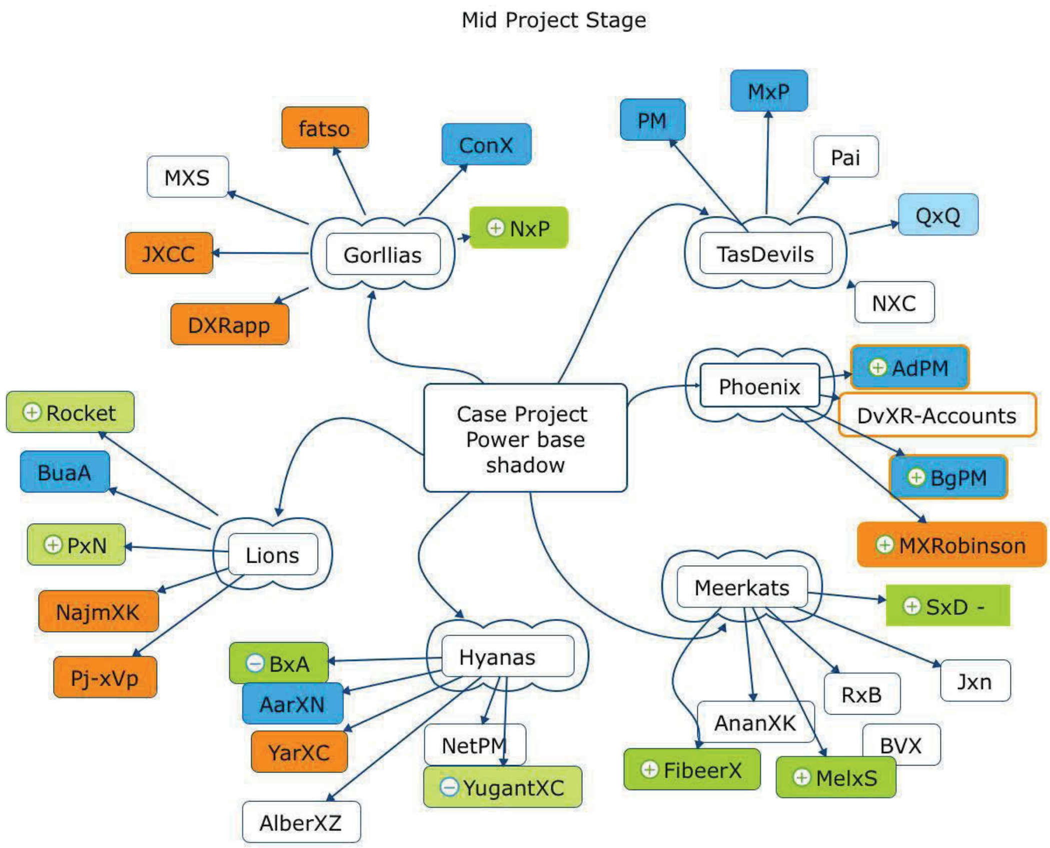


Figure 8-8: Power Relations

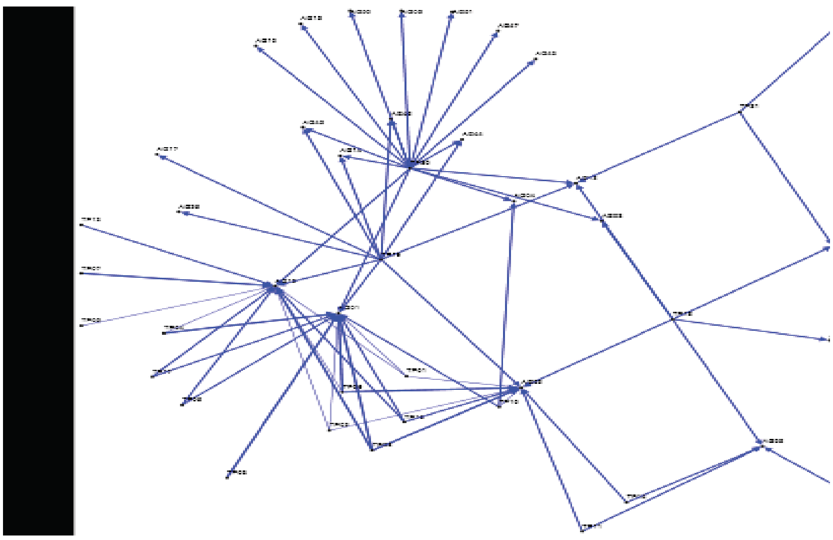
Figure 8-8 shows the formal power (blue indicators) positions created by the project charter. However, other people (green indicators), the emergent power base, also played a key role, influencing a project outcome. The red indicators were the external agents, who influenced the project unexpectedly. Overall, this diagram shows power dissipation and dynamic power attribution, emanating to and from the *hubs* and *power brokers* that also feature.

Cohesion unravelled the thought concurrence among the agents in critical decision-making, whilst coupling brought out the informal, unspoken interdependence in tipping point situations. The CRPR defines this as *'action of relating'* and *'process of power relating, enable and constrain action.'*

Group behaviour, such as amplification/de-amplification of a message, undue escalations to higher management, social exclusion as a punitive measure, fault-finding in every deliverable, attributing failure to a single person, expectation of conformance to the group norms, image creation and condescending behaviour were all noted as a result of cohesion and coupling in several project events studied during this research. Social complexity was evinced in the case project as a concomitant effect of these group behaviours.

8.6.5.3 Concentric regions of interaction

This research also recorded the stakeholders who participated in each tipping point. It is noticeable that the 'concentric regions of interaction' occurred because multiple stakeholders were involved in multiple tipping points at the same time (in social network analysis this is referred to as the cluster co-efficient for events.



Agents present (Reference to Figure 6-9) at tipping points in a concurrent fashion (NODEXL)

If tipping points are considered as strange attractors of a complex system (the project), then these concentric regions as shown in the above diagram are a manifestation of a self-balancing act, an ecological response by this complex system. This buttresses my argument that connectedness in terms of cohesion and coupling is a suitable lens for comprehending complexity The facilitation is part of the PM's or architect's role. As noted in the diagram, the clustering co-efficient for both these roles is very high. Thus, they experience complexity in terms of information flow, intensity, frequency, locus of attention and engagement of stakeholders.

My observation is that the number of tipping points and involvement of stakeholders are signs of brewing complexity in a project. If an extremely high number of tipping points occur with high frequency, involving many stakeholders, especially the private influencing networks (PINS), then it indicates a higher degree of complexity. A higher degree of complexity is generated because of the volume, type of interaction and associated group behaviour. This is an alarming sign for a project, as complexity at this level could lead to chaos and disruption.

8.6.6 Adaptive Response

Space and time is the framework within which the mind is constrained to construct its experience of reality.

− Immanuel Kant

The following sections discuss the Adaptive and Reflexive Response lenses by citing examples from the case project.

8.6.6.1 Self-Adjustment

An agent's ability to adapt (adjust or realign) to a context and influence through networks creates complexity. The theory of a Complex Adaptive System (CAS) as a multi-agent system with seven basic elements of aggregation, non-linearity, flow and diversity, tagging, and internal models provides an explanation of how adaptability of agents can create complexity (Holland 1992). Environmental conditions change due to agents' interactions as they compete for, or cooperate with, the same resources or to achieve a given goal. This, in turn, changes the behaviour of the agents themselves. If an individual changes his/her views dynamically, this change brings complexity to the project situation. While the tipping point situation itself is a complex scenario due to other multiple factors, no one can predict 'change of position', as the interaction is still forming and continuing to be formed.

In CAS, agents interact according to a set of rules; new rules can be generated due to interactions and a newly found state, or a hidden state revealed because of the interaction. Ongoing variety in the rules is generated through random mutation of the rules.

The most remarkable phenomenon exhibited by CAS is the emergence of highly-structured collective behaviour (a form of self-organisation) over time by the interaction of simple subsystems, usually without any centralised control (Monostori & Ueda 2006).

A key concept taken from the principles of CAS for this research is that a simple interaction between stakeholders changes the project landscape, and they adapt to the situation. This adaptability is subjective and induces complexity (Kautz 2012).

Adaptive response is the ability to change position to suit the context in a tipping point situation. Two interactional patterns were tracked in this research. One was to formulate a position prior to interaction and attempt to lobby for this position through stakeholders; the other was to formulate a position during an interaction and adjust according to collective opinion.

Adaptive behaviour also influences the environment itself, at times triggering changes in policies, procedures and exchange of people (e.g., expulsion of agents as happened with DX Test Manager in Snapshot 6-32). These participants shape the project while wading through conflict and controversy. Adaptive response demands self-control and a search for supportive sources through conscious enactment. (Snapshot 6-24)

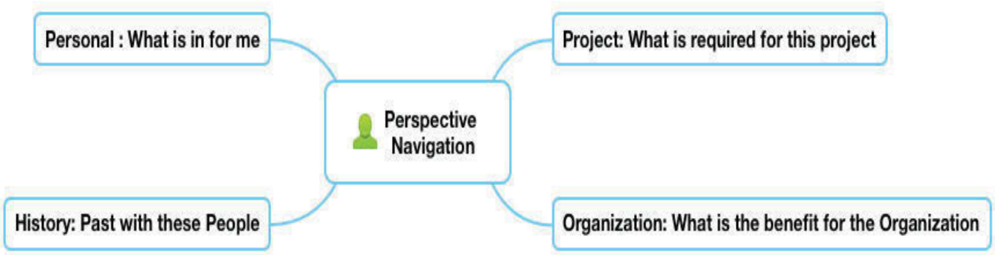


Figure 8-9: Perspective Navigation

As shown in Figure 8-9, project participants undergo a perspective analysis in their mind before enacting a position, orienting themselves in any one of the perspectives ranging from personal, group history or project to organisational. In tipping point situations, the focus has to remain towards the final objectives of the project, while receiving the cues from the field on current situations and responding to them. A disconnect from the current scenario has to occur, otherwise the project manager may be so engrossed in myriad details of the current situation as not to be aware that the project is changing course. Disconnecting from a current situation while at the same time being connected to the end objectives creates a certain level of cognitive complexity. The project manager experiences a dilemma-like state of action-inaction, connection-disconnection – a token representation of complexity.

An adaptive response is generated because of this perspective analysis carried out at *'that moment of interaction'*. Adaptive response is a mechanism of self-organisation within the network. For example, in the case project, when cost discussions were taking place, the PM used the BPgM's intervention to advise his manager that increased testing resources could not be allocated to the project as it would have an impact on the project budget.

The manager, ConX, adapted to this position upon the intervention of the BgPM after some haggling. In another instance, the Government changed its position on progress status reporting after some negotiation with all the other telecommunication carriers.

This research recorded the construction or deconstruction of various positions in tipping points over a period of time (t0 to tn) by applying the Adaptive Response lens. For example, in Figure 8-10 the construction and deconstruction of various positions for a tipping point (snapshot 6-26) has been captured in bubble charts against a timeline.

Mutuality, in terms of long-term or short-term benefit sharing, is one of the reasons for adaptive behaviour. Project participants adapt to a developing context at a given point in time. Adaptation is seen here as incremental responses to developing contexts. As soon as a tipping point situation is encountered, the resolution is attempted through dialogue, debate and facilitated conversations.

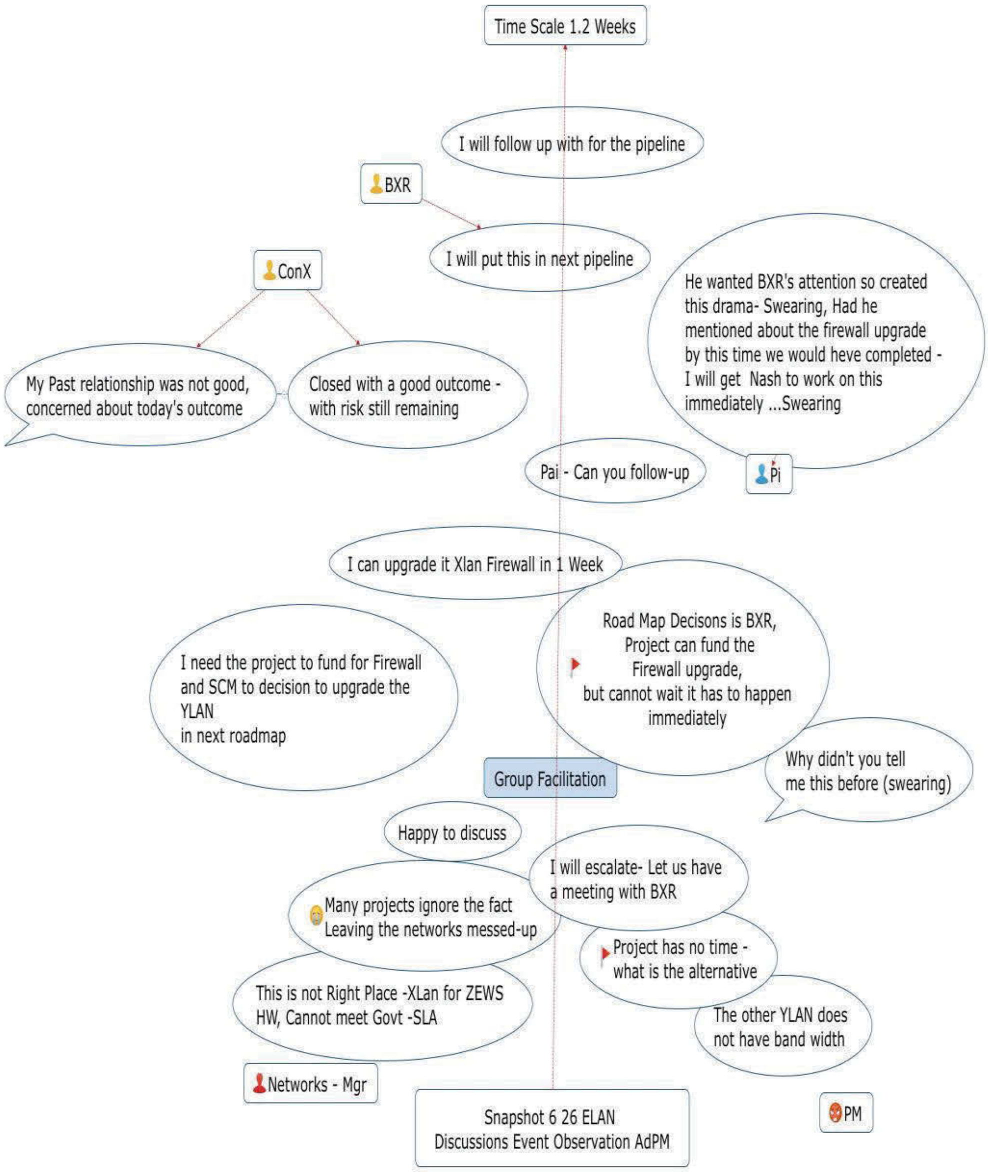


Figure 8-10 Construction and changing of Position

Figure 8-10 captures the positions taken by project participants over a period of time, showing adaptive response and mutual adjustments. It also shows sharing and turns taking, while assessing the benefits, occurring in tipping point situations.

8.6.7 Reflexive Response

Follow effective action with quiet reflection. From the quiet reflection will come even more effective action.

-Peter Drucker

Meaning as a unit of operation adds a reflexive layer to human interaction. Meaning creation is done at the receiving end, without any regard to the participants. The response can be immediate or time-phased.

Reflexive response in a project tipping point situation is expected behaviour. 'We will get back to you later' is a commonplace response from stakeholders. The project participants receive the stimulus, assess the situation, collect more cues, relay to their network and then trigger an action.

The stakeholders pass through a process of sense-making in a gradual and time-phased manner. In the case project, a decision by the project manager to terminate the testing manager (DX) is an example of a reflexive response over the team behaviour.

It is extensively argued in sociology literature that people not only react to symbols, language and gestures but attempt to interpret the events by asking, 'What is going on here?' in their mind and then acting upon their interpretation. Karl Weick called this aspect of interpretation with time lapse and reflexivity as 'sense-making' (Weick 1995).

People pass through different stages in their mind dynamically when they encounter a situation. A circumstance happens, individuals organise the circumstance into a coherent structure for interpretation. Different stakeholders interpret a project event in different fashion and their response depends upon this interpretation. Weick's theory consists of enactment, selection and retention. The extended version of his theory discusses retrospective sense-making, loose coupling and partial inclusion. He explains the preparatory stages of sense-making as identity, construction, retrospection, enactment, socialisation, continuation, extracted cues and plausibility.

Let me illustrate this with an example from the case project:

```
Identity: MXS -I am a project coordinator, PM told me to keep an eye on the vendor activity, I have to work towards the project goals, not simply looking into admin work. I am also an important member of this project. DXS appreciates my work.
```

Noticing an event and reflecting upon it

```
Retrospection: I heard something from NXN team that the Servers in sunshine have failed in CPU configuration and Testing cannot be carried out next week. NXN is working with the OEM Vendor.
```

Construction of future state

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Enactment: The following day, MXS meets with the QZN and describes what she heard and then both went to the PM and described the scenario.

First reaction from the PM was why did NXN inform me in yesterday's status meeting. I will enquire about this today afternoon. The conversation ended with some remarks on AYZ.

Social: MXS and QZN went and met Pi and asked him to do ping tests for the sunshine servers. Pi
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confirmed there is no response from the systems and captured the systems log. QZN: we have collected the evidence now, and let us send it to the PM, in case if he requires for his discussions with AYZ. MXS thought NXN hides many things and not transparent with us.

Continuation: PM asked NXN about the issue, NXN stated, no need to worry HP had fixed it. The argument turned around transparency. NXN asked his team who said to the client about the CPU issue of [sunshine.] sunshine?

Extract Cues: NXN: It should be the MXS as she is the one who is always in the project room. Next time any of our discussions find a room around. We have to maintain the customer sensitivity.

Plausibility: NXN meets with DXS and complains, the PM has to slow down let me manage my field, I feel he is getting involved too much in my space, without right information creates noise.

Sense-making provides an explanation of why people act outside of the organisation. In a project situation, as noted in the case project, most of the time the participants acted outside their defined roles and responsibilities. Since tipping point situations are like a crisis situation, the concept of sense-making (Weick 1988) provides a good explanation of project participants' behaviour (Nathan 2004).

Sense-making is about shared meaning creation and enactment. Project participants execute an action out of many possible actions; they also contemplate their choice of words, expression, language and tone. As opposed to Senge's Model (Senge 1999), there is no reference to stored mental schema, but a soliloquy, then action carried out as a continuum to their thoughts through discussion with other stakeholders. In a project, a continuously changing environment acts like stimuli to this reflexive process, triggering interaction, and the project outcomes are influenced by these reflections (Weick 1979).

I recorded several narratives with a chain of counter narratives from the project participants mentioned in the first narrative and called it a thread. In each thread, I attempted to trace the reflexivity in thought and action; it became evident that this pattern of sense-making was natural to human interaction within the project as a social unit. There was definitely unpredictability about the action, as it depended upon construction of a world in gradual stages through interaction. The stages were: noticing a change to their environment, cue collection, interpretation through shared meaning, verification and enactment (Daft & Weick 1984.). The project participants experienced these stages randomly and this randomness generated project complexity.

8.7 Summary

If we can really understand the problem, the answer will come out of it, because the answer is not separate from the problem.

- Jiddu Krishnamurti

This research has demonstrated that *underpinning* social complexity can be unveiled by applying lenses to project tipping point events. Therefore, a simple way of exposing social complexity in a project is first to trace the tipping points and then apply the lenses to these tipping points.

This research has covered complexity emerging in personal/individual self, network level behaviour, and interactional-response generation aspects. The process of communication itself is complex, especially when high-stake situations are encountered. Even though it would be an extreme claim to state every form of human communication is complex, given a context of high stake, the communicative process appears to have unpredictability and emergence.

Project participants correlate their past to the present they are experiencing currently (Cicmil 2006; Cicmil et al. 2006), as shown in the data: 'I had confronted this person vehemently in the past, worried about today's outcome.' By subjecting the voice data and text data (notes) into coding techniques, I traced a pattern of communication in which participants took turns building their positions through deliberation. Classifying the themes into patterns of communication generated through narratives as Private/Public and Legitimate/Shadow, and noting about how memories of past can be connected into present, Stacey argues that turn-taking and turn-making occurs in human interaction (Stacey 2001).

During the interaction, they adapt to the developing context because they have gained insights and start appreciating the other's view or seeing a dimension they had not considered earlier. An example in this project was when the government commissioner got involved in SLA discussions, he started to appreciate the telecom carriers' view. Meaning arises out of social interaction through which it also gets modified (Cicmil 2009, p. 39).

Applying the principles of CRPR, CAS and other complexity theory concepts, key points to be considered from this research are that project outcomes are driven through communicative interactions, organised as patterned themes, responsive and self-referential, triggering joint action that has unpredictable outcomes. Projects can be understood as evolving around a particular kind of patterned conversation and power-relating among project participants; cooperative project work can be understood as a consequence of ongoing communicative interaction, and the process of relating is emerging, hence self-organising (Cicmil et al. 2009, p. 64).

It is to be noted that the social interaction at a tipping point situation, where the agents have the highest stake, individually or collectively, is context-sensitive, and adaptive and reflexive in nature. The interaction is carried out through private influencing networks (PIN), more informal than formal relationships, and dynamically constructed throughout the trajectory of the project (Antoniadis, Edum-Fotwe & Thorpe 2011).

In a nutshell, contexts are co-created as perpetual construction. Interactions contain multiple themes, which are bounced to be validated, acknowledged, endorsed and acted upon. Supportive and/or opposing actions through power relationships and close-knit networks generate project outcomes.

The behaviour of these forming and formed networks is incomprehensible and unpredictable. The stakeholders display adaptive behaviour to match emerging contexts. Time-phased reflexivity brings out complexity due to unpredictability.

In order to comprehend social complexity in projects, in particular the tipping point situations, these lenses can be applied to unravel the intricacies of the interaction, collision of minds, and movements in time and space.

I have summarised the basis of lenses on these theoretical concepts. In the next chapter, I summarise the conclusions from this thesis, its contributions to theory, practice, limitations and future directions for this research.

Table 8-3 Theoretical basis and exposure

Lens	Symbolic Interaction (SST)	CAS	CRPR	Sense Making	Towards Exposing to…
Context: A 'cognitive bubble' they co-create through interaction.	The world they build through interaction - I, Me and Self and Others. Communications as key. Professional image, definition of Self-Stake.	Co-Creation. Mutuality. Adjustments. Emergence, Simple Interactions, Initial Conditions, Strange Attractors.	Construction & deconstruction, dynamic change adjustments. Collective meaning creation. Conversations, Dialogue and Expressions	Collective & Individual Sense-Making	Complexity emerging out of subjectivity, interpretation.
Cohesion: 'stick-to' factor.	Preferences made, 'stick-to' effect created. Communicational needs preferences and group acceptance levels.	Bonds and Relationships. Ecology.	Enabling Relationship Private/public conversations	Interpretations – Meaning creation	Complexity emerging out of group influences on decision-making and resources management.
Coupling – Futuristic Transactional relationship		Bonds and Connections, emergence in pattern of communication	Power Relating - Future expectations. Private Influencing Networks.	Meaning Creation. Definition of power Relationship. Purpose.	Complexity emerging because of group behaviour – Agency creation.
Adaptive	Response	Adaptive behaviour,	Adaptive response to	Enactment.	Complexity

Response – ability to change	Development Individual and Collective – based on understanding of ‘communication’	self-organisations, adjustments, power balancing. Tagging Memory.	fit to the context. Co-creation, construction-deconstruction, formed-forming, perpetual development. Position taking, chance giving.	Developing response based on the sense they have created. Event Interpretation.	emerging out of uncertainty about the choice of decision change in positions / decisions
Reflexive Response – Time-phased reflection	Symbols, Cues and Metaphors, - meme as stimulus generation.	Reflected to Others movements, expectations and contexts.	Iterations, chain of events, recursion until matter is sorted out.	Time Phased Response. Plausibility	

9 Conclusion

There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things.

- Machiavelli

9.1 Restatement of the research problem

As a project manager for the past twenty years and more, I have delivered a few large projects in multiple industries. I do believe that the social aspect is one of the pivotal reasons for IT project failures, and this was confirmed by the literature review. At Xfone, one of the largest telecommunication organisations in Australia and where I was employed as a program manager, I observed that the project failure rate was very high (greater than 38%) despite the application of standard project management methodology. In its attempts to reduce this failure rate, Xfone applied more rigid governance; however, it failed to understand the dynamic nature of the evolving technologies and changing business world in telecommunications in Australia. One of the reasons frequently expressed by the project managers was that the Xfone projects had become too complex.

Professional discussions with my colleagues and PMO always revolved around one predominant theme – 'project complexity'. The practitioners felt that they experienced complexity because of stakeholder interaction, as it brought group behaviour in the organisation. This in turn related to the social dimension that the PMO failed to acknowledge in appraising the projects. I was keen to know what they meant by 'complexity' and how human interaction (stakeholder interaction) generated complexity.

Between 2006 and 2010, several articles were published in the International Journal of Project Management under the title 'Rethinking Project Management'. These articles asked researchers to look into complexity and consider projects as social processes; this, too, increased my curiosity to explore social complexity in projects.

A critical view of existing project management methodologies by academic researchers and practitioners in these articles pointed out that the normative approach and command-control mechanisms were antiquated because of the continuously changing business world. It also became apparent from the literature review that the application of complexity theory, metaphors and principles was an emerging concept in project management. There were no comprehensive frameworks specifically using lenses that included social aspects that could be applied to understand inherent complexity in IT projects. Prominent researchers called for building theory from the practice to closely reflect the actuality of the project environment.

Initial discussions with my fellow practitioners confirmed that an interpretive framework to understand the complexity experienced by the project stakeholder would be very helpful to them and also make a valuable contribution to emerging theories of project management.

My research problem, therefore, was to explore the complexity in IT projects in terms of factors and investigate how project interactions engendered social complexity as experienced by project stakeholders at Xfone. As part of this research, I also decided to propose a set of lenses through which to provide a meaningful interpretation of social complexity in projects, to link my findings to the theory.

9.2 Restatement of the research questions

The research questions were:

Q1: What are the factors believed to be causing complexity in IT projects?
Q2: How does human interaction engender social complexity in IT projects?

In search of an answer to my first research question, namely, 'what are the factors believed to be causing complexity in IT projects?' this research has identified numerous factors believed by the practitioners to cause complexity at Xfone, and classified them based on previously published taxonomy of project complexity factors.

In attempting to find an answer for the second research question, 'How does human interaction engender social complexity in IT projects?' this research has provided sufficient evidence to conclude that project interaction creates social complexity and it can be captured 'as it happens' through a set of proposed lenses.

9.3 Key contributions of this research based on the evidence

The research was conducted in three stages using qualitative research methodology within an interpretivist-constructionist paradigm. The practitioner's view of complexity was elicited through interviews as part of Stage 1 and the analysis was presented in Chapter 4. The practitioner's definition of complexity is based on uncertainty, unprecedented events and ambiguity. From the practitioner's viewpoint, complexity is stated as a 'felt and experienced abstraction'. It was believed that types of project events/scenarios/situations that are decision-making points, conflicts and impasse in projects could be considered as complex. This research tagged these events as tipping points.

In Chapter 5, I presented the complexity factors at Xfone and categorised them into technical, structural, environmental, directional and social. An attempt was made to check frequently experienced complexity factors by the project stakeholders at Xfone.

It was noted that there could be a possible correlation between perception of complexity and variables such as professional experience, subject knowledge and positions in the organisation. This research did not delve into these variables in detail.

In Chapter 6, I used a large case project to explore social complexity in project interactions through the lenses of Context, Connectedness (Cohesion & Coupling) and Adaptive-Reflexive Response. The case project provided ample opportunity to trace the interactions, record the tipping point situations and analyse the interpretation of the events using these lenses.

Chapter 7 presented the results of a triangulation exercise carried out through a focus group and interviews with senior project executives in another telecom. The triangulation process helped to confirm the primary findings about the directional, environmental and social complexity experienced by the Xfone project participants.

Chapter 8 discussed the complexity factors and the social complexity generated because of project interaction. In classifying the complexity factors, this research revealed that most of the time complexity in IT projects was due to environmental factors because of their volatile nature and to directional factors because of multiple direction or lack of direction. This research also established time pressure as a complexity factor. References were drawn from Luhmann's Theory of social systems (TSS) and Stacey's complex responsive process of power relating.

The research found evidence to conclude that social complexity in managing projects occurs due to multi-dimensional meaning and multiple interpretations. In the management of projects, contexts are dynamically created through intensive collaboration, construction and deconstruction of positions, wherein the project stakeholders display ownership, power relating and enactment of their position. When applied to tipping point situations, The 'Context' lens displayed the unfolding contexts in project events.

The 'Coupling' lens showed the forming and changing transactional relationships within large communities in the organisation, noted in this research as private influencing network (PINS), created beyond the formal relationships described by a project charter. By cohesion, ('sticking together'), the project participants formed groups, dynamically aligning with each other, supporting or opposing each other through power relations.

Connections among project stakeholders in which they demonstrated clan-like behaviour and their adaptive responses to changing events were also evidenced. History also played a role: agents (stakeholders) collected and replayed the gamut of their experience and tacit knowledge, sometimes spanning the time boundaries from past to present.

The agents changed their position to fit into the context. Time-phased reflexive responses were traced to show emergence in project situations. By obtaining necessary theoretical support from strands of complexity theory such as complex adaptive systems and complex responsive process of power relating principles, theory of sense making and theory of social systems, this research proposes that the lenses are meaningful instruments to interpret social complexity in project interactions.

Applying a level of 'offset' to balance the bias usually attributed to qualitative research like this, as a researcher I believe that the framework can be applied to other organisations in diverse industries.

In essence, the complexity framework for projects (CFP)™ consists of Context, Connectedness (cohesion and coupling), Adaptive/Reflexive Response lenses and a construct called a Tipping Point. A process is suggested whereby tipping point situations can be traced and the lenses applied onto the tipping point situations to expose the underpinning complexity.

Table 9-1 Research finding summary

Research Area	Literature	Research findings
IT project reasons for failure – root cause	The literature has documented the factors for IT projects failures and presented the root cause as power, politics, communication etc. in terms of social dimension but did not find a way to address these factors through project management frameworks.	This research considered 'inherent complexity' as a root cause for failure and asserted any normative remedial measures in isolation to address the root cause for failures do not guarantee project success; instead, a systemic-holistic approach should be adopted.
Definition of complexity by the practitioners.	The literature has documented definition of complexity based on uncertainty and ambiguity. The literature mentions dynamic and structural complexity.	This research found that a practitioner's definition is based on perception and experience. It confirms that uncertainty and unprecedentedness (including novelty) as characteristics of complexity. During the data analysis, both dynamic and structural forms were noted.

Correlation between level of perception of complexity and variables such as experience, subject matter expertise and position in organisation.	The literature does not provide any detailed observation on perceived levels of complexity and the variables a) professional experience, b) subject matter expertise and c) position in an organisation.	As a general observation, it was recorded that the research participants believed there were correlations between perception of complexity and experience, subject matter expertise and their position in an organisation.
Emotions	The literature does not mention any correlations between complexity in projects and emotional states experienced by project participants in complex scenarios.	This research recorded various emotions experienced by research participants when they were undergoing complex scenarios, but did not pursue any further investigation, as noted in the thesis.
Manifestation of complexity	The literature does not distinguish between factors of complexity and manifestation of complexity.	Practitioners believed complexity factors could be dormant, combination of several complexity factors could have a concomitant effect and could manifest in project interaction. Tracking the tipping points and mapping the involvement of stakeholders in each of the

		tipping points (a point-in-time observation), patterns were documented and these showed the concentric cycles in the pattern as the epicentre of complexity.
Should we consider a project or only a scenario as complex?	The literature treats projects in general as complex. Complexity is not specifically attributed to a particular type of project scenario.	A specific type of scenario is considered complex in this research and called a tipping point. A clear distinction is noted between a project's usual activity and tipping point situations.
Classification of complexity factors.	The literature has established several types of classifications of complexity factors in projects. It also points out a lack of direction for directional complexity.	Research applied Remington & Pollack's (2007) model of complexity factor classification. However, this research has shown that the environments themselves, not only their temporality (as mentioned by Remington & Pollack), are complex. This research found from the data analysis that time pressure is a factor of complexity. In relation to directional complexity, it was observed that

		not only lack of direction but also multiple directions and conflicting goals often lead to complex scenarios in a project (polytely). This research illustrated that directional complexity surfaces in project goal-setting activity and at micro level in tipping point situations because of decision-making. At Xfone, the project stakeholders experience environmental, directional, time pressure and social complexity **more frequently** than technical and structural complexity. This could be different in other industries.
Integrated Framework	The frameworks presented in the literature either focus on complexity factors or simply map certain characteristics of complexity theory metaphors to projects. There are no frameworks that integrate	This research has illustrated a viewpoint that whatever the inherent complexity factors may be, they result in human interaction and social complexity is manifested in these interactions. Hence, the research proposes a set of lenses

	both views, that is, complexity factors and characteristics of complexity such as autopoesis.	through which to view the social complexity. A form of recursion in the interaction until it settles back has been observed in tipping point situations.
Social Complexity – How it is engendered.	Theories such as Theory of Social Systems , Complex Process of Power Relating (CRPR), and Theory of Sense-making have bestowed clear explanation for social complexity in human interactions.	Applying these concepts to the data, the proposed lenses explain the following: **Context:** focuses on concurrence of thought, dynamic co-creation of viewpoints in project situations. **Connectedness**: Cohesion and Coupling help us to understand the group dynamics and evolving tribe-like identities in project scenarios. Cohesion graphs illustrate private influencing networks (PINS) active in projects and network behaviour such as accentuation and undue escalations were also observed.

		Adaptive-Reflexive Response: Adjustments to contexts and decision-making through collaboration and facilitation were illustrated.

9.4 Contributions to Theory

An attempt has been made in this research to apply the theory of social Systems (TSS), Complex Responsive Process of Power Relating (CRPR), and Sense Making theories in an integrated fashion to project management. The focus shifted from normative parameters to corroborating the power relations, building resonance and fostering synergy. The framework considered the project as a social process, therefore covered the areas neglected in normative models, and made inroads into including social dimensions into project management Theories.

The use of lenses is an innovative approach to studying complexity. The lenses as theoretical constructs can lead to further research and development of interaction theory. As observed by the focus group, it is possible to extending this framework by adding other social lenses.

This research has challenged the reductionist and normative forms of existing methodologies on philosophical grounds, by adopting a 'whole picture' and by pointing out the dynamic construction of positions in project events. The framework is agnostic to any standard project management methodologies, as it does not promote a mechanistic or regimented approach. However, it is complementary and an augmentation to existing methodologies.

9.5 Contributions to practice

As this complexity framework for project (CFP) has been developed from interviews with and narratives from project stakeholders, it has close relevance to the field; it guides our thinking and draws attention to critical emergent themes.

The complexity framework for project (CFP) can be applied to a project at any stage, from concept to closure stage. The framework can act as a predictive framework during the concept stage by focusing primarily on tracing static complexity factors. It can also act as an investigative framework during the midcourse or closure stage of a project.

If CFP were applied midcourse or at closure stage, the tipping point situations would be the actuality of events that occurred in the project. The social lenses would enable a project manager to look for themes around context. Practitioners can use the lenses to trace rigidity, agility, flexibility, level of rationalisation, frequency of deliberations, quality of facilitations, reflectiveness, and mindfulness in project events. The lenses will also help stakeholders to trace tribalism, cohesive forces and shadow networks (referred in this research as private influencing networks (PINs) and their influence on decision-making. In fact, the framework advocates for improved collaboration among all stakeholders at organisational level.

9.6 Contributions to Policy/Organisational adaptation

From the evidence collected in this study, the following recommendations could be made to practitioners and the industry:

- Classify projects based on structural complexity and introduce flexibility in project governance.
- Organisations need to understand fluidity in the course of projects; therefore, they should also recognise tipping point situations.
- Project objectives and goals should be articulated and communicated upfront, therefore hold sense-making sessions at the start of the project.
- Acknowledge 'agency' in project decision-making and promote consensus-building techniques.
- Acknowledge multiplicity in 'meaning' to stated goals and facilitate context creation through conscious effort in projects.
- Trace the evolution of groups through cohesion and attempt to balance the cohesive force for better outcomes.
- Trace shadow networks (PINs) at organisational level, create power balance and attempt to foster relationships for better outcomes.
- Acknowledge the possibility of adaptive and reflexive responses by the stakeholders through deliberation and facilitation.
- The measurements for project success, project manager, sponsor, and architects' success should consider the social dimensions within the specific project context.

- Introduce ‘catalytic agents’ to increase bonding, synergy and collaboration.
- Organisations need to create conducive environment/thriving ecology where mutual trust, knowledge sharing, free flowing communication, transparency and power balance are fostered.
- Organisations can balance power dissipation, power generation, individual-versus-collective identity dynamically within the context, and nurture connections for active agency creation.
- Organisations can echo value sets and codify behavioural factors that generate outcomes into organisational ‘memes’ (patterns and feedback loops).

9.7 Contributions to Methodology

In IT Project management research, mostly quantitative, survey based research paradigms have been applied. By applying qualitative research paradigm, this research also has used a single case study, interviews and observation data to get rich data of the actuality in project management. Narrative analysis, context/thematic analysis coupled with grounded theory based codification techniques have been used to analyse the data, resulting in deep analysis of multiple perspectives. This research contributes to the literature on qualitative research in its application to IT projects.

9.8 Bias

In this research, there are five areas where bias could possibly have affected the findings:

1. My experience as a project manager could have influenced the data collection and recording and the interpretation of the events. The researcher’s bias could have been present when identifying a complexity factor, selecting tipping point situations, and tracing the complexity through lenses. The interpretivist-constructionist research paradigm chosen for this research acknowledges this type of bias, as the researcher is part and parcel of the research.
2. English is not my first language. This could have affected the way I have reported the narratives and project events.
3. The research participants found this research to be an opportunity to share

their experiences ('vent') and do so in their narrations; they could have reported their wishful thinking rather than factual information of what was experienced or happening in the field.

4. This research has not adequately looked for 'anti-thesis' negative aspects to the lenses or classification of the complexity factors.
5. There is subjectivity in acknowledging a situation as a tipping point. There is no factual metric to determine a situation as a tipping point; only the researcher's subjective experience was applied to tag a tipping point situation as such.
6. The classification of complexity is subjective to the individual, in regards to their experience, role, age and gender. This research did not delve into details about the association of these factors to the participants' views about complexity.

In order to minimise bias, an attempt was made in Stage 1 to feed the research findings back to the research participants. The focus group session also attempted to cross-validate and triangulate the research findings.

This research has proposed a framework from the field, and from the lived experiences of the project stakeholders, by collecting and analysing their narrations and project events. It is therefore subject to their bias.

9.9 Limitations

The specificity of the telecommunication industry is also a limiting factor, and the framework should be re-examined for its applicability to other industries. Since the research was conducted in only one organisation, cross-validation was required with other industries to generalise the framework. The subjectivity in defining the lenses should be acknowledged as a limitation.

Applicability of this framework should be tested in less dynamic organisations such as government institutions, and hyper dynamic organisations such as product development houses before it can be generalised.

9.10 Future Directions

This research could be extended in the following areas:

1. The complexity factors in several other industries could be collected into a database and the predominant factors by industry (i.e., a cross-industry comparison) published for easy reference for project planning.
2. The definition of complexity can be further explored differentiating complicated and complex.
3. Social theories such as Bruno Latour's actor network theory, David Body's critical narrative inquiry, Ian Feinberg's position on the relevance of social sciences can be used to interpret social complexity in projects.
4. Authors like Gregory Bateson, Heinz von Förster, Paul Watzlawick, and Mike Jackson's work on systems paradigms can be explored to interpret project complexity.
5. Future research can be carried out to link the complexity factors to Success and Failure of the projects.
6. The attributes of the complexity factors and their associations to other parameters such as gender, age and organisational status could be researched.

7. Future research can be carried out to rank the complexity factors and trace the rationale behind this ranking.
8. Agent-based models (e.g., mathematical/statistical) using interactional patterns could be developed as predictive software tools for large-scale projects.
9. Specific aspects of complexity, such as cognitive complexity, perception on complexity, emotional effects because of complexity, group-dynamics and social behaviour in complex situations, could be researched and theories developed.
10. More relevant lenses could be developed through field-based research.

9.11 Concluding Remarks

Everyone has been made for some particular work, and the desire for that work has been put in every heart.

- Rumi

I believe this interpretive framework will be useful for practitioners to gain insights into the underpinning complexity of IT projects. I hope other researchers will expand the lenses and the research findings, generalising them to make them applicable to other industries.

I also hope that in the near future more researchers will develop project management theory/methodology based on theories of complexity and theories of social interactions.

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Glossary

11 Glossary

11.1 Abbreviations

Term	Definition
AdPM	Advisory PM - a Consultant
Agile	Project Management Methodology
AIPM	Australian Institute of Project Management
AOP	Annual Operating Plan
BOT	Behaviour Over Time
CAS	Complex Adaptive Systems
CEO	Chief Executive Officer
CFP	Complexity Framework for Project
CFU	Customer Facing Units
CIO	Chief Information Officer
COO	Chief Operating Officer
CPS	Complex Problem Solving
CRPR	Complex Responsive Process of Power Relating
DAB	Design and Build School
DCS	Data Control System
EPSRC	Engineering and Physical Sciences Research Council
ERP	Enterprise Resource Planning Application
GM	General Manager
HREC	Human Research Ethics Committee
HW	Hardware
ICCPM	International Centre for Complex Project Management
ICT	Information and Communication Technology
IRONP	International Research Network on Organizing by Projects
ISD	Information Systems Development
IT	Information Technology
ITIL	IT Service Management Framework
ITSM	Service Management System
KPI	Key Performance Index
LAN	Local Area Network
LBS	Location Based Alert System
MSP	Managing Successful Program - Certification
NDA	Non-Disclosure Agreement
NPS	Net Promoter Score
NTCP	A Complexity Model: N-Novelty, T-Technology, C-

	Complexity, P-Pace
OGC	Office of Government Commerce - UK
OSS	Operational
PAU	Project As Usual Situation
PCR	Project Change Request
PgM	Program Manager
PGM	Program Manager
PM	Project Manager
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PMO	Program Management office
PMP	Project Management Professional Certification from PMI
PO	Purchase Order
POC	Proof of Concept
PRINCE2	Project Management Methodology - Project in Control Environment
QTOC	A project code name
RACI	Responsibility Matrix
RFI	Request for Information
RPM	Rethinking Project Management
SCM	Steering Committee
SLA	Service Level Agreement
TMO	Complexity Model
TSS	Theory of Social Systems
SVN	Source Code Management Tool
SW	Software
T&M	Time and Material
UML	Unified Modelling Language
UTS	University of Technology
VP	Vice President - Executive Manager

11.2 Codes / Terms

Code	Description
ar(n)	Action to Reaction Cycle
Autopoesis	Self-adjusting systems because of emergence
Bleeding edge	Innovative technology
cf(n)	Complexity Factor
Co-Opt	Competing and cooperating with each other at the same time
Compression of Estimates	Reducing cost in estimates
Concept Gate	Project Governance Gate
Crashing Schedule	Reducing time duration in project schedule.
ef	Echo of complexity
Enactment	Consciously acting or playing a role
F&D	Feasibility and Definition - Project Governance Gate
fe	Feelings / Emotions
Network Cluster	Number of neighbouring connections to a node in network
PIN	Private Influencing Network
Polytely	Existence of Multiple Objectives and purposes
R	Relationship
Sense Making	Weick model of deriving meaning out of events and conversations
Teleology	Causal Framework.
TP(n)	Tipping Point tag.
Turf battles	Divisional conflicts

11.3 Qualitative Techniques

Qualitative Analysis Technique	Type of Data Item	Purpose
Open Coding & Axial Coding	Interview data, Focus group discussion data, PMO Project Records.	Detect complexity factors, rank complexity factors. Tag tipping points, trace action to reaction cycles in events.
Narrative Analysis / Context Analysis	Narratives, Self Reflections, project events	Find new themes, Trace social complexity, trace intensity of interactions, to list multiple perspectives, (XMIND – mind mapping tool was extensively used to document).

Appendices

12 APPENDICES

12.1 RPM – Rethinking Project Management

Rethinking Project Management (EPSRC Network 2004-2006)

Directions for Future Research

IMPORTANT NOTE: the word 'Towards' means to enhance the 'from' position rather than to discard it.

Theory ABOUT Practice

Direction 1

The Lifecycle Model of Projects and PM ➡	Theories of the Complexity of Projects and PM
From: the simple lifecycle-based models of projects, as the dominant model of projects and project management. And **from**: the (often unexamined) assumption that the lifecycle model *is* (assumed to be) the actual 'terrain' (i.e. the actual reality 'out there' in the world).	**Towards**: the development of new models and theories which recognise and illuminate the *complexity* of projects and project management, at all levels. And **towards**: new models & theories which are explicitly presented as only *partial* theories of the complex 'terrain'.

Implication

The need for *multiple images* to inform and guide action at all levels in the management of projects, rather than just the classical lifecycle model of project management, as *the* main guide to action, (with all its codified knowledge and techniques). Note: theories ABOUT practice can also be used as theories FOR practice.

Theory FOR Practice

Direction 2

Projects as Instrumental Processes ➡	Projects as Social Processes
From: the instrumental lifecycle image of projects as a linear sequence of tasks to be performed on an objective entity 'out there', using codified knowledge, procedures and techniques, and based on an image of projects as temporary apolitical production processes.	**Towards**: concepts and images which focus on social interaction among people, illuminating: the flux of events and human action, and the framing of projects (and the profession) within an array of social agenda, practices, stakeholder relations, politics and power.

Direction 3

Product Creation as the Prime Focus ➡	Value Creation as the Prime Focus
From: concepts and methodologies which focus on: *product creation* - the temporary production, development, or improvement of a physical product, system or facility etc - and monitored and controlled against specification (quality), cost and time.	**Towards:** concepts and frameworks which focus on: *value creation* as the prime focus of projects, programmes and portfolios. Note however: 'value' and 'benefit' as having multiple meanings linked to different purposes: organisational and individual.

Direction 4

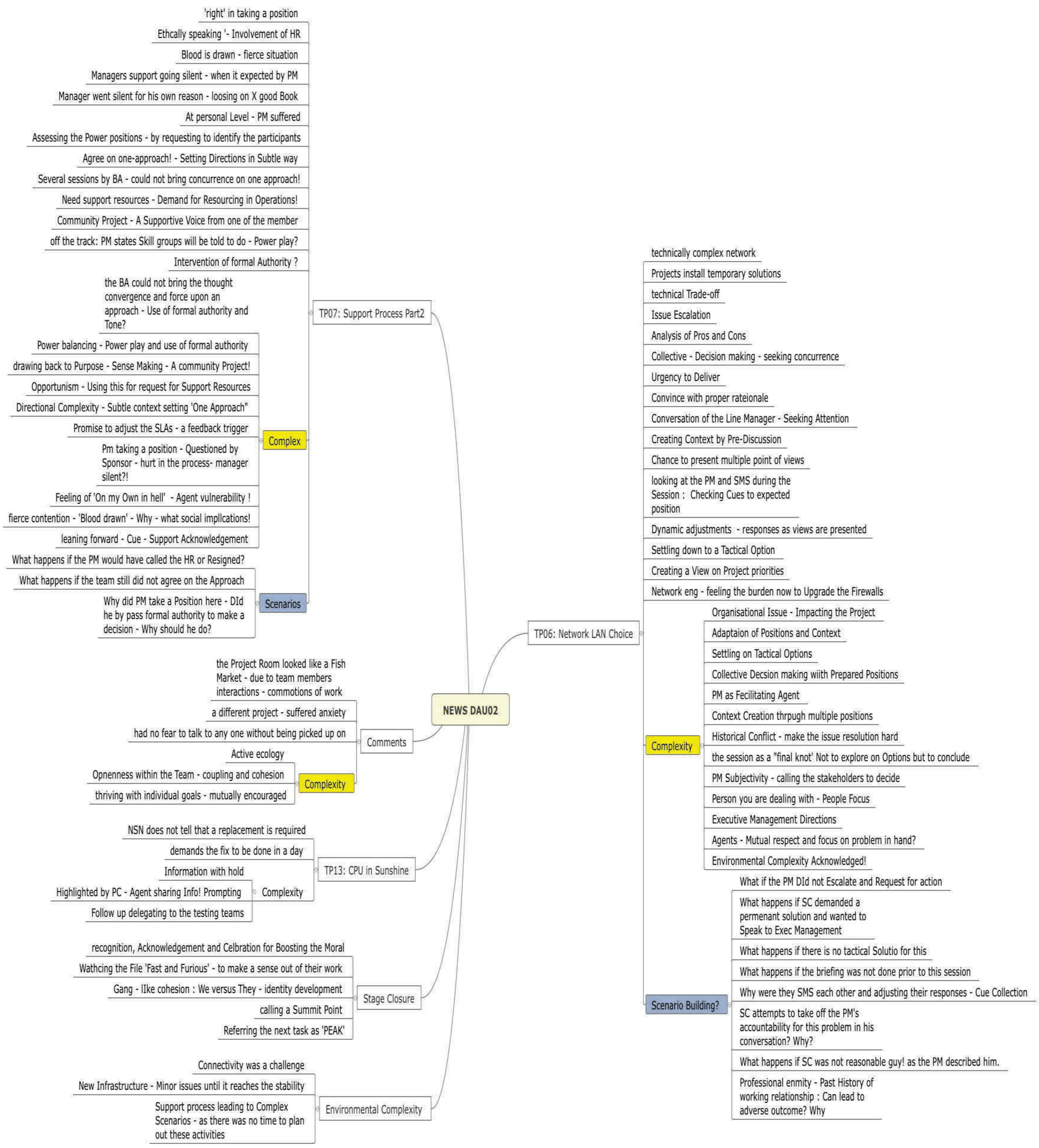
Narrow Conceptualisation of Projects ➡	Broader Conceptualisation of Projects
From: concepts and methodologies which are based on: the narrow conceptualisation that projects start from a well-defined objective 'given' at the start, and are named and framed around single disciplines, eg. IT projects, construction projects, HR projects etc.	**Towards:** concepts and approaches which facilitate: broader and ongoing conceptualisation of projects as being multidisciplinary, having multiple purposes, not always pre-defined, but permeable, contestable and open to renegotiation throughout.

Theory IN Practice

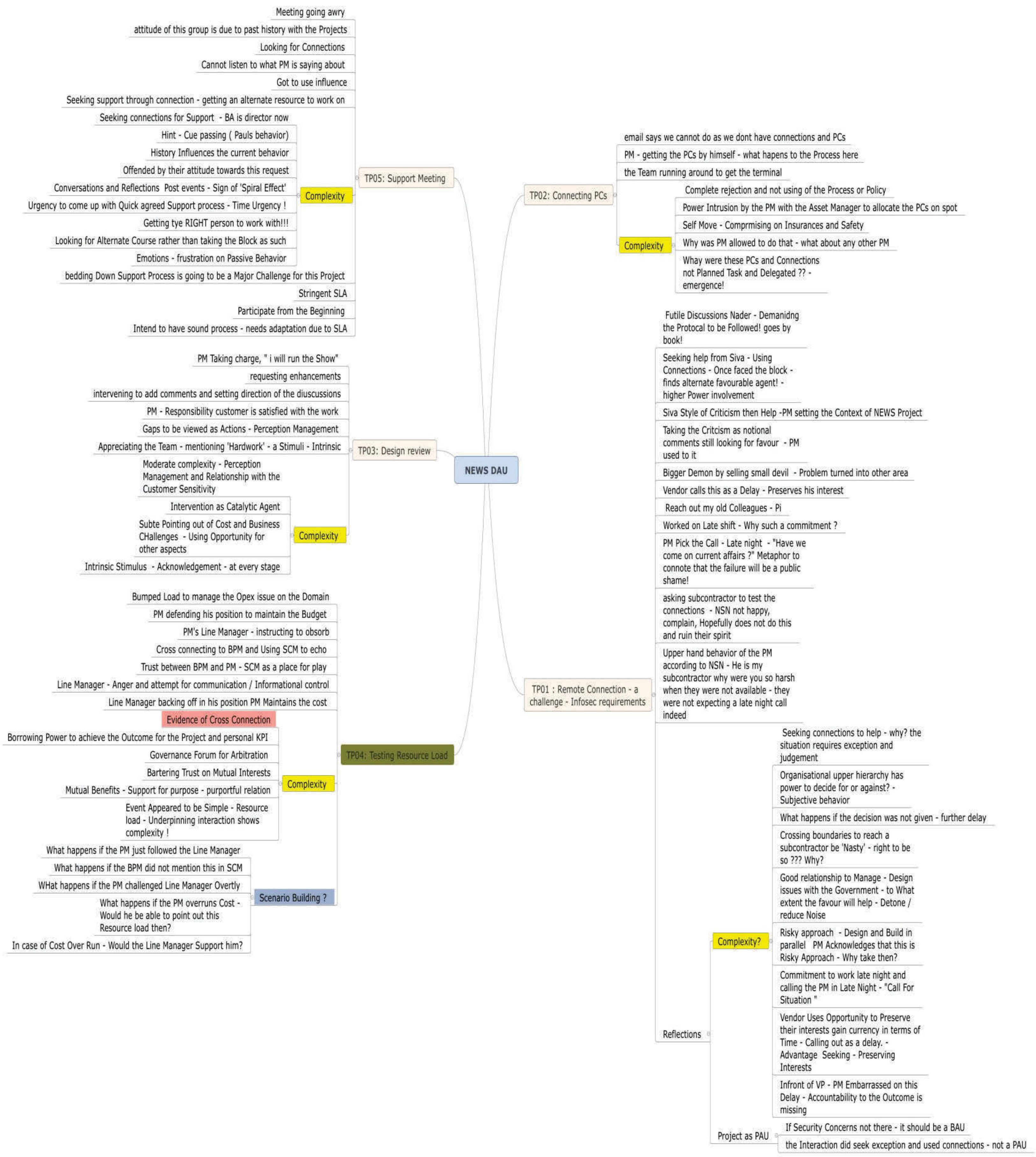
Direction 5

Practitioners as Trained Technicians ➡	Practitioners as Reflective Practitioners
From: training and development which produces: practitioners who can follow detailed procedures and techniques, prescribed by project management methods and tools, which embody some or all of the ideas and assumptions of the 'from' parts of 1 to 4.	**Towards:** learning and development which facilitates: the development of reflective practitioners who can learn, operate and adapt effectively in complex project environments, through experience, intuition and the pragmatic application of theory in practice.

12.2 Thematic Analysis of Case Project

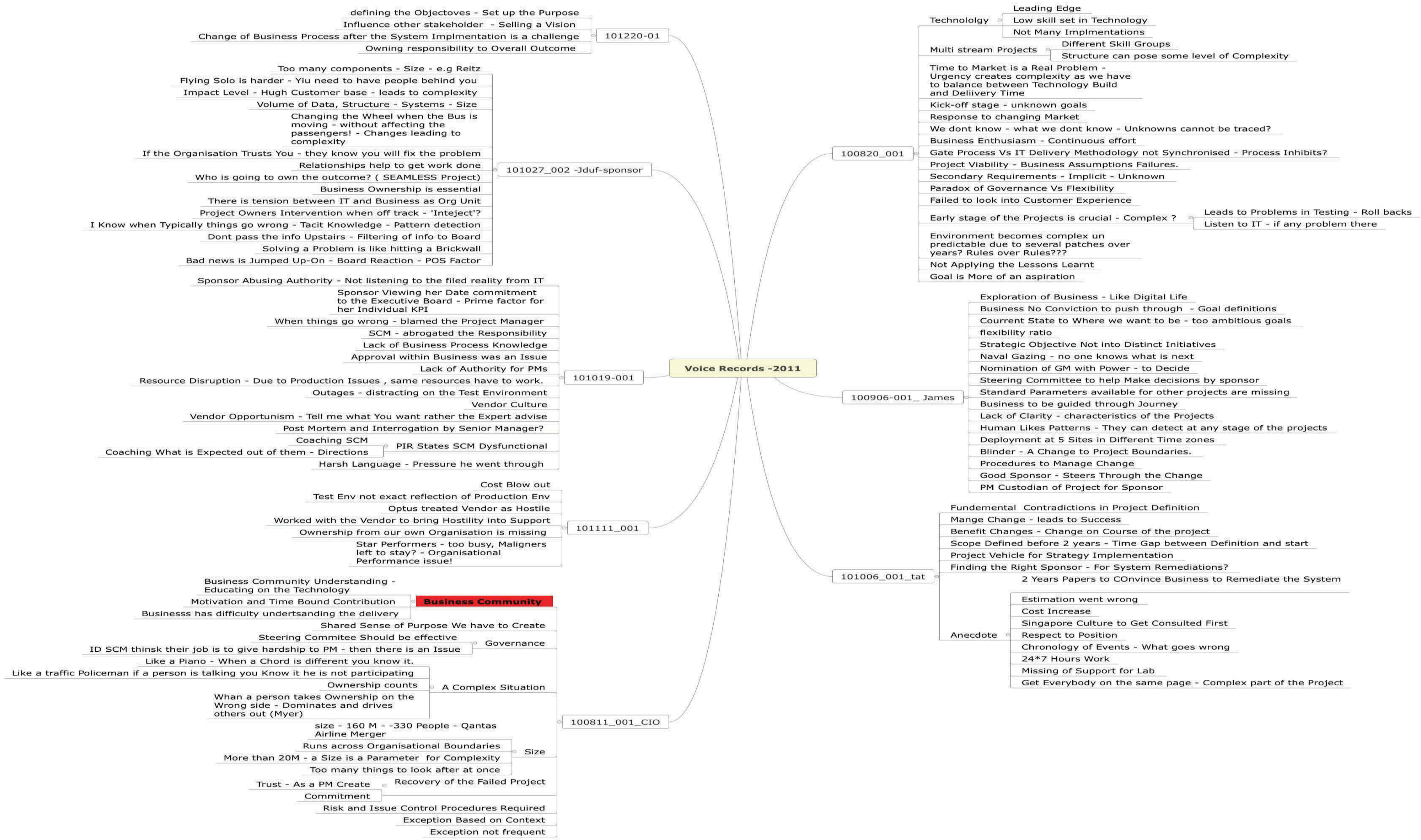


12.3 Thematic Analysis of Case Project … Continued



12.4 Thematic Analysis of Case Project … Continued

12.5 Thematic Analysis of Voice Records



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