Multimethodology: An Alternative Management Paradigm to

Process Quality Improvement

Thesis by

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Acknowledgements

This, doctoral thesis has been undertaken with the true belief that my years of 'thinking' and 'practising' a unique structured 'systems approach' to management, can facilitate the task of every managing executive to the extent of providing a simple but structured mechanism to facilitate the intervention and subsequent management of information systems development projects undertaken in the financial services industry. The latter in which I have spend some 34 years of my working life. Furthermore, it is my conviction that this 'structured approach', which is based on the philosophies formulated by revered academics during the Twentieth Century and supported by academic thinking of the Twenty First Century, which includes the author's own contributions, can add value to the existing body of knowledge and the art of project management in the financial services industry *per se*. This with particular reference to the systems dynamics of the 'systems approach' on which the structured sequence of events forming the mitigation factors are based, underpinned by the concept 'multimethodology'.

In submitting this thesis, I wish to take this opportunity to express my sincerest appreciation and gratitude towards the following persons, for their specific and valued contributions:

- My wife Hannetjie, my friend and soul mate for believing in me (yet again) and providing sustained encouragement, love and support.

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Multimethodology: An Alternative Management Paradigm to Process Quality Improvement

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PART 2

Synopsis

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This thesis is about the formulation of a structured sequence of events using a multimethodology approach to facilitate the intervention and subsequent management, of key factors contributing to the failure of management information system development projects undertaken in the financial services industry[1]. Furthermore, a clear distinction is made between information system development projects undertaken within the ambit of the broader development context of 'information technology', as opposed to information system development projects undertaken within the ambit of the financial services industry, the latter, the focus of this thesis.

The formulation of the structured sequence of events serving as mitigating factors, was mooted specifically as a result of known failure factors of management information systems development projects undertaken in the financial services industry. In terms of this research, these factors fall into two mainstream categories[2], namely:

[1] For the purpose of this thesis, the 'financial services industry' can be defined as financial institutions made up from the Corporate, Commercial, Retail, Private and Merchant Banks, Building Societies, the Securities Industry, Finance Houses and Money Market and Foreign Exchange Dealing Rooms.

[2] The author of this thesis acknowledges the plethora of failure factors 'commonly' associated with management information system development projects. In this thesis however, the field isnarrowed down to two main stream categories, specifically associated with information system development projects undertaken in the financial services industry.

- The quality of business requirement functional specifications.
- Change to business requirement functional specifications, while the latter is still in the process of being developed.

From the field research undertaken for this thesis both locally and abroad, the analogy was drawn that the above two factors are normally juxtaposed, contributing to multi-faceted impacts to information system development project lifecycles. Key impacts point to not only the escalation of previously approved budgets, but also to extended timelines and already mapped processes. The research shows that these two entities would typically lead to an executive call for rework of not only the business case, but also of the processes supporting the whole development. This could invariable culminate in the termination of the project or culminate in extensive recoding and process changes, which in turn would lead to the requirement for extensive change management initiatives. Alternatively, the additional rework could result in benefits harvesting from the initiative to be delayed or severely impacted. This statement is made with the clear *caveat*, that should the rework result in end user effectiveness being significantly boosted as a result of the required rework, to the extent that the ratio of operating profit over the benefit life span of the system to total development cost be raised, it would undoubtedly quantify such rework.

The structured sequence of events serving as mitigating factors to facilitate the intervention and subsequent management of key factors contributing to the failure of management information system development projects are formulated from selected key elements of the following system methodologies namely:

- The 'Systems Approach' forming the basis of the structured sequence of events, which Checkland[3] defines as 'an approach to a problem, which takes a broad view, which tries to take all the aspects into account, which concentrates on interactions between the different parts of the problem'.

[3] Checkland P 1989. Systems Thinking, Systems Practice. Chichester: Wiley. p5.

- The 'Six Sigma Methodology', which Pande *et al.*[4] defines as 'a comprehensive and flexible system for achieving, sustaining and maximizing business successes.
- The 'Capability Maturity Model', which Herbsleb *et al.*[5] defines as 'a reference model for appraising software process maturity and a normative model for helping software organizations progress along an evolutionary path from *ad hoc*, chaotic processes to mature disciplined software'.
- The 'Balanced Scorecard', which Kaplan & Norton[6] defines as 'a management system that can motivate breakthrough improvements in such critical areas as product, process, customer, and market development'.

A multimethodology approach will be deployed in the formulation of the mitigating factors from the above listed systems methodologies, underpinned by the concept 'system'. This then would be further enhanced by the author's own contributions gleaned from experience spanning some 34 years in systems development for the financial services industry, both locally and abroad.

These mitigating factors will come into play at two specific levels of a typical information technology project lifecycle namely:

- At the formulation of business requirement functional specifications.
- During the development and testing stages, which are typically associated with change in the systems development lifecycle.

Using a multimethodology approach, the interrelationship of the various core entities, gleaned from the above listed system methodologies, ultimately supporting the structured sequence of events serving as mitigating factors are graphically depicted below. In addition, the mitigating factors are positioned to

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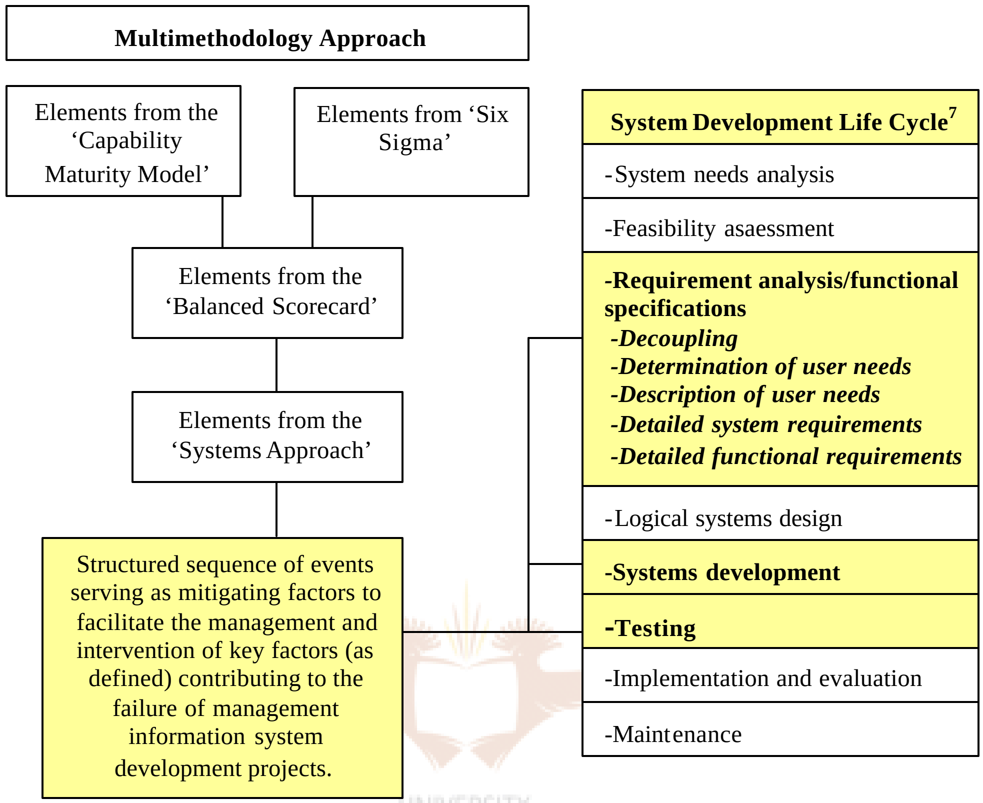
[4] Pande PS Neuman RP & Cavanagh RR. 2000. The Six Sigma Way. New York: McGraw–Hill. px.
[5] Herbsleb J Zubrow D Goldenson D Hayes D & Paulk M. 1997. Software Quality and the Capability Maturity Model. *Communications of the ACM,* 40(6), p32.
[6] Kaplan RS & Norton DP. 1993. Putting the Blanced Scorecard to Work. *Harvard Business, Review.* September–October. p134.

reflect their potential position in a typical systems development life cycle[7], commonly associated with information system development for the financial services industry.



The purpose of this thesis is then to determine if a set of mitigating factors can be developed from a structured sequence of events using a multimethodology approach to facilitate the intervention and subsequent management of key factors contributing to the failure of management information systems development undertaken in the financial services industry. Furthermore, the thesis proposes that the structured set of mitigating factors be incorporated as an alternative methodology within the ambit of the greater information technology project management life cycle for all project initiatives in the financial services industry.

[7] Adapted from Senn JA 1990 Information Systems in Management. Belmont: Wadsworth. p673.

Samevatting

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Hierdie proefskrif handel oor die formulering van 'n gestruktureerde volgorde van gebeurtenisse deur die gebruik van 'n multimetodologie benadering, vir die doeleindes van die fasilitering van tussentredes en gevolglike bestuur van sleutelfaktore wat aanleiding gee tot die mislukking van bestuursinligting-stelselontwikkelingsprojekte, wat onderneem word binne die bestek van die finansiëledienste industrie[1]. 'n Duidelike onderskeid kan gemaak word tussen stelselontwikkelingsprokekte wat onderneem word binne die raamwerk van die breër konteks van 'inligtingstegnologie' teenoor stelselontwikkelingsprojekte wat onderneem word binne die raamwerk van die finansiëledienste industrie. Laasgenoemde, die fokus van hierdie proefskrif.

Die idee vir die formulering van 'n gestruktureerde volgorde van gebeurtenisse (dienend as versagtende faktore) was geinisieër direk as gevolg van reeds bekende faktore wat aanleiding gee tot die mislukking van stelselontwikkelingsprojekte wat onderneem word in die finansiëledienste industrie.

[1] Vir die doeleindes van hierdie tesis, word die finansiëledienste industrie gedefinieër as finansiële instellings wat saamgestel word uit die volgende entiteite: Korporatiewe, Kommersële, Kleinhandel, Privaat and Handelsbanke, Bouverenigings, die Sekuriteite Industrie, Finansierings Huise, Geld en Valuta Markte en Buitelandse Valuta Handelaarskamers.

In terme van hierdie navorsing, val hierdie faktore binne die bestek van twee hoofkategorieë[2], naamlik:

- Die kwaliteit van besigheidsbehoefte-funksionele spesifikasies.
- Verandering aan besigheidsbehoefte-funksionele spesifikasies, terwyl laasgenoemde nog in die proses van ontwikkeling is.

Vanuit navorsing onderneem, plaaslik sowel as in die buiteland, kan tot die gevolgtrekking gekom word dat bogemelde twee faktore normaalweg saamgevoeg is, wat bydra tot meervuldige impakte op bestuursinligting-stelselontwikkelings projek lewensiklusse. Sleutel impakte verwys nie net na die eskalering van goedgekeurde begrotings nie, maar ook na verlengde tydskedules vir projekontwikkeling en geeikte prosesse. Die navorsing toon verder dat die genoemde twee entiteite normaalweg daartoe aanleiding gee dat uitvoerende bestuur sou versoek dat die oorspronklike besigheidsplan en geeikte prosesse aangepas moet word ingevolge die impak daarvan. Dit kan ook daartoe aanleiding gee dat die totale projekontwikkeling gestaak word, of dat herkoderings en proses aanpassings gemaak word, wat gevolglik daartoe aanleiding kan gee dat uitgebreide veranderingsbestuur binne die organisasie moet plaasvind. Alternatiewelik, kan dit daartoe aanleiding gee dat voordele voortspruitend uit die projek nie onmiddelik kan manifesteer nie, of gevolglik vertraag word. Hierdie stelling word gemaak met volle inagneming dat, sou sodanige aanpassings lei tot aansienlike gebruikersvoordeel in die sin dat die verhouding van operasionele profyt teenoor die voordeel lewenssiklus tot totale ontwikkelingskoste verhoog word, sulke veranderinge wel toelaatbaar sou wees.

Die gestruktureerde volgorde van gebeurtenisse dienend as versagtende faktore vir die fasilitering van tussentredes en gevolglike bestuur van sleutelfaktore wat aanleiding gee tot die mislukking van bestuursinligting-stelselontwikkelings

[2] Die outeur gee hiermee erkenning aan die groot hoeveelheid mislukkingsfaktore wat 'algemeen' ge-assosieër word met bestuursinligtingstelsel ontwikkelingsprojekte. In hierdie proefskrif word die spektrum van die mislukkingsfaktore beperk tot twee hoofkategorieë wat spesifiek geassosieer word met bestuursinligtingstelsel ontwikkelingsprojekte wat onderneem word in die finansiëledienste industrie.

projekte, sal geformuleer word vanuit geselekteerde sleutel elemente van die volgende stelselmetodologieë[3]:

- Die 'Stelselbenadering' wat die basis vorm van die gestruktureerde volgorde van gebeurtenisse wat Checkland[4] definieër as 'an approach to a problem, which takes a broad view, which tries to take all the aspects into account, which concentrates on interactions between the different parts of the problem'.
- Die 'Six Sigma Metodologie', wat Pande *et al.*[5] defineer as 'a comprehensive and flexible system for achieving, sustaining and maximizing business success'.
- Die 'Capability Maturity Model', wat Herbsleb *et al.*[6] defineër as 'a reference model for appraising software process maturity and a normative model for helping software organizations progress along an evolutionary path from *ad hoc*, chaotic processes to mature disciplined software'.
- Die 'Balanced Scorecard', wat Kaplan & Norton[7] defineër as 'a management system that can motivate breakthrough improvements in such critical areas as product, process, customer, and market development'.

'n Multimetodologie benadering sal gebruik word by die formulering van die stel versagtende faktore, saamgevoeg vanuit die bogemelde stelselsteorieë, en sal onderskryf word deur die konsep 'stelsel'. Verdere bydraes sal kom van die outeur wat gebaseer word op 34 jaar praktiese ondervinding in stelselsontwikkeling binne die bestek van die finansiëledienste industrie, beide plaaslik en in die buiteland.

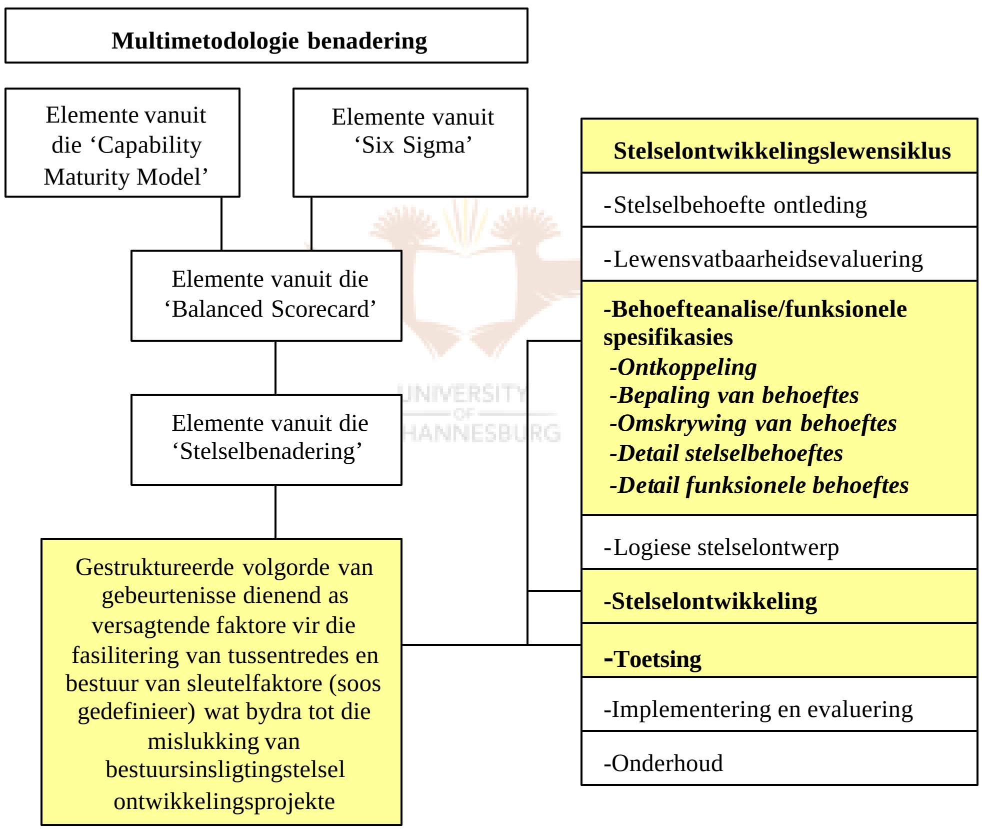
Die stel versagtende faktore tree in werking op twee vlakke van 'n tipiese inligtingstegnologie projeklewensiklus, naamlik:

- By die formulering van besigheidsbehoefte funksionele spesifikasies.

[3] Definisies van die onderskeie stelselmetodologieë word behou in die oorspronklike taal van formulering, om sodoende nie afbreuk te maak aan die interpretasies wat daaraan verleen is deur die verskeie outeurs nie.
[4] Checkland P. 1989. Systems Thinking, Systems Practice. Chichester: Wiley. Bladsy 5.
[5] Pande PS Neuman RP & Cavanagh RR. 2000. The Six Sigma Way. New York: McGraw–Hill. Bladsy x.
[6] Herbsleb J Zubrow D Goldenson D Hayes D & Paulk M. 1997. Software Quality and the Capability Maturity Model. *Communications of the ACM*, 40(6), Bladsy 32.
[7] Kaplan RS & Norton DP. 1993. Putting the Blanced Scorecard to Work. *Harvard Business Review*, September–October, Bladsy 134.

➢ Gedurende die ontwikkelings en toetsfases, wat normaalweg geassosieer word met inligtingstegnologie projeklewensiklusse.

Deur die gebruikmaking van ‘n multimetodologie benadering word die verskeie inter-verhoudinge van die verskillende sleutel entiteite onttrek uit die stelselsmetodologieë hierbo uiteengesit wat die gestruktureerde volgorde van gebeurtenisse dienend as versagtende faktore uitbeeld, en word grafies ter verduideliking hieronder uiteengesit. Voorts word die versagtende omstandighede geposisioneer om hul relatiewe posisies in ’n tipiese stelselsontwikkelingslewensiklus[8] te illustreer vir toepassing binne die bestek van die finansiëledienste industrie.



Die doel van hierdie proefskrif is dus om te bepaal of ’n stel versagtende faktore ontwikkel kan word vanuit ’n gestruktureerde volgorde van gebeurtenisse, deur die gebruik van ’n multimetodologie benadering vir die doeleindes van die

[8] Aangepas vanuit Senn JA 1990. Information Systems in Management. Belmont: Wadsworth. Bladsy 673.

fasilitering van tussentrede en gevolglike bestuur van sleutelfaktore wat aanleiding gee tot die mislukking van bestuursinligting-stelselontwikkelingsprojekte, wat onderneem word binne die bestek van die finansiëledienste industrie. Aanbevelings voortvloeiend vanuit hierdie proefskrif is dat die gestruktureerde volgorde van gebeurtenisse geinkorporeer word as 'n alternatiewe metodiek binne die bestek van inligtingstelsel projekbestuur lewensiklusse vir alle projek initiatiewe in die finansiele dienste industrie.

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Synopsis: Chapter 1

In this chapter, the reader is provided with background information into the failure of management information systems development projects undertaken in the Information Technology development industry. Two specific factors are identified, namely:

- The quality of business requirement functional specifications.
- Change to business requirement functional specifications, while the latter is still in the process of being developed.

The research process is explained, which leads into the research problem, the research question, and the associated investigative questions being formulated. The research design and methodology is based on the argument in favour of a taxonomy for information technology related research, illustrating the point that the scientific paradigm is not always the most appropriate basis for research in this field, and that a wider interpretation is required to include behavioural and organisational considerations.

The demand for a qualitative research strategy eludes to the fact that the concepts of 'practicality', 'validity' and 'reliability' were adversely impacted upon during the research by various internal factors commonly associated with the financial services industry *per se*. These factors resulted in the application of the set of mitigating factors to facilitate the management of key factors contributing to the failure of management information system development in a live environment, virtually impossible.

The thesis structure is approached from two perspectives, namely:

- **A general approach:** Whereby the individual chapters of the thesis have been grouped together to form four separate parts.
- **A specific approach:** Whereby the formulation of the set of mitigating factors are approached from two distinct perspectives, namely:
  - From the perspective of the systems analyst.
  - From the perspective of the academic reader of this thesis.

The chapter will be concluded with a detailed chapter and content analysis, whereby the contents of each chapter will be listed to provide the reader with an overview of the content thereof.

Chapter 1

The Scope of the Research

> *"You cannot discover new oceans, unless you have the courage to lose sight of the shore".*
>
> **Anonymous**

1.1 INTRODUCTION

Research conducted in the latter part of the 20th Century with computerisation standing at the forefront of innovation and growth, portray a plethora of subjects related to the management of information technology system development projects, where the focus are primarily centred according to Senn (1990:9) on three mainstream initiatives, namely:

- Transaction processing systems development.
- Management information systems development.
- Decision support systems development.

The author of this thesis is of the opinion that a more appropriate categorisation is mooted by Steyn (2001:24), who proposes the following categories of development projects, namely:

- Strategic projects, which refer to organisational transformation of which the benefits are focussed on organisational effectiveness.
- Innovation projects, which refer to continuous improvement projects of which the benefits are focussed on organisational effectiveness and efficiency.
- Capital expenditure projects, of which the benefits are focussed on organisational efficiency.

Against the background of information system development projects undertaken in the financial services industry, it would be appropriate to add to the proposal of Steyn (2001:24) a category of projects, namely 'compliance projects' undertaken specifically to satisfy compliance to government legislation or rulings[1] set for the industry by either the Minister of Finance, the Central Bank, or the industry itself.

Drilling down one level further, systems involving software focus on one of three general activities (Scott 1986:490), namely:

- The acquisition of prewritten software packages from vendors.
- The development and programming of new applications or systems programs.
- Maintenance of existing applications.

In the opinion of the author of this thesis, again specifically in view of the focus of this thesis on the financial services industry, 'business process re-engineering' should be added to the above list.

In spite of the extensive deployment of project management methodologies, systems development tools and processes, a 1995 report by The Standisch Group (1995:1), show that 31% of software development projects are cancelled before completion. This was supported by the findings cited in a 1997 KPMG Strategies and Services report (1997:1), where more than half the projects under development will cost an average of 189% of their original estimates. These findings against the background that the estimated 1995 spend on information technology application development in the United States according to The Standish Group report (1995:1), amounted to USD 250 billion! More recent surveys on individual project failure cited by Paulk *et al.* (2001:3-4), return a more catastrophic background to system failure and the following are cited:

- Seventeen American Department of Defence software contracts found that the average of twenty eight-month schedules was missed by twenty months.
- Deployment of the B1 bomber was delayed due to a software problem.
- A four -year project was delivered in seven years.
- USD 58 billion A12 aircraft program was cancelled partly due to software problems.

[1] In these instances according to Morris & Hough (1987:221 -224), Government can act as sponsor, as regulator, as champion or as owner.

Zahran (1998:xix), cite the instance of unreliable software in the United Kingdom attributing to the failure of emergency services and social security payment disasters. Failure of the London Stock Exchange's Taurus share settlement system in March 1993, costing GBP 75 million, according to Galliers (1995:55), was attributed to the failure of taking into account the possibilities for new processes to replace existing procedures, and the different interests and viewpoints of key stakeholders. Kaplan & Norton (1996a:102), cite the instance of a company who changed the design of their system under development. It was estimated that each design error/change cost USD 185,000. This extrapolated into an average of two errors/changes per product introduced and with 110 new products introduced by the company each year, the total amount spent on design error/changes was about USD 40 million. This figure represented more than five percent of the company's revenue!

Of concern is the fact that every researcher documenting the key factors contributing to these failures, document a different set of contributing factors, however with clear tangent planes between dominant factors. Of even more concern is the fact that during the research for this thesis, the author could not find a single reference where the following key factors are identified as primarily contributed to the failure of management information systems development projects undertaken in the financial services industry, or for that matter, mitigated by a single set of mitigating factors, formulated from a structured sequence of events.

- The quality of business requirement functional specifications.
- Change to business requirement functional specifications, while the latter is still in the process of being developed.

This mooted the need for a set of mitigating factors to be formulated to facilitate the intervention and management of these key factors, specifically focussed on system development in the financial services industry.

1.2 THE RESEARCH PROBLEM

Field research by the author into the failure of management information system development projects undertaken in the information technology development industry, show that the following two factors are not commonly dealt with in terms of the general methodologies prescribed within the context of project management, namely:

- The quality of business requirement functional specifications.
- Change to business requirement functional specifications, while the latter is still in the process of being developed.

The literature search cited in this thesis and academic readings commonly associated with work of this nature, also did not return a single reference where these two entities were singled out or juxtaposed as being the most prevalent contributing factors associated with the failure of management information systems development projects. Neither for that matter, and more specific, for information system development projects undertaken in the financial services industry. Furthermore, no evidence could be found where these two entities were being mitigated by a single set of mitigating factors, formulated from a structured sequence of events. To ensure that the proposed solution to the research problem has a scientific base and fulfil an operational need, this thesis will be directed to the extent that the concept be applied against the background of a systems engineering approach, which Blanchard (1992:9) define as 'the effective application of scientific and engineering efforts to transform an operational need'.

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The research problem can thus be formulated into the following problem statement, namely:

> *'No known methodology exists to address specifically the quality aspect of business requirement functional specifications and subsequent change to these requirements as failure factors within the ambit of management information system development projects undertaken in the financial services industry'.*

It is important to note that the stated research problem fall within the ambit of Checkland's (1989:155) definition of a 'problem', which he defines as 'a problem relating to real-world manifestations of human activity systems is a condition characterised by a sense of mismatch, which eludes precise definition, between what is perceived to be actuality and what is perceived might become actuality'.

1.3 THE RESEARCH QUESTION

The research question, which will form the crux of this thesis, is:

> *"Can a set of mitigating factors be developed, from a structured sequence of events, using a multimethodology approach, to facilitate the intervention and subsequent management of key factors (as identified), contributing to the failure of management information systems development projects undertaken in the financial services industry?"*

The focus of Chapter 8 and supporting Appendix F is centred on providing an answer to not only the research question, but also the research problem.

1.4 THE RESEARCH PROCESS

The problem statement and associated research question are approached using the Question Hierarchy of Emory and Cooper (1995:56-59), modified by Piquito (1999:5) and further adapted to address the issues in this thesis. This approach depicted in Figure 1.1 assumes the research problem to be composed of a hierarchy of questions with a descending level of specificity.

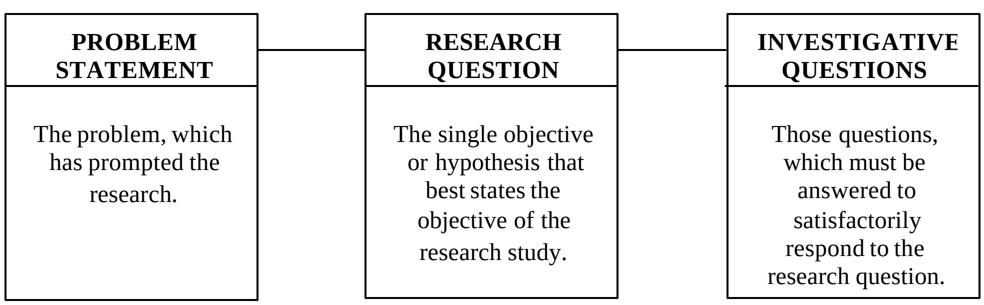

FIGURE 1. 1: The Question Hierarchy. (Emory and Cooper 1995:56 -59), modified by Piquito (1999:5).

The aim of the adapted and modified question hierarchy is to achieve a focus on the research problem as a result of increasingly descriptive questions. In line with the Research Problem presented in Paragraph 1.2 above and the Research Question presented in Paragraph 1.3, the following Problem Statement, Research Question and Investigative Questions are defined in terms of the Question Hierarchy:

- **Problem Statement:** No known methodology exists to address specifically the quality aspect of business requirement functional specifications and subsequent change to these requirements as failure factors within the ambit of management information system development projects undertaken in the financial services industry.
- **Research Question:** Can a set of mitigating factors be developed from a structured sequence of events, using a multimethodology approach, to facilitate the intervention and subsequent management of key factors (as defined) contributing to the failure of management information systems development projects undertaken in the financial services industry?
- **Investigative Questions:**
  - To what extent are multimethodology approaches used to structure the outcome of paradigm shifts introduced into the financial services industry with respect to technology development, and how do they contribute to overall process quality improvement?
  - Is poor quality business requirement functional specifications and subsequent change to these specifications while the latter is still in progress of being developed limited to management information system development projects undertaken in the financial services industry, or is it a universal problem, which can be extrapolated to all management information development projects undertaken in the information technology development industry?

1.5 THE RESEARCH DESIGN AND METHODOLOGY

Galliers and Land (1987:900) draw the attention to two tendencies in information systems research. The first relates to the primacy of traditional, empirical research, which is more suited to the natural sciences, while the second relates to the tendency to advocate a particular mode of information systems research, irrespective of the particular mode of information systems research topic being studied. Citing the results of a study of Vogel and Wetherby, where it was found that 85 percent of published information systems research undertaken by leading US institutions are of the traditional kind. Galliers and Land (1987:900) are of the opinion, that while such research may be deemed to be academically acceptable and internally consistent, it all too often leads to inconclusive results.

Due to the fact that information systems research has often been viewed as residing within the province of technology (Galliers and Land 1987:900), the analogy can be drawn that the same norms would be applicable to systems related research as presented in this thesis. The crux of the matter however, lies embedded within the context of an observation made by the above mentioned two authors, which reads as follows:

> *"Increasingly, however, both information systems academics and practitioners have begun to realize it is more appropriate to extend the focus of study to include behavioural and organizational considerations".*

This is supported by the wish to place information systems, and for the purpose of this thesis, also systems related research in a broader category, since both entities are according to Galliers and Land (1987:900), being impacted upon. They substantiate this claim when referring to information systems being impacted by:

> *"the organization and the people they serve".*

Although a plethora of approaches are available for research, there are only a few published accounts of the successful application of newer approaches to information technology related research. One well-documented exception to this rule relates to 'action research' described by Easterby–Smith *et al*. (2002:10), and by Checkland (1989:151), quoting from Checkland and Jenkins. Galliers and Land (1987:901), suggest a taxonomy of research approaches, when dealing with society, organisation groups, individuals, technology and methodology, and for the purpose of this thesis, to also include methodologies pertaining to the concept systems approach. In this respect, refer to Chapter 4, Paragraph 4.4.

The taxonomy has the objective to ensure that the 'object' on which the research effort is focused and the 'mode' by which the research is carried out is differentiated. The above mentioned authors further suggest subjective/argumentative and descriptive/interpretative approaches to be applied to the identified entities as part of a broader focus to the concept of information technology related research as opposed to the traditional empirical research.

Subjective/argumentative and descriptive/interpretative approaches require further explanation:

- **Subjective/argumentative approach:** Quoting the research of Vogel and Wetherbe, this approach is defined by Galliers and Land (1987:901) as 'creating management information systems research based more on opinion and speculation than observation'.
- **Descriptive / interpretative approach:** Citing Boland, this approach is defined by Galliers and Land (1987:900) as 'being in the tradition of phenomenology i.e., concerned with description'. Emory and Cooper (1995:11), in describing the essence and importance of descriptive research, point out that:

> *"The very essence of description is to name the properties of things: you may do more, but you cannot do less and still have description". "The more adequate the description, the greater is the likelihood that the units derived from the description will be useful in subsequent theory building".*

The above argument in favour of a taxonomy for information technology related research, illustrates the point that the scientific paradigm is not always the most appropriate basis for research in this field, and that a wider interpretation is required to include behavioural and organisational considerations. It is then on this premise that the proposed approach will be formulated for the management of key factors contributing to the failure of management information systems development projects by using various diverse entities. This is supported by the view that information technology research attempts to achieve some synergy between the 'old' and the 'new', a form of 'syntegration' (synergy + integration) of the ways of the past in the search of new truths (Pellissier, 2002:8).

1.6 THE DEMAND FOR A QUALITATIVE RESEARCH STRATEGY

While the researcher acknowledges that a number of strategies can be applied in similar research projects, the well-known concepts of objectivity, reliability etcetera, inherited from the empirical analytical paradigm, have been utilised within the ambit of this research in more or less the traditional way. Quoting Thorndike and Hagen, these concepts are defined by Emory and Cooper (1995:156), as follows:

- **Practicality:** Practicality is concerned with a wide range of factors of economy, convenience, and interpretability.
- **Validity:** Validity refers to the extent to which a test measures what the researcher actually wishes to measure. Yin (2003:34-36) identifies three subsets to the concept 'validity', namely:
  - Construct validity.
  - Internal validity.
  - External validity.
- **Reliability:** Reliability has to do with the accuracy and precision of a measurement procedure.

The concepts of practicality, validity and reliability defined by Emory and Cooper (1995:156) quoting Thorndike and Hagen, were adversely impacted upon during the research by various internal factors commonly associated with the financial services industry *per se*. These factors resulted in the application of the set of mitigating factors to facilitate the management of key factors contributing to the failure of management information system development in a live environment, virtually impossible. The most significant elements attributing to this situation were precipitated by the following:

- That the set of mitigating factors formulated from a structured sequence of events, using a multimethodology approach as proposed in this thesis, is aimed at introducing a paradigm shift to existing project management processes. To implement the set of mitigating factors on an experimental basis to prove the concept, would be unacceptable to any executive as a matter of principle operating at such a level in an organisation, as it would invariable deviate from proven project management disciplines in force and incur additional expense to execute.

- Should permission be granted to implement the set of mitigating factors in an organisation on an experimental basis, it would be most likely that the new project management discipline would be considered confidential and part and partial of the organisation's Intellectual Property Rights. Making such results public, would constitute breach of these rights.
- Programme managers at the top echelon of an organisation normally follow a very specific project management methodology, which stems from either tradition or from organisation culture, or from proven innovation management processes. The latter, according to Senge (2002:30), is fundamentally human and social, making it by implication a private and confidential matter to the exclusion of third parties. Furthermore, introducing a new approach on an experimental basis into established structures would most likely require information technology board approval, and impact executive strategies and decision making[2]. In addition, it would most likely require change management on a broad front in the organisation, which by implication would not be easily accepted. This statement against the background of the significant cost associated with process and technology changes in an organisation.
- An aspect, which Pascale (1991:11) term 'conservatism', has furthermore a significant impact on the validation potential of the set of mitigating factors. Due to the fact that management in the words of Pascale (1991:11) like to 'stick to their knitting' irrespective of the fact that such a great strength, would inevitable culminate as the root of weakness, are unwilling to change.

[2]With this statement, the author of this thesis does not suggest that organisations are totally inflexible to their management approaches, which they follow. As organisations evolve, management and new management approaches are introduced. This statement refers specifically to *ad hoc* experimentation with a new management approach, which in view of the author, would not be permitted at executive level in corporate environments, as there are too much at stake (Christensen & Raynor 2003:72).

- The South African financial services industry has in the last five years undergone phenomenal change through the deployment of technology and process cultures to gain competitive advantage and market share. Furthermore with mergers and acquisitions in the order of the day, the industry is controlled by a number of large conglomerates, with competitiveness and market share the ruling commodities of importance. Similar 'competitive constraints' was reported by Kähköne and Huovila (2002:2), during their research of a similar nature. Due to the extent of these factors, individual strategic project initiatives within these conglomerates are considered confidential and part of corporate strategy. An attempt to introduce a new radical concept within such an environment would in view of the author, be an exercise in futility.

It was therefore a requirement for the researcher to become aware of all these critical issues identified above, and prepare and equip him to handle these issues with skill and sensitivity. In addition, to guarantee the anonymity of all parties concerned in the quest to establish the validity of the set of mitigating factors forming a structured sequence of events.

A qualitative investigation of a particularly sensitive nature conducted by Oskowitz and Meulenberg-Buskens (1997:83), qualified the importance of handling mission critical issues as identified above when the authors stated:

> *"Thus any type of qualitative investigation could benefit from the researchers being skilled and prepared, and the sensitive nature of an investigation into a stigmatizing condition made the need for such an undertaking even more imperative in the current study"*.

The sensitivity of certain issues and issues identified as impacting the research negatively in the environments being evaluated, not only demanded intimate personal involvement, but also demanded the 'personal and practical experience' of the author. This view was upheld by Meulenberg-Buskens (1997:111), as being imperative to assure quality in qualitative research being undertaken. Checkland (1989:152) supports this view, however extends the concept with the opinion that:

'The researcher becomes a participant in the action, and the process of change itself becomes the subject of research'.

To bridge the listed impeding factors, while still proactively validating the structured set of mitigating factors as a viable alternative entity within the project management lifecycle, a limited validation survey will be conducted, the results of which is contained within the ambit of Appendix D. The purpose of this limited validation survey will be to ascertain the opinions of technology executives both locally and abroad with regard to the key factors contributing to project failure. It is not the intention of the author to conduct a full-scale survey with extensive supporting statistical analysis as used in similar research projects. The objectives of the limited survey underta ken in this thesis is to provide the reader with an appreciation of the applicability of the set of mitigating factors as perceived by experienced executives within a spectrum of disciplines and in so doing, reinforce both the uniqueness thereof and its potential as a viable proposition to be explored.

1.7 THESIS STRUCTURE: GENERAL APPROACH

This thesis has been structured in such a way as to ensure adherence to the following concepts:

- The concepts presented within the document must flow logically from one part to the next, in order to maximise reader comprehension of the various topics presented.
- Given the diverse nature of the respective literature review interpretations, the order of presentation must be such that the reader is equipped with a deeper understanding of each review interpretation presented. This is to ensure that the set of mitigating factors formulated from a structured sequence of events are understood, particular the sub-entities thereof, as it relates to the various philosophies and processes imbedded therein.

For the reasons listed above, the individual chapters of this thesis have been grouped together in four separate parts namely:

- **Part 1:** Consists of the abstract, the scope of the research, including a detailed analysis of intervention concepts, and project failure dynamics. In addition an in depth analysis of the multimethodology approach is provided. Furthermore, this part would include a detailed analysis of the complexities and potential impact of poor quality specifications, which originally mooted the research. Field research conducted both locally and abroad underpinned by literature reviews places the research problem in context of the overall thesis research. These aspects are contained within the ambit of Chapters 1 – 3.
- **Part 2:** Contain the literature reviews pertaining to the ruling principles for the following systems methodologies namely:
  - The 'Systems Approach' forming the basis of the structured sequence of events, which Checkland (1989:5) defines as 'an approach to a problem, which takes a broad view, which tries to take all the aspects into account, which concentrates on interactions between the different parts of the problem'. The systems approach was specifically chosen to form the basis of this research based on two significant factors namely:
    - It forms the basis of systemic reason, is perfectly rational, and remains verbal, analytic, as well as synthetic, holistic and dynamic. Furthermore, it accepts non-measurable elements, in its very nature deals with dynamic behaviours and its focus is not on the individual parts, but on the interrelationship between these parts (Ballé 1994:36).
    - While the world changes – and continues to change at an accelerated pace – it does not mean that we should abandon the quest for fundamental concepts '*such as the systems approach*' (my italics), that stood the test of time (Collins and Porras 1998:xiv).
  - The 'Six Sigma Methodology', which Pande *et al.* (2000:x), defines as 'a comprehensive and flexible system for achieving, sustaining and maximizing business success'.
  - The 'Capability Maturity Model', which Herbsleb *et al.* (1997:32) defines as 'a reference model for appraising software process maturity and a normative model for helping software organizations progress along an evolutionary path from *ad hoc*, chaotic processes to mature disciplined software'.

- The 'Balanced Scorecard', which Kaplan & Norton (1993:134) defines as 'a management system that can motivate breakthrough improvements in such critical areas as product, process, customer, and market development'.

An analysis of each of these methodologies is contained within the ambit of Chapters 4 – 7. As a multimethodology approach will be used to formulate the structured sequence of events, key construction elements of each of the cited methodologies will be extrapolated and presented in Appendix F of this thesis. In turn, these key elements will be taken up into the multimethodology approach forming the structured sequence of events to ultimately culminate in the set of mitigating factors (see Part 3, Chapter 8).

- **Part 3:** This part forms the crux of the research and within the ambit of Chapter 8, a detailed analysis of the key construction elements, gleaned from Part 2, (Chapters 4 - 7) will be taken up in a structured sequence of events, to ultimately culminate in the set of mitigating factors. Furthermore, in Chapter 8, the research problem and research questions will be addressed, including the research objectives of this thesis.
- **Part 4:** This part consists of Chapter 9, which refocuses on the research problem and associated research question. Furthermore, it contains the conclusions of the research and identified areas for further research.

1.8 THESIS STRUCTURE: SPECIFIC APPROACH

The formulation of the set of mitigating factors, will be 'specifically' approached from two distinct perspectives, namely:

- **From the perspective of the 'systems analyst'[3]:-**
  - A practical process flow model reflecting the structured sequence of events serving as mitigating factors as applied within the context of a

[3] Due to the plethora of naming conventions used by the financial services industry to denote the role of the 'systems analyst', this term will be used in context and will include the roles of project manager, systems engineer, information systems analyst, business analyst, project integrator, process integrator, programme integrator, systems integrator and product integrator. This means the day to day 'practical users' of the set of mitigating factors within the financial services industry.

typical systems development life cycle will be analysed in detail (refer Chapter 8, Paragraph 8.5, Figure 8.3 A-G). For ease of reference, each element of the structured sequence of events will be shown as 'numbered frames' within the context of the workflow analysis of the systems development life cycle. Furthermore, each 'numbered frame' will be categorised into six phases with supporting guidelines annotated per individual frame to enable the systems analyst to apply the solution practically within the financial services industry.

- **From the perspective of the academic reader:-**
  - To not only provide scientific credibility to the research solution, but also to provide the academic reader with a comprehensive analytical view of the compilation of the set of mitigating factors, each element of the structured sequence of events will be cross referenced to each of the individual methodologies from which it was originally formulated. Furthermore, each element of the structured sequence of events will be supported by appropriate theoretical references gleaned from the literature reviews cited in this thesis. This analysis will be contained within the ambit of Appendix F.

> The attention of the reader is also drawn to the specific structure of this thesis, whereby significant supporting research materials are contained within the ambit of the various appendixes of the thesis. These appendixes are considered an integral part of the main body of the thesis and should not be viewed as 'supplementary' information to the thesis.

1.9 CHAPTER AND CONTENT ANALYSIS

The chapter and content analysis, which is in line with the Research Design and Methodology (refer Paragraph 1.5), requires closer scrutiny and the following analysis in respect thereof is provided:

- **Abstract:** Provides the reader with a short synopsis of the extent of the research pertaining to the set of mitigating factors, formulated from a structured sequence of events.
- **Chapter 1 - The Scope of the Research:** Sets the scene for the research contained within the ambit of the thesis. The chapter starts with a brief

introduction and background to the key factors (as identified), which contribute to the failure of management information system development projects undertaken in the financial services industry. This will be followed with an introduction to the research problem, and subsequent research questions. The research process will be explained feeding in to the overall research design and methodology, the demand for a qualitative research strategy and an overview of the thesis structure. The chapter furthermore provides detail on the chapter and content analysis of the thesis, and is concluded with the key research objectives of the thesis.

- **Chapter 2 – Intervention and Project Failure Dynamics:** The analysis in this chapter is aimed at explaining the core elements attributing to the research problem previously defined and elements, which will ultimately facilitate the answer to the research question. The analysis is underpinned by appropriate literature reviews, and will deal with the following elements:
  - **Intervention:** This 'core remedial element', which will be analysed in terms of intervention types with focus on planned and forced interventions.
  - **Project Failure Dynamics:** These 'core causal elements' will be analysed in terms of their general impact on information technology development, and also in terms of their impact on major projects and technology driven projects. Furthermore, business requirement specifications, the key dynamic in this thesis, will be analysed supported by related factors impacting the concept, namely quality, user focus and project management. The chapter will be concluded with the validation survey results on project failure dynamics, the detail of which is contained within the ambit of Appendix D.
- **Chapter 3 – The concept 'Multimethodology':** In this chapter, the concept 'multimethodology' as proposed by Mingers (2001:301) will be analysed in detail. Further aspects, which will be included in the detailed analysis deals with the design and the need for the approach within the greater ambit of the thesis structure. Application of this concept would in return be dealt with in detail in Chapter 8, where the construction elements of the proposed set of mitigating factors will be formulated.

- **Chapter 4 - Literature Review of the 'Systems Approach':** This chapter provides a literary background to the ruling principles of the systems approach, and selected attributes of the concept applicable to the research, which will form the basis of the proposed set of mitigating factors. The systems approach will be analysed from the following perspectives:
  - A general introduction to the systems approach methodology.
  - The concept 'system' defined.
  - The concept of the 'general systems theory' explained.
  - The concept 'systems approach' defined.
  - The concept 'cybernetics' defined.
  - The concepts 'closed and open systems' defined.
  - The roles of 'models' explained.
  - The impact of the notions '*weltanchauung*' and 'appreciative systems' explained.
  - 'Causal loop diagrams' and 'reinforcing and balancing processes' explained.

  A list of key components, which will in terms of the multimethodology approach, be extrapolated from the 'Systems Approach', and taken up in the formulation of the structured sequence of events to ultimately culminate in a set of mitigating factors, will be contained in Appendix F for ease of reference. For completeness of the overall research on the systems approach methodology, a high level analysis of the 'hard systems' approach and the 'soft systems' approach will be included in Appendix A and Appendix B. In addition, a comparative analysis of the 'hard systems' approach and the 'soft systems' approach will be contained within the ambit of Appendix C.
- **Chapter 5 - Literature Review of the 'Six Sigma methodology':** This chapter provides a literature background to the ruling principles of the Six Sigma methodology. The Six Sigma methodology will be analysed to provide insight into its core usability components. A list of key components, which will in terms of the multimethodology approach, be extrapolated from the 'Six Sigma' methodology, and taken up in the formulation of the structured sequence of events to ultimately culminate in a set of mitigating factors, will be contained in Appendix F for ease of reference.

- **Chapter 6 - Literature Review of the 'Capability Maturity Model':** This chapter provides a literature background to the ruling principles of the Capability Maturity Model. Furthermore, in this chapter the Capability Maturity Model will be compared with the Six Sigma methodology to highlight tangent planes between the two entities. A list of key components, which will in terms of the multimethodology approach, be extrapolated from the 'Capability Maturity Model', and taken up in the formulation of the structured sequence of events to ultimately culminate in a set of mitigating factors, will be contained in Appendix F for ease of reference.
- **Chapter 7 - Literature Review of the 'Balanced Scorecard':** This chapter provides a literature background to the ruling principles of the Balanced Scorecard methodology. A list of key components, which will in terms of the multimethodology approach, be extrapolated from the 'Balanced Scorecard', and taken up in the formulation of the structured sequence of events to ultimately culminate in a set of mitigating factors, will be contained in Appendix F for ease of reference.
- **Chapter 8 - In depth analysis of the construction elements of the proposed set of mitigating factors:** This chapter will be introduced with a refocus on 'causal elements' as discussed in Chapter 2, which is to be followed by a philosophical perspective of the author of this thesis on the concept of 'reasoning and thinking'. The initial reasons/objectives which mooted this research, will be briefly re-visited to set the scene for the set of mitigating factors to be formulated. In this chapter, considered to form the crux of the research, the set of mitigating factors will be formulated to form a structured sequence of events to facilitate the intervention and management of key factors contributing to the failure of management information development projects undertaken in the financial services industry. Using a multimethodology approach, the mitigating factors will be formulated from an extract of the key components identified in each of the system methodologies analysed in Chapter 4 (the Systems Approach), Chapter 5 (the Six Sigma methodology), Chapter 6 (the Capability Maturity Model) and Chapter 7 (the Balanced Scorecard). This important component of Chapter 8, will include this author's own contribution to the research problem and will be contained within the ambit of Appendix F for ease of reference. Furthermore, Appendix

F is specifically aimed at the academic reader of this thesis. The process of formulating the set of mitigating factors within the context of a systems development lifecycle[4], is graphically depicted in Figure 1.2 reflecting the interrelationship of core entities[5], and to place Chapter 8 in context of the overall research.

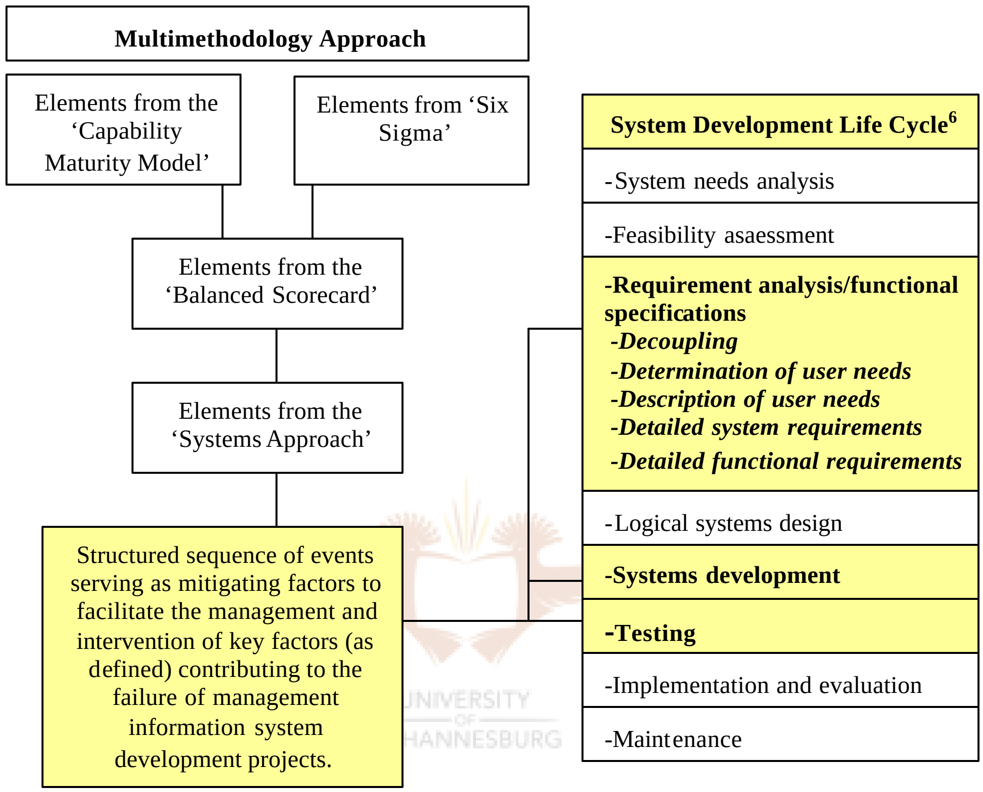

Figure 1.2:- Interrelationship of core entities.

[4] It is of importance to note that when the 'systems approach' (which will be discussed in detail in Chapter 4), is applied to the development of a management information systems solution, 'a systems development life cycle' emerges (Smit & Cronjé 1992:166).

[5] Figure 1.2, while reflecting the interrelationship of core entities, graphically depicts the process to be followed in the formulation of the set of mitigating factors. Furthermore, Figure 1.2 reflect a structured sequence of events (serving as mitigating factors), which will be formulated within the ambit of a multimethodology approach from elements extrapolated from the Systems Approach, the Six Sigma methodology, the Capability Maturity Model and the Balanced Scorecard. In terms of the scope of this thesis, Figure 1.2 in addition draws the boundaries of the application of the set of mitigating factors within a typical systems development life cycle, namely that of: 1) Requirement analysis/functional specifications. 2) Systems development. 3) Testing.

[6] The systems development life cycle as depicted in Figure 1.2, represents a 'process-oriented approach', which views software development as a sequence of cycles (Floyd & Keil 1987:167).

- **Chapter 9 – Research Consolidation:** In this concluding chapter, the research is summarised and evaluated for its applicability for the management of information development projects undertaken in the financial services industry. The remainder of the chapter focuses on concluding observations pertaining to the research and possible avenues of further research.

1.10 KEY RESEARCH OBJECTIVES

The key objectives of the author with this thesis and by implication forming the basis of any research undertaken at doctoral level according to Easterby-Smith *et al.* (2002:11) are:

- That theoretical contributions are produced with some degree of originality by either replicating known studies with one or two of the variables, such as country or industrial sector being changed, or by looking at a practical problem from two different theoretical perspectives.
- That the research would involve the collection of empirical data and would include some original data.
- To demonstrate that the research builds on ideas developed by others.

Of more importance to the author, that this research serves two very specific objectives[7]:

- Makes a significant contribution (add value) to the existing body of knowledge from the perspective of the academic reader.
- That the set of mitigating factors to be formulated, using a multimethodology approach be of such a nature that it not only solves the research problem, but also facilitates the implementation thereof from a practical perspective by the average systems analyst.

The primary *raison d'être* for this thesis, that the author's own contribution superimposed on those of revered academics of the 20th and 21st Century, would culminate in effecting a paradigm shift in organisations who elect to use the

[7] In this respect, it is of importance for the reader to refer to Paragraph 1.8 of this chapter entitled 'Thesis Structure: Specific Approach'.

formulated structured mitigating factors, to intervene and manage information systems development projects in the financial services industry.

1.11 CLOSURE

In this first chapter, the scope of the research has been outlined starting with an introduction and background to the subject matter to be researched, followed by clear definitions of the research problem and associated research question and subsequent investigative questions. This was followed by the research design and methodology, complemented with a topic on the demand for qualitative research strategy. An overview of the thesis structure was provided, followed by the chapter and content analysis of the thesis. The chapter was concluded with an item on the key research objectives and final conclusion.

The analysis in Chapter 2 is aimed at explaining the core elements attributing to the research problem previously defined and elements, which will ultimately facilitate the answer to the research question. The analysis is underpinned by appropriate literature reviews, and will deal with the elements 'intervention' and 'project failure dynamics'. The chapter will be concluded with the survey results on project failure dynamics, detail of which is contained within the ambit of Appendix D.

In final conclusion, this thesis is about both a set of mitigating factors formulated from a structured sequence of events, using a multimethodology approach to aid the intervention and management of key factors impacting information technology projects undertaken in the financial services industry. The structured tailored sequence of events serving as mitigating factors, this way of 'system thinking', implies thinking about the world outside ourselves, and doing so by means of a concept 'system', very much in the same way as envisaged by Albert Einstein, in an extract from Schilpp cited by Checkland (1989:3–4).

> *"What, precisely, is 'thinking'? When at the reception of sense impressions, memory pictures emerge, this is not yet 'thinking'. And when such pictures form series, each member of which calls forth*

another, this too is not yet thinking. When, however, a certain picture turns up in many such series, then – precisely through such return – it becomes an ordering element for such series. Such an element becomes an instrument, a concept. I think that the transition from free association or 'dreaming' to thinking is characterised by the more or less dominating role which the 'concept' plays in it".

Table of Contents: Chapter 2

Synopsis: Chapter 2

In this chapter, the core elements attributing to the research problem ('causal elements'), and elements which will ultimately facilitate the answer to the research question ('remedial elements') will be analysed. The analysis is underpinned by appropriate literature reviews, and will deal with the following elements:

- **Intervention:** This core 'remedial element' will be analysed in terms of intervention types, with focus on planned and forced interventions. It is specifically the concept 'planned intervention', which is of particular importance in this thesis as the set of mitigating factors to be formulated, is based on this premise.
- **Project Failure Dynamics:** These core 'causal elements' will be analysed in terms of their general impact on information technology development, and also in terms of their impact on major technology driven projects. This is an important part of the chapter, as the project failure dynamics are the very elements, which mooted the research in this thesis.
- **Business requirement functional specifications:** Business requirement functional specifications are the key dynamics in this thesis and will be analysed supported by related factors impacting the concept namely, 'quality' and 'user focus'.
- **Project management:** In the analysis pertaining to project management, the main focus is centered on change dynamics in support of the concept 'planned intervention'.

Chapter 2

Intervention and Project Failure Dynamics

> *"The world that we have made as a result of the level of thinking we have done thus far creates problems that we cannot solve at the same level as they were created."*
>
> **Albert Einstein**

2.1 INTRODUCTION

The research question reads: 'Can a set of mitigating factors be developed from a structured sequence of events, using a multimethodology approach to facilitate the intervention and subsequent management of key factors (as defined), contributing to the failure of management information systems development projects undertaken in the financial services industry?' The analysis in this chapter is aimed at analysing the core elements attributing to the research problem ('causal elements'), and elements which will ultimately facilitate the answer to the research question ('remedial elements'). The analysis is underpinned by appropriate literature reviews, and will deal with the following elements:

- **Intervention:** This core 'remedial element' will be analysed in terms of intervention types, with focus on planned and forced interventions.
- **Project Failure Dynamics:** These core 'causal elements' will be analysed in terms of their general impact on information technology development, and also in terms of their impact on major technology driven projects.
- **Business requirement functional specifications:** Business requirement functional specifications are the key dynamics in this thesis and will be analysed supported by related factors impacting the concept namely, 'quality' and 'user focus'.
- **Project management:** In the analysis pertaining to project management, the main focus is centred on change dynamics, the latter forming a key element in the formulation of the set of mitigating factors. It is of importance to note that 'project management' as referred to in this thesis will be limited to the interface with certain elements of the project development lifecycle as it

pertains to the concepts 'intervention' and 'business requirement specifications'. The chapter will be concluded with the survey results on project failure dynamics, the detail of which is contained within the ambit of Appendix D.

The analytical process followed thus far, is graphically depicted in Figure 2.1, which places the chapters in context with the overall thesis objectives, and furthermore indicates the relative positioning of this chapter.

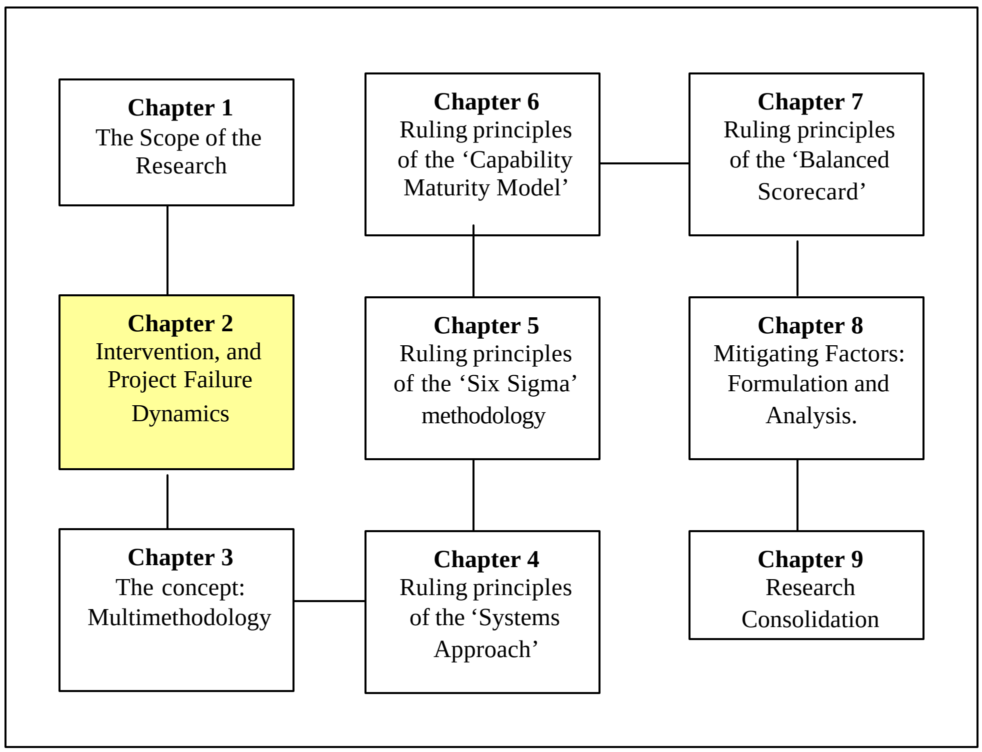

Figure 2.1: Chapters in context of the overall research

2.2 ANALYSIS OF 'INTERVENTION' AS CORE REMEDIAL ELEMENT

Before an analysis of 'interventions' are attempted, it is appropriate to define the task of the 'interventionist'. Argyris (1970:31) defines 'interventionist' as:

> *"Someone who enters an ongoing system or set of relationships primarily to achieve three tasks. They are (1) to help generate valid and useful information (2) to create conditions in which clients can*

make informed and free choices, and (3) to help clients develop an internal commitment to their choice".

The Oxford English Dictionary (1989:Vol. viii) defines 'intervention' as:

"The action of intervening, 'stepping in' or interfering in any affair, so as to affect its course or issue".

It is interesting to note that The Oxford English Dictionary does not limit itself to this definition, but also expands the concept of intervention to a category, which contains an element of 'force'. This is demonstrated in the following *caveat* when referring to the application of intervention as being:

"frequently applied to the interference of a state of government in the domestic affairs or foreign relations of another country".

From this the analogy can be drawn that this statement would also hold true if the words 'or foreign relations of another country', were substituted with 'an organisation'.

The focus that Cummings & Worley (1997:141) place on interventions concentrates on 'help' to the organisations when they define the concept as:

"A set of sequenced planned actions or events intended to help an organisation increase its effectiveness".

Cummings & Worley (1997:141) expand this definition when they view interventions as 'a mechanism, which purposely disrupt the *status quo* to deliberately attempt to change an organisation to a different and more effective state'. The focus on 'help' which Cummings & Worley (1997:141) place on interventions, is echoed by Argyris (1970:15) who defines 'intervention' as:

> *"To intervene is to enter into an ongoing system of relationship, to come between or among persons, groups, or objects for the purpose of helping them"*.

Chin & Benne (1973:310), introduce an element of 'generalisation' to the definition of intervention when they identify one element applicable to all approaches of planned changes (interventions), namely:

> *"the conscious utilisation and application of knowledge as an instrument or tool for modifying patterns and institutions of practice"*.

A different perspective of planned change interventions is provided by Porras & Silvers (1991:54). These authors divide 'planned change interventions' into two general types, namely into 'organisation development', and into 'organisation transformation'. The latter being defined as:

> *"a set of behavioural science theories, values, strategies, and techniques aimed at the planned change of any organisational vision and work settings with the intention of generating alpha, beta, gamma (A) and/or gamma (B) cognition change in individual organisational members, leading to behavioural change and thus promoting paradigmatic change that helps the organisation better fit or create desirable future environments"*.

A similar definition is provided by Porras & Silvers (1991:54) for organisational development, however here the focus is concentrated on 'creating a better fit between the organisation's capabilities and its current environmental demands'. Chin & Benne (1973:311) also identify a type of intervention falling into the ambit of a different sphere as to the intervention defined by Argyris (1970:15 and 18–20) (containing the element of 'free informed choice'). This type of intervention is defined by Chin & Benne as:

> *"getting the authority of law or administrative policy behind the change to be affected".*

The net effect of such a forced intervention would culminate in the organisation to customise its re-engineering, and change programmes to the norms of such interventions (Watkins *et al.*1999:5).

2.2.1 INTERVENTION TYPES

Interventions can be categorised into various groups, which are dependent on the individual view placed on the concept 'intervention'. Cummings & Worley (1997:145), categorise interventions according to the kinds of organisational issues they are intended to resolve and list the following four categories of interventions:

- **Strategic Interventions:** Strategic progress directed at how the organisation uses its resources to gain a competitive advantage in the larger environment.
- **Techno-structural Interventions:** Techno-structural methods are directed at information technology and structures for linking people and technology.
- **Human Resource Management Interventions:** Interventions aimed at successfully integrating people into the organisation.
- **Human Process Interventions:** Human process programs aimed at people within organisations and their interactive processes.

If the analogy can be drawn from the four categories of interventions listed above by Cummings & Worley (1997:145) that they, (in terms of their definition of interventions), 'attempt to change an organisation to a different and more effective state', then these interventions map the objectives which Schaffer & Thomson (1992:83) attach to interventions, namely that they have the objective of being 'results-driven' (as opposed to 'activity centred'). Schaffer & Thomson (1992:83) define 'results-driven' interventions as programmes, which bypass lengthy preparations and aim for quick measurable gains within a few months and have the following methodological base:

- They are measurable short-term performance goals.
- They lead directly toward improved results.

- Force immediate results.
- Require a team effort.
- Results are verifiable.
- Process is initiated with minimum capital outlay.

Argyris (1970:31–32) identifies the following three types of intervention activity:

- **Interventions based upon existing knowledge and techniques:** This type of intervention is used when little time is available to resolve problems or the organisation lacks the resources for a more comprehensive study.
- **Interventions involving the creative arrangement of existing knowledge:** This type of intervention is used when the client system has adequate time, resources and permits experimentation to accurately perceive the potential of the system.
- **Interventions which involve the resources of the interventionist:** This type of intervention calls for resources to be joined together to conduct an intervention that helps the client understand the nature of its problem and adds to the basic theory of intervention activity. Furthermore, this activity assists the client system and simultaneously helps to develop new conceptual models that explain a particular case.

Chin & Benne (1973:311–324) identify three types of strategies for changing (interventions) namely:

- Empirical rational strategies.
- Normative re-educative strategies.
- Power-coercive approaches.

A 'power coercive approach' is a concept explored by Argyris (1970:15), however not within the context of either planned or forced interventions. Although not specifically defined as such, Argyris (1970:15) cites examples of 'other' intervention types which clearly points to interventions which are not 'planned' by the organisation but neither aimed at 'forcing' the organisation, or more specific in the words of the said author:

> *"to coercing the clients to do what the intervenor wishes them to do".*

This train of thought is in line with 'revolutionary' changes as suggested by Blake & Mouton (1973:164), where change is effected through the exercise of power and authority, which compels compliance. Argyris (1970:15–16) cites an example of such an activity namely: Modern militants who intervene to demand that a university change their entry level criteria in accordance with their wishes. The issue of forced interventions are dealt with in Paragraph 2.2.1.2 of this chapter, however it is of importance to note that the foregoing view of Argyris (1970:15–16) pertaining to 'other' intervention types, is not supported by the author. This is based on the fact that forced interventions, although normally emanating from a source external to an organisation could, as an exception rather than the rule, have a source internal to the organisation. This falls within the ambit of the definition of Argyris (1970:15), of 'other' intervention types, and the definition of Chin & Benne (1973:324-325) of 'power-coercive approaches'.

Three basic requirements for intervention activity are listed by Argyris (1970:17–20) namely:

- Valid and useful information.
- Internal commitment.
- Free informed choice.

The latter is of particular interest when intervention types are analysed as Argyris (1970:17) upholds the view that:

> *"…free, informed choice is also a necessary process in effective intervention activity"*

'Free, informed choice' is clearly associated by Argyris (1970:17) with a planned intervention. For this reason, the following rather lengthy description of a planned intervention is provided by Argyris (1970:19):

> *"A choice is free to the extent that the members can make their selection for a course of action with minimal internal defensiveness; can define the path (or paths) by which the intended consequences is to be achieved, can relate the choice to their central needs, and can*

> *build into their choices a realistic and challenging level of aspiration. Free choice therefore implies that the members are able to explore as many alternatives as they consider significant and select those that are central to their needs."*

The importance of choice when the correct type of intervention is sought, is according to Cummings & Huse (1989:134) who maintained that:

> *"Choosing appropriate intervention requires careful attention to the needs and dynamics of the change situation, the skills of the practitioner, and the effectiveness and applicability of the change method".*

The methodology proposed by Porras & Robertson (1987:24) to use in choosing the appropriate intervention involves diagnosing the organisation to determine what gaps exist between actual and desired organisational functioning.

The 'force' element contained within interventions (acknowledged by Argyris (1970:15) and confirmed by Chin & Benne (1973:325), with their aptly termed 'power-coercive' approaches, requires further analysis. Government legislation with the objective to regulate the financial services industry serves as an example of such an approach. Another example is the steps the State is taking to change information technology in respect of black participation (Stones 2002:1). These examples fall within the ambit of a forced intervention, but also enforce the definition which Chin & Benne (1973:325) associates with a power-coercive approach namely, 'that particular power carries with it legitimacy and the sanctions which accrue to those who break the law'. An example cited by Chin & Benne (1973:325) supporting the elements of a forced intervention embedded within their 'power-coercive approach', reads as follows:

> *"Getting a law passed against racial imbalance in the schools brings legitimate coercive power behind efforts to desegregate the schools, threatening those who resist with sanctions under the law*

and reducing the resistance of others who are morally oriented against breaking the law."

Table 2.1 selectively adapted from a figure provided by Chin & Benne (1973:312) under the title 'Strategies of Deliberate Changing', provides insight into not only the concept of 'power-coercion', but also of the concept falling within the ambit of a 'forced intervention'. Three focus strategies are being addressed in Table 2.1, namely 'non-violent strategies', use of political institutions', and changing power elites'.

POWER-COERCION AS A FORCED INTERVENTION STRATEGY		
NON-VIOLENT STRATEGIES	**USE OF POLITICAL INSTITUTIONS**	**CHANGING POWER ELITES**
Thoreau Gandhi Martin Luther King Conflict confrontation. Strikes Sit-downs Negotiations Administrative rulings	Ballot laws Compromise Judicial decisions Administrative decisions	Marx C. W. Mills F. Hunter Influencing power Deciders Building countervailing power against established power.

Table 2.1: Power coercion as a forced intervention strategy.

Should the steps taken by the State to change information technology in respect of black participation therein be superimposed and mapped to the example provided by Chin & Benne (1973:312), it would leave the reader with no doubt of the elements contained within the ambit of a forced intervention. The adjusted example for the purpose of the argument, now would reads as follows: 'Getting a law passed against racial imbalance in the information technology industry, brings legitimate coercive power behind efforts to desegregate races within the workplace, threatening those who resist with sanctions under the law'.

2.2.1.1 PLANNED INTERVENTIONS

Porras & Silvers (1991:53) provide a conceptual model of planned change, which deals with the change interventions associated with organisational transformation and organisational development. If organisational transformation and organisational development interventions are categorised to fall within the ambit of planned interventions, the model of Porras & Silvers (1991:53) can be adapted to illustrate the core components, variables and process flows associated with planned intervention implementations. Figure 2.2 depicts the components, variables and process flows associated with planned intervention implementations.

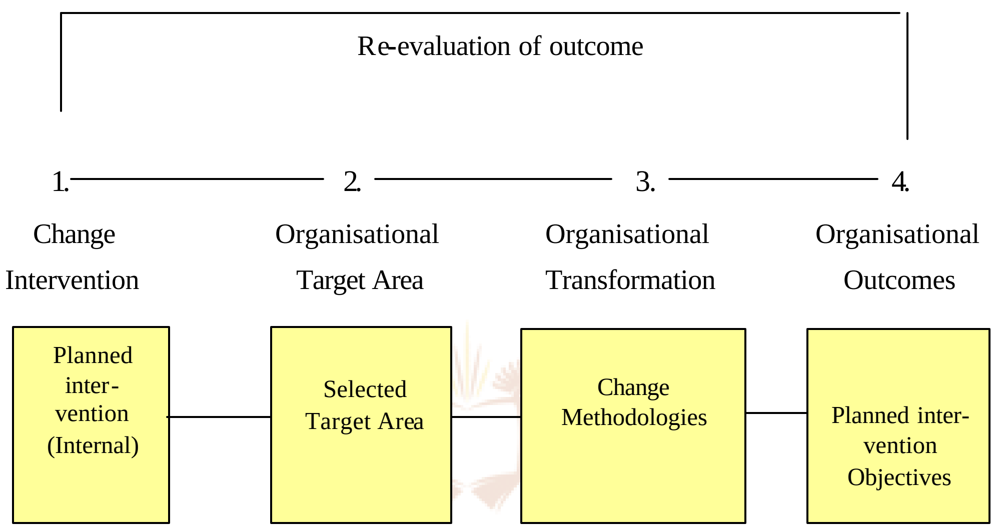

Figure 2.2: Components, variables and process flows associated with planned intervention implementations. Adapted from Porras & Silvers (1991:53)

An analysis of the components of Figure 2.2 returns the following critical components:

- **Change Intervention (1):** The change intervention applicable (planned) is internal to the organisation as a result of a decision from management to change. Business process reengineering initiatives, information technology development projects, change in corporate strategy or change in corporate culture serves as examples of planned interventions internal to the organisation.
- **Organisational Target Area (2):** A planned intervention normally targets a selected area within the organisation as opposed to the whole organisation. An information technology project to address client scoring in the retail section of a financial service institution serves as an example.
- **Organisational Transformation (3):** The definition which Porras &

Silvers (1991:54) associate with organisational transformation is adapted as follows to map the concept of a planned intervention as presented in this thesis: 'A set of behavioural science theories, values, strategies, and techniques aimed at the planned change of the identified target area with the intention to bring about paradigmatic change in processes, the environment and individual organisational members, culminating in sustained process improvement at all levels within the organisation'.

- **Organisational Outcomes (4):** Due to the fact that the organisational outcomes are governed by the focus of the initial (planned) change intervention, the outcomes should ideally if the intervention is successful, map to the original objectives of the intervention. From this the analogy can be drawn (assumed the planned intervention is successful), that the organisational outcomes would bring about paradigmatic changes in processes, the environment and individual organisation members, culminating in sustained improvements at all levels within the organisation.

Against the background of the above analysis, and in particular pertaining to this thesis, planned interventions can now be re-defined as:

> *"Any planned information technology based project development initiative internal to the organisation, structured to address a specific target area within the organisation to effect paradigmatic change to technology, processes or people, culminating in sustained improvements at all levels of the organisation"*

This definition will be taken forward and applied within the context of this thesis and will be associated with any further references to planned interventions.

2.2.1.2 FORCED INTERVENTIONS

Using the same conceptual model of Porras & Silvers (1991:53), which depicts planned change, the model (as in the case of planned interventions), can also be adapted to illustrate the core components, variables and process flows associated with forced intervention implementations. Figure 2.3 depicts the components, variables and process flows associated with a forced intervention.

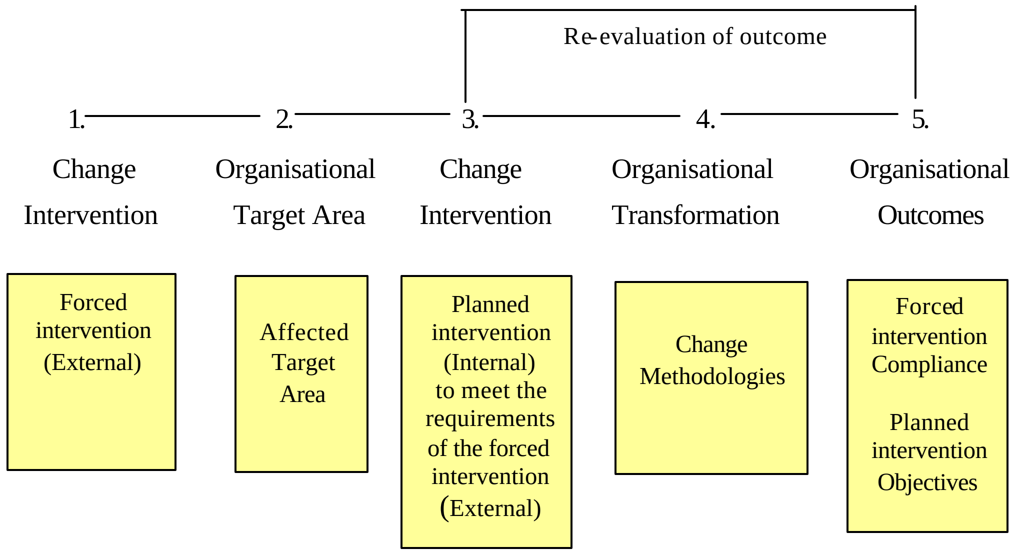

Figure 2.3: Components, variables and process flows associated with a forced intervention implementations. Adapted from Porras & Silvers (1991:53)

An analysis of the components of Figure 2.3 returns the following critical entities:

- **Change Intervention (1):** The change intervention applicable is external to the organisation. Changes envisaged by the State as alluded to by Stones (2002:1), to change the information technology industry in respect of black participation therein, can be considered to be a forced intervention type. Scott (1986:491), list the following examples of forced interventions which also have tangent planes with the financial services industry:
    - New accounting rules to be adhered to, such as switching from LIFO to FIFO, or changing the accounting methodology to AC129.
    - Changes in payroll tax le gislation.
    - A subsidiary is acquired or sold, or a merger is being negotiated.
    - Union contract changes alter the pension fund accounting rules.

This is supported by Beckhard & Harris (1987:30), who are of the opinion that the forces requiring change in large organisations today, tend to originate outside the organisation, like the cited change in legislation, market demands resulting from world-wide competition, development of new technology and social responsibility.

- **Organisational Target Area (2):** A forced intervention normally targets areas directly affected by such a forced intervention. In the case of legislation to say change the procedures in dealing with currency fraud control in South Africa, the areas to be effected within the financial services industry would typically be:
  - Staffing.
  - Processes and procedures.
  - Training.
  - Technology.
- **Change Intervention (3):** This change intervention pertains to a planned intervention 'internal' to the organisation formulated especially to meet the requirements of the forced intervention 'external' to the organisation. This is supported by Wallace & Ridgeway (1996) who observe that internal changes (planned interventions), are frequently the result of dramatic change (forced interventions) from the external environment. The following serves as an example: Should one of the requirements of the forced intervention be that the systems in financial institutions be upgraded to control the risk of foreign exchange transactions in terms of a Central Bank compliance requirement, a specific planned intervention must be formulated to comply and meet the requirements as set out by the forced intervention. Such planned intervention may take the form of immediately upgrading the skills level of managerial staff, an upgrade in technology to handle the required functionality, process changes and training.
- **Organisational Transformation (4):** The same norms would apply as cited in Figure 2.1.
- **Organisational Outcomes (5):** Here again, the outcomes map to the outcomes of a planned intervention as cited in Figure 2.2 with one difference, namely 'forced intervention compliance'. When a forced intervention, (in the words of Chin & Benne 1973:311) 'is subject to getting the authority of law or administrative policy behind the change to be affected', it is to the advantage of the organisation as a whole and its people to comply with the demands of such an intervention. It is thus important that compliance to the forced intervention is adhered to and viewed as a specific outcome of the forced intervention.

It is of interest to note, specifically in view of the research at hand taking place in an environment of information technology driven infrastructures, that Porras & Silvers (1991:65) identify two specific interventions taking place in the technology area. Their research returned that interventions in the technology area have utilised primarily 'socio-technical systems' and 'quality of work life approaches'. Furthermore, that a most recent variant of these two approaches uses parallel organisations as a key mechanism to implement change. Parallel organisations according to Herrick[1] cited by Porras & Silvers (1991:65) can be viewed as a 'metapractice' of the socio-technical systems theory, which serves as models leading to the implementation of the socio-technical systems concept across the whole organisation.

Against the background of the above analysis, 'forced interventions' can now be defined as:

> *"Any forced information technology initiative external or internal to the organisation, structured to focus on either a specific target area within the organisation, or on the whole organisation to effect paradigmatic change to technology, processes or people in the organisation, in compliance with the law of the land, and require a planned intervention to affect such change."*

This formulated definition is of importance as it will be taken forward and applied within the context of the set of mitigating factors to be formulated in Chapter 8. In addition, this definition will be associated with any further references to forced interventions.

2.3 ANALYSIS OF 'KEY FACTORS' AS CAUSAL ELEMENTS

In dealing with key factors as 'causal elements', the focus will be on the quality aspect of software development which has in the past few years received much attention in the financial services industry, if compared to project failure within

[1] Hirrick NQ. 1985. Parallel Organizations: Implications for Organizational Research. *Hum. Relat.* (38) pp963–981.

the ambit of information technology. In software and products which are the prevalent entities marketed by the financial services industry, the concept of quality usually incorporates both the 'conformance' and 'service views' of quality. This according to Prahalad & Krishnan (1999:111), are reflected in the fact that:

- Customers will not tolerate errors (for example on their financial statements).
- Customers would equally not tolerate it when they are experiencing problems with software applications provided by the financial services industry (for example when using an automated teller machine).

'Key factors', which forms the 'causal elements' within the ambit of this thesis, consist of:

- The quality of business requirement functional specifications.
- Change to business requirement functional specifications, while the latter is still in the process of being developed.

Despite the enormous attention project management and analysis have received over the years, the track record of projects is fundamentally poor. Projects are often completed late and or over budget, do not perform in the way expected, involve severe strain on participating institutions or are cancelled prior to their completion after the expenditure of considerable sums of money. The analogy can be drawn that under-performance on information technology projects represent a significant, but substantially avoidable loss of economic value (Sauer *et al.* 2001:39). While the area of research in this thesis is restricted to management information development projects undertaken in the financial services industry, the literature reviews will cover a spectrum of project failure dynamics in a number of technology development initiatives.

2.3.1 PROJECT FAILURE DYNAMICS: GENERAL

The general view of Newport 1986:132-142) is that 'we continue to provide too many project failures marked by cost overruns, late deliveries, poor reliability and user dissatisfaction'. Lyytinen (1988:61) conducted a comprehensive survey of the empirical literature concerning in formation systems failures and concluded that:

> *"Studies ranging from personal biographies, and case studies up to statistical surveys all show that information systems problems are so widely spread and pervasive that one may speak of information systems failures. Many reports show that somewhere between one-third to half of all systems fail, and some researchers have reported even higher failure rates"*.

An important analogy can be drawn from the above namely, that while the nature and causes of information systems failures are extremely varied, they can all be seen ultimately as failures of expectations – that is, the final information system did not meet in some way the legitimate expectations of the end users. This emphasis the requirement for the research undertaken in this thesis.

2.3.2 PROJECT FAILURE DYNAMICS: MAJOR PROJECTS

An interesting statistic is provided by Maglitta (1994:85) on the failure of reengineering projects, the latter which is described by Martinez (1995:52) as extreme examples of large scale projects. The statistics read that reengineering projects *per se*, have failure rates ranging from a high of 84% to a low of 25%. An article on the Piece Schield project by Baker & Silverberg (1989), describes this project, which was then four years behind schedule and estimated to be up to USD 300 million over budget. Morris & Hough (1987:4) draws the conclusion from the above analysis that project management fails to take a strategic interest in how projects can better achieve the objectives of those promoting, undertaking or being affected by them. Morris & Hough (1987:212) conclude their observations on the reasons for project failure by making the following statement:

> *"The worst situation, perhaps, is where the objectives of the project change imprecisely during the project without proper recognition of the new situation. Unrecognised change is a classic cause of catastrophic failure."*

Data specifically adapted from Morris & Hough (1987:2-3) to reflect the tangent planes with this research, reflect the project failure dynamics for predominantly major[2] projects, is shown in Table 2.2.

Projects Studied	Overrun	Principle Reasons
940 US civil and military projects. (1997)	75% cost increase. $346 billion to $607 billion.	Schedule changes.
444 US civil and military projects. (1982)	140% cost increase. $460 billion to $842 billion.	Schedule changes.
25 US weapon systems projects. (1970)	50% – 700% cost increase.	Complexity.
36 US weapon systems projects. (1971)	0% – 220% overrun.	Scope changes 50%.
61 TVA projects 68 Corps of engineers projects 79 Bureau of reclamation projects. (1970)	-18% to + 16% cost overrun. -35% to + 55% cost overrun. -34% to + 80% cost overrun.	Design changes. Schedule changes. Scope changes.
13 Indian irrigation and power projects. (1964)	12% - 230% cost increase.	Design changes.
187 Indian public sector projects. (1964)	19% to +45% cost increase, 0% - 19% schedule overrun.	Scope and design changes.
13 UK Power projects 16 UK Oil and chemical plants.	0% - 50 % cost increase. 0 – 27 month (35%) schedule increase.	Late design information and too many changes.

Table 2.2: Major project failure reasons. Adapted from Morris & Hough (1987:2-3)

Mitigation for the above is provided by Morris & Hough (1987:218 and 267) as follows:

- Once agreed, design should be 'frozen' and changes made only in the most controlled of circumstances.
- External forces influencing the project definition must be monitored and their impact on the project managed.

[2] The following serves as examples of major projects: The Channel Tunnel (1960-1975). Concord (Aerospace). The Thames Barrier. Heysham 2 (Power Station). Fulmer (North Sea oil and gas).

In a summary of project success and failure in respect of large projects, Morris & Hough (1987:273-290) provides the following list, which has been adapted for the purpose of this thesis:

- Poor project definition[3].
- Need for formal reviews.
- Project preparation.
- Control of changes.
- Changing corporate strategies.
- Design faults.
- Unclear objectives.
- Changes in specifications.
- External factors.

2.3.3 PROJECT FAILURE DYNAMICS: INFORMATION TECHNOLOGY PROJECTS

The software development industry suffers severely as a result of project failures. A survey conducted by The Standish Group (1995:1-7) included some 365 respondents which represented 8380 applications, of which only 12% of these projects were on time and on budget. The survey returned the following data, which are contained in table format below for ease of reference:

- **Cost overruns:** The average across all companies is 189% of the original cost estimate. The average cost overrun is 178% for large companies, 182% for medium companies, and 214% for small companies.

Cost Overruns	% of Responses
Under 20%	15.5%
21% – 50%	31.5%
51% - 100%	29.6%
101 – 200%	10.2%
201% - 400%	8.8%
Over 400%	4.4%

[3] 'Definition' in this context, is interpreted as being the 'business requirement specifications' of a project.

- **Time overruns:** For the same combined challenged and impaired projects, over one-third also experienced time overruns of 200% to 300%. Sometimes, project issues are glossed over or not addressed in the hope, usually in vain, that things will improve over time (Murray 2001:26). The average overrun is 222% of the original time estimate. For large companies, the average is 230%, for medium companies, the average is 202%, and for small companies, the average is 239%. The sheer amount of money spent on extended implementations is overshadowing historic information technology spending (Kehayas 2000:42). This leads into the dilemma that by the time a system is implemented, the company's business processes, markets and customer needs have changed, and so has the technology (Coetzer 2000:1).

Cost Overruns	% of Responses
Under 20%	13.9%
21% – 50%	18.3%
51% - 100%	20.0%
101 – 200%	35.5%
201% - 400%	11.2%
Over 400%	1.1%

- **Content deficiencies:** Reflects the quality of business requirement specifications and the survey reflected that more than a quarter were completed with only 25% to 49% of originally specified features and functions. On average, only 61% of originally specified features and functions were available on these projects. Large companies have the worst record with only 42% of the features and functions in the end product. For medium companies, the percentage is 65%. And for small companies, the percentage is 74%.

% of Features and Functions	% of Responses
Less than 25%	4.6%
25% - 49%	27.2%
50% - 74%	21.8%
75% - 99%	39.1%
100%	7.3%

The most important aspect of the research by The Standish Group, is discovering why projects fail. This was achieved by surveying information technology executives for their opinions about 'why projects succeed'. The three major reasons that a project will succeed are:

- User involvement.
- Executive management support.
- Clear statement of requirement.

These reasons or derivatives thereof, if evaluated under the headings of: 'Project success factors', 'Project challenged factors' and 'Project impaired factors' return the following:

Project Success Factors	**% of Responses**
User involvement	14.7%
Clear statement of requirements	12.0%
Clear vision and objectives	1.7%
Project Challenged Factors	**% of Responses**
Lack of user input	11.8%
Incomplete requirements and specifications	11.3%
Changing requirements and specifications	10.8%
Project Impaired Factors	**% of Responses**
Incomplete requirements	12.1%
Lack of user involvement	11.4%
Changing requirements and specifications	7.7%
Didn't need it any longer	6.5%

A later survey conducted by KPMG in Canada during 1997, also focussed on information technology development projects with equal disconcerting results as reflected in The Standish Group report of 1995. The survey by KPMG (1997:7), found that failure by overrunning schedule, was by far the most common as 87% of failed projects exceeded their initial schedule estimates by 30% or more.

One of the most common reasons for project failure, which was cited in the KPMG report (1997:9), was poor project planning, of which 51% of the respondents who identified this a problem attributed it to 'change in scope of technology, functionality, or business case'. Furthermore, under the heading of 'business and operational changes needed to deliver the benefits', returned 48% of the respondents agreeing. The KPMG report (1997:13), cited that ten percent of respondents who reported failed projects, relayed through open comments that they ran into problems at least partially due to poor definition of requirements or specifications. A further finding, very pertinent to the financial services industry in South Africa, which are invariably made up of large conglomerates, the survey results showed that in general, the larger the organisation, the greater the danger of suffering from serious budget overruns.

The following interesting statistics are provided by Yeh *et al.* (1988:147), which relates to the lack of thorough attention to requirement analysis and specification:

- Two large command/control systems, 67% and 95% respectively of the software had to be rewritten after delivery due to mismatches with user requirements.
- Cancellation of the USD 56 million Univac-United Airlines reservation system and the USD 217 million Advanced Logistics system.
- In general it has been found that 'design errors', (all made before implementation) range from 36% to 74% of the total error count. Furthermore, a design error takes from 1.5 to 3 times the effort of an implementation error to correct.

While not specifically specifying the root cause, Turban *et al.* (1999:564), provide the following 'despairingly' statistic relating to software development projects namely, that 73% of the software development projects at 360 US corporations were cancelled, over budget or late! The root cause of the above can be mapped to management's undisciplined approach to software management (Humphrey 2002:17-23). The five most common causes of project failure according to Humphrey (2002:17-23), are:

- **Unrealistic schedules:** When software projects starts with unrealistic schedules, they are invariably delivered much later than they would have been with a rational plan.
- **Inappropriate staffing:** When management fails to provide timely, adequate, and properly trained resources, their projects will generally fail.
- **Changing requirements during development:** While the requirements change might seem to be the source of the problem, it may only be a catalyst.

- **Poor quality work:** There is a saying about software quality: ' If it doesn't have to work, we can build it really fast'.
- **Believing in magic:** It generally cost as much to test and fix a defective product as it took to develop it in the first place.

According to Wheelwright and Clark cited by Burgelman *et al.* (2001:901), 'the themes that characterise outstanding development projects are clarity of objectives, focus on time to market, integration inside and out, high-quality prototypes and strong leadership'.

2.3.3.1 OUTSOURCING

To mitigate the failures commonly associated with information systems development, a number of organisations associated with the financial services industry has resorted to 'outsourcing'. Devaris & Levy (2000:5) make the observation, that 'three years ago, one in twenty jobs was outsourced, now it is in the region of one in twelve'.

The objective of outsourcing is that it enables management to focus on core activities and improved profitability through improved work efficiencies and through cost saving measures implemented by outside service providers (Armitage 1999:31). This view is supported by Van Vuuren (2001:33) who confirms that outsourcing has helped to conserve budgets and has been key in improving quality of performance.

2.4 BUSINESS REQUIREMENT FUNCTIONAL SPECIFICATIONS

The term 'business requirement functional specifications' as used in this thesis, was specifically selected as it is commonly associated with business specifications drawn for the financial services industry. The terms 'information system studies', 'information analysis', 'information requirement analysis' (Goldkuhl 1987:338), 'information requirements analysis' and 'requirements analysis' (Turban 1999:531), 'requirements engineering' (Williams and Kennedy 2001:1), are in the opinion of this author more commonly used by the information systems development industry. With regard to business requirement functional specifications, recognition of the role of requirements is beginning to emerge within the entire software development community. Requirements provide the direction that guides every aspect of the design activity and are the standards against which the developed software ultimately must be validated (Bunyard and Coward 1982:79).

The general function of information systems are to determine user needs, to select pertinent data from the infinite variety available from an organisation's environments (internal and external), to create information by applying the appropriate tools to the data selected, and to communicate the generated information to the user (Nichols 1987:8). The overall purpose of requirements analysis is to determine user and organisational needs (Smith 1989:963-981), which can involve assessing the systems' ability to adapt to changing user needs (Stair 1992:425). In view of the author of this thesis, a more appropriate categorisation for the financial services industry of reasons for developing information systems is provided by Senn (1990:648), namely:

- To solve a problem.
- To capitalise on an opportunity.
- To respond to a directive.

Information systems requirement development within the financial services industry can be compared favourable with the broader view of Finkelstein *et al.* (1990:1) on information systems development *per se* namely, that 'the development is considered to be a complex engineering task in a real-time system, which is tightly embedded in its environment'. This view is supported by Putman (1991:105) and Rook (1988:108), and adds that the development and maintenance of large-scale software systems is considered as being the most complex undertakings that management can be faced with. An opposing yet very valid view is upheld by Gibson & Jackson (1987:119), who are of the opinion that 'the fact that information systems have a reputation of being complex and difficult to build and use, is a barrier to integration'.

Davis (1987:238-239), proposes two levels of information requirements:

- **Organisation-level information requirements:** To define an overall information systems structure and to specify a portfolio of applications and data basis.
- **Application-level information requirements:** To define the detailed information requirements for an application.

Gutierrez (1987:348) proposes that the analysis of information requirements involve the following:

- Observing, selecting and recording organisational tasks.
- Interpreting and transforming these accounts into understandable means of communication.
- Verifying that these requirements have been incorporated into a working model.
- Assuring that the end product will satisfy the needs of the users in their own working environment.

Requirements *per se*, according to Valusek & Fryback (1987:140) can be thought of as the representation of a need. The latter represents a gap between the existing conditions and the desired conditions. This emphasises the fact that the processes which are used to create products, are as important as the products themselves (Colson & Prell 1992:49). The term 'business requirement functional specifications' as used in this thesis, maps the definitions which Githens (2000:49) attach to the individual concepts of 'requirement' and 'specification', namely:

- **Requirement:** A term, which is defined as the capacity or capability that is needed for describing the project's product, thus satisfying a set of customer purposes.
- **Specification:** A term, which is defined as a formal notation of requirement.

Githens (2000:50), defines the purpose of project requirements management, or in terms of this thesis, the purpose of 'business requirement functional specifications', as being:

> *"The building of a valid knowledge structure that communicates the essential characteristics of 'the problem' as input to project design and implementation"*

The formulation of a business requirement functional specification is conceived of as a process involving a series of steps (King & Cleland 1987:308), which reads as follows:

- Identification of user set and interfacing organisations.
- Identification of decision areas.
- Development of a descriptive model of the system.
- Development of a normative model of the system.
- Development of a consensus model of the system.
- Decision model identification and specification.
- Specification of information requirements.

An interesting deviation for this step by step process is to develop requirements with a view towards how they would be explained in the context of a user's manual (Howes 1987:173). A more recent approach by Githens (2000:57), proposes that this could be accomplished through the deployment of four processes, namely:

- Problem understanding.
- Requirements elicitation.
- Requirements specification.
- Requirements validation.

Bordering on simplicity, the formulation of business requirement specifications, 'involves determining an end user's specific information requirements and the information processing capabilities required for each system activity to meet these information needs (Smit & Cronjé 1992:168). Key to the capturing or recording of business requirement specifications, the following guidelines thereto comes from Berry & Parasuraman (1997:71), which reads: 'information precision and usefulness go hand in hand' and 'information that is overly broad or general, is not useful'. It is acknowledged that tangent planes exist between the concepts 'interface definition' and 'business requirement specification'. While not exactly within context, Boehm (1987:50) cites the instance 'that as early as 1961, software managers were realising that every sheet of accurate 'interface definition', is quite literally, worth its weight in gold'. This, according to Land & Kennedy-McGregor (1987:87), calls for the following pitfalls to be observed when formulating business requirement specifications, namely:

- The system when implemented meets the requirements established when the business requirement specifications were formulated – possibly two or three years previously – and not the present day requirements.
- The system is based on a model of the real world and of real world behaviour, which is untested and often in error.
- Failure to capture the deep knowledge about the system, which those who have to work with it '*the users*', (my italics) possess.
- To this, Kliem & Ludin (1998) 'selectively' add:
    - Work breakdown structures not having sufficient detail.
    - Work breakdown structures the result of the effort of one individual.
    - Work breakdown structures covering only a certain portion of the project.

A general statistic gleaned from the results of the 'McKinsey-UCLA Long Range MIS Planning Survey' cited by McLean and Sodon (1977:65), returned that the user community had little confidence in the MIS group's ability to deliver major new information systems on time within budget and meeting required specifications. While not necessarily within context, it is according to Pascale *et al*. (1997:136), 'to bridge the gap between overall strategy and individual performance *strategy*' (my italics). This, in the opinion of Davenport (1993a:1) can be achieved by the concept 'process innovation', which combines the adoption of a process view of the business with the application of innovation to key processes. Furthermore, in return it is information technology which will act as enabler of process innovation (Davenport 1993a:49).

Functional completeness pertains to the extent to which a software system meets user requirements (Sneed 1989:74). It is divided into:

- **Informational completeness:** Which implies that all the results or output data requested by the user are actually produced.

$$\text{Informational completeness} = \frac{\text{Actual results}}{\text{Target results}}$$

- **Procedural completeness:-** Which implies that all the actions and conditions requested by the user are actually carried out.

$$\text{Procedural completeness} = \frac{\text{Actual actions/conditions}}{\text{Target actions/conditions}}$$

Functional completeness should also take into consideration the information need of managing executives, an aspect which is readily overlooked during the formulation of business requirement functional specifications. Rockart (1979:274) suggests that 'one should take into account the requirements of individual managers current information needs'.

2.5 THE QUALITY OF BUSINESS REQUIREMENT FUNCTIONAL SPECIFICATIONS

The 'Deming management method' advocates quality as 'a new religion'. Deming cited by Walton (1996:58), emphasises that:

> *"…we can no longer afford to live with mistakes, defects, and inattentive sullen service".*

Common measurements of software quality according to Phan (2001:57), are:

- Mean time between failures.
- Mean time to repair a fault.
- Defect rate by hour, day, week or month.
- Defect rate per unit of software size, such as function point or thousand lines of code.
- Size of defect backlog.
- Number of clean lines of code or system components that passed quality assurance on the first attempt.
- Cumulative defects per version.
- Timelines of response to defect or time to fix defect.
- Customer level of satisfaction with software and quality of work done to fix defects.

- Rate of defects per unit of software size discovered in the first year after delivery.

Statistics gathered on the quality of user requirements for software development, show that in two large command/control systems, 67% and 95% respectively of the software had to be rewritten after delivery because of mismatches with user requirements (Boehm 1973:48-60). Furthermore, according to Yeh *et al.* (1988:519-520), there are also many examples of total cancellation of projects due to the lack of appropriate requirements. This leads to the analogy that as the requirement phase takes place early in the development lifecycle, it has a tremendous impact on quality of the developed effort. This view carries the support of Ramamoorthy *et al.* (1984:194), who advoca tes that most development errors can be traced back to poor understanding or misinterpretation of user requirements.

The importance of business requirement specifications seems to be juxtaposed with the requirement for quality. These seemingly opposing requirements are explained by Wang *et al.* (1998:39), with the following *verbatim* extract:

> *"Too often, information technology departments empasize improving the quality of the delivery system and its components rather than optimizing the quality of the information product delivered to the consumer. The latter approach requires a thorough knowledge of the consumer's information needs and quality criteria".*

Requirements as per the previous paragraph, were identified as 'a representation of a desired condition', hence the observation by Elmendorf (1992:57), that 'quality is measured by customer delight'. This is linked to the concept of 'quality' by Valusek & Fryback (1987:141), when they determine that the 'quality' of that representation sets the upper bound on the quality of the resulting system. Gilbert (1983:100), defines quality specifications as :

> *"A precise statement of a set of program characteristics, each characteristic being called a quality, or, equivalently, a quality*

attribute. For each quality, a minimum acceptable level, a maximum desired level, and an expected or planned level are specified"

Support for the above definition is provided by Clark & Augustine (1992:151) who is of the opinion that, 'the quality of information can be expressed in terms of a set of attributes that define its nature'. The analogy is made by Ahituv & Neumann (1987:34) that, 'the quality of an information system is affected by its major characteristics (attributes)' an aspect, which is also supported by O'Reilly (1982:756:771) and Swanson (1987:131-145). In the same realm, the definition of quality provided by Stebbing (1987:489) reads: 'The totality of features and characteristics of a product or service that bear on its ability to satisfy a given need'. A study by Zmud (1978) suggests an eight-factor attribute structure to describe information, which was divided into four groups namely:

- Overall quality.
- Relevance.
- Presentation.
- Meaning.

Gilbert (1983:103) also provides the following three-step process, in which quality specifications can be attained, namely:

- Define the broad objectives of the system.
- Refine each broad objective into a set of detailed objectives.
- Quantify each detailed objective and desired system quality.

Turner (2000:267), provides the following short attributes of 'quality' in the context of projects, namely:

- Meets customer requirements.
- Meets the specification.
- Solves the problem.
- Fit for purpose.
- Satisfies or delights the customer.

Turner (2000:268-269), as in the case of Gilbert cited above, provides a five-element model for achieving quality, namely:

- Quality of product.
- Quality of management process.
- Quality assurance. (Right first time)
- Quality control. (Right every time, zero defects)
- Attitude. (Towards achieving success)

Kor and Wijnen (2000:57), provides the following advice on pitfalls regarding the quality aspect of business requirement specifications:

> *"The project has to be managed with requirements that are unclear (a broad support base), too wide (optimal), unmanageable (according to the verbal agreement), or too vague (as quickly as possible)"*.

The analogy from the above can be drawn that, 'quality does not just accidentally happen – it must be built in through a conscious process of specification of quality, design of quality, and assurance of quality by means such as the use of standards, inspection, and cross-checking against those standards' (Gilbert 1983:24). Commitment to quality in software development is described by Van Vliet (1993:70) as, 'a sheer necessity' as producers (the financial services industry), could be held liable for damage caused by defects in a project as manifested in the well documented radiation therapy disaster known as 'Malfunction 54'. A cautionary guide in this respect is provided by Forrester (1987:158), who is of the opinion that 'more is to be gained by improving areas of major importance than by optimising areas of minor importance'. This, from a business requirement specification perspective, relates to a full understanding of the user's true needs when a specification does not correctly reflect the intended processing, since such defect is not detectable in any other way. It is then not a surprise to learn from a survey conducted by the Journal of Marketing, under the heading 'What Customers Care About' and cited by Tschohl (1996:125), that 100% of the respondents chose 'product quality'.

It is of interest to note that the approach, which was developed by Ives & Ohlson (1984:591-593), to determine if a system complies to user requirements, contain two elements, which refer to quality, namely:

- System quality.
- Perceived quality or satisfaction of information requirements.

In summary, Pirsig (1989:253), defines quality as, 'the response of an organisation to its environment', however with the clear *caveat* that the term is also associated with a certain amount of elusiveness. In this respect, Pirsig (1989:187) states:

"What the hell is quality? What is it?"

Quality and business requirement functional specifications are synonymous, which is borne out by the clear statement of Huff (1992:50), that 'quality, first and foremost, means conformance to specifications'. This is supported by Humphrey (2001a:1), who states that, 'one critical requirement for lasting business success is meeting customers' needs and doing it as well or better than the competition'. This is supported by the exhortation of Mody (2000:4), which reads:

> *"…doing the right thing, right now, in the right place, every time, are imperative because first impressions are lasting ones".*

2.5.1 IMPACT OF QUALITY ON PROJECT FINANCIALS

A financial metric that does not appear on corporate balance sheets, is the cost of quality or $C_{q.}$ Quality in this respect according to Pettljohn (1986:86), is important because of its direct impact on bottom-line profitability. In equation form, cost of quality equals the sum of the cost to 'prevent', 'appraise' and 'correct' defects, thus: $C_q = C_p + C_a + C_c$.

Howes (1984:31), identifies changes in the scope of work as one of three reasons why software development work does not progress in accordance with the plan. Buttrick (1997:8), identifies inadequately scoped and specified requirements as one of the reasons for project failure, as this could culminate in changes while the system is being developed. The latter situation calls for the control of changes in software development, which is fundamental to business and financial control as well as to technical stability (Humphrey 1988:75).

As a rule, it is the users who change their specifications during the project development lifecycle. An interesting real life experience is shared by Burnett (1998:52). Burnett cites the instance of a project in which he was involved in, where the system had taken twice as long to develop. This was not because the end user constantly changed the requirements, but because the developer kept convincing the client of the advantages of adding functionality, with no end user signoff at each stage of the development.

The economics of software quality largely concern the costs of defect detection, prevention and removal. According to Fox & Frakes (1997:4-5), the cost of finding and fixing a defect includes the cost of each of the following elements:

- Determining that there is a problem.
- Isolating the source of the problem.
- Determining exactly what is wrong with the product.
- Fixing the requirements as needed.
- Fixing the design as needed.
- Fixing the implementation as needed.
- Inspecting the fix to ensure that it is correct.
- Testing the fix to ensure it fixes the identified problem.
- Testing the fix to ensure it doesn't cause other problems.
- Changing the documentation as needed to reflect the fix.

Quality of project deliverables can impact project financials adversely. Chance (1994:41-53), identifies the following six project risk areas:

- **Credit Risk:** This risk is primarily determined by the project's ability to service its debt requirement impacting the project's cash flow. A project is economically viable when the present value of free cash flow exceeds the present value of the construction cost, operating cost, debt service and return on equity (Finnerty 1996:34-30).
- **Construction and Development Risk:** These issues pertain to the availability of natural resources, capacity, risk of obsolescence and labour. These views are

supported by Razavi (1996:10-17), who adds management skills, infrastructure and technology to the list. To this, Finnerty (1996:40-66) and Harvey (1983:70-71) adds the risk of 'non completion' to the determining factors.

- **Marketing and Operating Risks:** With financial institutions in South Africa expanding their processing capabilities abroad, this particular risk becomes very real and pertain to the correct choice of market segment both locally and abroad.
- **Political and Regulatory Risk:** Relates to those factors affecting the project due to direct or indirect intervention by government and its subordinated structures. The bid by Nedcor for Standard Bank and the subsequent refusal of permission by the regulator for the take-over, serve as an example of this particular risk. A political risk is a risk, which say a South African financial institution would have when rolling out technology to an unstable third world country (Razavi 1996:16).
- **Legal Risk:** Involves issues affecting the contractual obligations of parties involved.
- **Financial Risk:** A risk, which Finnerty (1996:40-66), defines in terms of the currency risk and interest rate risk due to the utilisation of floating rate debt in financing. To this, Razavi (1996:13-17), adds 'the reliance on foreign capital'.

Turning the focus to financial project management, should a project fail, all three principles of financial management are impacted (Cronjé *et al*. 2000:287). These principles are:

- **The risk-return principle:** In this instance, the risk is associated with the probability that the actual results of a decision may deviate from the planned end result, with an associated financial loss or waste of funds.
- **The cost-benefit principle:** Cost of resources should not be the only determinant when a decision has to be made to stop a project or not. Sound financial decision-making in the instance of say change to the scope of work of the project, would require an analysis of the total cost and the total benefits, and assuring that the benefits always exceed the cost.
- **The time-value of money principle:** Means a person can increase the value of any amount of money by earning interest on it and can be approached from two perspectives, namely:
    - The calculation of the future value of some given present value or amount.

- The calculation of the present value of some expected future amount.

From this the analogy can be drawn that any decision associated with a technology project being impacted, should undergo a proper financial analysis. This requirement according to Cronjé *et al.* (2000:299) 'is necessary to monitor the general financial position of a business *or a project* (my italics), and in the process, limit the risk of financial failure as far as possible'. While risk management is considered an important part of project management (Ward 1999:1), risk management *per se*, is perceived to be a facet of quality, hence the requirement to manage risk properly to avoid a state of perpetual crisis (Turner 2000:1). This could be achieved if a development project is not allowed to go from one stage into the next until a formal risk assessment has been performed against the deliverables (Tusler 1996:1).

2.6 THE IMPORTANCE OF 'USER FOCUS' WHEN DEFINING BUSINESS REQUIREMENT FUNCTIONAL SPECIFICATIONS

The previously discussed item on quality, has tangent planes with the important role of the user in defining business requirement functional specifications. Cronjé *et al.* (2000:386) makes the observation that 'quality products or services can only be manufactured or provided if every function in the business contributes to the achievement of such an objective'. Furthermore, in this respect, quality is defined as:

"continuous conformance to customer/clients expectations"

The importance of the business user in any information technology systems development project is emphasised by Premkumar & King (1992:101), by identifying the primary objective as being the 'alignment of information systems plans with business plans of the organisation'. This view is supported by Jaafari (2000:12), who states:

> *"Successful projects are those which focus on the relevant business objectives from start to finish"*.

This statement and the total focus on the importance of the user and subsequent user requirements, is accentuated by Turner & Simister (2000:79), with the following list of potential success criteria for a project:

- The product delivered by the project achieves its stated business purpose.
- It makes a profit for the owner, sponsor or promoter.
- It meets the needs of the owner, the operators or users, the consumers and the community.
- The project delivers the pre-stated objectives.
- They are delivered with the required functionality and with the required quality.
- They are delivered at an appropriate time and for an appropriate cost.
- The project meets the needs of the project team.
- The work makes a profit for the project team.

A concept known as ‘participative design’ (also known as ‘joint application design’), sees the end user as an active participant in the design process (Gunton 1990:226, Macvittie 2002:69, Baker 2001:31). Robertson & Secor (1986:98) propose that customer-related quality criteria are needed at each step, from concept to customer/user. Allen (1996:14), advocates a user-centred design, which focuses on information-as-a-process, particular on the ways that information systems meets the information needs of users. In this respect, Vandenbosch & Dawar (2002:40), report that the sharing of information and business-process integration at every step of the way were major factors in the customer’s successful launch of the new product. Sheth & Parvatiyar 2000:48 emphasise the focus to move from ‘transaction focus’ to ‘relationship focus’.

What is required to ensure user focus is collaboration between all the parties, whereby users and technology experts jointly engage in the search for viable solutions to problems (Grupe 1994:30, Moser & Ramires 1995:49). User focus comes to the fore on the question of how systems can be designed that improve organisational performance. Bensaou & Earl (1998:121) answer this question by using the Japanese framing whereby the maxim ‘human design’ is used, which equates to the thinking that one should design the system to make use of the tacit and explicit knowledge that employees (the user) already possess. It is the user that provides the logic of decisions, the definition of data elements and description of reports (Schultheis and Sumner 1989:662).

In view of this author, it is perhaps Harry (1997:286) who captures the essence of user involvement in the formulation of business requirement functional specifications, the best with the view that, 'the client is a potential source of the values on which the desired system is going to be based'. This leads into a further observation by Harry (1997:288), that:

> *"…involvement of the client in the development process is a means of ensuring satisfaction, commitment of the product of systems development"*

According to Whitten & Bentley (1998:16), citing Yourden[4], (a noted systems author), 'the user is the customer in two important aspects: (1) As in many other professions, the customer is always right, regardless of how demanding, unpleasant, or irrational he or she may seem; and (2) the customer is the ultimate person paying for the system and usually has the right or ability to refuse to pay if he or she is unhappy with the product received'. User participation should not be limited to providing input to the business requirement specifications, but also participate through the use of prototyping, i.e. users being allowed to see and discuss what they will receive in the way of information (Clifton & Sutcliffe (1994:40). It is for this reason that there is a strong call for users to take ownership of their processes (Griffiths 2002:29). From this, Cadle & Yeates (2001:7) draws the analogy that:

> *"…no significant products will really be approved until the person at the top has said yes"*

Against the background of the emphasis placed in this thesis on 'user involvement', it is perhaps appropriate to position the importance of the user in relation to the project manager on a project. Clegg *et al*. (1999:206) view the role

[4] Yourdon E. 1989.Modern structured analysis. Yourdon Press Computing Series. Englewood Cliffs: Prentice-Hall. p49.

of the project manager as, 'to ensure the achievement of their customer's interests through advising them on the progress of the project and the steps that might be taken to avert problems'.

2.7 PROJECT MANAGEMENT

The systems approach to be analysed within the ambit of Chapter 4, forms the basis of the structured sequence of events in the formulation of the set of mitigating factors. The systems approach was specifically selected due to the fact that, in the words of Cleland & King (1975:15), 'has had a substantial impact on both the planning and the implementation functions of management. Furthermore, in this context, the fact that according to Jeyathevan (2002:44) 'project management lacks a methodology'. In the same realm of thought, 'project' in terms of this thesis is defined as, 'a problem scheduled for solution' (Lewis 1995a:1). Adopted from Cleland & King (1975:15) and extrapolated into 'project management' *per se*, the systems approach comes to the fore on two separate levels, namely that the project manager:

- Desire to achieve overall effectiveness in the organisation – not to have parochial interest of one organisational element distant the overall performance.
- Operate in an organisational environment, which invariable involves conflicting organisational objectives.

It must be understood that this thesis deals with the management, or more precise, the 'project management' of only 'certain elements' within the greater project management lifecycle, and not with project management *per se*. For clarity, the role of the project manager can be described as 'one of idea generator, project leader, gate keeper, sponsor and coach and must be clearly distinguished from using a project management tool (Anthes 2002:48). Against this background, 'project management' in this thesis will be limited to the facilitation of interventions and subsequent management of key factors (as identified in Chapter 8, Paragraph 8.5, Figure 8.3 A-G) contributing to the failure of management information development projects undertaken in the financial services industry.

This however does not take the focus away from the fact that risk management (an element of project management), is an integral facet of quality (Tusler 1998:1).

Support for this concentrated focus on certain elements of project management as opposed to project management in the greater project management lifecycle, comes from Elton & Roe (1998:156). The authors advise that 'project managers should stay focused on a few critical areas and not divide their attention around all of a project's tasks and resources'. The lack of visibility the software manager has into various tasks of a typical software development project, handicaps that manager in his or her attempts to do a good project management job (McDonald 2001:56).

The thesis research problem points to two aspects within the context of failure of management information development projects undertaken in the financial services industry. These pertain to:

- The quality of business requirement functional specifications.
- Change to business requirement functional specifications, while the latter is still in the process of being developed.

On a broader perspective, clear tangent planes do exist where elements of these two entities are clearly identifiable. These facts are supported by a number of academics in different forms and approaches, which are contained within the ambit of Appendix E and will form the focus of the risk analysis when the set of mitigating factors are formulated. Furthermore, elements reflected in Appendix E, would also fall within the ambit of the concept of 'project risks'. Ward (1999:1) identifies project risks as 'risk response control' and, which Wideman (1986:21) defines as: 'The chance of certain occurrences adversely affecting project objectives, and the degree of exposure to negative events, and their probable consequences'. This definition can be expanded into critical success factors (Rowe *et al.* 1994:551-552) and, which Rockart (1979:85) defines as:

> *"Critical success factors are, for any business, the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization. They are the few key*

> *areas where 'things must go right' for the business to flourish. If results in these areas are not adequate, the organization's efforts for the period will be less than desired".*

Hofer & Schendel (1978:77) define critical success factors as 'variables, which management can influence', while Leidecker & Bruno (1984:24) define critical success factors as, 'having a significant impact on the success of a firm competing in a particular industry'. The measures offered by Koomen & Pol (1999:8-9) to remedy poor quality includes: Prevention measures, detective measures and corrective measures. In conclusion, the view of Gilb (1988:54) which determines that, 'if you don't actively attack the risks, they will actively attack you', and the answer to a question by Brooks (1988:3), which reads: 'How does a project get to be a year late?' --- 'One day at a time'.

2.7.1 CLARITY ON CHANGE DYNAMICS

For Weil & White (1994:1), the formula has always been simple namely to, 'provide a product or service that meets a need and can be sold at a profit, and you can win in the marketplace'. The difficulty is that over time, products and services must respond to changing needs, resulting in all three being impacted by changing organisational and environmental conditions. This culminates in the analogy that 'the greatest constant of modern times is change' (Sterman (1994:291).

In today's dynamic ever changing financial services industry, it has become an accepted norm that 'changes' are typically ongoing processes, made up of opportunities and challenges that are not necessarily predictable at the start (Orlikowski & Hofman 1997:20). The two key factors as identified in the previous paragraph as being the primary contributing factors of project failure in the financial services industry, contribute to multi-faceted impacts to information system development project lifecycles. This is attributed to the fact that computer based developments are inherently less flexibly, which follows from the way computers have to be programmed that any change, which involves a change to the program, requires an elaborate sequence of steps to be taken. Furthermore, some changes, even changes which appear trivial, cannot be incorporated in the system without a substantial redesign (Land 1987:204). As a result, key impacts point to not only the escalation of previously approved budgets, but also to extended timelines and already mapped processes.

The research shows that these two entities would typically lead to an executive call for rework of not only the business case, but also of the processes supporting the whole development. This could invariable culminate in the termination of the project[5], or culminate in extensive recoding and process changes, which in turn would lead to the requirement for extensive change management initiatives. Alternatively, the additional rework could result in benefits harvesting from the initiative to be delayed and or, severely impacted. This statement is made with the clear *caveat*, that should the rework[6] result in end user effectiveness being significantly boosted as a result of the required rework, to the extent that the ratio of operating profit over the benefit life span of the system to total development cost be raised, it would undoubtedly quantify such rework.

From the above, Buttrick (1997:328) and Oliver & Langford (1987:120), draw the analogy that 'managing change does not mean preventing change', but rather allowing only beneficial changes to be adopted and included in the project. This means, 'creating a framework for identifying, prioritising, managing, and controlling application development and subsequent change (Merhoff & Bhela 1994:49). Of the reasons offered by Normann & Ramirez (1993:65), are that 'global competition, changing markets, and new technologies are opening up qualitative new ways of creating value'. To this list Methlie (1987:322), adds 'changes in the organization', while Byars (1984:108) adds, 'advancement in technology', which could result due to mergers and acquisitions.

In the South African financial services industry, information technology is intertwined with almost all corporate initiatives, which according to Petrozza (1995:17), it is used to reengineer operations and launch new objectives.

[5] Druker & Senge (2002:10), term the termination of a project prior to completion 'planned abandonment'.
[6] According to Grove (2002:61), such changes represent 'strategic inflection points', (events that cause fundamental change to business strategy).

Niedermann *et al.* (1991:481), while advising on technology development, is of the opinion that 'an infrastructure must be built that will support existing business applications, while remaining responsive to change'. This is key to long-term enterprise productivity and supported by The Forrester Report (1998:10).

While not exactly within context of this thesis, The Forrester Report proposes that companies should plan two to three technology upgrades per year to apply changes to accommodate compelling customer services. This culminates in the analogy that the world of technology is linked to the world of business, as one cannot exploit the virtues of information systems without aiming for structured changes compatible with them (Clark 1989:96-97). As business process re-engineering is considered a planned intervention within the context of this thesis, the design of the re-engineering processes must be flexible to adjust to things that inevitably arise and require design modifications (Manganelli & Raspa 1995:42).

Justification for an information technology application in the event of scope changes links to one of two conditions (Parker *et al.* 1988:233):

- It improves the performance of the organisation.
- It improves the outlook for new business opportunities.

These views are supported by the results from a study conducted by Miller & Doyle (1987:116), in the South African financial services industry, which concluded that, 'information systems effectiveness is a function of a relationship between perceived performance, and performance on individual information systems attributes'.

It is the wisdom of Ackoff (1977:2) on change, in the opinion of the author of this thesis that prevails when he (Ackoff) claims that, 'due to the accelerating rate of technological and social change, solutions and the problems to which they apply can be expected to continue to decrease'. It is often difficult to get the relevant scientific and technical personnel to agree on the probabilities of failure and potential exit scenarios, or change required for each stage of a project. This could result in midstream discussions about project closure often to be biased (D'Souza 2002:9).

The light at the end of this *'change tunnel'* (my italics), comes with sound advise from Handy (1995:4), who advises that, 'those who realise where changes are heading, are better able to use those changes to their own advantage', and from McKersie & Walton (1991:244), who believes that, 'effective implementation of information technology is, at its core, a task of managing change'. Against this background, it is of importance that changes to requirements are interpreted as 'business changes', as opposed to 'technology changes' (Wah 2000:21).

Intervention to change a project while depending on its technical characteristics will require the sanction of all parties affected by such change, given the interconnected nature of projects (Pycroft *et al.* 2001:590). The following steps are suggested by Deloitte Touche Tohmatsu (1992:43-44), to control scope changes:

- Review earlier scope changes if in existence.
- Determine the nature of the scope change.
- Determine the benefits of the scope change.
- Determine the impact of the scope change.
- Revise the cost estimates to reflect the scope change.
- Determine if scope change is advisable.
- Advise sponsor of impact on time and cost.
- Obtain sponsor signoff of change.
- Revise contractual agreements if required.
- Adjust project plan to accommodate change.
- Present overall impact to sponsor and steering committee.
- Communicate changes to rest of project team.

The observant reader will notice two distinct and opposing points of view being advocated. The first view, vehemently opposed to change of business requirement functional specifications taking place during the life cycle of the project, which is supported by a plethora of academics and statistics provided in the analysis pertaining to project failure dynamics cited in this chapter. This will be further supported by the findings of the validation survey results contained in Paragraph 2.8 of this chapter. The second view, supported by a powerful plea for allowing change to take place during the life cycle of the project, as put forward in this paragraph, however with the clear *caveat* that such change should only take place under the most stringent qualifying conditions. This author supports the second view, which will be taken forward in the formulation of the set of mitigating factors in Chapter 8.

The process flow model, which represents a structured sequence of events (refer Chapter 8, Paragraph 8.5, Figure 8.3 A-G), will represent a finely tuned balance between 'over control' and 'chaos', which can be compared with the *'Scylla'* and *'Charybdis'* in Greek mythology and the *'Yin'* and *'Yang'* from Chinese ontology. A more modern approach for the balance between 'order' and 'chaos', can be found in the concept known as the 'chaordic system'. Within the context of non-linear systems[7], it seems paradoxical that these systems have indeed 'order, i.e. that there is 'order' in 'chaos'- and, consequently 'chaos in 'order' (Durrance 1997:25-31, Pellissier 2001:33,). This concept can also be extrapolated to the 'chaos theory', which is referred to as '…the science of chaord or chaordic systems…' (Fitzgerald & Von Eijenatten 1998:264), combining 'cha-os' and 'ord-er'. This would imply that this balance can be achieved by extrapolating elements from the 'hard' systems approach (refer Appendix A), and juxtapose them with elements extrapolated from the 'soft' systems approach (refer Appendix B). The 'systems approach' will be forming the basis of the multimethodology approach in this thesis.

Supporting the call for change dynamics to be allowed, the wisdom of Pellissier (2001:26), who is of the opinion that 'change and its management, is the challenge that every organisation faces, but it is the management of change that means the difference between winning and losing in the ultra-competitive new world order'. In conclusion, the observation that, 'years of study and experience show that the things that sustain change are not bold strokes, but long marches – the independent, discretionary, and ongoing efforts of people throughout the organization' (Kanter 2000:48).

[7] Organisations, due to the fact that they are made up of people and therefore highly complex, are non-linear systems.

2.8 VALIDATION SURVEY RESULTS

The validation survey, details of which are contained in Appendix D, returned the following results, presented here in table format for ease of reference. Fifty-four respondents completed the survey and percentages indicated under each option, represent the agreement choice of the respective respondents.

Statement 1: The quality of business requirement specifications as a project failure factor has a direct impact on information technology development project timelines and budgets.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
42/54 77.8%	12/54 22.2%	0/54 0%	0/54 0%	0/54 0%

The author of this thesis has identified the target population as experts in the field of information systems development in general, with the added requirement of having extensive exposure to systems development for the financial services industry. The qualifying requirement for respondents to participate was to have a minimum of fifteen years exposure to the information systems development environment, and at least five years extensive exposure to information systems development in the financial services industry (Refer Appendix D, Paragraph D3). Against this background, the analogy can be drawn, that the high level of agreement (77.8% + 22.2% = 100%) attained in this statement, confirms that the problem statement is a universal problem and not limited to management information system development projects undertaken in the financial services industry. This in addition provides the answer to the second of the investigative questions as defined in Chapter 1, Paragraph 1.4.

Statement 2: Changes to business requirement specifications after finalisation thereof or during development, are common occurrences in a typical information technology project development life cycle.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
47/54 87%	7/54 13%	0/54 0%	0/54 0%	0/54 0%

The high level of agreement (87% + 13% = 100%) attained in this statement, confirms that the technology development industry findings on 'change', maps to the literature review analysis, contained within the ambit of Chapter 2, Paragraph 2.7.1, namely that:

- Changes to business requirement specifications after finalisation thereof or during development, are common occurrences in a typical information technology project development lifecycle.

Statement 3: Specific or customised methodologies are commonly in use to mitigate and manage the quality aspect of business requirement functional specifications and subsequent changes to these requirements during development.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
0/54 0%	4/54 7.4%	0/54 0%	19/54 35.2%	31/54 57.4%

The above analysis confirms that failure factors are not commonly dealt with by applying a specific or customised methodology. Exceptions are however acknowledged within the broader context of information systems development with 7.4% of the respondents acknowledging that customised methodologies are being utilised to mitigate failure factors. This however has no significant impact, should the 'disagree' and 'strongly disagree' percentages be juxtaposed, returning a staggering 92.6% of respondents agreeing, that no specific or customised methodologies are commonly in use to mitigate and manage the quality aspect of business requirement functional specifications and subsequent changes to these requirements during development. This high level score in addition gives impetus to the reason why this research was mooted in the first instance and, which led to the formulation of the research problem (Refer Chapter 1, Paragraph 1.2), and subsequent research question (Refer Chapter 1, Paragraph 1.3).

Statement 4: The main reasons attributed to the failure or partially failure of information technology development projects can be mapped to the quality of business requirement specifications, or changes to these specifications while the latter was already under development.

Strongly Agree	**Agree**	**Undecided**	**Disagree**	**Strongly Disagree**
24/54 44.5%	22/54 40.7%	0/54 0%	8/54 14.8%	0/54 0%

The high level of agreement (44.5% + 40.7% = 85.2%), attained in this statement confirms that:

- The main reasons attributed to the failure or partially failure of information technology development projects can be mapped to the quality of business requirement specifications, or changes to these specifications while the latter was already under development.

The above are confirmed by the plethora of literature reviews on the issue cited within the ambit of Chapter 2. A much higher disagreement percentage than 14,8% was expected, as project failure in general is attributed to a plethora of reasons, and not limited to the instances as reflected in the survey statement.

2.9 CLOSURE

The objective of this chapter was to explain the core elements attributing to the research problem and elements, which will ultimately facilitate the answer to the research question. The analysis dealt with the following elements:

- **Intervention:** This core remedial element was analysed in terms of intervention types, with focus on planned and forced interventions.
- **Project Failure Dynamics:** These core causal elements was analysed in terms of their general impact on information technology development, and also in terms of their impact on major projects and technology driven projects. It is of interest to note that the project failure dynamics as identified, invariably maps to the two failure factors as identified in this thesis namely:
    - The quality of business requirement functional specifications.

- Change to business requirement functional specifications, while the latter is still in the process of being developed.

These risks culminate in unsuccessful projects (Berkeley *et al.* 1991:143, Fairley 1989:45, Niwa 1990:140, McFarlan 1981:143, Wideman 1986:2), in one or more of the following instances:

- The project was not finalised within the scheduled timeframes.
- The project was not finalised within budget.
- The end result did not comply with user requirements.

Adding to the above list, Turban *et al.* (1999:589), provide the following range of possibilities for various types of failures:

- Outright failure.
- Abandoned.
- Scaled down.
- Runaway.

The recommendations by Aktes (1987:23) map the objectives of this thesis when he proposes, 'a structured approach for the formulation of business requirements', as it emphasises user participation and communication, which would obviate user dissatisfaction and system failures.

- **Business requirement functional specifications:** Business requirement functional specifications the key dynamic in this thesis, was analysed supported by related factors impacting the concept, namely quality and user focus.
- **Project management:** In the analysis pertaining to project management, the main focus centred on change dynamics, the latter forming a key element in the formulation of the set of mitigating factors. Of significant importance in this chapter, is the Paragraph 2.7.1, which provides clarity on project change dynamics. This will be taken forward into Chapter 8 in the formulation of the set of mitigating factors. Furthermore, that 'change' to business requirement functional specifications while in the process of being developed would be allowed to take place with the clear *caveat*, that such changes should only take place under the most stringent conditions.

In Chapter 3, the main theme of the thesis will be discussed, namely the concept – ‘Multimethodology’. From Figure 1.2 (refer Chapter 1, Paragraph 1.9), the multimethodology approach will be used to juxtapose the following elements to ultimately culminate in a structured sequence of events serving as mitigating factors to facilitate the management of key factors contributing to the failure of management information systems development projects, namely:

- Elements from the Capability Maturity Model.
- Elements from Six Sigma.
- Elements from the Balanced Scorecard
- Elements from the Systems Approach.

Table of Contents: Chapter 3

Synopsis: Chapter 3

The concept 'multimethodology' forms the crux of the contents of Chapter 3. The multimethodology approach will furthermore be used to juxtapose the following elements to ultimately culminate in a structured sequence of events serving as mitigating factors to facilitate the management of key factors contributing to the failure of management information systems development projects, namely:

- Elements from the Capability Maturity Model.
- Elements from Six Sigma.
- Elements from the Balanced Scorecard
- Elements from the Systems Approach.

The use of the concept 'multimethodology' at its simplest just means employing more than one method or methodology to solve complex phenomena. The challenge in doing so is vested in the different possibilities for combining the different methodologies to ultimately culminate as a 'multimethodology'. The combinations could manifest as:

- **A methodology combination:** Whereby two or more methodologies are used within the same intervention.
- **Methodology enhancement:** When one methodology is used, but enhanced by importing methods from elsewhere.
- **Single -paradigm multimethodology:** When parts of several methodologies are combined from the same paradigm.
- **Multi-paradigm multimethodology:** The proposed application of the multimethodology approach within the ambit of this thesis, when parts of several methodologies are combined from different paradigms.

The design of a phased approach for a multimethodological intervention is of particular importance in this thesis, as this approach will be applied in the formulation of the structured sequence of events in Chapter 8. In Paragraph 3.6 of this chapter, a powerful motivation is put forward for the need for a multimethodology approach, however with the clear *caveat*, that there is not likely to be 'a single silver bullet solution' to the essential difficulties of developing software.

Chapter 3

The Concept: Multimethodology

3.1 INTRODUCTION

The theory and practice of the concept 'multimethodology' is described by Rosenhead and Mingers (2001:xiv) as:

> *"the creative combination of methods in order to suit the particular circumstances in which analytic assistance is being offered"*

At its simplest, according to Mingers (2001:289), 'multimethodology just means employing more than one method or methodology', which can be viewed as a particular form of 'methodological pluralism' (Mingers 1997:2, Mingers and Gill 1997:244, Midgley 1997:250). Methodological pluralism is a concept, which requires closer scrutiny and will be expanded upon in Paragraph 3.2 of this chapter.

The multimethodology concept is being used within the framework of a number of commonly applied systems methodologies, as demonstrated by the following cited examples: The use of 'systems dynamics' within the context of 'multimethodology' for example is often combined with the 'soft systems' methodology (Cavana *et al.* 1996:181-207, Coyle & Alexander 1997:205-222), and with 'cognitive mapping', which is closely related to 'causal loop diagrams (Ackerman *et al*. 1997:48-65, Bennett *et al.* 1997:59-88).

The use of a multimethodology approach can be extended to a plethora of applications. Of particular interest, is how the approach is applied within the context of academic research? In this respect, Abrahamson (1983), points out that the use of a multimethodology approach prevents the research becoming method bound. According to Abrahamson, 'the strength of almost every measure is flawed in some way or other, and therefore research designs and strategies can be offset by counter balancing strengths from one to another'. Galliers and Land (1987:901) suggest a taxonomy of research approaches when dealing with society, organisational groups, individuals, technology and methodology. The concept multimethodology also manifest in using qualitative and quantitative research methods for social research, where the two methods are used in complementary ways (Neumanm 2003:16, Todd 1979:602-611). The same maxim would apply for management research where qualitative and quantitative methods can be listed as a multimethodology from within the same paradigm, or across paradigms (Easterby-Smith *et al.* 2002:146).

The application of the multimethodology approach is also diverse, for example, the use of multiple but independent measures from navigation and surveying, where a minimum of three reference points are taken to check an objects location (Smith 1989). It is of interest to note that in line with the content of this thesis, Breyfogle *et al.* (2001:29-30) suggest a multimethodology approach when the Six Sigma methodology (refer Chapter 5), is implemented into an organisation requiring 'soft' skills in the process. Intervention is another field in which the concept multimethodology is being applied. This in particular is of importance as the multimethodology approach within the context of this thesis specifically pertains to its application within the ambit of an 'intervention' (refer Chapter 2, Paragraph 2.2). The use of the concept multimethodology within the context of 'interventions', comes from Ormerod (1997:37-48), who cites examples pertaining to strategic modelling, information systems modelling and customer service strategy, while Bennett *et al.* (1997:59) add 'litigation' to the list.

It would be naive to generalise, but the following statement supported by a number of academic writers provide impetus to the power underpinning the concept multimethodology: 'The concept multimethodology, provides the wherewithal to manage the complete cycle of interventions from the initial diagnosis of the problem to taking action', (Jackson & Keys 1984:473-486, Bennett 1990:99-109, Bennett & Cropper 1990:29-45, Mingers & Brocklesby 1996:101-132).

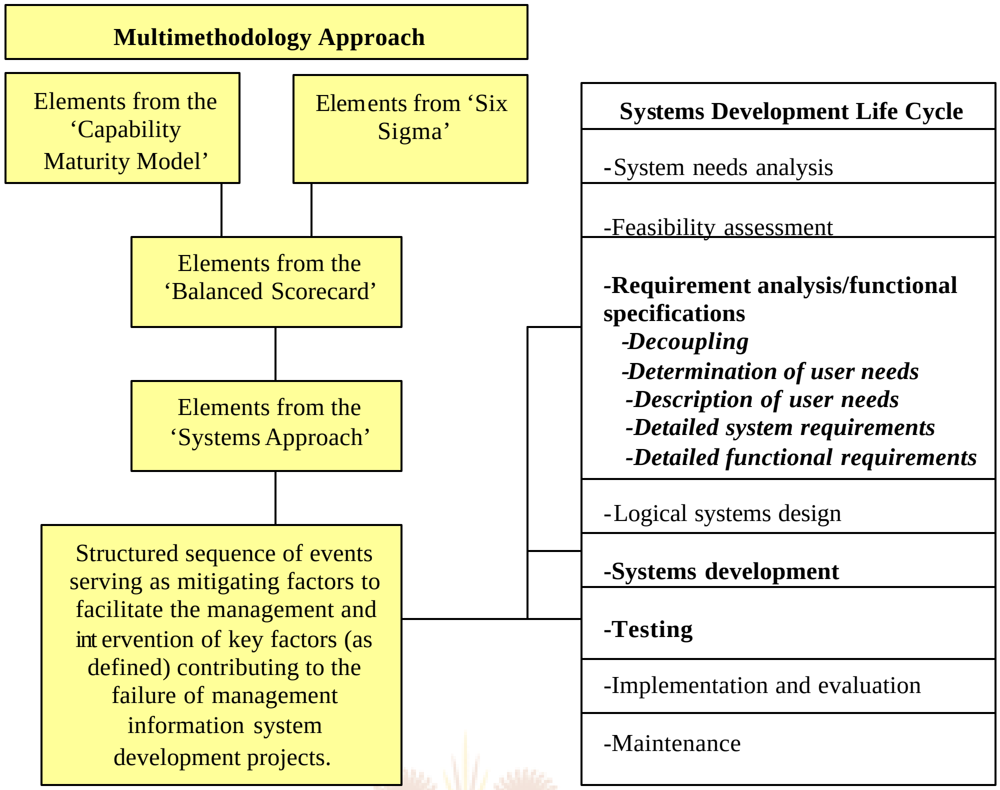

Figure 3.1:- Interrelationship of core entities.

From Figure 3.1 it can be seen that the multimethodology approach will be used to juxtapose the following elements to ultimately culminate in a structured sequence of events serving as mitigating factors to facilitate the management of key factors contributing to the failure of management information systems development projects, namely:

- Elements from the Capability Maturity Model.
- Elements from Six Sigma.
- Elements from the Balanced Scorecard
- Elements from the Systems Approach.

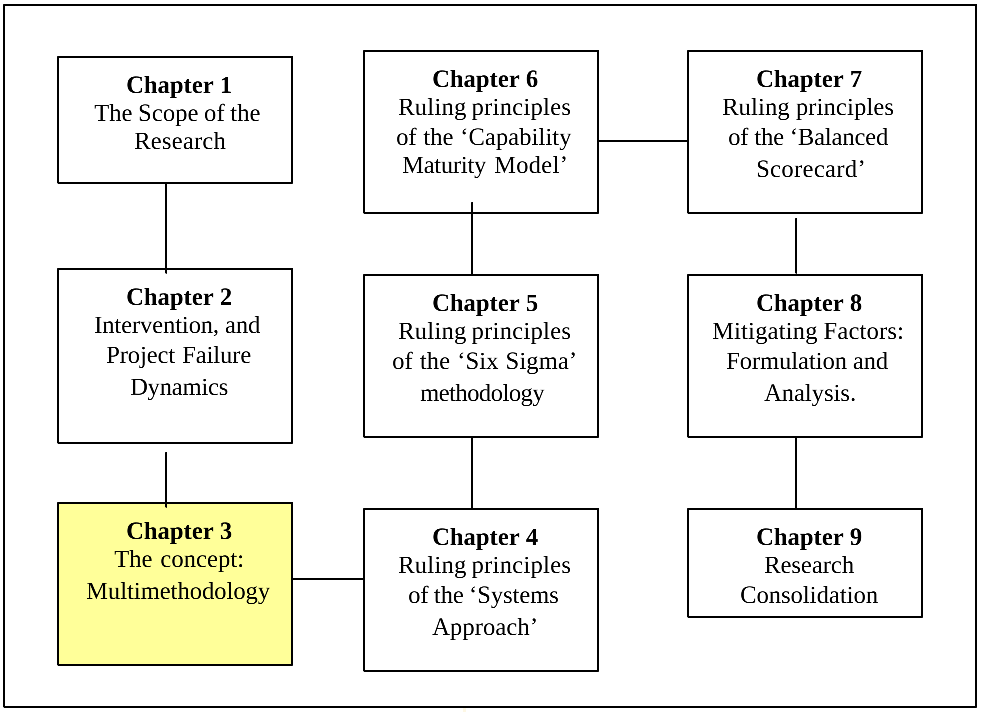

Figure 3.2: Chapters in context of the overall research

The analytical process followed thus far, is graphically depicted in Figure 3.2, which places the chapters in context with the overall thesis objectives, and furthermore indicates the relative positioning of this chapter.

3.2 THE CONCEPT 'METHODOLOGICAL PLURALISM'

It is of importance for the reader to have an understanding of the concept 'methodological pluralism' as it is used within the context of this thesis. Mingers and Gill (1997:2) defines 'multimethodology' as:

> *"Combining together more than one methodology (in whole or part) within a particular intervention. Thus it is not the name of a single methodology or even of a specific way of combining methodologies together. Rather it refers to the whole area of utilizing a plurality of methodologies or techniques or techniques within the practice of taking action in problematic situations".*

In certain instances, mixing methodologies to apply to a specific type of intervention is conceptually straightforward. In other instances, the task could become complex, for example when mixing 'parts' of methodologies, (often referred to as 'partitioning' (Midgley, 1989)) from different paradigms, or within the same intervention (Jackson, 1990), or managing the diversity of methodologies within an intervention (Flood, 1995). It is then against this background that methodology can be seen as a particular form of 'methodological pluralism'.

3.3 MULTIMETHODOLOGY IN PRACTICE

A study conducted by Munro and Mingers (2000)[1] cited by Rosenhead and Mingers (2001:305) was carried out to discover the extent of the use of the concept 'multimethodology', and in particular combinations that work well together. It was found that the most popular combinations occurred in pairs of methods (refer Table 3.1), and in triads of methods (refer Table 3.2).

Method 1	Method 2
Simulation	Statistics
Forecasting	Statistics
Swot	Soft systems methodology
Simulation	Soft systems methodology
Influence diagram	Soft systems methodology
Strategic choice	Soft systems methodology
Critical systems heuristics	Soft systems methodology
Soft systems methodology	Interactive planning
Soft systems methodology	Cognitive mapping
Statistics	Soft systems methodology
Viable system model	Soft systems methodology
Maths. modelling	Statistics
Maths. modelling	Simulation
Structured analysis and design	Soft systems methodology
Maths. modelling	Heuristics
Decision analysis	Strategic choice

[1] Munro I & Mingers J. 2000.The use of multimethodology in practice- Results of a survey of practitioners.Coventry: Warwick Business School.

Decision analysis	Cognitive mapping
Statistics	Cognitive mapping
Influence diagrams	Viable system model
Influence diagrams	Soft systems methodology
Strategic choice	Cognitive mapping
Interactive planning	CHS
Strategic choice	Interactive planning

TABLE 3.1: Pairs of methods (Source: Rosenberg & Mingers 2001:305)

Method 1	Method 2	Method 3
Strategic choice	Soft systems methodology	Interactive planning
Maths. modelling	Simulation	Statistics
Maths. modelling	Simulation	Heuristics
Statistics	Influence diagrams	Cognitive mapping
Statistics	Swot	Soft systems methodology
Statistics	Soft systems methodology	Cognitive mapping
Statistics	Project networks	Forecasting
Statistics	Forecasting	Inventory
Soft systems methodology	Viable system model	Strategic choice
Soft systems methodology	Viable system model	TSI
Soft systems methodology	Viable system model	CSH
Soft systems methodology	Interactive planning	CSH
Soft systems methodology	Scenarios	CSH
Cognitive mapping	Delphi	Scenarios
Hypergames	Delphi	Scenarios
Cognitive mapping	Delphi	Systems dynamics
Cognitive mapping	Decision analysis	Strategic choice
Cognitive mapping	Influence diagrams	Systems dynamics

TABLE 3.2: Triads of m ethods (Source: Rosenberg & Mingers 2001:305)

Underpinning the observations in the above two tables, Rosenhead and Mingers (2001:304), make the following interesting observation, namely that 'the soft systems methodology is used extensively as a methodolo gy that can be combined with many others'. This is supported by Stowell (1995a), who is of the opinion that the soft systems methodology has been used extensively in Information

Systems development both as a 'front-end' to harder, structured systems analysis techniques, and as a controlling method throughout systems development.

While not exactly within context, however highly appropriate, Bentham (1997:103), when referring to the use of a combination or sequence of techniques, is of the opinion that 'one size will not fit all customers at all times'. Furthermore, Bentham continues with the view that the introduction to any specific methodology needs to be carefully tailored to suit the nature of the overall transformation.

3.4 MULTIMETHODOLOGY INTERVENTIONS

An orthodoxy in organisational theory does not exist, and a plethora of theories are to be found that vary from abstruse formulations deriving in part from philosophical considerations to more pragmatic varieties of analysis. This creates immediate complexity in determining, which theory to use followed by a still more difficult problem of how to package that theory in the form of practical technique. An interesting technique has been adopted by Hirschheim and Klein (1989:1199-1216), (1992:294-392), (1994:83-109). They use Birell & Morgan's well-known classification that categorises social theory by its epistemological (way in which it produces knowledge), and ontological (its assumptions about reality), premises. In terms of this, the majority of current theorisation, by implication, current practice is found in just one quadrant, labelled functionalism. The question however, is that if a space is to be made to legitimate other social/organisational analysis, which one is to be chosen.

Different types of methodologies, such as the hard and soft systems methodologies, which will be analysed within the ambit of Chapter 4 (refer Appendixes A and B), will focus on particular aspects of the very complex world of the management of information systems development. It is for this reason that the approach in this thesis in the formulation of the structured sequence of events to facilitate the intervention and subsequent management of key factors contributing to the failure of management information systems development projects, to employ more than one method in combination with each another. This to facilitate the different levels and dimensions of the research problem. It was however Mitroff & Lintstone's 'second way of knowing – the world as a formula'[2], which mooted the idea to base the formulation of the structured sequence of events to facilitate the intervention and subsequent management of key factors, as proposed in this thesis, on a multimethodology approach. The very essence of this 'second way of knowing – the world as a formula', of Mitroff & Lintstone (1993:47), culminates in the analogy that:

> *"If we have to have precise definitions of complex problems before we can proceed, and if in order to obtain such precise definitions we need to base them on the adoption of a single scientific discipline or profession, then precision and clarity may lead us deeper into deception and not rescue us from it. By selecting a single scientific discipline or profession, we cut off innumerable other pathways that we could have chosen to explore the nature of our problem".*

The terms 'mixed methods' or 'multimethodology' as the concept will be referred to in this thesis, typically according to Tashakkori & Teddlie (1998:43) refers to both 'data collection techniques' and 'analysis', given that the type of data collected is so intertwined with the type of analysis that is used. In general, multimethodology is referred to by Mingers (2000:679) as 'being the utilisation of a plurality of methods and techniques, both qualitative and quantitative within a real-world intervention'. In the simplest of terms, Mingers (1997:2) refers to multimethodology as, 'the process of combining together more than one methodology (in whole or part) within a particular intervention'. The latest attempt by Mingers (2001:289) is to define the meaning of multimethodology as 'employing more than one method or methodology in tackling some real-world problem'. Furthermore, Sterman (1988:217) suggests that two opposing approaches be applied to decision making models namely, 'soft' and 'hard' variables, which by implication implies the application of a 'multimethodology approach'. Based on this, the approach in this thesis is to link together different

[2] This concept forms part of the 'soft systems approach', which is analysed in Appendix B, but contained within the ambit of Chapter 8, Paragraph 8.2

parts from several methodologies, creating a design specific to the particular elements as outlined in the research problem.

Arguments in favour of multimethodology according to Mingers (2000:679), (2001:289) are:

- That real-world problem situations are inevitably multimethodology.
- That an intervention is not a single discreet event, but it is a process that typically proceeds through a number of phases, and these phases pose different tasks and problems for the practitioner.
- Multimethodology, a recent innovation is being deployed in practice to modern post millennium technology solution requirements.

The analogy drawn from the above, according to Mingers (2001:289), the fact that while methodologies tend to be more useful in relation to some phases than others, the prospect of combining them has immediate appeal. Combining a range of approaches may well yield a better result. That combining different methodologies, even where they actually perform similar functions, can often provide a 'triangulation'[3] on the situation, generating new insights and providing more confidence in the results by validating each other.

In support of the views of Mingers cited above, Greene *et al.* (1989: 255-274) list the following five purposes of the concept multimethodology:

- 'Triangulation' or seeking convergence of results.
- 'Complementarity' or examining overlapping and different facets of a phenomenon.
- 'Initiation' or discovering paradoxes, contradictions, fresh perspectives.
- 'Development' or using the methods sequentially, such that results from the first method inform the use of the second method.
- 'Expansion', or mixed methods adding breadth and scope to the project.

[3] 'Triangulation' within the context of this thesis, can be defined as, 'seeking to validate data and results by combining a range of data sources, methods or analysts'.

3.5 DESIGN OF A MULTIMETHODOLOGY INTERVENTION

Mingers (1997:7) suggests different possibilities for combining different methodologies to ultimately culminate as a multimethodology, namely:

- One/more methodologies.
- One/more paradigms.
- Same/different intervention.
- Whole/part methodology.
- Imperialist or mixed.

To assist in the design of an multimethodology intervention in practice, Mingers (2001:292) cite Mingers & Brocklesby (1977)[4], who identified four phases for this purpose, namely:

- **'Appreciation':** Appreciation of the situation as experienced by the practitioner involved and expressed by any actors in the situation. This will involve an initial identification of the concerns to be addressed, conceptualisation and design of the study, and the production of basic data using such methods as observation, interviews, experiments, surveys, or qualitative approaches. Ormerod (1995:75) proposes that the type of multimethodology to be used in an intervention should be negotiated with the end user or sponsor. This author supports this approach as the suggested multimethodology to be used for the intervention in this thesis is focussed on a particular area of application, namely the financial services industry, specifically customised for this purpose to fulfil the expectations and requirements of the end user or sponsor.
- **'Analysis':** Analysis of the information produced so as to be able to understand and explain the situation as it is. This would involve analytical methods appropriate to the goal(s) of the intervention and the information produced in the first stage. Explanations will be in terms of possible hypothetical mechanisms or structure that, if they existed, would produce the phenomena that have been observed, measured, or experienced.
- **'Assessment':** Assessment of the postulated explanation(s) in terms of other predicted effects, alternative possible explanations, and consideration of ways

[4] Mingers J & Brocklesby J. 1977. Multimethodology: Towards a framework for mixing methodologies. *Omega,* 25 (5) pp489-509.

in which the situation could be other than it is. Interpretations of the results, and inference to other situations.

- **'Action':** Action to bring about changes, if necessary or desired.

The phased approach in designing a multimethodology intervention is also supported by Ormerod (1997:56), who is of the opinion that the intervention will be easier to understand and manage if broken up in phases. Mingers (2001:299) suggests an approach to multimethodology, whereby parts of methodologies (as proposed in this thesis) are linked together, as opposed to combining whole methodologies. This would then require a detailed study of the different methodologies (refer Chapters 4 - 7); to determine where fruitful links can be created. An important observation is that the 'new formulated approach, should not be seen as a generic multimethodology, but simply one that is suitable for a particular intervention, as would be the case in this thesis dealing with a particular research problem within the ambit of the financial services industry. An example of a multimethodology approach comes from Omerod (2001:325), where the following methodologies were applied:

- The interactive planning approach of Ackoff (1974a:7) (refer Appendix B, Paragraph B5), to create a forward-looking dynamic, which is exciting and fun.
- The soft systems methodology to support the process analysis (refer Appendix B, Paragraph B4).
- Systems thinking as a stimulus for creative thought by the task force syndicates (refer Chapter 4, Paragraph 4.4).
- The viable systems model to help the syndicates analyse the business processes (refer Appendix B, Paragraph B2).
- The strategic choice approach for the evaluation of the business process redesigns opportunities and the shaping of the strategy.

The overriding maxim for the deployment of a multimethodology approach is that it will necessitate the methodology, which will be applied while reflecting the personal skills, experience values and personality of the practitioner. This observation is supported by Ormerod (1997:56-57), who is of the opinion that, 'practitioners review their range of knowledge and skills and develop their methodological competence'.

Some might argue objectivity requires that the nature of the 'task' rather than the 'practitioner' should determine the choice of the approach. From a multimethodology perspective, this according to Mingers (2001:303) is impossible, both philosophically and practically. This view of Mingers is supported by Ackoff (1977:1-6), who gives the following rendition of the situation: 'Philosophically because objectivity can only be the result of many subjectivities …it is value-full not value-free'. 'Practically, because individuals' skill and experience actually matter in their choices of method'. 'Everyone is not equally competent across a wide range of quantitative and qualitative approaches, and we all tend to have our own favourites with which we feel comfortable'.

3.6 THE NEED FOR A MULTIMETHODOLOGY APPROACH

While it can be argued that information system development failure, can be attributed to a varied number of valid business reasons, many of these failures occur as a result of the limitations in conventional (or 'hard') information system design methodologies. In support of the above statement, Mingers (1995:19) identify the following 'weaknesses' of the hard systems approach:

- Hard systems are geared primarily towards the technological aspects of design, which causes a concentration on technical solutions to what may be complex social, organisational and communicational problems.
- Hard systems are usually orientated towards computerisation of existing processes assuming that these processes are effective, or they assume that the end users know what they want and that eliciting user requirements is straight forward.
- Hard systems pay little attention to the wider business and organisational settings within which the information system must operate.
- Hard systems assume a particular positivist (or objectivist) philosophy towards both information and the organisational context, which many argue, is inappropria te.

Mingers (2001:30), cite a recent survey of the operational research and systems practitioners undertaken by Munro and Mingers (2000)[5], to discover the extent of multimethodology use, and the particular combinations of method that worked well together. The results of the survey returned, of 64 respondents, details of 163 different interventions, each employing a combination of methods.

Avison & Wood-Harper (1995:102) is of the opinion that a combination of approaches creates a theoretical framework, w hich attempts:

- To account for the different viewpoints of all those involved in using a computer system.
- To reconcile issue-based with task-related aspects.

The above requires closer scrutiny, and Avison & Wood-Harper (1995:109), provides insight into this framework by claiming that the multimethodology approach comes from computer related questions and also matters relating to people and business functions, which is part issue-based and part task-related. The analogy follows that one cannot solve a problem until it is known what the problem is. Issue-related aspects are concerned with debating definitions of system requirements in the broadest sense, that is: What real-world problems is the system to solve? Conversely, task-related aspects work toward forming the system that has been defined, with appropriate complete technical and human views. The analogy is concluded with the observation that:

> *"The system, once created, is not just a computer system; it helps people do their jobs".*

The general need for a multimethodology approach, and for that matter, the need for the approach to solve the research problem and simultaneously providing a partial answer to the first of the investigative questions, can be found in the summary of the work of De Bono (1986:182), when he claims:

> *"There is a vacuum. There is a gap. There is a need. We simply do not have the structures necessary for the resolution of conflicts. This is not*

[5] Munro I and Mingers J. 2000. The use of multimethodology in practice – results of a survey of practitioners.Coventry: Warwick Business School.

> *through any ill will or incompetence. It is simply that structures designed for a specific purpose may be inadequate for other purposes".*

It was Hamel & Prahalad (1989:70) who captured the crux underpinning the need for a multimethodology approach very succindly with the following:

> *"It is not very comforting to think that the essence of Western strategic thought can be reduced to eight rules of excellence, seven S's, five competitive forces, four product lifecycles, three generic strategies, and innumerable two -by-two matrices"*

Hamel and Prahalad (1989:70), argued that to revitalise corporate performance, we need a whole new model of strategy. The extensive high level analysis of the methodologies: The 'Systems Approach', the 'Six Sigma Methodology', the 'Capability Maturity Model', and the 'Balanced Scorecard' methodology depicted in Chapters 4 - 7, flows directly from the requirement in this thesis to use a multimethodology approach in the formulation of the set of mitigating factors in Chapter 8. This approach is supported by Watson (2002:36), who proposed an approach to drive software breakthroughs by integrating the Capability Maturity Model and Six Sigma methodology to improve software quality performance. This requirement to do an analysis of the methodologies to be used in the multimethodology approach, is supported by Skyrme (1995:237), who is of the opinion that 'methodologies need to be decomposed into their basic units'. 'Thus each methodology would be a seamless toolkit that allows dipping and diving into appropriate techniques to support a multimethodology'.

Examples of the use of the concept 'multimethodology' in practice, in particular applied to information systems development, are provided by Mingers (2000:677). The following serves as examples of accounting information systems, where the Soft Systems Methodology was used.

- Information systems strategy, where the Viable Systems Model was used.
- Capturing process knowledge, where the Soft Systems Methodology + Process Model were used.

- Development information systems strategy, where Interactive Planning + Soft Systems Methodology + the Viable Systems Model were used.

In view of the author of this thesis, there is another significant motivation for using a multimethodology approach, as opposed to a single methodology for the purpose of a specific customised process intervention as proposed in this thesis for the formulation of the structured sequence of events. To implement a full blown Six Sigma methodology (see Chapter 5), or a Capability Maturity Model (see Chapter 6), or a Balanced Scorecard methodology (see Chapter 7), into an organisation would require extra-ordinary demands on human resources, time, money, training and change management, to mention but a few. This opinion is based on the fact that the combined expenditure of US companies on management consulting and training in 1997 was over USD 100 billion, and a sizeable fraction towards efforts to develop operational capabilities matching those of the best firms in the business. Furthermore, despite the vast expenditure and not withstanding dramatic successes in a few companies, few efforts to implement such programmes actually produced significant results (Repenning & Sterman 2001:64). Alternatively, according to Pryor & McGuire (1997:621), organisations wishing to use any of the extensive process improvement methodologies mentioned above for small non-mission critical initiatives, may not be able to justify the cost (Hollenbach *et al.* 1997:44), and time associated with using the full end-to-end processes of these methodologies. Furthermore, specifically referring to the Six Sigma methodology and the Capability Maturity Model, Watson (2002:36-37), makes out a strong argument to use a multimethodology approach, when he states:

> *"Both perspectives have a unique contribution to defining 'goodness' in software, and both of these perspectives are necessary in order to have 'world class' levels of quality performance". "It is equally important to note that neither viewpoint is sufficient by itself, to achieve the highest levels of software quality".*

According to Watson (2002:40), the following benefits can be gleaned by forging a link between the Six Sigma methodology and the Capability Maturity Model, namely:

- Establish a common language between hardware and software developers.
- Define a shared objective for product design performance improvement.
- Build a set of processes that applies the *systems approach* (my italics) to product design.
- Provide a consistent framework for assessing project performance.
- Assume the integration of product development and business strategy.

Against the above background, it seems most appropriate to heed to the warning of Fred Brooks (1987)[6] cited by Herbsleb *et al.* (1997:30), 'that there was not likely to be a single silver bullet solution to the essential difficulties of developing software'. In view of the author of this thesis, this statement by Brooks is a powerful motivation for the requirement for a multimethodology approach. In conclusion the wisdom of Gammack (1995:160-161), who dictates that 'notwithstanding philosophical theories of everything in the information systems world, (where the proof of thinking is generally constrained by a requirement to be applied in physically located practice), there are to date few explicit attempts to reconcile the ontology's that different systems approaches span'. The motivation contained in this paragraph clearly demonstrates that a multimethodology approach can be used effectively to structure paradigm shifts introduced into a financial services organisation and furthermore demonstrates that the approach can contribute to overall quality improvement, thus providing the answer to the first of the investigative questions.

3.7 CLOSURE

Methodologies, and therefore methods, according to Mingers (2001:307-308) make implicit or explicit 'assumptions' about the nature of the world and of knowledge. A combination of 'assumptions' thus forming a paradigm, the latter being a construct that specifies a general set of philosophical assumptions

[6] Brooks FP. 1987. No silver bullet: Essence and accidents of software engineering. *IEEE Computer Society.* (20).

covering, for example, ontology (what is assumed to exist), epistemology (the nature of valid knowledge), ethics (what is valued or considered right) and methodology. From the above, the analogy can be drawn that a methodology specifies 'what' to do, a paradigm defines 'why' this should be done, and a method, 'how' to do it.

Against this background, the essence of 'multimethodology' as proposed in this chapter, is to utilize more than one methodology or part thereof, possibly from different paradigms within a single interventions. There are according to Mingers (2001:308) several ways in, which such combinations can occur, namely:

- **Methodology combination:** Whereby two or more methodologies are used within the same intervention.
- **Methodology enhancement:** When one methodology is used, but enhanced by importing methods from elsewhere.
- **Single -paradigm multimethodology:** When parts of several methodologies are combined from the same paradigm.
- **Multi-paradigm multimethodology:** Represents the proposed application of the multimethodology approach within the ambit of this thesis, when parts of several methodologies are combined from different paradigms.

In Chapter 4, the complexities of the 'systems approach' are introduced to provide the reader with the required insight into the ruling principles that govern the approach. The 'systems approach' will form the basis on which the structured sequence of events will be formulated, to ultimately culminate in the set of mitigating factors, to facilitate the intervention and management of key factors contributing to the failure of management information development projects undertaken in the financial services industry. The mitigating factors will be formulated from an extract of selected elements identified in each of the system methodologies to be analysed namely:

- The Systems Approach, to be analysed in Chapter 4.
- The Six Sigma methodology, to be analysed in Chapter 5.
- The Capability Maturity Model to be analysed in Chapter 6.
- The Balanced Scorecard to be analysed in Chapter 7.

Furthermore, the concepts making up the complexities of the systems approach cover a range of diverse (and often seemingly unrelated) topics. This will only become clear as the research progresses into Chapter 8, where the entities surface as integral components of the set of mitigating factors to be formulated.

The following concepts are investigated and where appropriate, defined:

- The concept 'system'.
- General Systems Theory.
- The concept 'systems approach'.
- The concept 'cybernetics'.
- 'Closed' and 'open systems'.
- The role of 'models'.
- The notions '*Weltanschauung*' and Appreciative systems.
- 'Causal loop diagrams' and 'Reinforcing and balancing processes'.

This chapter concludes Part 1 of this thesis, with Part 2 dealing with the analysis of the various methodologies reflected in Chapters 4 - 7. Part 2 contains a number of words and phrases, which are closely associated with the financial services industry. Going forward, for absolutely clarity, the following words and phrases are defined:

- **Organisation:** An organisation (a bank), forming part of the greater financial services industry.
- **Information technology department:** Refers to the technology development component or department operating within the ambit of an organisation as part of the organisation.
- **User/end-user/sponsor or client:** Refers to a user, end-user, sponsor or client of either the organisation (external clients doing business with the organisation), or the organisation itself being an internal client or user of the information technology department.

Table of Contents: Chapter 4

Synopsis: Chapter 4

In this chapter, the ruling principles of the systems approach will be analysed. The 'systems approach', will form the basis on which the structured sequence of events will be formulated, to ultimately culminate in the set of mitigating factors to facilitate the intervention and management of key factors contributing to the failure of management information development projects undertaken in the financial services industry.

The chapter is introduced with a systems classification, whereby the elements are positioned to guide the reader and serve as navigational roadmap. The concepts making up the complexities of the systems approach cover a range of diverse (and often seemingly unrelated) topics. These concepts will surface as integral components of the set of mitigating factors to be formulated and include the following:

- The concept 'system'.
- General Systems Theory.
- The concept 'systems approach'.
- The concept 'cybernetics'.
- 'Closed' and 'open systems'.
- The role of 'models'.
- The notions '*Weltanschauung*' and Appreciative systems.
- 'Causal loop diagrams' and 'Reinforcing and balancing processes'.

It is of importance to note that the key components gleaned from the systems approach, will include components from the 'hard' systems methodology (discussed in Appendix A) and the 'soft' systems methodology (discussed in Appendix B).

Chapter 4

Ruling Principles of the 'Systems Approach'

"It isn't that they can't see the solution". "It is that they can't see the problem".

G.K. Chesterson

4.1 INTRODUCTION

In this chapter, the complexities of the 'systems approach' are introduced to provide the reader with the required insight into the ruling principles that govern the approach. The 'systems approach', will form the basis on which the structured sequence of events will be formulated, to ultimately culminate in the set of mitigating factors to facilitate the intervention and management of key factors contributing to the failure of management information development projects undertaken in the financial services industry.

The mitigating factors will be formulated from an extract of selected elements identified in each of the following system methodologies using a multimethodology approach:

- The Systems Approach, to be analysed in this chapter.
- The Six Sigma methodology, to be analysed in Chapter 5.
- The Capability Maturity Model to be analysed in Chapter 6.
- The Balanced Scorecard to be analysed in Chapter 7.

For ease of reference, the interrelationship of the various core entities, gleaned from the above defined system methodologies, ultimately supporting the structured sequence of events serving as mitigating factors are graphically depicted in Figure 4.1. In addition, the mitigating factors are positioned to reflect their potential position in a typical systems development life cycle as proposed by Senn (1990:673).

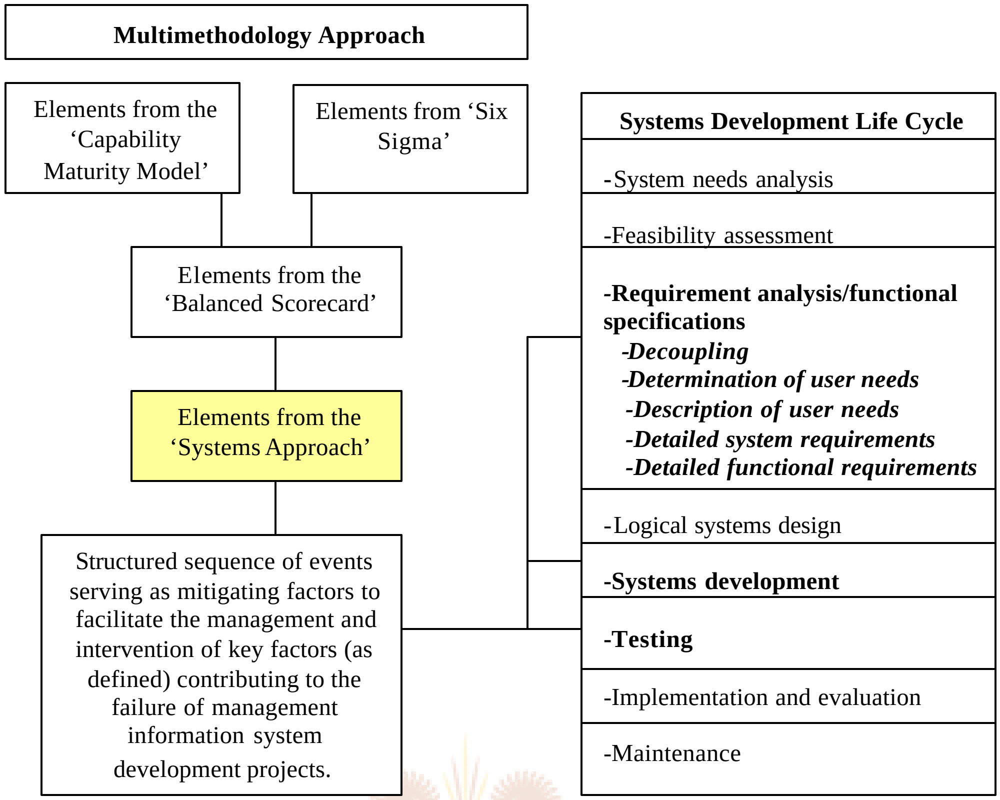

Figure 4.1: Interrelationship of core entities

Furthermore, the concepts making up the complexities of the systems approach cover a range of diverse (and often seemingly unrelated) topics. This will only become clear as the research progresses into Chapter 8, where the entities surface as integral components of the set of mitigating factors to be formulated.

The following concepts are investigated and where appropriate, defined:

- The concept 'system'.
- General Systems Theory.
- The concept 'systems approach'.
- The concept 'cybernetics'.
- 'Closed' and 'open systems'.
- The role of 'models'.
- The notions '*Weltanschauung*' and Appreciative systems.
- 'Causal loop diagrams' and 'Reinforcing and balancing processes'.

The analytical process followed thus far, is graphically depicted in Figure 4.2, which places the chapters in context with the overall thesis objectives, and furthermore indicates the relative positioning of this chapter.

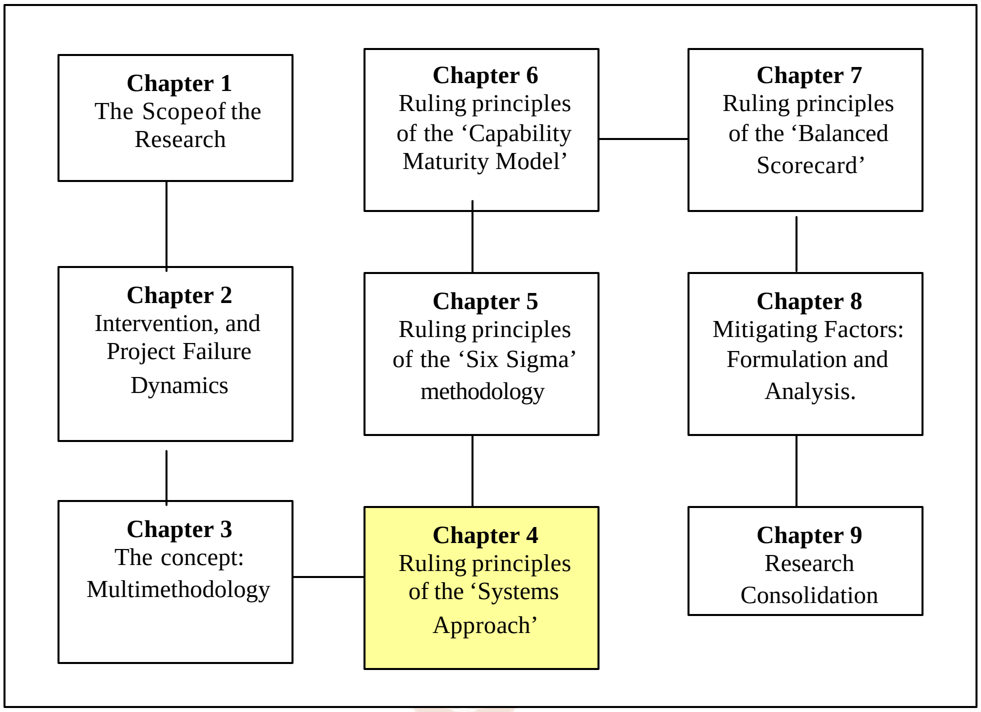

Figure 4.2: Chapters in context of the overall research

In addition, to provide the reader with a navigational roadmap to understanding the complexity of the systems approach, the components[1] of which are reflected in Figure 4.3, being adapted from Checkland (1989:95-97) for this purpose. It is acknowledged by the author of this thesis that the classification of systems within the context of the systems approach as depicted in Figure 4.3, is merely 'one of many' such classifications in existence today.

A more popular systems classification, is provided by Jackson (1991:27-31). In terms of the classification by Jackson, system approaches are classified according to the assumptions they make where the terms, unitary, pluralist and coercive are used for describing the relationship between the various stakeholders with an interest in organisations, also referred to as 'the system of system methodologies'.

[1] Checkland (1989:96) refers to the 'components' of the systems approach as 'The shape of the systems movement'.

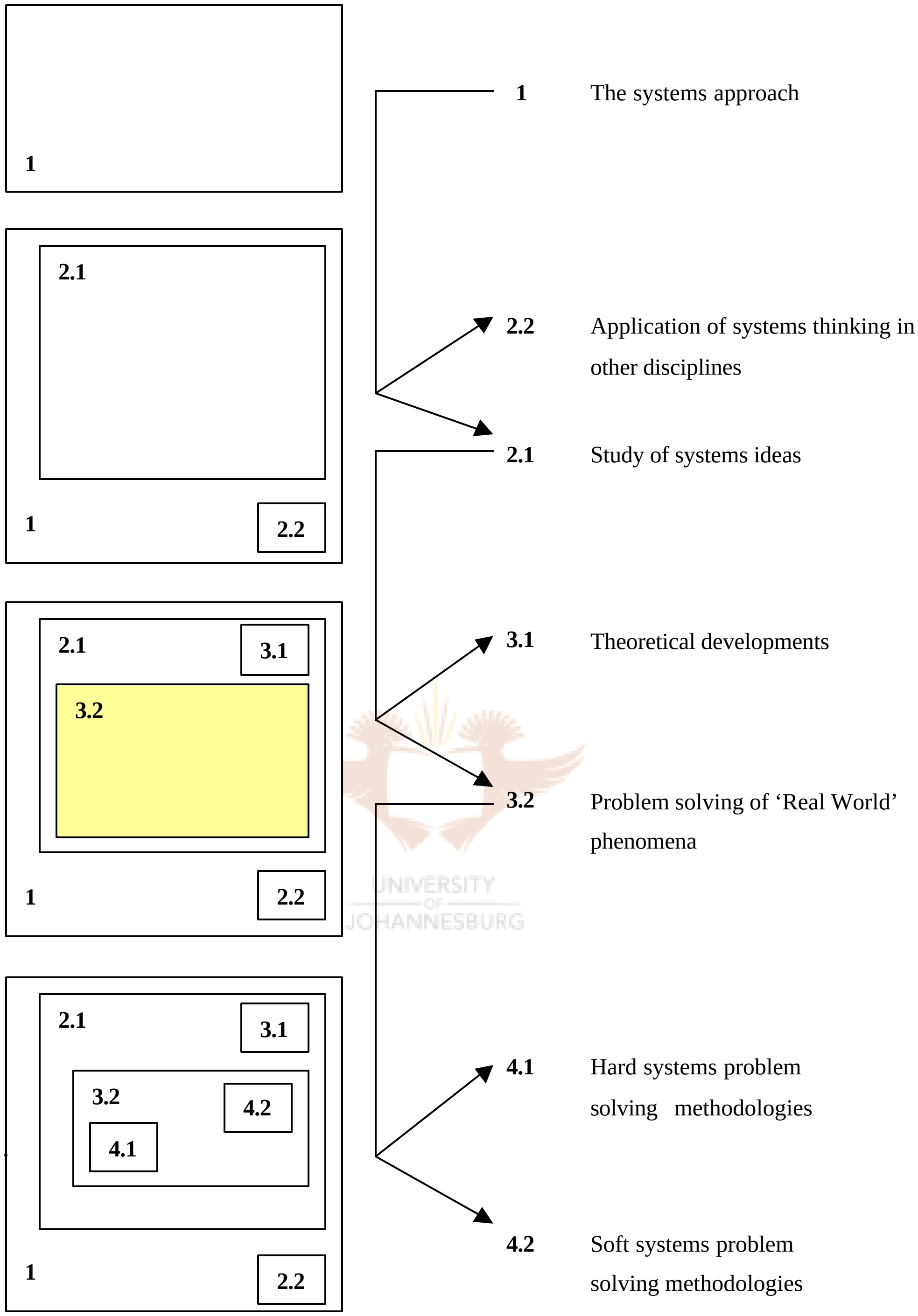

Figure 4.3: Classification of systems falling within the context of the 'systems approach'

One dimension of the 'the system of system methodologies' deals with how complex the problem context is, while the second concerns the relations between stakeholders. This concept was first mooted by Jackson & Keys (1984:473), which was in essence a typology classification of the different assumptions made by methodologies (Mingers 1997:5). While the classification as depicted in Figure 4.3, was selected to demonstrate the 'classifications of systems', the focus in this thesis is centred on the multimethodology approach as described in Chapter 3, where there are clear tangent planes with the concept 'methodological pluralism' (refer Paragraph 3.2).

Analysing Figure 4.3, the systems approach (shown as Frame 1) is presented as an all incumbent 'overall' problem solving methodology consisting of a multitude of different approaches to address complex phenomena. These different approaches led in the first instance to the 'application of systems thinking in other disciplines', (shown as Frame 2.2), of which the 1970's system revolution in geography serves as an example. In the second instance, the 'study of systems ideas' (shown as Frame 2.1), which are split into two distinct fields namely:

- Theoretical developments (shown as Frame 3.1), of which the 'General Systems Theory' further discussed in Paragraph 4.3 serves as an example.
- Problem solving of real world phenomena (shown as Frame 3.2).

The hard systems approach, (shown as Frame 4.1) and contained within the ambit of Appendix A, is made up of the following problem solving methodologies:

- Systems engineering.
- Systems analysis.
- Operational research.
- Management cybernetics
- Systems Dynamics

The soft systems approach (shown as Frame 4.2), and contained within the ambit of Appendix B, is made up of the following problem solving methodologies:

- The Viable Systems Model of Beer (organisational cybernetics).
- Churchman's Social Systems Design.
- Mitroff and Mason's Strategic Assumption Surfacing and Testing Methodology.
- Ackoff's Social Systems Sciences.
- Checkland's Soft Systems Methodology.

It is this 'problem solving of real world phenomena', which gave rise to the very essence of the research contained within the ambit of this thesis.

4.2 THE CONCEPT 'SYSTEM' DEFINED

A philosopher once said he knew no two objects that were not related in some way, if only by the distance between them. This philosopher according to Rosenblatt *et al.* (1977:54), has broadly defined the concept of a 'system'. This statement leads to the analogy that, 'everything is related to everything else', which according to Beer (1970:242) is in line with the philosopher Hegel's enunciation of the proposition called 'The Axiom of Internal Relations'. In terms of this concept, the relations by which terms are related, are an integral part of the terms they relate to. So the notion of anything being enriched by the general connotation of the term which names it, describes the relationship of the thing to other things. In fact, Hegel's Axiom entails that things would not be the things they are, if they were not related to everything else in the way that they are.

The term 'system' can be associated with a plethora of interpretations depending on the field one wishes to apply the concept to. The term is used in almost all sciences and in everyday language, resulting in the term being associated with amongst others, system science, systems thinking, systems design, systems analysis, systems engineering and the systems approach.

According to Ackoff (1960:331–332), the term system is used to cover a wide range of phenomena, some of which are conceptual constructs, and others are physical entities. The following can be listed, namely:

- Philosophical systems.
- Number systems.
- Communication systems.
- Control systems.
- Educational systems.
- Weapon systems.

Against this background, Ackoff (1960:332), defines the concept 'system' as:

> *"Any entity, conceptual or physical, which consists of interdependent parts".*

Kauffman (1980:1), Meadows (1982a:101), and Sisk (1969:12), provide 'near' identical definitions of 'system', which are consolidated here to read as follows:

> *"a system is a collection of parts which interact with each other to function as a whole".*

Strümpher (1992:2) citing Vickers[2] defines a system as:

> *"a regulated set of relationships, and the key to its understanding is the way in which it is regulated".*

Strümpher (1992:3) makes two important observations regarding the systems definition of Vickers of which the true impact will become clear only in Chapter 8 of this thesis where the set of mitigating factors will be formulated. These rather lengthy comments, which are quoted *verbatim* as not to lose the true meaning of the author, read as follows:

[2] Vickers G. 1984. A classification of systems. [Talk to Society of General Systems Research. Also published as Article 2 in General Systems Yearbook, 1970 and as Chapter 2 in *The Vickers Papers,* ed. by Open Systems. London: Harper & Raw.

- *"The first aspect that Vickers' definition captures is that anything that we care to group together and label as an entity proves upon further investigation to be constituted from more relationships. In fact why we care to label an entity as such is because the constituent relationships show resilience or stability through time, i.e., 'it' persists. It is precisely because the relationships hang together through time that we observe them (it) in the first place. One perspective on relationships then is this stability, which I will call the structure. By structure I therefore mean those relationships that remain relatively unchanged through the period of interest to the inquiry".*

- *"A second aspect touched by Vickers' system definition is that there is a dynamic dimension to the relationships. This perspective on systems relationships, which I will call the process dimension, refers to the altering or changing of relationships over the time frame of the enquiry. Process refers to the matter/energy and/or information flow, and their transformations, which place within the entity, as well as between the entity and its environment, during the timeframe of interest in the inquiry. Process describes the logical thinking of inputs to output(s). It should be borne in mind that definitions of input and output depend on how the systems boundary is drawn, which is by no means determined absolutely. Whereas structure describes 'static' or (relatively) unchanged relationships, the process perspective describes the changes in relationships within the time frame of interest".*

Strümpher (1992:3-4) also quotes the definition, which Ackoff[3] associates with the concept of 'a system'. This definition portrays a system:

[3] Ackoff RL. 1981. Creating the Corporate Future: Plan or be planned for. New York: Wiley.

> *"as a set of elements where the behaviour of any part depends on the interaction with other parts. i.e., behaviour depends on interrelationships".*

Churchman (1971:43) does not define a system *per se*, but provides nine conditions that determine a system. Briefly, the necessary conditions that something ***S*** be conceived as a system are as follows:

- ***S*** is teleological[4]. (i.e., a view that developments are due to the purpose of design that is served by them.)
- ***S*** has a measure of performance.
- There exists a client whose interests are served by ***S*** in such a manner that the higher the measure of performance, the better the interests are served, and more generally, the client is the standard of the measure of performance.
- ***S*** has teleological components, which co-produce the measure of performance of ***S***.
- ***S*** has an environment, which also co-produces the measure of performance of ***S***.
- There exists a decision-maker who – via his resources - can produce changes in the measures of performance of ***S's*** components and hence changes in the measure of performance of ***S***.
- There exists a designer, who conceptualises the nature of ***S*** in such a manner that the designer's concepts potentially produce actions in the decision maker and hence changes in the measures of ***S's*** components and hence changes in the measure of performance of ***S***.
- The designer's intention is to change ***S*** so as to maximise ***S's*** value to the client.

[4]According to Churchman (1971:5) design belongs to the category of behaviour called 'teleological', i.e. 'goal seeking' behaviour. More specifically, design is thinking behaviour, which conceptually selects among a set of alternatives in order to figure out which alternative leads to a designed goal or set of goals.

- ***S*** is stable with respect to the designer, in the sense that there is a built-in guarantee that the designer's intention is ultimately realisable.

Churchman (1983:11), underwrites the above nine conditions that determine a system with the following definition:

> *"a system is a set of parts co-ordinated to accomplish a set of goals"*

Very closely mapping this definition is the description of a system as perceived by Thierauf (1975), who describes the concept as 'an ordered set of methods, procedures, and resources designed to facilitate the achievement of an objective or objectives'. Returning to the root meaning of the word, The Oxford English Dictionary (1989:Vol. xvii) defines system as:

> *"An organized scheme or plan of action, esp. one of a complex or comprehensive kind; an orderly or regular method of procedure"*.

According to Capra (1996:27) the word 'system', descends from the Greek verb '*sunistánai'*, which originally meant 'to place together', hence the view that a system is a perceived whole whose elements 'hang together', because they continually affect each other over time and operate toward a common purpose. This interpretation can be expanded upon if viewed against the definitions provided by Lannon-Kim (1994:4), and the definition by Kramer & De Smit (1977:14).

- Kim (1992:2) and Lannon-Kim (1994:4), defines system as:

> *"a group of interacting, interrelated, or interdependent elements forming a complex and unified whole that has a specific purpose"*.

- Kramer & De Smit (1977:14) define a system as:

> *"a set of interrelated entities, of which no subset is unrelated to another subset"*.

The definitions provided by Lannon-Kim and Kramer & De Smit cited above, map in certain instances to the definition, which Kast & Rosenzweig (1974:20) attach to the concept system namely:

> *"an organized, unitary whole composed of two or more interdependent parts, components, or subsystems and delineated by identifiable boundaries from its environmental suprasystem".*

Within this context, the term system covers a broad spectrum of the physical, biological and social world. This suggests the requirement for a 'General Systems Theory', which provides a broad macro view from which all types of systems, given effect to the following words of Ashby[5] (1964) cited by Kast & Rosenzweig (1974:20):

> *"So has arisen systems theory – the attempt to develop scientific principles to aid us in our struggles with dynamic systems with highly interactive parts".*

While the simplistic view of the concept system for Pascale (1991:42), only refers to 'how information moves around within the organisation'. Churchman *et al.* (1966:42) view 'system' as, 'an interconnected complex of functionally related components'. The concept system is expanded by Ackoff and Rivett (1967:10) to 'a system's orientation', which they define as:

> *"deliberately expands and complicates the statements of problems until all the significantly interacting components are contained within it".*

This leads into the rather lengthy explanation by Johnson (1997:98) of a system, which is provided in terms of the following fundamental characteristics:

[5] Ashby WR. 1964. Views on General Systems Theory. New York: Wiley. p166.

> *"First, a system is a whole that consists of a set of two or more parts. Each part affects the behaviour of the whole, depending on the part's interaction with other parts of the system. In addition, the essential properties that define any system are properties of the whole, and none of the parts have those properties".*

The fact that a system is a whole that consists of a set of two or more parts' requires closer scrutiny. This implies that systems are composed of parts, which are themselves systems, according to Cleland & King (1972:32), who cites the following example: 'The human body is a system composed of various 'subsystems' (nervous, cardio-vascular, etc.)'. 'In turn, these sub-systems are composed of cells, each of which is itself a system'. 'Thus, systems typically exhibit a structure in which these are parts (sub-subsystems) imbedded within other parts (subsystems) within overall systems'. This issue is deliberated further by Ackoff & Emery (1972:3), who look at 'human behaviour as systems of purposeful (teleological) events'. Ashby (1960:230) is of the opinion that when a set of subsystems are richly joined, each variable is as much affected by variables in other subsystems as by those in its own. Furthermore, the imbedding of one system in another can go on through many stages and indeed go on endlessly.

In summary, Capra's (1996:27) conceptualisation of system, in view of the author of this thesis, draws together all the components of the concept. For Capra, 'system' means 'an integrated whole whose essential properties arise from the relationship between the parts, which can be traced back to the root meaning of the word 'system' which derives from the Greek *'sunistánai'* (to place together)'.

In final conclusion, the controversial view of Weinberg (1975:52) who, when answering the question: What is a system? – retorts with:

> *"As any poet knows, a system is a way of looking at the world. The system is a point of view – natural for a poet, yet terrifying for a scientist".*

4.3 GENERAL SYSTEMS THEORY

According to Kramer & De Smit (1977:3), Köhler a German physicist, was the first to give impulse towards the 'General Systems Theory' with his book: *'Die physischen Gestalten in Ruhe und im stationären Zustand'*[6]. Focussing on management, the earliest system models used in management according to Jackson (1991:42), studied organisations as mechanical systems in equilibrium. The idea of studying social systems in this way according to Jackson originally derived from Pareto (1919) and thereafter promoted in the United States by Henderson, a powerful figure at Harvard University in the 1930's.

According to Jackson (1991:41), citing Kast & Rozenweig[7] three different models of management emerged from the 1930's onward namely, the Traditional Approach, the Human Relations Theory and the Systems Theory. The Traditional Approach was based on Taylor's Scientific Management, Fayol's Administrative Theory, and Weber's Bureaucracy Theory. Another theory, the Human Relations Theory grew out of the critique of the Traditional Approach with theorists in the likes of Mayo, Maslow, Hertzberg and Mc Gregor avid supporters thereof.

Ludwig Von Bertalanffy, in 1940 published in German his first discussion on open systems (Von Bertalanffy 1950:46), which was followed with an essay in 1950, entitled *'The Theory of Open Systems in Physics and Biology'*. This according to Jackson (1991:48) citing Emery[8] and Lilienfeld[9]:

> "*establishes systems theory as a scientific movement*".

This furthermore according to Jackson (1991:48-49), establishes von Bertalanffy rightfully, as the founding father of the systems theory[10], and who gave

[6] Köhler W 1924. Die physischen Gestalten in Ruhe und im stationären Erlangen: Zustand.
[7] Kast FE & Rosenweig JE. 1981 Organization and Management: A Systems and Contingency Approach. 3rd ed. New York: McGraw–Hill.
[8] Emery FE. ed. 1969. Systems Thinking Harmondsworth: Penguin.
[9] Lilienfeld R 1978. The rise of systems theory: An ideological analysis. New York: Wiley.
[10] According to Von Bertalanffy cited by Kast & Rosenzweig (1974:102): "The various fields of modern science have had a continual evolution toward a parallelism of ideas. This parallelism provides an opportunity to formulate and develop principles which hold for systems in general".

institutional embodiment to the concept by setting up the society for General Systems Research in 1954 with co-founders Boulding, Rapoport and Gerard.

Capra (1996:46), citing from the work of Von Bertalanffy (1968), provides the following definition of the 'General Systems Theory' from a holistic point of view:

> *"General system theory is a general science of 'wholeness' which up till now was considered a vague, hazy, and semi-metaphysical concept". "In elaborate from it would be a mathematical discipline, in itself purely formal but applicable to the various empirical sciences". "For sciences concerned with 'organized wholes', it would be of similar significance to that which probability theory has for sciences concerned with 'chance events'".*

Furthermore, according to Capra (1996:49) again citing Von Bertalanffy (1968), the latter believed that a 'General Systems Theory' would offer an ideal conceptual framework for unifying scientific disciplines that had become fragmented:

> *"General systems theory should be an important means of controlling and instigating the transfer of principles from one field to another, and it will no longer be necessary to duplicate or triplicate the discovery of the same principle in different fields isolated from each other. At the same time, by formulating exact criteria, general systems theory will guard against superficial analogies which are useless in science".*

Caution in the use of the 'General Systems Theory' comes from Checkland (1989:94) who is of the opinion that:

> *"The problem with General Systems Theory is that it pays for its generality with lack of content. Progress in the systems movement seems more likely to come from the use of systems ideas within a*

> *specific problem area than from the development of overarching theory".*

It is of importance to note that while Von Bertalanffy is commonly credited with the first formulation of a comprehensive theoretical framework describing the principles of organisation of living systems, the first papers on the general systems theory were formulated, not by Von Bertalanffy, but by the Russian Alexander Bogdanov twenty to thirty years earlier. According to Capra (1996:43-46), Bogdanov called his theory 'Tektology' from the Greek *'tekton'* (builder), which can be translated as 'the science of structures'. Bogdanov's pioneering book *'Tektology'*, was published in Russian in three volumes between 1912 and 1917, while the German edition was published and widely revised in 1928. Furthermore, according to Capra (1996:44), tektology anticipated the conceptual framework of Ludwig Von Bertalanffy's General Systems Theory, and it also included several important ideas that were formulated decades later as key principles of cybernetics by Robert Wiener and Ross Ashby.

Kramer & De Smit (1977:4) acknowledge these parallel developments to the systems theory, namely contributions before 1950 pertaining to cybernetics citing Sziland, being in the forefront thereof with his book: *'Über die Entropieverminderung in einem thermodynamischen System bei Eingriffen intelligenter Wesen'*, and the work of Norbert Wiener in this respect, which led to the publication of his book *'Cybernetics'* in 1948, claiming that this was the most important impulse to the development of the General Systems Theory.

It was only during the 1960's, that the systems approach came to dominate management theory, due to the fact that the Traditional Approach concentrated on task and structure, the Human Relations Approach on people, and the systems approach was said to be 'holistic', because it focussed on organisations as a whole.[11] This 'holistic' approach became a requirement according to Von Bertalanffy, cited by Kramer & De Smit (1977:3–4), due to the fact that in various

[11] The essence of the General Systems Theory can be expressed according to Kramer & De Smit (1977:3) as: 'the whole is more than the sum of its parts'.

academic principles, problems were becoming increasingly complex owing to progress in the respective sciences.

Vickers[12], cited by Haines (2000:5), provides the following, rather lengthy, explanation of the General Systems Theory, in layman's terms, repeated here *verbatim* as to not lose the original meaning of the author:

> *"The words general systems theory imply that some things can usefully be said about systems in general, despite the immense diversity of their specific forms. One of these things should be a scheme of classification".*

> *"Every science begins by classifying its subject matter, if only descriptively, and learns a lot about it in the process. Systems especially need this attention, because an adequate classification cuts across familiar boundaries and at the same time draws valid and important distinctions which have previously been sensed but not defined".*

> *"In short, the task of General Systems Theory is to find the most general conceptual framework in which a scientific theory or a technological problem can be placed without losing the essential features of the theory or the problem".*

According to Haines (2000:5), this theory then, is 'a marvellous vehicle for framing and describing universal relationships'. 'Its basic precept is that, in our work in any problem, the whole should be our primary consideration, with the parts secondary'.

[12] Vickers G 1972. General Systems Thinking. *Chapman & Hall.* London.

4.4 THE CONCEPT 'SYSTEMS APPROACH' DEFINED

It is the 'approach' to the concept 'system', which is encapsulated in the following definition from *The Oxford English Dictionary* (1989:Vol. i), which defines 'an approach' as:

"A way of considering or handling something, esp. a problem"

This definition is identical to the definition provided by Checkland (1989:5), who defines 'approach' as:

"a way of going about tackling a problem".

Checkland expands this definition into a definition for the systems approach, which reads as follows:

> *"An approach to a problem, which takes a broad view, which tries to take all aspects into account, which concentrates on interactions between the different parts of the problem".*

Lannon-Kim (1994:4), defines systems thinking (the systems approach) as:

> *"a school of thoughts which focuses on reorganizing the interconnections between the parts of a system and synthesizing them into a unified view of the whole".*

This definition maps to the systemic views of Palazzoli *et al.* (1986) and Karnopp & Rosenberg (1975:2), where the authors make the observation that, 'no phenomenon can be grasped unless the field of observation includes the whole context in which the phenomenon occurs'. This definition leads into the requirement to understand the difference between systems analysis and systems synthesis, as Johnson (1997), is of the opinion that, 'the systems approach is more synthesis than analysis'[13].

Somerhoff (1969:152) is of the opinion that 'system analysis' is useful for revealing '*what*' a system does and not '*how*' it does it, while 'system synthesis' reveals '*why*' a system works the way it does. The latter the very essence of the systems approach, which is supported by Kramer & De Smit (1977:5), who is of the opinion that, 'the systems approach is a means of tackling problems, a methodology', which maps to the theme of this thesis. This is conceptually supported by Goodman *et al*. (1997:1–2), when discussing the power of systems thinking. The authors upheld the opinion that, 'the systems approach is especially useful for defining problems, formulating and testing potential solutions and implementing effective solutions that endure'.

Oversimplified in its most basic format, and bordering on layman's terms, the 'systems approach to problem solving' involves according to McLeod (1979:83) and Athey (1982:5), the following steps:

- Formulate the problem.
- Gather and evaluate information.
- Develop potential solutions.
- Decide on the best solution.
- Communicate the system solution.
- Implement the solution.
- Establish permanent standards.

On the broadest level according to Churchman (1979:8), the systems approach belongs to a whole class of approaches to managing and planning human affairs with the intent that a living species should conduct itself properly in this world. More in line with the theme of this thesis, Churchman (1983:39) evaluates the systems approach from the point of view of the management scientist. In this respect, the systems approach entails:

[13] See also Appendix A, Paragraph A3 dealing with 'systems analysis'.

> *"The construction of 'management information systems' that will record the relevant information for decision-making purposes and specifically will tell the richest story about the use of resources, including lost opportunities".*

Churchman (1983:11) continues and draws the analogy that, 'systems are made up of sets of components that work together as a whole, and that the systems approach is simply a way of thinking about these total systems and their components', which is in line with the view of Senge (1990b:73), who is of the opinion that the discipline of the systems approach lies in a shift of mind:

- Seeing interrelationships rather than linear cause-effect chains.
- Seeing processes of change rather than snapshots.

A natural progression from the definitions above, is to map the systems approach to the concept 'management', or more appropriate to this thesis, the *'process of managing projects'* (my italics). Checkland (1989:72) defines the process of management as being:

> *"concerned with deciding to do or not to do something, with planning, with considering alternatives, with monitoring performance, with collaborating with other people or achieving ends through others; it is the process of taking decisions in social systems in the face of problems, which may not be self-generated".*

The systems approach since inception have been expanded upon and changed over the years and specifically applied to a world where complex phenomena are of the order of the day. The systems approach, as a regulated mechanism, specifically provides structure and order to any mode of inquiry within the context of such complex phenomena. The complex phenomena associated with the art of management, and for the purpose of this thesis, the 'process of managing projects' is encapsulated by the following extract from Goodman (1994:1):

> *"English, like most other Western languages, is linear–its basic sentence construction, noun - verb - noun, translates into a worldview*

> *of X causes Y. This linearity predisposes us to focus on one way relationships rather than circular or mutually causative ones, where X influences Y, and Y in turn influences X. Unfortunately, many of the most vexing problems, confronting managers and corporations today are caused by a web of tightly interconnected circular relationships. To enhance our understanding and communication of such problems, we need a language more naturally suited to the task".*

Goodman (1994:1) suggests the systems approach is the most suited 'language' for communicating such complexities and interdependencies. This is supported by Dearden (1972:95), a Harvard professor, who referred to the systems approach as 'nothing more than good management'. The systems approach is represents a powerful method for problem solution and decision-making (McLeod 1979:100), hence the reason why the approach was selected to form the basis of this research. The statement of Churchman (1983:232) that 'the systems approach is not a bad idea', encapsulates all of the issues above.

An all incumbent analogy provided by Capra (1996:27), is most appropriate when the author views 'a system as meaning an integrated whole whose essential properties arise from the relationship between its parts', and 'systems thinking', as 'the understanding of a phenomenon within the context of a larger whole'.

The concepts 'systems thinking' and 'larger whole' requires closer scrutiny. 'Systems thinking' according to Duhl (1983:60) as an internal mode of 'seeing' ordered patterns of relationships, processes and interconnectedness in and between objects, phenomena, and people, has perhaps existed forever in the minds of various disparate individuals. As a particular way of looking at the world that when extended, becomes a shared total world-view of a dynamically interacting model of the universe. According to Haines (2000:7-8), systems thinking represents a new way to view and mentally frame the world. A worldview and way of thinking whereby the entity or unit, is first perceived as a whole, with its fit and relationship to its environment as primary concerns, the parts secondary. This 'whole' view of the systems approach is supported by Senge (1990a:68) in the following philosophical approach to the concept, which is retained in the original text to ensure that the full impact of the wisdom can be appreciated:

> *"The words 'whole' and 'health' comes from the same root (the Old English 'hal', as in 'hale and hearty'). So it should come as no surprise that the unhealthiness of our world today is in direct proportion to our inability to see it as a whole. Systems thinking is a discipline for seeing wholes. It is a framework for seeing interrelationships rather than things, for seeing patterns of change rather than static snapshots. It is a set of general principles-distilled over the course of the twentieth century, spanning fields as diverse as the physical and the social sciences, engineering and management".*

The most generally known thesis with regard to 'wholes' is the following:

"The whole is more than the sum of its parts".

According to Angyal (1941:26), this is not a very felicitous formulation since – contrary to the concept of Gestalt psychologists – it may suggest that a summation of parts takes place and that, besides the summation, a new additional factor enters into the constitution of wholes. Feiblemen & Friend (1945:31) underpins the understanding of the concept of 'wholes', with this following powerful analogy of the concept namely:

> *"Wholes are not a level of analysis, but that from which analysis starts".*

This statement becomes more relevant if viewed against the background of the study at hand, in particular with respect to the analysis of complex phenomena. Senge (1990b:69) concludes that the systems approach is a sensibility – for the subtle interconnectedness that gives living systems their unique character. According to Singer cited by Mitroff & Linstone (1993:95) the fundamental notion of interconnectedness, or non-reparability forms the basis of the systems approach. It is perhaps the summary of Ossenbruggen (1994:2-3), which drives to the core of the systems approach with the following analysis: Problem analysis '*and resolution thereof*' (my italics), involves the following stages:

- Problem definition (PD).
- Generation of alternatives (GA).
- Model formulation (MF).
- Analysis and alternative selection (A&AS).

From this analysis the overall strategy called the systems approach, endeavours to simplify a problem by reducing it into these stages, hence the very reason why the systems approach was selected to form the basis of this research. This overall strategy is depicted in Figure 4.4 for ease of reference.

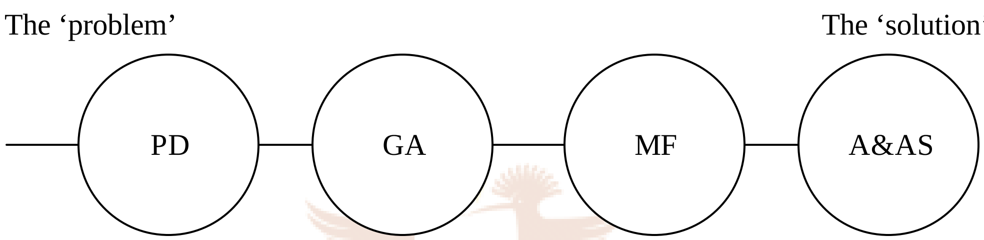

Figure 4.4:- The systems approach as a flow of information

In final conclusion the views of Chestnut[14], cited by Silvern (1973:1), who stated that 'the systems approach is dedicated to emphasising the ideas which are common to the successful operation of somewhat independent parts in an integrated whole'.

4.5 CYBERNETICS DEFINED

According to Checkland (1989:84), a part of 'systems theory' known as cybernetics, the word coming from the Greek word '*kybernetes*' meaning 'steersman', forms the link between control mechanisms studied in natural systems as opposed to 'engineered', 'man made' systems. According to Kramer & De Smit (1977:99), the Greek philosopher Plato used it in his discussions about the analogy between navigating a ship and governing a country

[14] Chestnut H. 1965. *Systems Engineering Tools*. New York: Wiley.

or group of people, and was rediscovered in 1840 by Ampere in his classification of the sciences. The first application of the concept can be traced back to Arabic and Greek manuscripts around 200 BC referencing control systems.

It is Lerner (1975:2–3), who draws the attention to the fact that cybernetics is generally associated with the date of publication (1948) by Norbert Wiener of his book *'Cybernetics, or Control and Communication in the Animal and the Machine'*, however in addition acknowledging valuable earlier contributions from Maxwell, Vyshnegradskiy, Shestakov, Gavrilov, Nakashimo, Pascal, Leibniz and Babbage.

Checkland (1989:84) and Kramer & De Smit (1977:100–101) cite the studies of Wiener (1948), who defined cybernetics as:

> *"the entire field of control and communication theory, whether in the machine or in the animal"*.

Checkland (1989:84) further cites Ashby[15], the latter considered the leading theoretician in the 1950's and 1960's, and who describes cybernetics somewhat different from Wiener, when he defines cybernetics as follows:

> *"Cybernetics is similar in its relation to the actual machine. It takes as its subject matter the domain of 'all possible machines'. What cybernetics offer is the framework on which all individual machines may be ordered, related and understood"*.

Another definition of Wiener[16], this time cited by Clemson (1984:19) defined the concept as:

[15] Ashby WR. 1956a. An Introduction to Cybernetics. London: Chapman and Hall.
[16] Wiener N. 1948. Cybernetics: OR and communications in the animal and machine. New York: Wiley.

> *"The science of effective communication and control in men and machine".*

Flood and Jackson (2002:87) expand on this and describe cybernetics as:

"the science of organisation".

Wiener furthermore, according to Kramer & De Smit (1977:101), is of the opinion that cybernetics is not a science which studies systems, but a science which studies the 'behaviour of systems'. From this the analogy can be drawn that the origins of modern cybernetics are diverse, but are to be found most concretely in the research of Wiener during the Second World War, particularly in the attempt according to Morgan (1986:85), to develop and refine devices for the control of gunfire. This leads onto the notion that cybernetics has tangent planes to the control of processes, an analogy that is confirmed by Churchman (1983:144) when he defines cybernetics as:

> *"a mathematical method of evaluating and controlling a process on the basis of its experience".*

Churchman (1968:57), expands on this definition when he views cybernetics as the discipline concerned with the way in which individuals pursue – or ought to pursue – their goals. According to Churchman, it emphasises the importance of equilibrium, of an internal state that is capable of responding to environmental change without the system's getting off its chosen course. Beer (1981:391) is of the opinion that, cybernetics is about all manner of control, all kinds of structure, and all sorts of system. Beer (1995:ix) defined the concept as:

"the science of effective organization".

Clemson (1984:19), gives the following rendition of Beer's thoughts[17] in respect of the above definition when, the latter thinks of systems with the following characteristics:

- **Complex:** They have more relevant detail than the given observer can possibly cope with.
- **Dynamic:** They are changing in their behaviours or structure or both.
- **Probabilistic:** There are important elements whose behaviours are at least partly random.
- **Integral:** They act in some important sense as a unity.
- **Open:** They are embedded in an environment which affects them and which they affect.

From the above, according to Clemson (1984:19), the analogy can be drawn that:

> *"Cybernetics studies the difference between effective and ineffective modes/structures/methods of organization in certain classes of systems".*

It is of importance to draw a clear distinction between 'management cybernetics' falling within the ambit of hard systems methodologies discussed in detail in Appendix A, and 'organisational cybernetics' falling within the ambit of soft systems methodologies discussed in detail in Appendix B. The following descriptions according to Jackson (1991:102–104), can be attributed to these two entities:

- **Management Cybernetics:** This kind of cybernetics treats organisations as if they were actually like machines or organisms. The starting point for a management cybernetic model of the organisation is the input-transformation-output schema. This is used to describe the basic operational activities of the enterprise. The goal or purpose of the enterprise is in management cybernetics, invariable determined outside the system. Then, if the operations are to succeed in bringing about the goal, they must, because of inevitable disturbance, be regulated in some way. This regulation is effected by

[17] Clemson citing Beer's thoughts as contained in: Von Foerster H & Zoph G. 1962. Eds. 'Principles of Self-organization'. Elmsford: Pergamon.

management. Management cybernetics attempts to equip managers with a number of tools that should enable them to regulate operations. Simplifying considerably (since in fact the cybernetic tools represent an interrelated response to the characteristics of cybernetic systems), extreme complexity can be dealt with using the black box technique, self-regulation can be appropriately managed using negative feedback, and probabilism yields to the method of variety engineering.

- **Organisational Cybernetics:** This concept, according to Jackson (1991:104), is primarily the brainchild of the revered Professor Stafford Beer. Organisational cybernetics is a strand of cybernetic work concerned with management and organisations that breaks somewhat with the mechanistic and organismic thinking that typifies management cybernetics, and is able to make full use of the concept of variety. Stafford Beer's version of organisational cybernetics seems to have emerged from management cybernetics as a result of two breakthroughs. First, in his book, *"The Heart of the Enterprise"*, Beer (1979) succeeds in building his 'Viable Systems Model' in relation to the organisation from cybernetic first principles. This enables cybernetic laws to be fully understood without reference to the mechanical and biological manifestations in which they were first recognised. Second, more attention is given in organisational cybernetics to the role of the observer. Clemson (1984:20–21), makes a distinction between a first order cybernetics appropriate to organised complexity because it studies matter, energy, and information and a second order cybernetics (organisational cybernetics) capable of tackling relativistic organised complexity because it studies, as well, the observing system. Organisational cybernetics, will be discussed in greater detail in Appendix C, as part of the analysis of the soft systems approach.

4.6 CLOSED AND OPEN SYSTEMS DEFINED

It was Von Bertalanffy (1950:70), confirmed by Emery & Trist (1960:281), who first made a clear distinction between two types of systems -'closed' and 'open' in contrasting biological and physical phenomena.

Davis (1974:275), defines a closed system as a system which is self-contained, does not exchange material, information or energy with its environment and as an example of a closed system, cites a chemical reaction in a sealed, insulated container. It is for this reason then that Kremyanskiy (1960:129), argues that the entropy of a closed system as a rule only grows, whereas the system as a whole, being subservient to the environment and incapable of renewing itself, is inevitable destroyed, without, moreover, leaving a successor.

Davis (1974:275), cites a biological system (such as man) as an example of an open system as the elements exchange information, material, or energy with the environment. This exchange according to Kremyanskiy (1960:129), serves as the basis for the perpetua tion of this form of existence and as the basis for the decrease of relative constancy of entropy only when the system possesses certain features of internal organisation and interaction with the environment.

According to Von Bertalanffy (1950:71–72), the following criteria distinguishes between closed and open systems:

Closed Systems:

- A system is closed if no material enters or leaves it.
- A closed system must, according to the second law of thermodynamics, and according to Köehler (1938:59–69), eventually attain a time-independent equilibrium state, with maximum entropy and minimum free energy, where the ratio between its phases remains constant.
- A closed system in equilibrium does not need energy for its preservation, nor can energy be attained from it.

- Closed systems cannot exhibit equifinality[18].

Open Systems:

- From a physical point of view, the characteristic state of a living organism is that of an open system.
- A system is open if there is import and export, therefore, change of the components.

[18] The ability to reach the same final state from different initial conditions and in different ways.

- An open system may attain a time-dependent state where the system remains constant as a whole and in its phases, though there is a continuous flow of the component materials.
- The character of an open system is the necessary condition for the continuous working capacity of the organism.
- The basic characteristics of self-regulation are general properties of open systems adapting to circumstances by changing the structure of processes of their internal components.
- Open systems which are exchanging materials with the environment, in so far as they attain a steady state, the latter is independent of initial conditions, is equifinal.
- Open systems can evolve toward states of greater complexity and differentiation, reversing the law of entropy.

Katz & Kahn (1966:92–100) identifies the following nine characteristics as definitive of all open systems:

- **Importation of energy:** Open systems import some form of energy from the external environment.
- **The through-put:** Open systems transform the energy available to them.
- **The output:** Open systems export some product into the environment.
- **Systems as cycles of events:** The pattern of activities of the energy exchange has a cyclic character.
- **Negative entropy:** To survive, open systems must move to arrest the entropy process – they must acquire negative entropy.
- **Information input, negative feedback, and the coding process:** Inputs are informative in character, and furnish signals to the structure about the environment and about its own functioning in relation to the environment. The simplest type of information input found in all systems is negative feedback. The general term for the selective mechanisms of a system by which incoming materials are rejected or accepted and translated for the structure is coding.
- **The steady state and dynamic homeostasis:** The importation of energy to arrest entropy operates to maintain some constancy in energy exchange, so that open systems, which survive, are characterised by a steady state.

- **Differentiation:** Open systems move in the direction of differentiation and elaboration.
- **Equifinality:** Open systems are characterised by the principle of equifinality, meaning that a system can reach the same final state from differing initial conditions and by a variety of paths.

The view of Von Bertalanffy (1950: 83–84), is that:

> *"The formal correspondence of general principles, irrespective of the kind of relations or forces between the components, lead to the conception of a 'General Systems Theory' as a new scientific doctrine, concerned with the principles which apply to systems in general"*.

This statement by Von Bertalanffy emphasises the importance of the concept open systems, in particular with reference to the research contained within the ambit of this thesis.

4.7 THE ROLE OF MODELS

This thesis is based on the system dynamics of a formulated structured sequence of events, specifically applied to the art of management, to structure the outcomes of paradigm shifts introduced into organisations as a result of unstructured complex phenomena. The concept 'model conceptualisation', as proposed in this thesis as a 'structured sequence of events', was first mooted by Watkins (2000:ii) and Watkins & Kruger (2001:21). To create a deeper understanding of the importance of the concept 'model' within the ambit of this thesis, the following humoristic explanation thereof is offered by Cleland & King (1972:40):

> *"The layman's idea of the meaning of the word 'model' probably concentrates on that sort which are commonly found in Playboy magazine and in fashion shows, however if however pressed to consider other varieties, most people would react to the idea by describing a model airplane"*.

In doing so, the most important characteristic of models as they are used in management and in decision analysis have been brought to light, namely that:

"A model is a representation of something else".

In the analysis of the definition of the concept model, Cleland & King (1972:40) point to the fact that the 'something else' in the definition usually denotes some observable system or phenomenon existing in the real world, which is to be represented for purposes of display and analysis. They cite the examples of a child's model airplane being a representation of a real-world airplane and a schematic diagram, which represents the configuration of a large-scale electrical system. A basic, general descriptive definition of a model is provided by Takahashi & Takahara (1995:1), as follows:

"Let A and B be two objects. If B is considered to copy the features of A, B is called a model of A. Then A is a prototype of B".

There are many different kinds of models and there are many kinds of classification schemes, which have been applied to models. One of the taxonomies, which is most useful in understanding the structural differences in models is that given by Churchman *et al.* (1966:159–162) and Cook & Russell (1993:11), when the authors categorise models as either 'iconic', 'analog', or 'symbolic'.

- **Iconic models:** An iconic model is a simple scale transformation of the real-world system thus, the model airplane is an iconic model.
- **Analog models:** An abstract variety of models as the properties thereof are transformed – i.e., one property is used to represent another. A graph is the simplest illustration of an analog model.
- **Symbolic models:** The most abstract variety of model is the symbolic model. In such a model, symbols are substituted for properties. For example the equation $x = ½\ gt^2$ is a simple physical model if x is interpreted to be the distance travelled by a body falling from rest, g is a constant describing the acceleration caused by the force resulting from gravity, and t is the duration of time which the body is allowed to fall. In management, symbolic models have

long been used to describe simple phenomena. For instance, the model $P = R - C$ or, '*Profit* equals *Revenue* minus *Cost*', has long been recognised and used by managers. Only recently, however, have managers begun to use symbolic models for more complex phenomena.

According to Sterman (1988:14), one of the most useful classifications of models, divides models into those that 'optimise' versus those that 'simulate'. Clemson (1984:77) provides an appropriate description of the requirement for models in organisations, which reads as follows:

> *"The manager is always faced with some 'thing' which he/she is trying to 'manage' into behaving in one sort of way rather than some other sort of way".*

This rather abstract description of the manager applies equally well to a cowboy herding steers, a teenager nursing along a jalopy, a teacher coaxing a class into learning, a doctor running a hospital, or the president of the United States trying to dictate foreign and domestic policy. In all cases, the 'manager' acts on the basis of some framework that includes at least four elements:

- Some image of a preferred state, perhaps a goal or perhaps merely a way of behaving by the system (e.g. a low rate of crime is desired).
- Some image of the current state of the system (e.g. society suffers from a high rate of crime).
- Some image of the 'way the system works'. (e.g. the reducible system view of crime noted above).
- A belief based on the previous three images, that the situation might be improved by a given sort of 'managing'. (e.g. increase the penalties for criminal behaviour and criminals should be deterred).

The above maps to the description of 'mental models' as provided by Sterman (1988:18), who describes the concept as flexible, taking into account a wider range of information than just numerical data, and can be adapted to new situations and be modified as new information becomes available. Furthermore, mental models can be described as the 'filters' through which we interpret our experiences, evaluate plans, and choose among possible courses of action.

Richmond (1993:2), is of the opinion that mental models are the dominant 'thinking paradigm' in most of the western world today.

Given that the situation to be managed is always more complex than the manager, the problem of choosing reasonable actions is quite difficult. To be precise, it is quite common for gross errors to occur in all four of the elements noted above. This means:

- The image of the preferred state may be in error. It is quite common that once achieved, the desired state turns out to be less valuable than was expected. In particular, the desired state may have unanticipated negative consequences that outweigh the beneficial results. Typically, desired states are seen as means to some other end and the assumed relationship to the higher end may be wrong so that achievement of the desired state does not, in fact, assist in reaching the higher goal.
- The image of the current state of the system is often seriously in error. The most common way in which this happens in large systems is that the manager is simply unable to remain informed about the relevant system aspects. Another common problem is that the manager may seriously misjudge critical aspects of the system. For instance, managers are frequently grossly wrong in their beliefs about subordinate's values, attitudes, desires and the need for communication.
- The image of 'the way the system works' is almost always inadequate and is frequently wrong for social systems. Errors in the image of 'the way the system works', frequently lead us to undertake actions, which end up having an effect opposite to that which is desired.
- The beliefs about the relationship between action and outcome constitute a model of 'the way the system works'.

Blake & Mouton (1973:165), provide the following specifications for designing a model based on systematic development[19], 'of what should be', which is repeated here *verbatim* to retain the original thoughts of the authors and to enforce the concept of formulating an 'approach' as opposed to formulating a 'model':

[19] A more detailed presentation of the theory, techniques, and results of systematic development is contained in: Blake RR. & Mouton JS. 1968. Corporate excellence through grid organization development: A systems approach. Houston: Gulf.

> *"Clear-cut objectives are a prerequisite to the kind of development that takes place under the systematic approach. An ideal model specifies what the result should be at a designated time. To be systematic, the model must be based on theory, fact, and logic, uncontaminated in the status quo or by extrapolations from the past. The model must be understood to represent the ideal, not the idealistic. Ideal thinking can identify what is possible according to theory, logic and fact. Ideal thinking can be tested against objective criteria to assess its practicality. Idealistic thinking, on the other hand would have an unreal quality, probably rooted in self deception and expressing what is desired or what is wanted without having been tested against theory, logic or fact. Ideal thinking is subjective and is based on criteria having little or nothing to do with the facts of the situation. Ideal thinking has sometimes been suspect and rejected as idealistic. Yet through history, some of what might qualify as among the world's greatest change projects – The Magna Charta, the Constitution of the United States – have probably come about through ideal-type formulations".*

The above can be appropriately summarised by the view of Cook & Russell (1993:11), who in general terms, 'view a model as a representation or an abstraction of an object or a particular real world phenomenon'.

Although this thesis deals primarily with the formulation of a structured sequence of events, a process, which will serve as input mechanism to the building of systems models, a discussion brief on models would not be complete without bringing to the attention of the reader, the works of Hall (1976), and Morecroft *et al.* (1991). These are singled out as two of the most prominent academics, especially in describing the processes involved in systems model building.

4.8 IMPACT OF THE NOTIONS '*WELTANSCHAUUNG*' AND APPRECIATIVE SYSTEMS

According to Jackson (1991:133), the social world is seen as being the creative construction of human beings. It is necessary therefore, to proceed by trying to understand subjectively, the point of view and the intentions of the human beings who construct social systems. Hence the importance in 'soft' systems thinking (discussed in more detail in Appendix B) of probing briefly the worldview or '*Weltanschauung'* of Churchman (1983:121) and the concept of 'appreciative systems' of Vickers (1965:67), that individuals employ in understanding and constructing the social world. In this thesis the above notions will only be discussed briefly as they relate to soft systems to create an understanding of the concepts.

- **The notion of '*Weltanschauung*'**

This notion according to Jackson (1991:134) carries the implication that an individual's interpretations will be far from random, they will be consistent in terms of a number of underlying assumptions that constitute the core of that individual's world view or '*Weltanschauung'*. Flood (1990:158–160) is of the opinion that 'world-viewism' has several theoretically orientated scenarios, each one neglecting to recognise that no single position has or is ever likely to explain everything. The '*Weltanschauung'* idea has been used by Churchman (1983:121-124) and Checkland (1989:215–221) in the development of methodologies to solve problems in systems.

Checkland (1989:279) has suggested that this methodology can be applied to reveal any recurrent '*Weltanschauungen'* and that it therefore opens up the prospect of discovering 'the universal structures of subjective orientation in the world' (Luckmann[20], quoted in Checkland 1989:279). The notion of '*Weltanschauung'* is brought into context with the systems approach by Checkland (1989:215), as follows: 'A systems approach tries explicitly to avoid reductionism by viewing the world in systems terms'. 'It uses systems concepts in order to see the raw data of the outer world in a particular way, namely a set of

[20] Luckmann T. 1978. Phenomenology and Sociology. Harmondsworth: Penguin.

systems'. 'It converts the raw data into a particular kind of information, and this is the process occurring in virtually all human thinking'. Whether we realise it or not, we view raw data via a particular mental framework, or worldview ('*Weltanschauung*'). The hard systems methodology according to Checkland (1989:219) is concerned only with a single '*Weltanschauung*' – a need is defined or an objective is stated, and an efficient means of meeting the need or reaching the objective is needed. In soft systems methodology, we are forced to work at a level at which worldviews or '*Weltanschauungen*' are questioned and debated. Soft problems are concerned with different perceptions deriving from different '*Weltanschauungen*'.

➢ **The notion of Appreciative Systems**

According to Jackson (1991:135) citing Vickers (1965[21]) (1970[22]) (1973[23]) 'the only way to understand decision making in human systems is to understand the different appreciative systems that the decision-makers bring to bear on the problem'. Jackson (1991:135), explains the concept as follows: 'An individual's appreciative system will determine the way he or she sees and values various situations and hence how he or she makes 'instrumental judgements' and takes 'executive action' – in short, how he or she contributes to the construction of the social world'. It follows, according to Vickers (1973) cited by Jackson, that if human systems are to achieve stability and effectiveness, then the appreciative systems of their participants need to be sufficiently shared to allow mutual expectations to be met. It is perhaps West (1995:140), who sums up the appreciative enquiry method the best, when he describes it, 'as a method being developed in a response to the need to be able to elicit and record the less structured, difficult-to-describe and 'tacit' aspects of any domain'.

[21] Vickers G. 1965. The art of judgement. London: Chapman and Hall.
[22] Vickers G. 1970. Freedom in a rocking boat. London: Allen Lane.
[23] Vickers G. 1973. Making institutions work. London: Associated Business Programmes.

4.9 CAUSAL LOOP DIAGRAMS AND REINFORCING AND BALANCING PROCESSES

Two of the most powerful systems approach tools are ‘causal loop diagrams’, and ‘reinforcing and balancing processes’. These two entities can be analysed as follows:

- **Causal Loop Diagrams:-** According to Kim (1999:5), ‘feedback’ is the ‘transmission and return’ of information, with ‘return’, the very characteristic that makes the feedback perspective different from the more common linear cause-and-effect way of viewing the world. The linear view depicted below as Figure 4.5, sees the world as a series of un-directional cause-and-effect relationships: A causes B causes C causes D, etc.

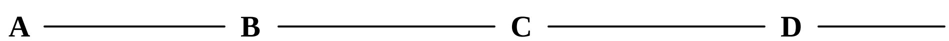

Figure 4.5: The linear view perspective (Single Loop). Kim (1999:5)

The linear view perceives the world as a series of events that flows one after the other (Ballé 1994:46-47). For example, if sales should go down (event A), action can be taken by launching a promotions campaign (event B), sales rises (event C), and backlogs increase (event D). Should sales go down again, action can be taken by launching yet another promotional campaign, and so on. Through the lens of the linear perspective, the world is perceived as a series of events that trigger other events. The feedback loop perspective depicted below as Figure 4.6, on the other hand, sees the world as an interconnected set of circular relationships, where something affects something else and in turn is affected by it: A causes C causes A, etc.

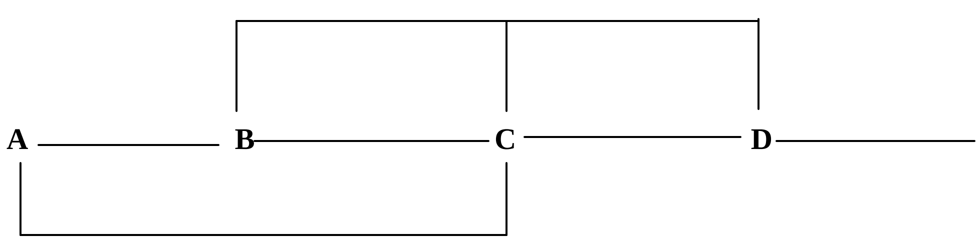

Figure 4.6: The feedback loop perspective (Double Loop) Kim (1999:5)

Using the same example as in the linear view perspective, the feedback loop perspective would demand that when sales go down (event A), action can be taken by launching a promotions campaign (event B). As orders increase (event C), and sales rise (change in event A), backlogs increase (event D), (another eventual effect of event B), which affects orders and sales (change in events C and A), which leads to a requirement to repeat the original action (event B). Mathematically, according to Capra (1996:123), a feedback loop corresponds to a special kind of non-linear process known as 'iteration' (Latin for 'repetition'), in which a function operates repeatedly on itself. For example, if the function consists of multiplying the variable x by 3, i.e. $f(x) = 3x$, the iteration consists in repeated multiplication. In mathematical shorthand, this is written as x? $3x$, $3x$? $9x$, $9x$? $27x$ etc. Each of these steps is called a 'mapping'. If the variable x is visualised as a line of numbers, the operation x? $3x$ maps each number to another number on the line. More generally, a mapping that consists in multiplying x by a constant number k, is written x? kx. An iteration found very often in non-linear systems, is the mapping x? $kx(1-x)$, where the variable x is restricted to values between 0 and 1. This mapping is known as 'logistic mapping' and has many important applications of which the description of growth of a population under opposing tendencies serves as an example and also known as the 'growth equation'.

According to Kauffman (1980:5), feedback provides stability in a system that would otherwise be unstable. The importance of 'feedback' is emphasised by Skyrme (1998) as follows:

> *"We are particular poor at appreciating the role of feedback structure in dynamics we experience in the systems we strive to manage . . . The possibility exists that management policy and decisions actually contribute to creating the dynamic problems they are intended to solve".*

The impact of feedback can perhaps best be described in terms of single loop and double loop learning using the same principle as explained above. The processes of single and double loop learning as advocated by Argyris (1992:8) are depicted in Figure 4.7.

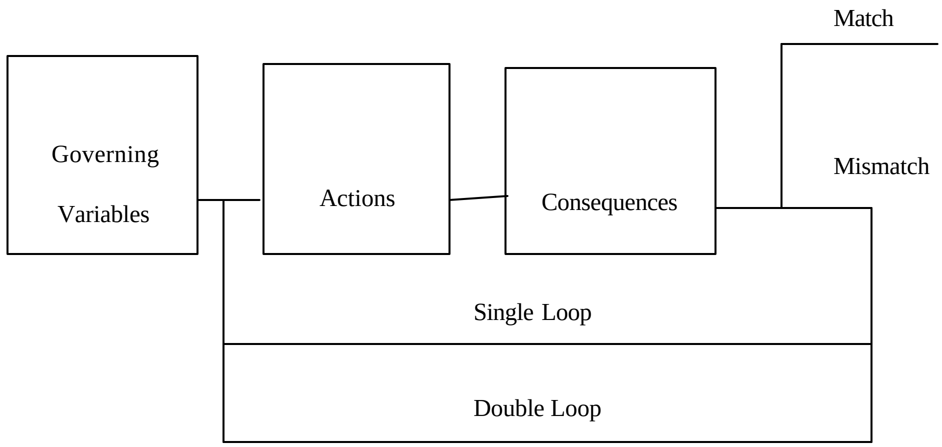

Figure 4.7:-Single-Loop and Double-Loop Learning. Argyris (1992:8)

The following rather extensive explanation of the above concept by Argyris (1977:116), could not be improved upon, and based on the practicality of the example, is repeated here *verbatim* as follows:

> *"Single loop learning can be compared with a thermostat that learns when it is too hot or too cold and then turns the heat on or off. The thermostat is able to perform this task because it can receive information (the temperature of the room) and therefore take corrective action. If the thermostat could question itself about whether it should be set at 68 degrees, it would be capable not only of detecting error but of questioning the underlying policies and goals as well as its own program. That is a second and more comprehensive inquiry; hence it might be called double loop learning. When the plant managers and marketing people were detecting and attempting to correct the error in order to manufacture Product X, that was single loop learning. When they began to confront the question whether Product X should be manufactured, that was double loop learning, because they were now questioning underlying organisation policies and objectives".*

Specifically pertaining to solving unstructured complex phenomena, Richardson (1991:22), makes the observation that, 'management rarely have the luxury of being able to make a decision in which causality goes only outward and does not generate repercussions that feedback to influence or affect management'. Richardson continues his observation with the view that, 'management plans and decisions alter the playing field, and consequently always have a hand in shaping the subsequent conditions to which management must respond'.

- **Reinforcing Processes:** According to Senge (1990a:73), reinforcing feedback processes are the engines of growth. Whenever the situation occurs where things are growing, one can be certain that reinforcing feedback is at work. Furthermore, reinforcing feedback can also generate accelerating decline – a pattern of decline where small drops amplify themselves into larger and larger drops, such as the decline in bank assets when there is a financial crisis on the financial markets. Figure 4.8 represents reinforcing processes using a savings account as an example. Kim (1999:7), provides the following explanation of the two diagrams in Figure 4.8 to illustrate the mechanisms pertaining to reinforcing processes: If there is a positive balance each time there is an interest payment calculation, the amount will be slightly bigger than the preceding payment period. This is due to the fact that the balance has increased since the previous calculation. The time period after that, the interest amount will be bigger still, due to the fact that the balance has increased a little more since the time before.
- **Balancing Processes:** According to Senge (1990a:73) balancing feedback processes operates whenever there is a goal-orientated behaviour. If the goal is to be not moving, then balancing feedback will act the way the brakes in a car do. If the goal is to be moving at sixty miles per hour, then balancing feedback will cause the car to accelerate to sixty, but not faster. The goal can be an explicit target, as when a firm seeks a desired market share, or it can be implicit, such as a bad habit, which despite disavowing, we stick to nevertheless. Figure 4.9 represents balancing processes using a thermostat in a house as an example.

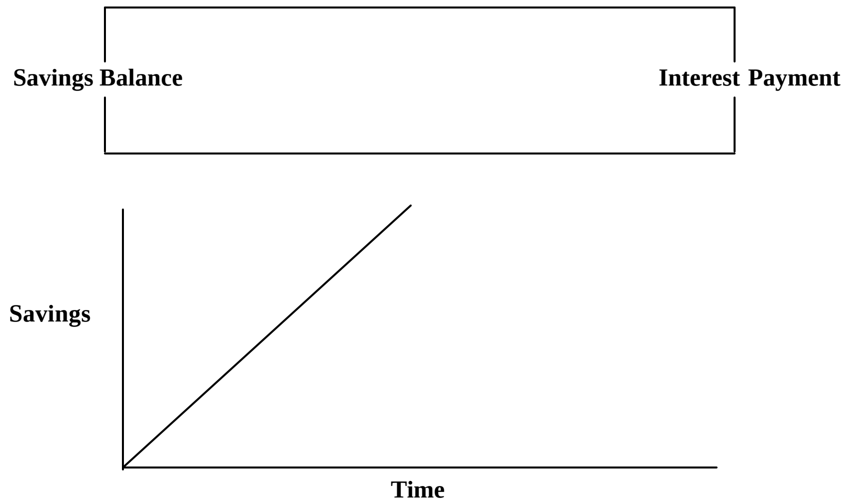

Figure 4.8: Reinforcing Processes. Kim (1999:7)

Kim (1999:8) provides the following explanation of the two diagrams in Figure 4.9 to illustrate the mechanisms pertaining to balancing processes: When a home thermostat detects that the room temperature is higher than the thermostat setting, it shuts down the heat.

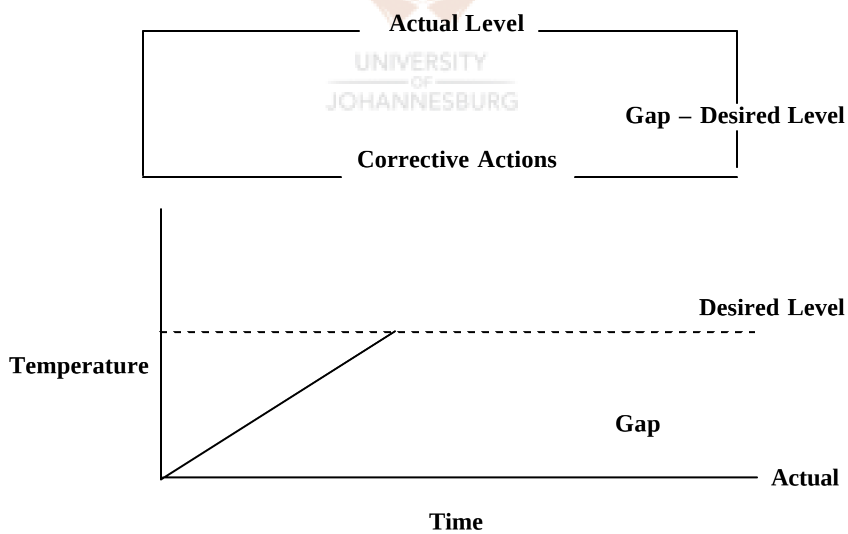

Figure 4.9: Balancing Processes. Kim (1999:7)

There is always an inherent goal in a balancing process, and what 'drives' a balancing loop is the gap between the goal (the desired level) and the actual level. As the discrepancy between the two levels widen, the system takes corrective actions to adjust the actual level until the discrepancy decreases. In the thermos tat example, gaps between the actual room temperature and the temperature setting of the thermostat (the goal) prompt the thermostat to adjust the heating and cooling mechanisms in the house to bring the actual temperature closer to the desired temperature. In this sense, balancing the processes always try to bring conditions into some state of equilibrium.

4.10 KEY COMPONENTS FROM THE SYSTEMS APPROACH

A list of key components, which will in terms of the multimethodology approach, be extrapolated from the 'systems approach' and taken up in the formulation of the structured sequence of events to ultimately culminate in the set of mitigating factors (refer Chapter 8), will be contained in Appendix F, for ease of reference. It is of importance to note that the key components gleaned from the systems approach, will include components from the 'hard' systems methodology (discussed in Appendix A) and the 'soft' systems methodology (discussed in Appendix B).

4.11 CLOSURE

The primary impetus for using the systems approach as the basis on which the structured sequence of events will be formulated, to ultimately culminate in the set of mitigating factors can be found in the revered wisdom of Albert Einstein[24] cited by Ossenbruggen (1994:1) and repeated here *verbatim* as not to lose the true meaning thereof:

> *"Why does this magnificent applied science, which saves work and makes life easier bring us little happiness?" "This simple answer runs: we have not yet learned how to make sensible use of it"*

In this chapter, the complexities of the 'systems approach' were introduced to provide the reader with the required insight into the ruling principles that govern

[24] Albert Einstein (1879-1955).

the approach. The following concepts were investigated and where appropriate, defined:

- The concept 'system'.
- General Systems Theory.
- The concept 'systems approach'.
- The concept 'cybernetics'.
- 'Closed' and 'open systems'.
- The role of 'models'.
- The notions *'Weltanschauung'* and Appreciative systems.
- 'Causal loop diagrams' and 'Reinforcing and balancing processes'.

Chapter 5 provides a literature background to the ruling principles of the Six Sigma methodology. The Six Sigma methodology will be analysed from a high level perspective to provide insight into its core usability components. The chapter will be concluded with a list of key components, which will in terms of the multimethodology approach, be selected from the Six Sigma methodology. This in turn will be taken up in the structured sequence of events to ultimately culminate in the set of mitigating factors to be formulated in Part 3 (Chapter 8).

Table of Contents: Chapter 5

Synopsis: Chapter 5

As in the case of the 'systems approach' discussed in the previous chapter, this chapter will focus on the ruling principles of the 'Six Sigma' methodology. A comprehensive background to the Six Sigma methodology is provided, supported by definitions of the concept by various academic writers.

The attention of the reader is drawn to the importance of two specific paragraphs in the chapter, namely:

- **Paragraph 5.4:** This paragraph deals with the principles of Six Sigma where 'genuine focus the customer' features as a key determinant.
- **Paragraph 5.6:** In this paragraph detail is provided of the approach in defining business requirement functional specifications using the Six Sigma methodology. This approach will be specifically taken up in the formulation of the structured sequence of events in Chapter 8.

> Of importance to the reader, the differences and similarities between the Six Sigma methodology, analysed in this chapter, and the Capability Maturity Model, analysed in Chapter 6. A comparative analysis of the two entities are highlighted in Chapter 6 (refer Paragraph 6.10)

Chapter 5

Ruling Principles of 'Six Sigma'

"The aim of education is the knowledge, not the fact, but the values".

Winston S. Churchill

5.1 INTRODUCTION

In the previous chapter, the 'systems approach', which forms the basis of the structured sequence of events was analysed in detail. The systems approach was specifically selected for this purpose as it takes a broad view, which takes all aspects into account and, which concentrates on interactions between different parts of a problem. The systems approach will be underpinned by elements from the 'Capability Maturity Model', the 'Balanced Scorecard' and the 'Six Sigma' methodology.

In this chapter, the complexities of the 'Six Sigma' methodology is introduced to provide the reader with the required insight into the ruling principles that govern the approach. In the paragraph describing the background to the Six Sigma concept, an overview will be provided of the evolution of the concept and its current status within the software development field. This will be followed by various definitions which were over time attributed to the concept by academics and field operators of the methodology. At the same time it will provide insight to the applicability of the concept as a mechanism to achieve greater customer satisfaction when defining business requirement functional specifications. In addition, an analysis of the principles on which Six Sigma is based will be provided. As the ultimate aim of Six Sigma is centred upon achieving performance excellence, a high level analysis of the two methods of Six Sigma namely DMAIC and DFSSS, will be provided.

As the focus of this thesis is on business requirement functional specifications, this chapter will in addition describe how business requirement functional specifications are defined using the DMAIC Six Sigma improvement model. This will be followed by a list of the salient benefits of Six Sigma and its pre-requisites, considered critical success factors, which are required to establish Six Sigma within an organisation. These issues are of particular importance as the difficulties with establishing Six Sigma within an organisation, serves as impetus for the multimethodology approach proposed in this thesis.

The analytical process followed thus far, is graphically depicted in Figure 5.1, which places the chapters in context with the overall thesis objectives, and furthermore indicates the relative positioning of this chapter.

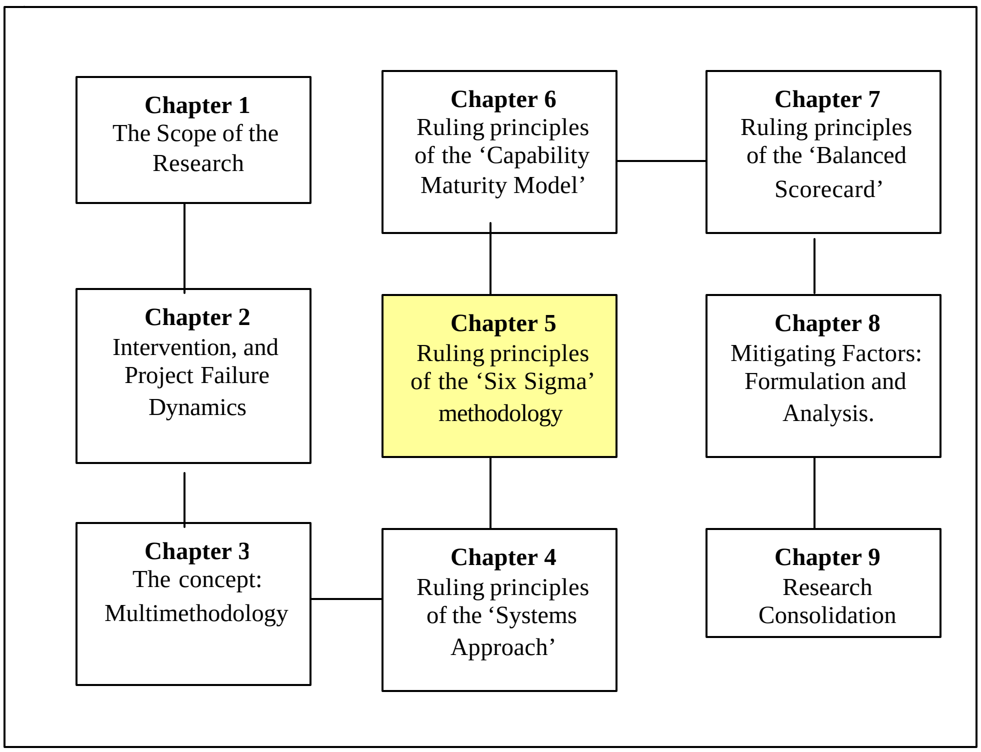

Figure 5.1: Chapters in context of the overall research

For ease of reference, the interrelationship of the various core entities, gleaned from the above defined system methodologies, ultimately supporting the structured sequence of events serving as mitigating factors are graphically depicted in Figure 5.2. In addition, the mitigating factors are positioned to reflect their potential position in a typical systems development life cycle as proposed by Senn (1990:673).

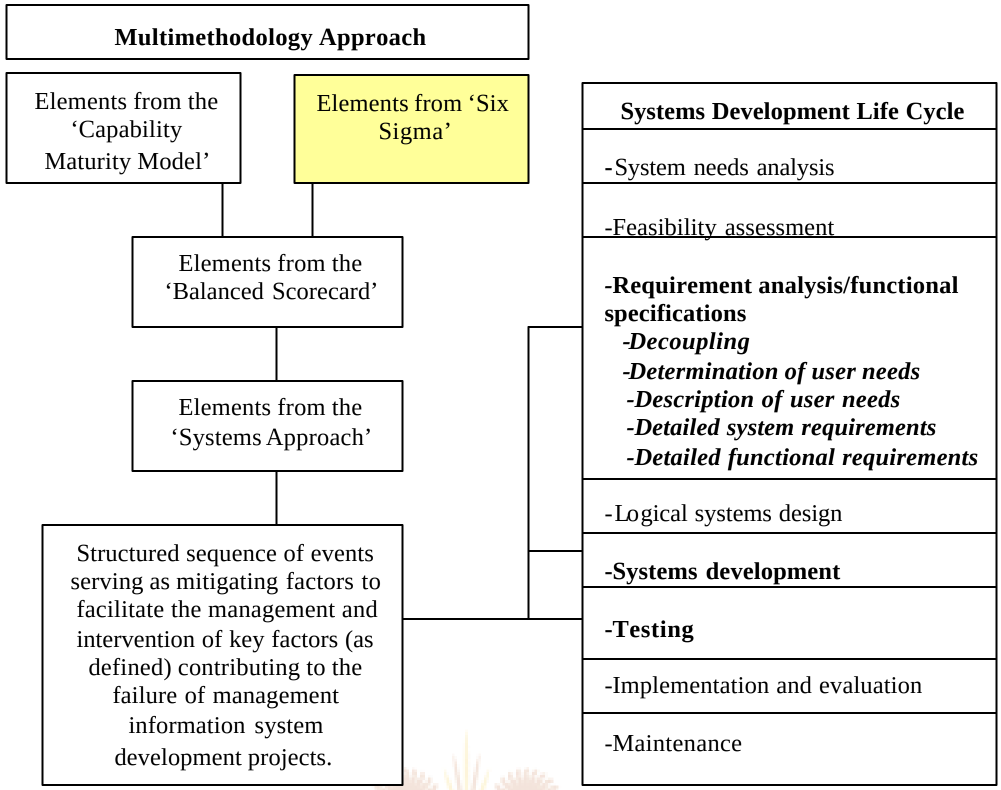

Figure 5.2:- Interrelationships of core entities

While there is no single definition of Six Sigma, or for that matter a single approach to implementing it, the foundation thereof is vested in the fact that the Six Sigma methodology according to Pivotal Resources (2001:2-3), is:

- A measure to define the capability of a process.
- A goal for improvement that reaches near perfection.
- A system of management to achieve lasting business leadership and top performance.

5.2 BACKGROUND TO SIX SIGMA

Sigma, is a letter of the Greek alphabet, used as a symbol by statisticians to mark a bell curve showing the likelihood that a process will deviate from the norm (Arnold 1999:1). Six Sigma, in turn is a statistical measure of near perfect (or 99.9999998 percent correct) operation (Stair 1992:430). Today, most companies using the Six Sigma methodology, operate at 'three Six Sigma', which allows for 66,803 defects per million (93,332 percent perfect) (Arnold 1999:1).

The sigma level numbers often associated with Six Sigma, represent according to George (2002:161), 'the capability of a core business process, as measured in defects per million opportunities'[1] as reflected in Table 5.1 below.

Sigma Level	Defects per million opportunities	Yield
6	3.4	99.9997%
5	2.33	99.977%
4	6.210	99.379%
3	66.807	93.32%
2	308.537	69.2%
1	690.000	31%

Table 5.1:-Defects per million opportunities (George 2002:16)

While Six Sigma technically means a failure rate of 3.4 parts per million, Chase (2002:39) is of the opinion that it is more than just counting defects. For Chase, it is the implementation of a quality culture of strategies, statistics and other tools for improving a company's bottom line. This is supported by Juran (1993:22), who estimates the cost of poor quality in most companies between 20% and 40% of sales. These according to Magnusson (1999:4) include warranties, rejects, scrap, rework, inspection cost, engineering change orders, long cycle times, time value of money, more set ups, expediting costs, working capital allocations, lost sales, late deliveries, excess inventory, excessive material orders or planning and lost customer loyalty.

According to Harry & Schroeder (2000:83-84) there are three fundamental metrics that, when used collectively, can expose even the smallest inefficiencies in a process, which are deployed within the context of Six Sigma. The metrics are:

- **Throughput yield:** Refers to the probability that all defect opportunities produced will conform to their respective performance standards.
- **Rolled throughput yield:** Refers to the probability of being able to pass a unit of product or service through the entire process defect free.

[1] It is acknowledged that certain academic writers compensate for the inevitable consequences associated with process centering errors and subsequently offset the distribution mean by 1.5 standard standard deviations (Harry & Schroeder 2000:145) (B reyfogle *et al.* 2001:40).

- **Normalised yield:** Refers to the 'average' throughput yield result one would expect at any given step of the process – it represents the 'typical' yield one could expect. Normalised yield is also referred to as the 'baseline' measure.

Of the leaders in the quest for quality is Motorola, Inc., who in 1987 launched a five-year quality program based on the Six Sigma methodology. The Japanese experience has shown that the highest quality, produced the lowest cost, due to the fact that employees do not have to waste time correcting mistakes and soothing irate clients. It is of interest to note that of the Six Sigma six step procedures devised by Les Shroyer, Motorola's chief information officer, the second step of the sequence deals with 'the identification of customer requirements', ('a transaction record is either right or wrong, a delivery is either on time or late') (Stair 1992:430). Motorola's achievements as a result of Six Sigma, included the following (Pande *et al.* 2000:7):

- Five-fold growth in sales, with profits climbing nearly 20% per year.
- Cumulative savings pegged at USD 14 billion.
- Stock price gains compounded to an annual rate of 21,3%.

The successes achieved with Six Sigma extend into major American corporates (Arnold 1999:1). These companies return impressive results and include names in the likes of AT&T, Ford Motor Co., Bank of America Corp., Eastman Kodak Co., American Express Co., US Sprint Communications Co., MCI Communications Corporation, IBM, Digital Equipment Corporation, General Electric and Allied Signal/Honewell (Stair 1992:431, Hammer 2002:30).

Pearson (2003:79) predicts that the next generation systems will combine best measurement practices and Six Sigma methods, in an environment where dynamic systems rule and dramatically improved response times are required. Furthermore, measures will often be better than the product requires, because they will provide simultaneous information about the core processes and their correlation to both good products and good business.

5.3 SIX SIGMA DEFINED

Six Sigma is a business improvement approach that seeks to find and eliminate causes of mistakes or defects in products and business processes by focusing on outputs that are significant to customers. Furthermore, the concepts underlying Six Sigma, deals with the fact that process and product variations are known to be strong factors affecting product production lead times, product and process costs, process yields and ultimately, customer satisfaction. The heart of the Six Sigma approach lies within the rigorous problem-solving approach, the dedicated application of trained business analysts to well-structured processes or product improvement projects, and the attention of management for delivering bottom-line results and sustaining these results over time (Watson 2002:39).

Hammer (2002:29) defines Six Sigma as:

> *"a set of methodologies and techniques used to improve quality and reduce costs"*

Pande *et al.* (2002:x-xi), attach a number of definitions to the concept Six Sigma, namely:

> *"a highly technical method used by engineers and statisticians to fine-tune products and processes"*

> *"it's a goal of near-perfection in meeting customer requirements"*

> *"a sweeping culture change effort to position a company for greater customer satisfaction, profitability and competitiveness"*

Pyzdek (1999:26) attaches the following interpretation to Six Sigma:

> *"Six Sigma . . . an entirely new way to manage an organization . . . Six Sigma is not primarily a technical program; it's a management program"*

Snee (1999:100-103), in support of Pyzdek, defines Six Sigma as:

> *"A strategic business improvement approach that seeks to increase both customer satisfaction and an organization's financial health"*

The preferred definition of Six Sigma according to Pande *et al.* (2000:xi), reads:

> *"A comprehensive and flexible system for achieving, sustaining and maximizing business success. Six Sigma is uniquely drawn by close understanding of customer needs, disciplined use of facts, data, and statistical analysis, and diligent attention to managing, improving, and reinventing business processes".*

Siviy (2001:1), closely maps the above definition of Pande *et al.* with the following description of the concept:

> *"A business-driven, multi-faceted approach to process improvement, reduced costs, and increased profits. With a fundamental satisfaction by reducing defects, its ultimate performance target is virtually defect-free processes and products".*

The definition which Chowdhury (2001:17) attach to Six Sigma is more broad based and general. His definition of Six Sigma reads:

> *"Six Sigma – the number six and sigma, the Greek letter. But Six Sigma means more in business and industry. It represents a statistical measure and management philosophy"*

Against the background of the theme of this thesis, dealing with business requirement functional specifications, it is perhaps the *obiter dictum* observation of Chowdhury (2001:44), which encapsulates the essence of Six Sigma with the following: 'We ask customers what problems we need to solve'. 'If we correctly identify and solve these problems, we'll save money and they'll be happier'. The curriculum of the Six Sigma Institute's training program provides the best definition of the relevant body of knowledge (Card 2000:11). Card, cites Jerome Blakeslee Jr.[2], as the author of this (rather lengthy) definition, repeated here *verbatim* as not to lose the true meaning of the definition:

> *"Basically, it is a high-performance data-driven approach to analysing the root causes of business problems and solving them. It ties the output of a business directly to marketplace requirements". At the strategic level, the goal of Six Sigma is to align an organization keenly to its marketplace and deliver real improvements (and dollars) to the bottom line. At the operational level, Six Sigma's goal is to move business product or services attributes within the zone of customer specifications and to dramatically shrink process variation – the cause of defects that negatively affect customers".*

5.4 THE PRINCIPLES OF SIX SIGMA

The principles of Six Sigma, falls into categories or themes, which according to Pande *et al.* (2000:15-18), include:

- **Genuine focus on the customer:** Six Sigma improvements are defined by their impact on customer satisfaction or value. Six Sigma focuses on why and how business can define customer requirements, measure performance against them, and stay on top of new developments and unmet needs. It is of importance to note that Six Sigma demands a clear definition of what the customer's requirements are (Pande *et al.* 2000:29). According to George (2002:17), this means 'customer centricity', which refers to the knowledge of what the customer values most at the start of the value stream analysis. In this regard, refer to Chapter 2 Paragraph 2.6.
- **Data and fact-driven management:** Six Sigma focuses on fact as opposed to decisions taken on opinions and assumptions.
- **Process focus, management and improvement:** Six Sigma positions 'process' as the key vehicle to success. With the focus of this thesis on business requirement functional specifications, it is interesting to note that

[2] Blakeslee J. 1999. Implementing the Six Sigma solution. *Quality Progress*, July.

within the ambit of Six Sigma process management, a pre-requisite is defined for 'customer requirements' to be clearly defined and regularly updated (Pande *et al.* 2000:35).

- **Proactive management:** Six Sigma proposes proactive management to instil creativity and effective change as opposed to reactively bouncing from crisis to crisis.
- **Boundary less collaboration:** Six Sigma creates an environment and management structure that supports true teamwork.
- **Drive for perfection, tolerance for failure:** With Six Sigma, there is an ever increasing push to be ever more perfect (since customer requirements will constantly change), however have in place mitigating factors to manage failure.

The premise of Six Sigma is that companies need consistently higher levels of quality and lower levels of cost and that a disciplined organised approach will root out the variance, waste and errors that plague operations (Hammer 2002:29). Furthermore, Six Sigma provides specific methods to recreate the process so defects and errors may never arise in the first place (Harry 2000:vii).

5.5 THE DMAIC SIX SIGMA IMPROVEMENT MODEL

To achieve the performance excellence that is inherent in a Six Sigma process, two methods can be applied to deliver predictable results. The first of these methods are commonly referred to as DMAIC, which denotes the concepts of 'define', 'measure', 'analyse', 'improve', and 'control' (Siviy 2001:1). The outcome of this method is to resolve a problem and put its process into a state of control where the process capability is consistently delivered (Watson 2002:39). A detailed analysis of the DMAIC methodology, returns the following process according to Pande *et al.* (2000:37-39) and Chowdhury (2001:85-100):

- **Define:**
  - Identify the problem.
  - Define requirements.
  - Set goal.

- **Measure:**
  - Validate problem/process.
  - Refine problem/goal.
  - Measure key steps/inputs.
- **Analysis:**
  - Develop causal hypothesis.
  - Identify root causes.
  - Validate hypothesis.
- **Improve:**
  - Develop ideas to remove root causes.
  - Test solutions.
  - Standardise solution/measure results.
- **Control:**
  - Establish standard measures to maintain performance.
  - Correct problems as needed.

The second of the Six Sigma methods is called 'Design for Six Sigma', commonly referred to as DFSS, which is used to develop new products or reengineer business processes. 'Design for Six Sigma' creates enhanced process capability that keeps ahead of market and technology changes by innovating design and delivering new product features that anticipate changing market needs and customer requirements. Furthermore, it is 'Design for Six Sigma' that assures the future competitiveness of an organisation by maintaining both its inherent process capability and its performance results on the leading edge of its industry (Watson 2002:39-40).

5.6 DEFINING BUSINESS REQUIREMENT FUNCTIONAL SPECIFICATIONS USING THE SIX SIGMA METHODOLOGY

The deliverables contained within the ambit of the definition of business requirement functional specifications using the Six Sigma approach are, according to Pande *et al.* (2000:72):

- A clear, complete description of the factors that drive customer satisfaction for each output and process.

- Output requirements, which is tied to the end product or service that make it 'work' for the customer.
- Service requirements, which describe how the organisation should interact with the customer.

Pande *et al.* (2000:190) prescribe the following steps toward defining of business requirement functional specifications using the Six Sigma methodology:

- **Identify the output:** Requirement for what?
- **Identify the customer or customer segment:** Defining exactly who is going to receive the product or service.
- **Review available data or customer needs, expectations, comments, complaints, etc.**: Using objective, quantified data, where possible, to define the requirements.
- **Validate the requirement:** Validation includes any step that can be taken to ensure that the requirement accurately reflects customer needs and expectations.
- **Refine and finalise the requirement stated:** Determining the gap between what the user wants, and what can actually be delivered.

Pande *et al.* (2000:190) views the above steps as absolute prerequisites to the successful definition of business requirement functional specifications.

5.7 BENEFITS OF SIX SIGMA

The benefits of Six Sigma, according to Pande *et al.* (2000:11-13), are:

- Generates sustained success.
- Sets performance goals for everyone.
- Enhances value to customers.
- Accelerates the rate of improvement.
- Promotes learning and cross-pollination.
- Executes strategic change.

More specific to the theme of this thesis, the benefits of Six Sigma can be extended to the software and systems field. According to Sivy (2001:3), Six

Sigma may be leveraged differently based on the state of the business. In an organisation needing process consistency, Six Sigma can help promote the establishment of a process. For an organisation striving to streamline their existing processes, Six Sigma can be used as a refinement mechanism. Furthermore, and more specific to the formulation of business requirement functional specifications, Six Sigma most appropriately meets the challenge.

5.8 PRE-REQUISITES FOR SIX SIGMA

Certain critical success factors as defined by Rockart (1979:85), are considered necessary according to Antony *et al.* (2002:181-183), for the effective implementation of Six Sigma projects. These are as follows:

- **Management commitment:** Top management involvement a top pre-requisite. According to Pearson (2003:76), executives will enthusiastically support Six Sigma as a business strategy when there are demonstrated business benefits.
- **Culture change:** Overcoming two basic fears on an individual level namely the fear of change and the fear of not achieving the new standards by understanding the need for change.
- **Organisation infrastructure:** Communication skills, a long term strategy and teamwork skills.
- **Training:** It is critical to communicate both the 'why' and the 'how' of Six Sigma.
- **Project management skills:** Six Sigma as a project management methodology cannot be implemented without the project manager having extensive project management skills. In this respect, also refer to Chapter 2, Paragraph 2.7.
- **Understanding Six Sigma techniques:** The understanding of the various Six Sigma techniques. The DMAIC methodology discussed in Paragraph 5.5 of this chapter, serves as an example.
- **Linking Six Sigma to business strategy:** Clarity is required of how Six Sigma projects link to customer core processes and competencies.
- **Linking Six Sigma to the customer:** An absolute pre-requisite is that any project should begin with the determination of the business requirement

functional specifications. In this respect, also refer to Chapter 2, Paragraph 2.6.

- **Linking Six Sigma to human resources:** The promotion of desired behaviour and results.
- **Linking Six Sigma to suppliers:** Supplier participation in the culture change.

5.9 KEY COMPONENTS FROM SIX SIGMA

A list of key components, which in terms of the multimethodology approach be extrapolated from the 'Six Sigma' methodology, to ultimately culminate in the set of mitigating factors, will be contained in Appendix F, for ease of reference.

5.10 CLOSURE

This chapter provided a literature background to the ruling principles of the Six Sigma methodology. Furthermore, the Six Sigma methodology was analysed from a high level perspective to provide insight into its core usability components. Card (2000:11) draws the following two analogies flowing from the Six Sigma methodology:

- The name Six Sigma derives from a statistical measure of a process's capability relative to customer specifications.
- Six Sigma provides a generic approach to improvement that applies to any process.

It is of importance to note that the customer/user, forms a key focus area for Six Sigma. Within the context of the Six Sigma discipline, according to the Six Sigma DMAIC Training Manual (Pivotal Resources Inc. 2001:8):

- Customer requirements are based on careful assessment.
- Processes are designed and run to fulfil customer requirements.
- The approach is signified by a multi-faceted, ongoing 'voice of the customer' effort.
- Customer focused data is key to managing the business.

The key focus of all Six Sigma programmes is to optimise overall business results by balancing cost, quality, features and available considerations for products and their production into a best business strategy. Furthermore, Six Sigma programmes combine the most effective statistical and non-statistical methods to make overall business improvements (Pearson 2003:76).

It is of interest to note that the Six Sigma notion of 'capability', does not have the same meaning as the definition of 'capability' implied in the title of the Capability Maturity model, which will be analysed in Chapter 6. The Capability Maturity model deals with the maturity of practices, as opposed to results. Furthermore, the Capability Maturity model describes the principle of disciplines, or key process areas, that an effective software engineering organisation must master. These include basic software and management as well as improvement practices.

In the next chapter, the complexities of the 'Capability Maturity Model' are introduced to provide the reader with the required insight into the ruling principles that govern the approach. In the paragraph describing the background to the Capability Maturity Model, a brief rendition of the evolution of the concept will be provided. This will be followed by various definitions of the concept and clarification thereof with a high level analysis of not only the definitions, but also of mature organisations from a Capability Maturity Model perspective. Fundamental concepts of the Capability Maturity Model will be briefly discussed, which then feeds into the five maturity levels of the concept. The maturity characteristics of the Capability Maturity Model are analysed and the benefits of the approach listed. The Capability Maturity Model requirements management processes are listed and the chapter is concluded with a comparative analysis of Six Sigma and the Capability Maturity Model.

Table of Contents: Chapter 6

Synopsis: Chapter 6

The implementation of the Capability Maturity Model in any organisation to achieve 'total quality management' does not constitute a systems implementation in the traditional sense. The implementation of the Capability Maturity Model forces an organisation to adopt not only a new process culture, but also realign the organisation to adopt various levels of maturity in these processes, culminating in a total paradigm shift for the whole organisation.

The focus of this paradigm shift in an organisation as a result of a Capability Maturity Model implementation is emphasised by Paragraph 6.6, where the five levels of the Capability Maturity Model are discussed. This is further supported in Paragraph 6.6.1, where the various process maturity characteristics are analysed in detail, to provide the reader with a comprehensive overview of the impact of a Capability Maturity Model implementation.

Of particular importance, the Capability Maturity Model requirements management process analysed in Paragraph 6.9, elements of which will be taken forward into Chapter 8 in the formulation of the set of mitigating factors.

Chapter 6

Ruling Principles of the 'Capability Maturity Model'

"Education is what survives when what has been learnt, has been forgotten".[1]

Prof. B.F. Skinner

6.1 INTRODUCTION

Initiatives to enhance operational performance can include some programs that strive for continuous improvement and others that attempt radical innovation (Allen & Kutnick 2000:9, Davenport 1993b:6) This statement holds true for the Capability Maturity Model discussed in this chapter as well as for the Six Sigma methodology (discussed in the previous chapter), both being applications of the process management concept of 'total quality management' (Watson 2002:36). Total quality management, according to Besterfield (1999) 'is the management of the whole to achieve excellence', and furthermore, 'it is the set of principles that guide an organisation to continuously improve'. Embedded in the total quality management concept, are some basic principles (Odendaal and Claasen 2002:26), namely:

- Commitment of management to support financially and otherwise.
- Focus on the customer to meet specific requirements.
- Involvement of the entire workforce to be trained to implement it.
- A constant drive to improve processes, reduce cycle times, reduce scrap and deliver on time.
- Involve suppliers as an extension to the business.
- Measurements to be taken analysed and controlled.

Total quality management *per se* is aimed at delivering to organisations not only incremental process improvements, but also quantum improvements in speed, quality and cost (Arthur 1997:46). Since Capability Maturity Model improvement

[1] New Scientist. 21 May 1994.

is an application of total quality management principles to software, the synergy of aligning these initiatives seems obvious (Paulk 1996:6). The amorphous nature of the quality paradigm culminates in different authors to emphasise different aspects thereof. Two elements highlighted by Fox & Frakes (1997:26), as being central value of the quality paradigm, and most appropriate to the theme of this thesis, namely:

- **The process perspective:** Processes must not only be improved, but they must be continuously improved.
- **Customer focus:** Making the customer the ultimate judge of performance, the driver of business decisions, and the focus of everyone's attention is both a value and a management technique in the quality paradigm.

As a pre-amble to analysing the ruling principles of the Capability Maturity Model, it is appropriate to list the requirements of the 'total quality management' concept. Arthur (1997:47-49), lists the five biggest mistakes in implementing any total quality management initiative into an organisation. Transposing Arthur's five biggest mistakes into 'pre-requisites', the following are returned:

- **Focus of 'Total Quality Management' should be on results:** Success must be measured by reductions in defects, cycle times, cost of waste and reworks.
- **Concentrated focus:** To achieve quantum improvements, the concentrated focus must be on the improvement of effort by identifying the few contributors to the cost that are responsible for the bulk of the problem.
- **Sponsorship:** Customers are the ones who should create leadership support for proposed solutions. Invariably, it is teams who selected problems that plagued the team, not their customer. This against the background that customer perceptions improve only as a by-product of being better, faster and cheaper than the competition.
- **A people focus on key results:** Success in any total quality management initiative can only be attained by skilled practitioners to lead the improvement in the key problem area.
- **Development of real-world experience:** It is suggested that with any total quality management learning, Deming's slow methodical instructional

process[2] be followed, which he learned at the Colorado School of Mines in 1922, be followed, namely:

- Explaining the theory (profound knowledge).
- Showing of a simple example.
- Having participants do a practice problem from a mythical case study.

Customer satisfaction has become the motto of many organisations attempting to survive and thrive in today's ever-increasing competitive world. While organisations focus on customer satisfaction, there is a growing perception that software quality is the weak link in developing high-quality products and services. These statements are underpinned by a definition attributed to the concept of total quality management, by Amsden *et al* (1998:185), who defines the concept as:

> *"A management system designed to continuously improve all processes of a company, both manufacturing and organizational, in order to meet the wants, needs, and expectations of its customers"*

Further support is provided by Amsden *et al.* (1998:187), with the powerful exhortation that:

> *"everything the organization does must be customer driven".*

This means the 'wants', 'needs', and 'expectations' of the organisation's customers are the primary considerations in determining the actions of all employees.

The analytical process followed thus far is graphically depicted in Figure 6.1, which places the chapters in context of the overall thesis objectives, and furthermore, indicates the relative positioning of this chapter.

[2] Deming, WE. 1986. Out of the crisis. Cambridge: MIT Press.

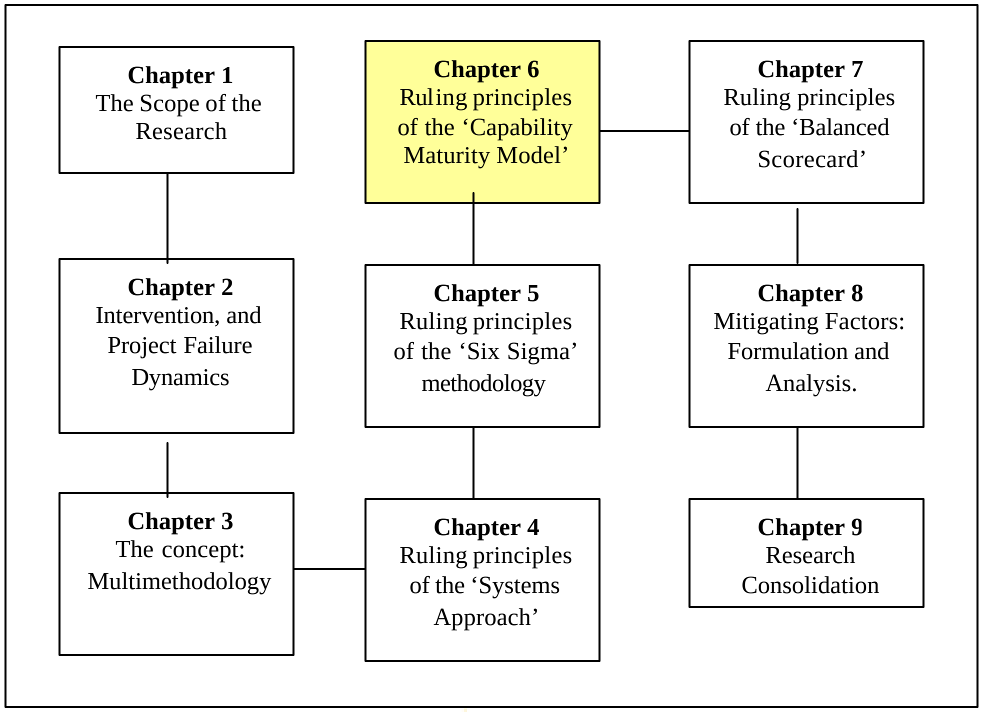

Figure 6.1: Chapters in context of the overall research

In this chapter, the complexities of the 'Capability Maturity Model' are introduced to provide the reader with the required insight into the ruling principles that govern the approach. In the paragraph describing the background to the Capability Maturity Model, a brief rendition of the evolution of the concept will be provided. This will be followed by various definitions of the concept and clarification thereof with a high level analysis of not only the definitions, but also of mature organisations from a Capability Maturity Model perspective. Fundamental concepts of the Capability Maturity Model will be briefly discussed, which feeds into the five maturity levels of the concept. The maturity characteristics of the Capability Maturity Model are analysed and the benefits of the approach listed. The Capability Maturity Model requirements management processes are listed and the chapter is concluded with a comparative analysis of Six Sigma and the Capability Maturity Model.

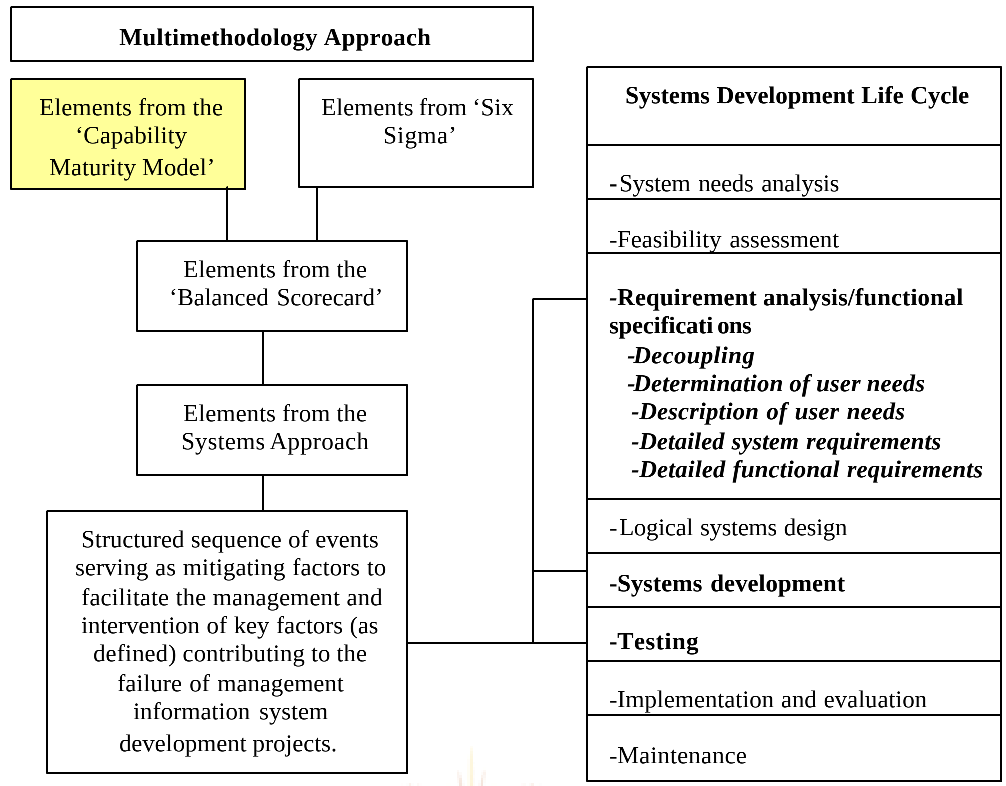

Figure 6.2:- Interrelationships of core entities

For ease of reference, the interrelationship of the various core entities, gleaned from the above defined system methodologies, ultimately supporting the structured sequence of events serving as mitigating factors are graphically depicted in Figure 6.2. In addition, the mitigating factors are positioned to reflect their potential position in a typical systems development life cycle as proposed by Senn (1990:673).

The Capability Maturity Model specifies key process areas, which are generally agreed to be fundamental practices required to produce quality software in a timely, cost effective and controlled manner. Furthermore, the Capability Maturity Model describes a framework, which provides an evolutionary path from *ad hoc*, chaotic processes, to mature disciplined software processes (Raffo & Vandeville 1997:609).

6.2 BACKGROUND AND EVOLUTION OF THE CAPABILITY MATURITY MODEL: A BRIEF SYNOPSIS

Paulk *et al.* (1994:4-5) provides the following background and insight into the evolution of the Capability Maturity Model.

The development of a process maturity framework that would help organisations improve their software process, was first mooted by the Software Engineering Institute in 1986, with assistance from the MITRE Corporation. In 1987, the Software Engineering Institute evolved the software process maturity framework into the Capability Maturity Model for software, which were based on:

- Actual practices.
- The best of the state of the practice.
- The needs of individuals performing software process improvement and software process appraisals.
- Documented processes.

Since then, the Capability Maturity Model has been in a constant state of being revised, which provides an appropriate and realistic balance between the needs for stability and continued improvement. If process thinking for software is a religion, then Watts Humphrey is its main 'prophet' without dispute. In addition, it was he who led the initial development of the Capability Maturity Model, and introduced the concepts of Software Process Management and Software Capability Evaluation (Zahran 1998:4). Furthermore, key players in the evolutionary development of the Capability Maturity Model, according to Zahran (1998:45), are:

- **Walter Shewhart (1930):** Promulgated the principles of statistical quality control.
- **Edwards Deming and Joseph Juran (1956):** Expanded on the Shewhart principles.
- **Phil Crosby (1980):** Developed a quality maturity grid.
- **Watts Humphrey (1986):** Adopted Crosby's grid and adopted the concept of maturity levels.

- **The Software Engineering Institute:** Developed a maturity framework on the Capability Maturity Model, including enhancements to date.

6.3 THE CAPABILITY MATURITY MODEL DEFINED

Herbsleb *et al.* (1997:32) define the Capability Maturity Model as:

> *"a reference model for appraising software process maturity and a normative model for helping software organizations progress along an evolutionary path from ad hoc chaotic processes to mature disciplined software".*

Paulk (1999:8) defines the Capability Maturity Model as being:

> *"Focused on process-centred change, whether the change is incremental or revolutionary, internal or external".*

Paulk *et al.* (1994:4), define the Capability Maturity Model as:

> *"a framework that describes the key elements of an effective software process"*

The following analysis of the Capability Maturity Model clarifies the above definition (Paulk *et al.* 1994:4-5): 'The Capability Maturity Model describes an evolutionary path for software organisations from *ad hoc*, immature process to a mature, disciplined one. The Capability Maturity Model covers practices for planning, engineering, and managing software development and maintenance. When followed, these practices improve the ability of organisations to meet goals for cost, schedule, functionality and product quality. The Capability Maturity Model guides software organisations that want to gain control of their processes for developing and maintaining software and evolve toward a culture of software engineering and management excellence. Its purpose is to guide these organisations in selecting process improvement strategies by determining their current process maturity and identifying the few issues most critical to improving their software process and software quality. By focusing on a limited set of activities and working aggressively to achieve them, an organisation can steadily improve its organisation-wide software process to enable continuous and lasting gains in software process capability'.

The basic premise of the Capability Maturity Model is that higher maturity processes would lead to increased productivity and reduced cycle time and defects (Phan 2001:56). From this, the analogy can be drawn that 'process thinking' forms the basis of the Capability Maturity Model.

6.3.1 PROCESS THINKING

Citing Humphrey (1989)[3], Zahran (1998:52) advocates that 'an important first step in addressing software problems is to treat the entire software task as a process that can be controlled, measured and improved'. Common process thinking aligns the behaviour and activities of those individuals towards achieving their common goal, which brings consistency and uniformity, which turn into improved capability and better quality results (Zahran 1998:4).

It is of importance to note that this paragraph should be read in conjunction with the extensive analysis on Reasoning and Thinking contained in Chapter 8, Paragraph 8.2.

6.3.2 CAPABILITY MATURITY MODEL 'INTEGRATION'

The purpose of the Capability Maturity Model 'Integration' according to the Carnegie Mellon Software Engineering Institute (2002:10), is to provide guidance for improving an organisation's processes and the ability to manage the development, acquisition and maintenance of products and services. Furthermore, the Capability Maturity Model 'Integration' places proven approaches into a structure that helps an organisation appraises its maturity or process area capability, establish priorities for improvement, and implement these improvements.

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[3] Humphrey WS. 1989. Managing the software process. Sydney: Addison-Wesley.

In addition, the Capability Maturity Model 'Integration' product suite contains and is produced from a framework that provides the ability to generate multiple models and associated training and appraisal materials. Typically an organisation can use a Capability Maturity Model 'Integration' model to help set process improvement objectives and priorities, improve processes, and provide guidance for ensuring stable, capable and mature processes.

6.4 THE MATURE SOFTWARE ORGANISATION FROM A CAPABILITY MATURITY MODEL PERSPECTIVE

The Capability Maturity Model represents an evolutionary improvement path for software organisations from *ad hoc,* immature processes, to a mature software organisation from a Capability Maturity Model perspective. As opposed to comparing each salient element of an immature organisation to that of a mature organisation, it would in view of this author be more appropriate to provide the characteristics of a mature organisation from a Capability Maturity Model perspective, which according to Paulk *et al*. (1994:7-8) are as follows:

- Possesses an organisation-wide ability for managing software development and maintenance processes.
- Accurately communicates the software process.
- Carries out work activities according to a planned process.
- The processes mandated are documented, usable and consistent with the way the work actually gets done.
- Process definitions are updated when necessary, and improvements are developed through controlled pilot-tests (Vandersluis 2001:13), and/or cost benefit analysis.
- Quality of software products are monitored including the processes that produce them.
- There is an objective, quantitative basis for judging product quality and analysing problems with product and process.

In general, the mature organisation follows a disciplined process consistently, because all of the participants understand the value of doing so, and the necessary infrastructure exists to support the process.

6.5 FUNDAMENTAL CONCEPTS UNDERLYING PROCESS MATURITY

Paragraph 6.4 provided insight into the attributes of a mature organisation, however there are a number of fundamental concepts which are used to describe mature organisations. Software process capability is the inherent ability of the software process to produce planned results. These statements are analysed by Paulk *et al.* (1994:8-10), as follows:

- **Process:** A process is a sequence of steps performed for a given purpose.
- **Software process:** A set of activities, methods, practices and transformations that people employ to develop and maintain software and associated products.
- **Software process capability:** Describes the range of expected results that can be achieved by following a software process.
- **Software process performance:** Represent the actual results achieved by following a software process.
- **Software process maturity:** Represents the extent to which a specific process is explicitly defined, managed, measured, controlled, and effective.
- **Organisational culture :** Which can be summed up as, 'that's the way we do things around here'.
- **Institutionalisation:** Is the building of infrastructure and culture to support methods, practices, and procedures so that they are the ongoing way of doing business.

The Capability Maturity Model uses the above statements to focus on the capability of software organisations to produce high quality products consistently and predictably.

6.6 THE FIVE LEVELS OF THE CAPABILITY MATURITY MODEL

As previously stated, the Capability Maturity Model provides a framework for ongoing continuous process improvement into five maturity levels. These five maturity levels define an ordinal scale for measuring the maturity of an organisation's process and for evaluating its software process capability.

Furthermore, they help an organisation prioritise its improvement efforts. The five levels of maturity of the Capability Maturity Model according to Paulk *et al.* (1994: 15-17) are:

- **Initial (Level 1):** The software process is characterised as *ad hoc*, and occasionally even chaotic. Few processes are defined, and success depends on individual effort and heroics.
- **Repeatable (Level 2):** Basic project management processes are established to track cost schedule and functionality. The necessary process discipline is in place to repeat earlier successes on projects with similar applications.
- **Defined (Level 3):** The software process for both management and engineering activities is documented, standardised, and integrated into a standard software process for the organisation. All projects use an approved, tailored version of the organisation's standard software process for developing and maintaining software.
- **Management (Level 4):** Detailed measures of the software process and product quality are collected. Both the software process and products are quantitatively understood and controlled.
- **Optimising (Level 5):** Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies.

Curtis (2003) categorises the five levels of organisations from a different perspective. In terms of these perspectives, the different maturity levels relate to the following 'focus' criteria:

- **Level 1:** Focus on heroes.
- **Level 2:** Focus on teams and work units.
- **Level 3:** Focus on the organisation.
- **Level 4:** Focus on the use of statistics (empowerment sets in).
- **Level 5:** Focus on agility and performance.

From the above, the analogy can be drawn that an organisation who implemented the Capability Maturity Model can be labelled a 'learning organisation'. In this respect, although not exactly within context, Senge (1990a:9) proposes that leaders in a 'learning organisation' are responsible for building organisations where people are 'continually expanding their capabilities to shape their future'. From the above the obvious conclusion can be drawn that these five levels reflect the fact that the Capability Maturity Model is a model for improving the capability of software organisations, however requires further clarification.

6.6.1 PROCESS MATURITY CHARACTERISTICS

According to Allen & Kutnick (2002:24-27), the following characteristics are associated with the Capability Maturity Model levels of maturity:

- **Initial (Level 1):** Level 1 is the farthest away from best practice because no planning or structure is applied. Characteristics of a Level 1 organisation, the following:
  - Processes not defined or documented.
  - Process tasks are performed *ad hoc*.
  - No relationships exist between service supply and demand.
  - Operational processes are not known.
  - Operational data is rarely collected.
  - Lines of business hardly perceive any value.

- **Repeatable (Level 2):** Level 2, includes a minimal amount of planning and documentation, which allows the process to be repeatable but does not allow for consistent execution. Characteristics of a Level 2 organisation, the following:
  - Processes are partially documented in terms of workflow and relationships, but little or no agreement exists regarding execution.
  - Corrective actions to remedy service failures are inconsistent.
  - Focus is on operation control.
  - Operational processes are not audited.
  - Operational data is not controlled due to the lack of standards.
  - Lines of business perceive value in vague terms.

- **Defined (Level 3):** Level 3 is a 'better practice' as sufficient planning, documentation and disciplines are used to make these repeatable processes that are executed consistently. Characteristics of a Level 3 organisation, the following:

- Key operational processes are fully documented, monitored, and measured on the basis of targets that are defined in terms of first level service level agreement metrics, which focussed on performance. Process workflow, roles and responsibilities are defined, and agreement on how processes should be performed are reached.
- Service failures are remedied through consistent, corrective actions, albeit in reactive mode, from staff having hands-on feeling of operational confidence.
- An internal fit is pursued, with users shifting focus from operational control to service control.
- Operational processes are audited occasionally.
- Extensive reports encompassing key metrics are produced.
- Lines of business perceive generic value.

- **Management (Level 4):** Level 4 moves us closer to a best practice because processes are not only repeatable and consistent, but provision is made for adaptation based on feedback from lines of business. Characteristics of a Level 4 organisation, the following:
  - Processes are fully documented, monitored, and measured on the basis of targets that are defined in terms of second level service level agreement metrics, which focussed on performance. Process inter-relationships and service cycles are defined.
  - Failures are reduced to a minimum.
  - Internal fit is achieved, with users shifting focus from service production to service consumption and tuning service levels to address changing business needs and requirements. Lines of business have an influence on service level definitions.
  - Operational processes are periodically audited to refine service level agreement and customer feedback is sort proactively.
  - Lines of business perceive extended value.

- **Optimising (Level 5):** Level 5 is a 'best practice'. Processes are repeatable, consistent, adaptable and optimised for maximum efficiency and effectiveness. Methods to adapt and optimise processes are based on sophisticated customer-oriented metrics and tools. Characteristics of a Level 5 organisation, the following:
  - The processes are fully documented, monitored, and measured on the basis of targets that are defined in terms of service value agreements metrics, which encompass cost, performance, service quality customer satisfaction, business results and impacts. Furthermore, also in terms of standards that are customer driven, will derive from the external environment. Information Technology and business process relationships are determined.
  - Corrective actions are imbedded into the processes.
  - External fit is pursued, by which users shift focus to balancing service supply and demand overtime, and line of business determine the service levels.
  - Operational processes are audited on an ongoing basis, as part of continuous improvement.
  - Lines of business value perceptions exceed expectations.

This above summary of the five process maturity characteristics demonstrates the extent of change when an organisation moves from one level of maturity to another. Furthermore, the analogy can be drawn that each level culminates in a paradigm shift within the organisation calling for a structured and planned intervention to facilitate the transition.

6.7 THE PERSONAL SOFTWARE PROCESS

The Capability Maturity Model provides a body of software engineering products that have been found effective for large-scale software development, while a subset of the methodology, the so called 'personal software process', scales down industrial software practices to fit the needs of small-scale program development (Humphrey 1994a:1-2). While the 'personal software process' uses various standard software-engineering methods, its primary objective is to show engineers how a defined and measured process can help them to improve their personal performance (Humphrey 1994b:2).

6.8 BENEFITS OF THE CAPABILITY MATURITY MODEL

Many benefits accrue from using the Capability Maturity Model and the following list provided by Paulk *et al.* (1994:13-14) serves as examples:

- The Capability Maturity Model supports measurement of the software process by providing a framework for performing reliable and consistent appraisals.
- The Capability Maturity Model builds on a set of processes and practices that have been developed in collaboration with a broad selection of practitioners.
- The Capability Maturity Model represents a 'common sense engineering' approach to software process improvement.
- The Capability Maturity Model provides a conceptual structure for improving management and development of software products in a disciplined and consistent way.
- The Capability Maturity Model identifies practices for a mature software process and provides examples of the state-of-the-practice.
- The Capability Maturity Model is a tool to help software organisations improve their software processes.

To realise the above potential benefits from an implementation of the Capability Maturity Model calls for an organisation wide implementation strategy to move the organisation from one level to the other.

6.9 CAPABILITY MATURITY MODEL REQUIREMENTS MANAGEMENT PROCESS

The Capability Maturity Model management process cited below by Zahran (1998:40) from Paulk *et al.* (1994)[4], refers to the requirement management and default mitigation processes for the 'Onboard Schuttle Software Project'. The

[4] Paulk M Weber C Curtis B and Chrissis MB. 1994. The CMM-Guidelines for improving the software process. Sydney: Addison-Wesley.

requirement management and default mitigation processes contain the following key elements:

- Requirements conception.
  - Identify need.
  - Examine architectural options.
  - Develop software system solution.

- Requirements generation.
  - Define software requirements in accordance with operational concepts and system requirements.
  - Produce requirements specifications.

- Requirements analysis.
  - Assess technical and resource impact.
  - Determine acceptability, implementability, and testability.
  - Examine requirement readiness.

- Requirements inspection.
  - Discuss proposed requirements in detail.
  - Discuss operational scenarios.
  - Identify issues and errors.

- Requirements approval.
  - Evaluate risks and benefits.
  - Decide on resource expectations.
  - Establish baseline.

The above referenced ‘default mitigation process’ involves:

- Determining the cause effect and correcting it.
- Identification and correcting the process cause of the default.
- Connecting defect-detecting activities for the defects passed.
- Checking for similar defects elsewhere in the product.

The attention of the reader is drawn to the fact that the above listed requirement management and default mitigation processes pertain to the Onboard Schuttle Software Project. While not exactly falling within the context of business requirement functional specification and default mitigation for the financial services industry as proposed in this thesis, these processes in the opinion of the author of this thesis can, with amendments, effectively be applied thereto.

6.10 THE CAPABILITY MATURITY MODEL AND SIX SIGMA COMPARED

Card (2000:11-12) citing Paulk *et al.* (1994) [5], identifies two key process areas of the Capability Maturity Model, which map to the Six Sigma methodology. The two areas, which map to each other are:

- In the area of 'quantitative process management', which involves the establishing of goals for the performance of the project's defined software process.
- In the area of 'defect prevention', which involves analysing defects encountered in the past and taking specific actions to prevent the occurrence of those types of defects in the future.

Wilson (2002:40) makes the following comparisons between the Capability Maturity Model and the Six Sigma methodology, namely:

- While Six Sigma relies on analytical tools and statistical methods to drive its performance improvements, these methods are only implied as an intention that is associated with the Capability Maturity Model approach to measurement.
- While Six Sigma begins by building process capability using DMAIC as the method for improving business, the Capability Maturity Model emphasis is on technology application that is more consistent with application of the DFSS method of Six Sigma.

[5] Paulk M Weber C Curtis B & Chrissis MB. 1994. The CMM-Guidelines for improving the software process. Sydney: Addison-Wesley.

- While Six Sigma improvement projects should be drawn from a portfolio of problems identified during strategic planning, the Capability Maturity Model linkage to strategy is weak and often ignored.
- While Six Sigma emphasises the development and certification of professionals, the Capability Maturity Model emphasises development of Capability Maturity Model assessors and certification of organisations.

Card (2000:12) is of the opinion that both approaches focus on reducing defects as the primary method of improvement. However, Six Sigma provides a relative broad definition of a defect, while the Capability Maturity Model acknowledges the possibility of focusing on other dimensions for improvement.

Based on the above analysis, it is clear that the Six Sigma methods are most complementary with the Capability Maturity Model Level 4 and Level 5 organisations that emphasise the use of quantitative measures for defect reduction in order to achieve business outcomes that are predictable.

6.11 KEY COMPONENTS FROM THE CAPABILITY MATURITY MODEL

A list of key components which in terms of the multimethodology approach be extrapolated from the Capability Maturity Model, and taken up in the formulation of the structured sequence of events to ultimately culminate in the set of mitigating factors, will be contained in Appendix F, for ease of reference. The aim of this thesis is to use a multimethodology approach to facilitate the intervention and subsequent management of key factors contributing to the failure of management information systems development programmes undertaken in the financial services industry.

The Capability Maturity Model, while a powerful process and quality improvement methodology, would under normal circumstances be implemented into an organisation as a holistic approach to evolve such an organisation through the five levels of maturity. Furthermore, the Capability Maturity Model, in view of the author of this thesis is not designed to cater for specific and customised interventions as proposed in this thesis. Notwithstanding the above observations, in view of this author, the Capability Maturity Model remains one of the most advanced mechanisms for overall process and quality improvement within organisations and to transform such organisations into mature process entities. Irrespective of the *caveats* listed above, elements of the Capability Maturity Model will be extrapolated for use within the context of the multimethodology approach to glean the full benefit for the structured sequence of events to be formulated.

6.12 CLOSURE

In this chapter, the complexities of the Capability Maturity Model were introduced to provide the reader with the required insight into the ruling principles that govern the approach. In the paragraph describing the background to the Capability Maturity Model, a brief rendition of the evolution of the concept were provided. This was followed by various definitions of the concept and clarification thereof with a high level analysis of not only the definitions, but also of a mature organisation from a Capability Maturity Model perspective. Fundamental aspects of the Capability Maturity Model were briefly discussed, which fed into the five maturity levels of the concept. The maturity characteristics of the Capability Maturity Model were analysed and the benefits of the approach listed. The Capability Maturity Model requirements management processes were listed and the chapter was concluded with a comparative analysis of Six Sigma and the Capability Maturity Model.

In 1986, Brooks[6] cited by Phan (2001:56), reviewed new software technologies and processes and concluded that there is 'no silver bullet' for problems in software development. Thirteen years later, Glass (1999:74-79) reviewed several new software technologies, and found that they still show only modest benefits, with productivity and quality improvements averaging in the vicinity of 20 to 25 percent. It is of interest to note that the best process model that provides reliable

[6] Brooks FP. 1988. The mythical Man-Month. (*In:* Thayer RH *ed.* 1988. Tutorial: Software engineering project management. Washington: Computer Society Press of the IEEE.)

data in his review, was the Capability Maturity Model, which showed a defect detection gain of 6 to 25 percent per year.

The Capability Maturity Model discussed in this chapter represented a 'reference model' for appraising software process maturity and a 'normative model' for helping software organisations progress along an evolutionary path from *ad hoc* chaotic processes to mature disciplined software. In Chapter 5, the Six Sigma methodology was analysed, which dealt with a comprehensive and flexible system for achieving, sustaining and maximising business success. While principally different, the Capability Maturity Model and Six Sigma methodology closely map one another with respect to their objectives. In contrast, the Balanced Scorecard to be analysed in Chapter 7, represents a dynamic paradigm shift with respect to its objectives if compared to the Capability Maturity Model and Six Sigma. This is attributed to the fact that the Balanced Scorecard represents a mechanism to help organisations implement their strategic goals, which is achieved by translating an organisation's mission and strategy into a comprehensive set of performance measures that provides the framework for a strategic measurement and management system. Furthermore, the Balanced Scorecard tracks the key elements of a company's strategy – from continuous improvement and partnerships to teamwork on a global scale (Kaplan & Norton 1992:72).

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Synopsis: Chapter 7

The well-known Balanced Scorecard has evolved from a measurement tool, to a strategic measurement system, to ultimately become a 'methodology' forming part of the concept of 'total quality management'.

In this chapter, the four perspectives of the Balanced Scorecard are analysed, with the 'customer perspective' forming the most important component. The 'customer perspective', is also the perspective which would feature prominently in the formulation of the set of mitigating factors in Chapter 8.

The tangent planes which the Balanced Scorecard has with information technology is of importance. The use of a scorecard within the technology development arena of an organisation, aligns the information technology department with the overall strategy. This in turn mitigates one of the frequent complaints about technology development, namely their failing to incorporate organisational strategy.

The Balanced Scorecard in view of the author of this thesis, is not designed to cater for specific and customised interventions as proposed in this thesis, but designed to provide managing executives with a comprehensive framework that translates a company's strategic objectives into a coherent set of performance measures. Irrespective of this *caveat,* elements of the Balanced Scorecard will be extrapolated for use within the context of the multimethodology approach to glean the full benefits for the structured sequence of events to be formulated. This decision is underpinned the fact that the Balanced Scorecard is intended to link short-term operational control to the long term vision and strategy of the business.

Chapter 7

Ruling Principles of the 'Balanced Scorecard'

"The empires of the future are the empires of the mind".

Winston S. Churchill

7.1 INTRODUCTION

A number of improvement initiatives are open to organisations in their quest to transform themselves to compete successfully in the marketplace. This moots the requirement to turn a variety of improvement initiatives 'to stay ahead' of the competition, irrespective of their lines of business. According to Kaplan & Norton (1996a:6), the following serves as examples of this trend:

- Just-in-time production and distribution systems.
- Time based competition.
- Lean production/lean enterprise.
- Building customer-focused organisations.
- Activity based cost management
- Employee empowerment.
- Reengineering.
- Implementation of total quality management.

The Six Sigma methodology analysed in Chapter 5 and Capability Maturity Model analysed in Chapter 6, fall within the ambit of 'total quality management' improvement initiatives. Many of these initiatives have yielded disappointing results in the past due to the fact that the programmes are often fragmented. Furthermore, they are invariably not linked to the organisation's strategy, nor are they achieving specific financial and economic outcomes. By ignoring the fundamentals of strategy, companies have adversely affected their industry structures, making it more difficult for anyone to gain competitive advantage (Niven 2002:8). In this regard, Porter (2001:62-78) suggests sustainable competitive advantage through operational effectiveness, and strategic positioning holds the answer. According to Kaplan & Norton (1996a:6), breakthroughs in performance require major changes in the measurement and management of systems used by an organisation. In addition, navigating to a more competitive, technological and capability-driven future cannot be accomplished merely by monitoring and controlling financial measures of past performance. For many organisations, the Balanced Scorecard has evolved from a measurement tool to what Kaplan & Norton have described as, 'a strategic measurement system' (Kaplan & Norton 1996c:75-85).

In this chapter, the complexities of the 'Balanced Scorecard' are introduced, to provide the reader with the required insight into the ruling principles that govern the approach. The analytical process followed thus far is graphically depicted in Figure 7.1, which places the chapters in context of the overall thesis objectives, and furthermore indicates the relative positioning of this chapter.

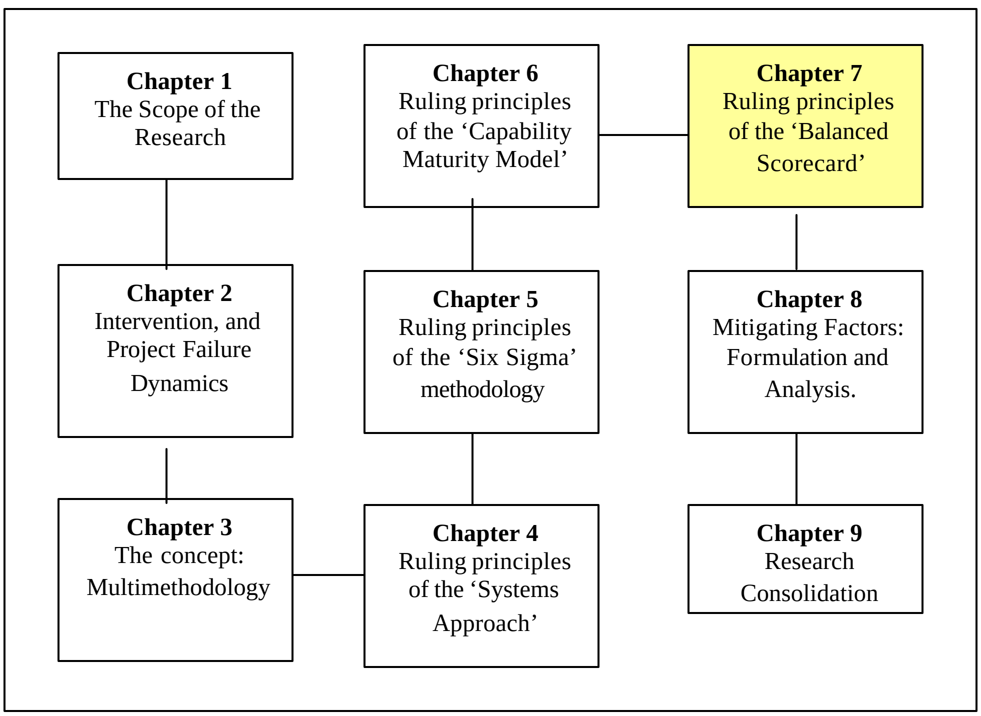

Figure 7.1: Chapters in context of the overall research

In the introductory paragraph of this chapter, the Balanced Scorecard was introduced as a methodology, which forms part of the concept of total quality management. This will be followed by various definitions associated with the Balanced Scorecard and explanation of key words in the phrase. A background to the Balanced Scorecard supported by a graphical depiction of the concept in practice will in addition be provided. The various Balanced Scorecard perspectives are analysed and the chapter is concluded with a high level process of scorecard building, with specific emphasis on the information technology environment.

For ease of reference, the interrelationship of the various core entities, gleaned from the above defined system methodologies, ultimately supporting the structured sequence of events serving as mitigating factors are graphically depicted in Figure 7.2. In addition, the mitigating factors are positioned to reflect their potential position in a typical systems development life cycle as proposed by Senn (1990:673).

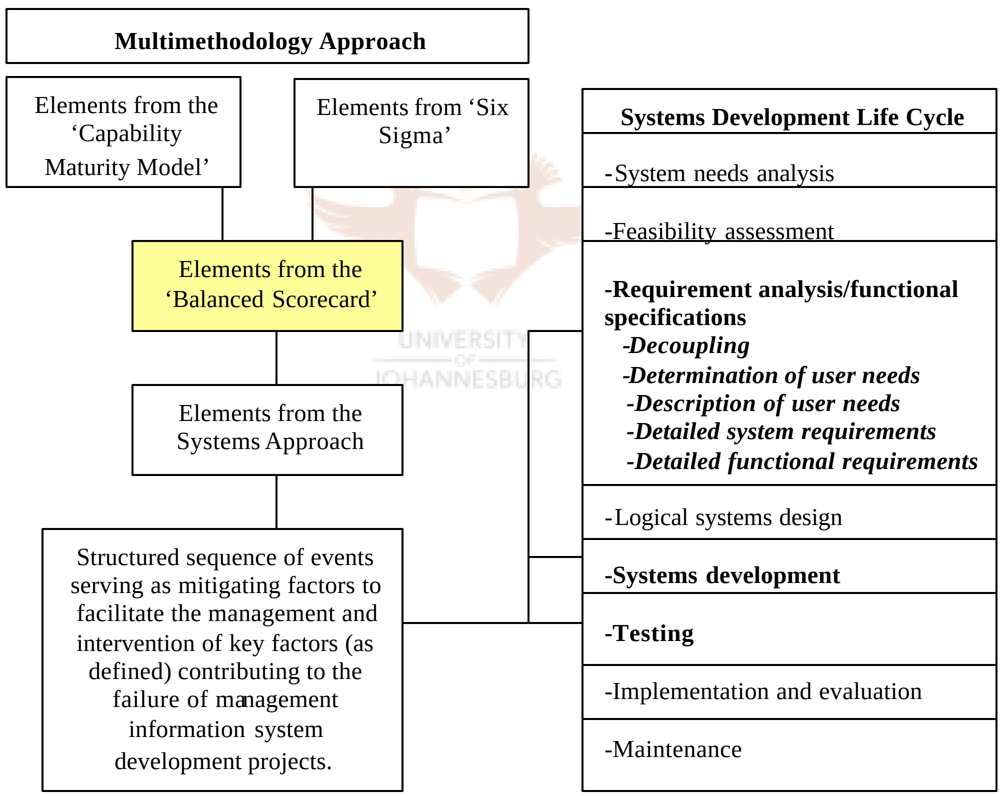

Figure 7.2: Interrelationships of core entities

7.2 THE BALANCED SCORECARD DEFINED

Much more than a measurement exercise, the Balanced Scorecard is a management system that can motivate breakthrough improvements in such critical areas as product, process, customer and market place development (Kaplan & Norton 1992:71). Kaplan & Norton 1993:134) provides this rather lengthy description of the Balanced Scorecard, which defines the concept as:

> *"A set of measures that gives top managers a fast but comprehensive view of the business. The Balanced Scorecard includes financial measures that tell the results of actions already taken. And it complements the financial measures with operational measures on customer satisfaction, internal processes, and the organisation's innovation and improvement activities - operational measures that are the drivers of future financial performance".*

Graeser *et al.* (1998:178), defines a Balanced Scorecard as:

> *"a translation of a company's strategic objectives into a set of performance measures".*

Graeser *et al.* (1998:178), in addition defines the concepts 'balanced' and 'scorecard' in context of the description of the approach, the Balanced Scorecard as follows:

> *"The use of the word 'balanced' in the description of the approach, implies a set of measures that spans the significant processes and focuses of an organization".*

> *"Scorecard implies measurement against a goal or target".*

7.3 BACKGROUND

The Balanced Scorecard was first proposed in the January/February 1992 issue of the Harvard Business Review with the title: 'The Balanced Scorecard – Measures that drive performance'. The Balanced Scorecard provides executives with a comprehensive framework that translated a company's strategic objectives into a coherent set of performance measures (Kaplan & Norton 1993:134). Furthermore, the Balanced Scorecard according to Kaplan & Norton (1992:72) and (Kaplan & Norton 2001:24), allows managers to look at business from four important perspectives, and provides answers to four basic questions, namely:

- **Customer perspective:** How do customers see us?
- **Internal perspective:** What must we excel at? **:**
- **Innovation and learning perspective:** Can we continue to improve and create value?
- **Financial perspective:** How do we look to shareholders?

Figure 7.3 below graphically depict the links of the performance measures described above.

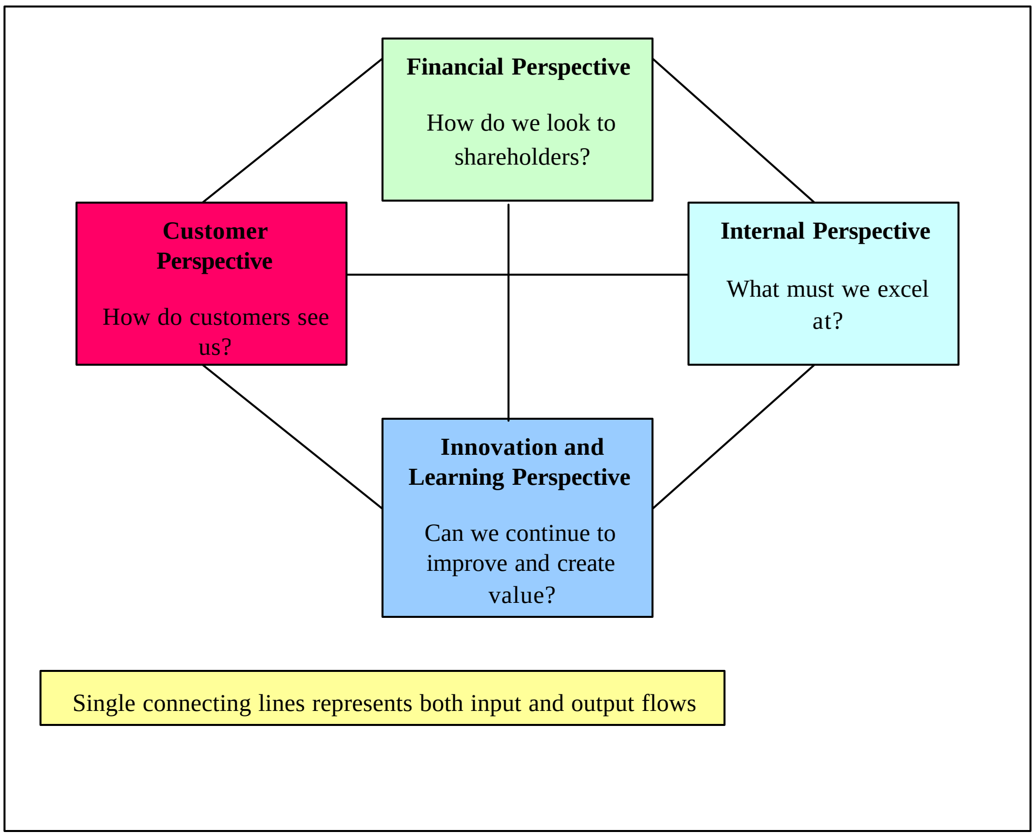

Figure 7.3: The Balanced Scorecard links performance measures (Kaplan & Norton (1992:72)

While giving executive management information from four perspectives, the Balanced Scorecard minimises information overload by limiting the number of measures used. From the above, the analogy can be drawn that the Balanced

Scorecard focus on a handful of measures that are most critical to the organisation (Kaplan & Norton 1992:73).

More recently according to Kaplan & Norton (1996c: 85), companies export their use of the Balanced Scorecard, employing it as a foundation for integrated and iterative strategic management systems. Through this approach, such companies:

- Clarify and update strategy.
- Communicate strategy throughout the company.
- Align unit and individual goals with the strategy.
- Link strategic objectives to long-term targets and annual budgets.
- Identify and align strategic initiatives.
- Conduct periodic performance reviews.
- Conduct periodic performance reviews to learn about and improve strategy.

From the above, Kaplan & Norton (1996a:19) draws the analogy that the Balanced Scorecard fills the void that exists in most management systems, namely the lack of a systematic process to implement and obtain feedback about strategy.

7.4 THE BALANCED SCORECARD PERSPECTIVES ANALYSED

According to Kaplan & Norton (1992:73), the Balanced Scorecard brings together in a single management report, many of the seemingly disparate elements of a company's competitive agenda:

- Becoming customer orientated.
- Shortening response times.
- Improving quality.
- Emphasising teamwork.
- Reducing new product launch times.
- Managing for the long term.

Furthermore, the Balanced Scorecard guards against sub-optimisation. By forcing executive managers to consider all the important operational measures together, the Balanced Scorecard lets them see whether improvement in one area may have been achieved at the expense of another. Against this background, a brief analysis of the various perspectives return, according to Kaplan & Norton (1992:73-79), the following:

- **Customer perspective:** The Balanced Scorecard demands that managers translate their general mission statement on customer service into specific measures that reflect the factors that really matter to customers. The factors that matter most to customers are: time, quality, performance, service and cost. To put the Balanced Scorecard to work, companies should articulate goals for time, quality, performance, service and cost, and then translate these goals into specific measures. Depending on customers' evaluations to define some of the companies' performance measures, forces that companies view their performance through the eyes of their customers. It is of interest to note in particular against the background of this thesis, that the customer perspective typically includes several generic measures of the successful outcomes from a well-formulated and implemented strategy (Kaplan & Norton 1996b:38). The generic outcome measures include the following elements:
  - Customer satisfaction.
  - Customer retention.
  - New customer acquisition.
  - Customer profitability.
  - Market and account share in targeted segments.

  From the above, the analogy can be drawn that the customer perspective enables business unit managers to articulate the customer and market-based strategy that will deliver superior future financial returns (Kaplan & Norton 1996a:26). From the perspective of this thesis, the importance of customer satisfaction cannot be overemphasised. Kaplan & Norton (1996a:70) cite recent research which indicated that just scoring adequately on customer satisfaction, is not sufficient for achieving high degrees of loyalty, retention and profitability. Only when customers rate their buying experience *(their developed software*) (my italics), as completely or extremely satisfied, can a company count on their repeat purchasing *(new future development initiatives)* (my italics) behaviour (Jones and Sasser 1995:88-99).

- **Internal perspective:** Customer based measures must be translated into measures of what the company must do internally to meet its customers' expectations. The internal measures for the Balanced Scorecard should stem from the business processes that have the greatest impact on customer satisfaction. According to Kaplan & Norton (1996a:26), the internal process perspective enables the internal business unit to:
  - Deliver the value propositions that will attract and retain customers in targeted market segments.
  - Satisfy shareholder expectations of excellent financial returns.

- **Innovation and learning perspective:** Due to the fact that success targets keep changing and local and global competition requires that companies make continual improvements to their existing products and processes and have the ability to introduce entirely new products with expanded capabilities. A company's ability to innovate, improve and learn ties directly to the company's value. That is, only through the ability to launch new products, can they create more value for customers, can they improve operating efficiencies continually, can they penetrate new markets and increase revenues and margins – in short, can they grow and thereby increase shareholder value.

- **Financial perspective:** Financial performance measures indicate whether the company's strategy implementation and execution are contributing to the bottom-line improvement. Typical financial goals have to do with profitability, growth and shareholder value. A failure to convert improved operational performance, (as measured in the scorecard) into improved financial performance, should send executives back to their drawing boards to rethink the company's strategy or its implementation plans. It is of interest to note that managers using the Balanced Scorecard do not have to rely on short-term financial measures as sole indicators of the company's performance. According to Kaplan & Norton (1996c:75-77), the Balanced Scorecard facilitates the introduction of four new processes that, separately and in combination, contribute to linking long-term strategy objectives with short-term actions. The four 'new processes' are:

- **Translating the vision:** Which helps managers build a consensus around the organisation's vision and strategy.
- **Communication and linking:** Which helps managers, communicate their strategy up and down the organisation and link it to departmental and individual objectives.
- **Business planning:** Which enables companies to integrate their business and performance plans.
- **Feedback and learning:** Which gives companies the capacity for what is commonly referred to as 'strategic learning'.

Of importance to this thesis, the fact that, according to Kaplan & Norton (1996a:28):

- The scorecard approach will usually identify entirely new processes at which an organisation must excel as to meet customer and financial objectives.
- The scorecard approach focus on the incorporation of innovation processes into the internal process perspective, which differ from the traditional performance measurement system focus centred on the processes of delivering today's products and services to today's customers. This 'short wave' value creation as opposed to a modern 'long wave' value creation.

From the above the analogy can be drawn that the Balanced Scorecard is well suited to the kind of organisation many companies are trying to become. Furthermore, the Balanced Scorecard puts 'strategy and vision', not 'control', at the centre.

7.5 BALANCED SCORECARD FORMULATION

There are a number of reasons, according to Kaplan & Norton (1996b:77) why it is important to build a scorecard that accurately tells the story of a business unit's strategy, namely:

- **The scorecard describes the vision of the future for the entire organisation:** If the vision is wrong, the fact that it is executed will become irrelevant.

- **The scorecard creates shared understanding:** It creates a holistic model of the strategy that allows all employees to see how they can contribute to organisational success. If the model is wrong, individuals and departments will unknowingly sub-optimise their performance.
  - **The scorecard focuses change efforts:** If the right lead indicators are identified, investments and initiatives will drive desired long-term outcomes. If not, investments will be wasted.
  - **The scorecard permits organised learning at executive level:** By making the cause-and-effect hypotheses among objectives and measures explicit, business can test their strategy in real-time and adapt as they learn. Without cause-and-effect linkages, no strategic learning can occur.

According to Niven (2002:42-45), there are seven criteria for choosing where to begin a Balanced Scorecard, namely:

- Strategy.
- Sponsorship.
- Need for a Balanced Scorecard.
- Support of key managers and supervisors.
- Organisational scope.
- Data.
- Resources.

Each of the criteria plays an important role in building a 'perfect' scorecard from a holistic perspective.

7.6 THE PROCESS OF BUILDING A BALANCED SCORECARD

The following tasks are required to build a Balanced Scorecard (Kaplan & Norton, 1993:138, 1996a:300-308):

- Define the measurement architecture.
  - Select the appropriate organisational unit.
  - Identify strategic business unit/corporate linkages.
- Build consensus around strategic objectives
  - Conduct first round of interviews.

  - Conduct synthesis session.
  - Conduct executive workshop (First round).
- Select and design measures.
  - Conduct subgroup meetings.
  - Conduct executive workshop (Second round).
- Build implementation plan.
  - Develop the implementation plan.
  - Conduct executive workshop (Third round).
  - Finalise the implementation plan.

While only four major tasks are identified as being required to build a Balanced Scorecard, the whole process is highly dependent on a team effort from all stakeholders to succeed.

7.6.1 THE BALANCED SCORECARD FROM AN INFORMATION TECHNOLOGY PERSPECTIVE

Following the theme of this thesis, it would be appropriate to evaluate the Balanced Scorecard from an information technology perspective. The use of a scorecard within the technology development area of an organisation[1], aligns the information technology department with the overall strategy. The Balanced Scorecard impact for information technology returns, according to Graeser *et al.* (1998:185), the following:

- **The financial quadrant:** The ability to associate financial measures with strategically based goals.
- **The internal processes quadrant:** Supports information technology's ability to focus on customer facing measures.
- **The learning and growth quadrant:** Provides information technology units with the ability to assimilate measurement results and experiences to attain process improvement and fine-tuned management of the organisation.

[1] It is of importance to note that whenever a reference is made in this thesis, pertaining to information terchnology development, the trend in the South African Financial Services Industry is for each organisation to have its own information technology development arena. Customers of such an area would typically be strategic functional business sectors within the organisation, execpt when a project is 100% outsourced to an external party.

- **The customer quadrant:** Focus on specific customer needs, in particular if the technology scorecard is derived from corporate level scorecards.

The Balanced Scorecard's alignment with overall strategy combat one of the frequent complaints about technology development, namely their failure to incorporate organisational strategy.

7.7 KEY COMPONENTS FROM THE BALANCED SCORECARD

A list of key components, which in terms of the multimethodology approach be extrapolated from the Balanced Scorecard, and taken up in the formulation of the structured sequence of events to ultimately culminate in the set of mitigating factors, will be contained in Appendix F, for ease of reference. The following relevant views pertaining to the Balanced Scorecard are important, specifically in terms of Chapter 8, and associated Appendix F:

The aim of this thesis is to use a multimethodology approach to facilitate the intervention and subsequent management of key factors contributing to the failure of management information systems development programs undertaken in the financial services industry. The Balanced Scorecard essentially represents a mechanism for the translation of a company's strategic objectives into a set of performance measures. Furthermore, the Balanced Scorecard, would under normal circumstances be implemented as a management system that can motivate breakthrough improvements in such critical areas as product, process, customer and market place development. The Balanced Scorecard, in view of the author of this thesis is not designed to cater for specific and customised interventions as proposed in this thesis, but designed to provide executives with a comprehensive framework that translates a company's strategic objectives into a coherent set of performance measures.

Notwithstanding the above observations, in view of the author of this thesis, the Balanced Scorecard remains one of the most advanced mechanisms for measuring and driving performance in an organisation. Irrespective of the *caveats* listed above, elements of the Balanced Scorecard will be extrapolated for use within the context of the multimethodology approach to glean the full benefits for the structured sequence of events to be formulated. This decision is underpinned by the finest content summary of the Balanced Scorecard contained in a practical guide this author has come across during the studies for this thesis. According to the authors of this practical guide (Olve *et al.* 1999:7), the Balanced Scorecard is 'intended to link short-term operational control to the long term vision and strategy of the business'. At its most basic, according to Olve *et al.* (1999:7), the Balanced Scorecard concept is based on three dimensions of time, namely:

- Yesterday.
- Today.
- Tomorrow.

The authors conclude that, 'what we do today for tomorrow, may have no noticeable financial impact until the day after tomorrow'. The company's focus is thus broadened, and it becomes relevant to keep continuous watch on non-financial key ratios.

7.8 CLOSURE

In this chapter, the Balanced Scorecard was introduced as a dynamically different paradigm to the Six Sigma or Capability Maturity Model analysed in previous chapters. This was followed by various definitions associated with the Balanced Scorecard and a explanation of key words in the phrase. This was followed by a paragraph dealing with the background to the Balanced Scorecard and graphical depiction of the concept. The various Balanced Scorecard perspectives were analysed and followed with the reasons of why it is important to build a scorecard. The chapter was concluded with a high level process of scorecard building, with specific emphasis on the information technology environment. In conclusion, the analogy was drawn that the Balanced Scorecard is well suited to the kind of organisation many companies are trying to become. Furthermore, the Balanced Scorecard puts strategy and vision, not control at the centre.

This chapter also concludes Part 2 of the thesis, which dealt with the literature reviews pertaining to the Systems Approach (Chapter 4), the Six Sigma methodology (Chapter 5), the Capability Maturity Model (Chapter 6), and the Balanced Scorecard (Chapter 7).

Chapter 8 represents an in depth analysis of the construction elements of the proposed set of mitigating factors. This chapter will be introduced with a refocus on 'causal elements' as discussed in Chapter 2 which is to be followed by a philosophical perspective of this author on the concept of 'reasoning and thinking'. The initial reasons/objectives which mooted this research will be briefly re-visited to set the scene for the set of mitigating factors to be formulated. Chapter 8, considered to form the crux of the research whereby the set of mitigating factors will be formulated to form a structured sequence of events to facilitate the intervention and management of key factors contributing to the failure of management information development projects undertaken in the financial services industry. Using a multimethodology approach, the mitigating factors will be formulated from an extract of the key components identified in each of the system methodologies analysed in Chapter 4 (the Systems Approach), Chapter 5 (the Six Sigma methodology), Chapter 6 (the Capability Maturity Model) and Chapter 7 (the Balanced Scorecard). This will include the author's own contribution in solving the research problem.

Table of Contents: Chapter 8

Synopsis: Chapter 8

This chapter represents an in depth analysis of the construction elements of the proposed set of mitigating factors. The tailored sequence of events serving as mitigating factors will be based on 'systems thinking', which implies 'thinking about the world outside ourselves and doing so by means of the concept system'. The thinking of the author of this thesis, is aimed at breaking the chains of traditional business thinking through the deployment of a multimethodology approach, which on a personal level is underpinned by the 'ways of knowing' as proposed by Mitroff and Lintstone (1993:19-110).

This important approach calls for an analysis of the following elements of the 'ways of knowing' (refer Paragraph 8.2) which include:
Agreement: The first way of knowing.
The world as a formula: The second way of knowing.
Multiple Realities: The third way of knowing.
Conflict: The forth way of knowing.
Unbounded Systems Thinking: The fifth way of knowing.

The chapter, prior to the formulation of the set of mitigating factors refocus on the interrelationship of core entities. This to ensure that the reader has a comprehensive view of all of the elements used in the formulation of the set of mitigating factors.

The formulation of the set of mitigating factors will be approached from two distinct perspectives:

- **From the perspective of the 'systems analyst':-**
  - A practical process flow model reflecting the structured sequence of events serving as mitigating factors as applied within the context of the proposed systems development life cycle will be analysed in Paragraph 8.5, Figure 8.3 A-G of this chapter. For ease of reference, each element of the structured sequence of events will be shown as a 'numbered frame' within the context of the workflow analysis of the systems development

life cycle. Furthermore, each 'numbered frame' is categorised into six logical phases with supporting guidelines annotated per individual frame to enable the systems analyst to apply the solution practically within the financial services industry.

- **From the perspective of the academic reader:-**
  - To provide scientific credibility to the formulated set of mitigating factors by supporting each of the elements of the structured sequence of events with research data elements as contained in this thesis.
  - To provide a comprehensive analytical view of the compilation of the set of mitigating factors, with each element of the structured sequence of events cross referenced to each of the individual methodologies from which it was originally formulated. Furthermore, each element of the structured sequence of events will be supported by appropriate theoretical references gleaned from the literature reviews cited in this thesis. For ease of reference of the academic reader, this portion of the research will be contained within the ambit of Appendix F.

Chapter 8

Mitigating Factors: Formulation and Analysis

> *"And thus we do not comprehend the practical unconditional necessity of the mortal imperative, we yet comprehend its incomprehensibility, and this is all that can fairly be demanded of a philosophy, which strives to carry its principles up to every limit of human reason".*[1]

Immanuel Kant

8.1 INTRODUCTION

Part 3 of this thesis consists of Chapter 8, which represents an in depth analysis of the construction elements of the proposed set of mitigating factors. The chapter will be introduced with a refocus on 'causal elements' as discussed in Chapter 2, which is to be followed by a philosophical perspective of this author on the concept of 'reasoning and thinking'. The initial reasons/objectives which mooted this research will be briefly re-visited to set the scene for the set of mitigating factors to be formulated. In this chapter, the set of mitigating factors will be formulated to form a structured sequence of events to facilitate the intervention and management of key factors contributing to the failure of management information development projects undertaken in the financial services industry. Using a multimethodology approach, the mitigating factors will be formulated from an extract of the key components identified in each of the system methodologies analysed in Chapter 4 (the Systems Approach), Chapter 5 (the Six Sigma methodology), Chapter 6 (the Capability Maturity Model) and Chapter 7 (the Balanced Scorecard). This will include the author's own contribution in solving the research problem.

[1] From: "Foundations of the Metaphysics of Mortals"

A refocus on the 'causal elements' as discussed in Chapter 2, is appropriate as an introduction to this chapter. The designing of information technology systems is an expensive undertaking (Boehm 1981:4), while ill-defined requirements (KPMG 1997:17), and changes to requirements (Cash & Fox 1992:12), cause projects to fail in respect of being behind schedule (Abdel-Hamid & Madnick 1990b:12, Macualay 1996:4) and over budget (The Standish Group 1995:1-7). More specific to this thesis, is the research problem which will be solved within the ambit of this chapter, and research questions, for which answers will be formulated.

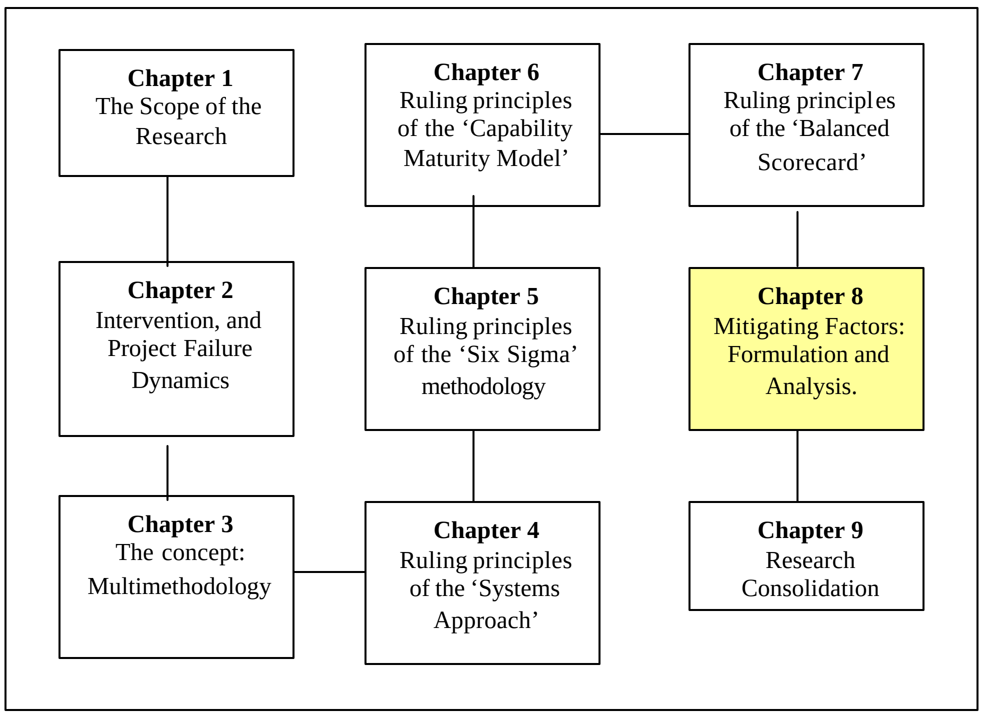

Figure 8.1: Chapters in context of the overall research

The analytical process followed thus far, is graphically depicted in Figure 8.1, which places the chapters in context with the overall thesis objectives, and furthermore indicates the relative positioning of this chapter.

'For information technology systems to be effective, there must be a balance between the technical worldview[2] of designers and the social worldview of users'

[2] Refer to the concept of *'weltanschauung'* as described in Chapter 4, Paragraph 4.8.

(Williams & Kennedy 2001:457-479). This statement by Williams and Kennedy contains critical elements which suggest that two opposing worldviews apply, which can not be satisfied by either a 'hard' or 'soft' systems approach. From this the analogy can be drawn that if a single methodology can not satisfy the opposing worldviews. The only option which remains lies imbedded within the ambit of a 'multimethodology' approach as proposed in Chapter 3 of this thesis. This is supported by Galliers (1987:291), who is of the opinion that:

> *"The focus of many of the techniques tends to be on the technical design of the existing system rather than on the information requirements of the human activity system, which dictates the need for information"*

As the systems approach will form the basis of this research, it is appropriate to encompass the dichotomy between 'hard' and 'soft' systems thinking. For this purpose, the summary of Gasson & Holland (1995:216) returns the following: 'Hard systems thinking, typified by systems engineering or structured systems analysis, sees the system development problem as relatively well defined: the methodological objective is to satisfy the given requirements through the technical implementation of a closed system'. 'In contrast, the soft systems thinking sees the problem situation as ill-defined: the target object system is perceived as a wider, social and political system, and the task of the analyst is to determine desirable and feasible change by exploring and expressing the problem situation'. 'In hard systems thinking, the concern is with the properties of a physical (technical) system and it is believed that human behaviour can be modelled using rule-based systems, so that the problem is analysed, by defining system objectives and requirements'. 'In soft systems thinking, the concern is with a system of human activity, so the problem is expressed, by examining elements of structure and process and their mutual relationship'. Furthermore, the systems approach *per se* demands that the solving of the research problem will not be based on the premise of 'taking the problem apart', but by viewing it as 'part of a larger problem' (Ackoff 1974a:74).

This view in part, is supported by Kling (1993:72), who is of the opinion that 'without a disciplined skill in analysing human organisations, computer scientists' claim about the usability and social value of specific technologies is mere opinion, and bears a significant risk of being misleading'. Furthermore, there is unease that those developing systems and in particular, those developing the software do not have the requisite skills and techniques in organisational analysis that may enable them to attain the expectations of organisational transformation through the deployment of information technology (Westrup 1995:158). Furthermore, the essential steps common to all computer developments are 'analysis' and 'coding' (Royce 1970:1). While this very simple implementation process will suffice for small internal development initiatives, a more grandiose approach is required for large systems, which are invariably marred with complex phenomena in the likes of societal and organisational aspects, which typifies system developments undertaken in the financial services industry.

The use of a 'set of skills' is extrapolated by Sanderson (1979:10) to include, imagination, organisation, judgement, speed and patience, flexibility and control, elaboration, synthesis, and determined continued effort. In the same realm, any manager must out of necessity admit the existence of the region of automatic accounting decisions, as they are common practice and not captured in formal decision rules. If however, the decisions lie beyond the capabilities of intuitive judgement, formal decision-making procedures are followed (Forrester 1994:60). The set of mitigating factors can also be viewed as the management of risk in a project. In this respect, risk management can be identified as 'the use of a set of skills, from an individual or group of individuals, which ensures that all risk events are identified, quantified, and handled for the project' (Jones 2000:39).

The golden thread in the formulation of the set of mitigating factors lies in the concept of *iteration* (my italics). A very descriptive definition of this concept is provided by Silverman (1987:11-12), which reads:

> *"Iteration is the review, reforecasting, and redirection of a management plan. As different unforeseen problems arise and have to be resolved, iteration provides for re-evaluating and rerunning a test*

or a program. It helps to correct discrepancies before they grow into major errors”.

Furthermore, this also provides an answer to the question: What system will cause quality? The only system that really causes quality is prevention (Crosby 1985:2), or in terms of this thesis, ‘mitigating factors’.

In Chapter 1, Paragraph 1.11 of this thesis, the statement was made that the tailored sequence of events serving as mitigating factors will be based on ‘systems thinking’, which implies thinking about the world outside ourselves and doing so by means of the concept ‘system’. The thinking of the author of this thesis, is aimed at breaking the chains of traditional business thinking, through the deployment of a multimethodology approach, which, on a personal level is underpinned by the ‘ways of knowing’ as proposed by Mitroff & Lintstone (1993:19-110).

8.2 REASONING AND THINKING: A PERSPECTIVE

This author’s attitude toward management philosophy is one of reverence for the great thinkers of the past, and confidence in his own personal and practical experience spanning some 34 years at various managerial levels. Furthermore, of pioneering originality regarding modern contemporary systems thinking to address unstructured complex phenomena, hence the author’s reading far beyond normal academic requirements with readings in the likes of Charles Peirce’s *‘Theory of Scientific Method’* and Immanual Kant’s[3] *‘Critique of Pure Reason’*.

The ‘reasoning and thinking’ of this author has at its source the wisdom of Charles Pierce, cited by Reilly (1970:20):

“Knowledge must involve a reference to experience; and this reference is an expectation, an imaginary (in the case of theoretical knowledge) anticipation of experience”.

[3] Kant I. 1929. Critique of pure reason. [Trans. by N. K. Smith.] London: MacMillan.

The rationale supporting the above being that knowledge, which has no possible bearing on any future experience – brings no expectation whatever – would be information concerning a dream. And the fact that in the arguments of Ackoff (1994:197-206) 'theories taught in management schools are often useless when applied to practical business'. The most complete statement of this position within a systematic theory is to be found in Immanual Kant's *'Critique of Pure Reason'*, which first appeared in 1781 and cited by Churchman & Ackoff (1950:100) and Churchman (1982:5), in three separate extracts as follows:

> *"There can be no doubt that all our knowledge begins with experience".*
>
> *"But though all our knowledge begins with experience, it does not follow that all arises out of experience".*
>
> *"By way of introduction or anticipation we need only say that there are two stems of human knowledge, namely, sensibility and understanding . . . Through the former, objects are given to us; through the latter they are thought".*

With this in mind, based on the personal and practical experience of this author[4], 'reasoning and thinking' as depicted in this thesis, are selectively based on the 'Ways of Knowing' as contained in Mitroff & Lintstone's *'The Unbounded Mind'*, which has as its objective the breaking of the chains of traditional business thinking. Mitroff & Lintstone's 'Ways of Knowing' can be summarised as follows (Mitroff & Lintstone 1993:19-110):

- **'Agreement' - the first way of knowing:** Achieved through the use of an inquiry system[5] in the likes of Delphi[6] where the main characteristics

[4] See also Chapter 1, Paragraph 1.10.
[5] Refer to Chapter 4, Paragraph 4.2, where Churchman (1971:43) specifies nine conditions which determine a system.
[6] Rowe G Bolger F & Wright G. 1991. The Delphi Method: An investigation of richness of feedback and change in majority/minority opinions. *Technology Forecasting & Social Change*,39(3), May.

pertaining to problem solving (where possible) are imbedded in the concepts of:

- Group participation[7].
- Interaction of responses over various rounds.
- Anonymity of responses.

While agreement and consensus are important in reaching conclusion and in achieving the necessary support to address complex phenomena, a *caveat* must be observed, as with all things human, they cannot be followed exclusively, nor are they the ultimate consideration for deciding all important questions.

- **'The world as a formula' - the second way of knowing:** Most of the academic literature cited in this thesis, contains mathematical models to help visualise complex phenomena. As a matter of fact, in the words of Toffler[8] cited by Mitroff & Lintstone (1993:38):

> *"No matter how 'hard' the final output may appear, all models are ultimately and inescapably, based on 'soft' assumptions. Moreover, decisions about how much importance to assign to any given variable or its weighting, are frequently 'soft', intuitive and arbitrary".*

This most appropriate conclusion against the background of the set of mitigating factors, which is being dealt with in this thesis, which invariably are societal and organisational based, viewed as systems problems and, which require systems-integrated solutions to solve. The analogy can be drawn from the words of Mitroff & Lintstone (1993:47) that:

> *"If we have to have precise definitions of complex problems before we can proceed, and if in order to obtain such precise definitions we need to base them on the adoption of a single scientific discipline or profession, then precision and clarity may lead us deeper into*

[7] This approach, in particular with respect to executive decision making, maps to the views of Beer, who is of the opinion that executive decision making is an elaborate interactive assemblage of elements. Beer calls this a 'thinking shop' after the Greek *'phrontisterion'*.
[8] Toffler A. 1990. Powershift. New York: Bantam.

deception and not rescue us from it. By selecting a single scientific discipline or profession, we cut off innumerable other pathways that we could have chosen to explore the nature of our problem"[9].

- **'Multiple realities' - the third way of knowing:** Ever since Immanual Kant, educated people have realised that both the experience of reality as well as its description are heavily dependent on the structure of the mind, much more so then empiricists would have believed. Contrary to the common-sense notion that reality is 'something out there' uninfluenced by human minds, humans contribute a great deal of nature to what is experienced as reality and how it is described. To this author, the following issues are of particular importance having direct bearing on the art of mitigating and managing key failure factors, and as thus, the thesis *per se*:
  - Due to the fact that long and arduous years are involved in mastering a particular discipline, the academic/professional mind easily becomes a prisoner of a particular way of viewing the world. For this reason, according to Mitroff & Lintstone (1993:54), crossing academic disciplines or professional boundaries, is a harrowing experience. It is worse than crossing foreign cultures – it constitutes culture shock of the highest order, culminating in the requirement for 'change management' becoming a necessity in any organisation subjected to change especially should it take place against the background of a forced intervention[10].
  - The fact that complex phenomena can be defined in different ways and furthermore, that such problems are problematic and of immense significance, which would require the executive manager to see a range of different representations of the phenomenon, in order to participate actively in the problem-solving process and not merely be a static recipient of the end results.
  - The fact that complex phenomena invariably contain societal organisational based issues, viewed as 'systems' problems which require

[9] It is of importance for the reader to note that the very essence of the motivation to use a multimethodolgy approach to formulate the set of mitigating factors is based on 'the second way of knowing'of Mitroff & Lintstone (refer Chapter 3, Paragraph 3.4).

[10] As detailed in Chapter 2, Paragraph 2.2.1.2

systems-integrated solutions (Haines 2000:2). This forces managers not to be purely formalised, but to depend on the exercise of 'wisdom'. This leads into the analogy that 'wisdom' is the one factor that cannot be cast into mathematical formula or procedure, but that 'wisdom' is thought combined with a concern for ethics (Churchman 1982:5).

- **'Conflict' - the forth way of knowing:** The analytical reasoning which is appropriate to address complex phenomena, the ability to zero in on the critical assumptions or key premises that underlie the phenomenon. This can only be achieved if analytical skills are honed in building models and determine solutions there from; however, more important is to challenge the assumptions on which the models rest. What is required is an intense, explicit debate between two polar positions to enable the executive to be in a much stronger position to know the assumptions of the two adversaries and as a result, clarify his or her own assumptions.

- **'Unbounded Systems Thinking' - the fifth way of knowing:** In terms of this thinking, 'everything interacts with everything', that all branches of inquiring depend fundamentally on one another, and that the widest possible array of disciplines, professions, and branches of knowledge – capturing distinctly different paradigms of thought – must be consciously brought to bear on the solving of com plex phenomena.

It is the intention of the author of this thesis to superimpose his own 'reasoning and thinking' in the formulation of the set of mitigating factors onto those of revered academics of the 20th and 21st Century. This would culminate in effecting a paradigm shift in organisations who elect to use the mitigating factors, to intervene and manage information systems development projects in the financial services industry based on. The 'reasoning and thinking' of the author of this thesis includes:

- Personal and practical experience combining the knowledge pools gleaned from years spent at lower, middle, senior and executive management levels, thus breaking the chains of traditional business thinking.

- Lessons learned from the this author's own judgement errors in solving unstructured complex phenomena.
- Proven management philosophies of revered systems thinking academics gleaned from primarily 'soft' and 'hard' systems thinking methodologies.
- Contains the elements of practicality, validity, feasibility and reliability gleaned from 'world best practice' initiatives observed by this author in the US, EC including the UK and the Far East.
- Manifest as a recognised alternative approach for executive management in their quest to solve unstructured complex phenomena.

Although not exactly within context, support for this type of formulation approach comes from Takahashi & Takahara (1995:3), who is of the opinion that:

> *"A reality itself is so complex that we cannot directly analyse it and obtain effective information from it to improve present situations including problems. To attack the reality it is necessary not only to analyse precisely individual elements, but to 'recognize' the situations in question as a whole entity and 'abstract' essential factors to be examined".*

This view of Takahashi & Takahara (1995:3) also serves as impetus to the author's 'reasoning' and 'thinking' in respect to the solving of unstructured complex phenomena, hence the approach been taken up and reflected in the process flow model represented by Figure 8.3 A-G.

8.3 REFOCUS ON THE INTERRELATIONSHIP OF CORE ENTITIES

It would be appropriate to refocus on the interrelationship of core entities, to create a clear understanding of the concepts prior to embarking on an analysis of the construction elements of the set of mitigating factors.

- Figure 8.2, while reflecting the interrelationship of core entities, graphically depicts the process to be followed in the formulation of the set of mitigating factors. Furthermore, Figure 8.2 reflects a structured sequence of events (serving as mitigating factors), which will be formulated within the ambit of a multimethodology approach from elements extrapolated from the Systems Approach, the Six Sigma methodology, the Capability Maturity Model and the Balanced Scorecard.

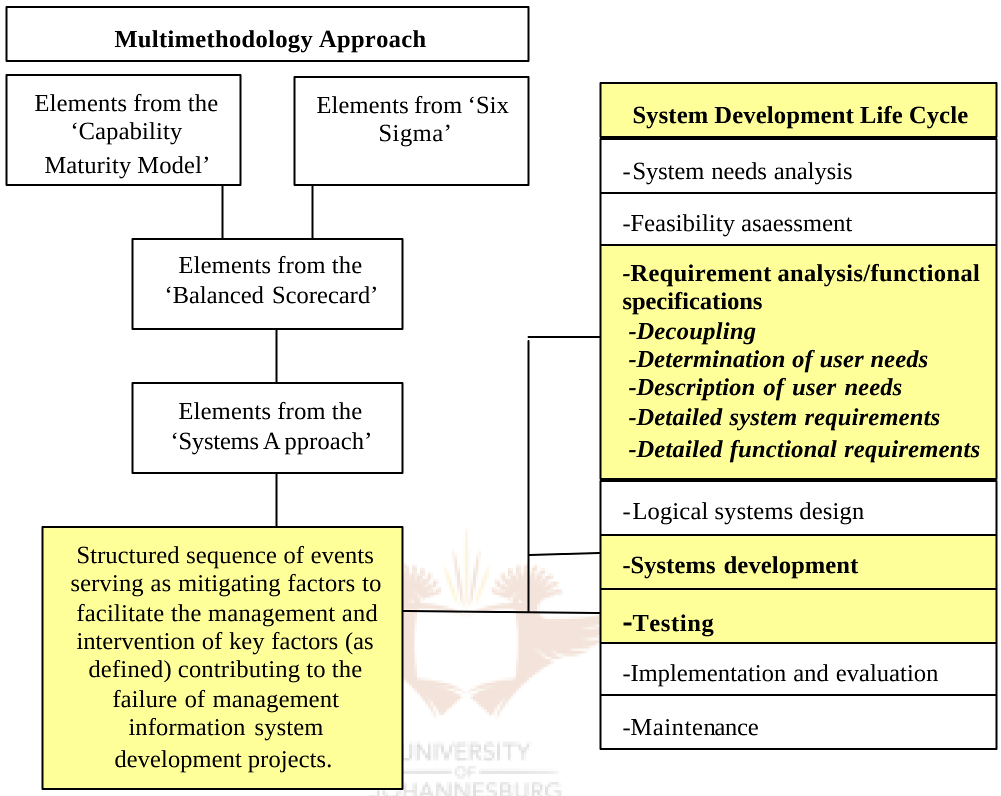

Figure 8.2: Interrelationships of core entities

In terms of the scope of this thesis, Figure 8.2 in addition draws the boundaries of the application of the set of mitigating factors within a typical systems development life cycle, namely that of:

- Requirement analysis/functional specifications.
- Systems development.
- Testing.

8.4 CONSTRUCTION PROCESS APPROACH

The construction process approach to be followed in the formulation of the set of mitigating factors from a structured sequence of events within the context of the multimethodology approach has two important objectives, which is in line with the key research objectives as defined in Chapter 1, Paragraph 1.10, namely:

- That the set of mitigating factors be of such a nature that it not only solves the research problem, but also facilitates the implementation thereof from a practical perspective by the average systems analyst. It would be naïve to suggest that the proposed approach would mitigate 'all' factors impacting a typical systems development life cycle. It is expected that all variables in a complex project must be planned for in advance, however 'nobody is that smart or has that clear a crystal ball' (Matta & Ashkenas 2003,110).
- That the research makes a significant contribution (add value) to the existing body of knowledge. This is supported by the view of James & Wolf (2001:102), who dictates that 'when customers demand consistent global quality, globally consistent processes become essential'.

To achieve these objectives, the formulation of the set of mitigating factors will be approached from two distinct perspectives, namely:

- **From the perspective of the 'systems analyst':**
  - A practical process flow model reflecting the structured sequence of events serving as mitigating factors as applied within the context of the proposed systems development life cycle will be analysed in Paragraph 8.5 of this chapter. For ease of reference, each element of the structured sequence of events will be shown as a 'numbered frame' within the context of the workflow analysis of the systems development life cycle. Furthermore, each 'numbered frame' is categorised into six logic phases with supporting guidelines annotated per individual frame to enable the systems analyst to apply the solution practically within the financial services industry.
- **From the perspective of the academic reader:**
  - To provide scientific credibility to the formulated set of mitigating factors by supporting each of the elements of the structured sequence of events with research data elements as contained in this thesis.
  - To provide a comprehensive analytical view of the compilation of the set of mitigating factors, with each element of the structured sequence of events cross referenced to each of the individual methodologies from

which it was originally formulated. Furthermore, each element of the structured sequence of events will be supported by appropriate theoretical references gleaned from the literature reviews cited in this thesis. For ease of reference of the academic reader, this portion of the research will be contained within the ambit of Appendix F.

8.5 MITIGATING FACTORS: FORMULATION

In this paragraph, a practical process flow model reflecting the structured sequence of events serving as mitigating factors as applied within the context of the proposed systems development life cycle will be analysed. For ease of reference, each element of the structured sequence of events will be shown as a 'numbered frame' within the context of process flow model, the systems development life cycle. Furthermore, each 'numbered frame' of the process flow model will be annotated with supporting guidelines to enable the systems analyst to apply the solution practically within the financial services industry. The process flow model will reflect the following sequence of events, which are categorised into the following six phases for ease of reference:

- **PHASE 1:**
  - Customer problem and or opportunity statement.
  - Customer needs statement.
  - Customer features list.
  - Customer interface requirements.
  - Process mapping.
  - Customer review.

- **PHASE 2:**
  - Financial/Risk analysis.
  - Detailed business requirement functional specification formulation.
  - Formal customer review of business requirement functional specifications.

- **PHASE 3:**
  - Planning.
  - Planning: Training requirements.
  - Planning: Communication requirements.
  - Planning: Change management requirements.
  - Preliminary program design (pilot model).
  - Formal customer review.

- **PHASE 4:**
  - Systems analysis.
  - Formal customer review.

- **PHASE 5:**
  - Final formal sign-off of customer and sanction from sponsor
  - System build (Coding).
  - Formal customer review.

- **PHASE 6:**
  - Testing.
  - Implementation of the designed system and rollout.
  - Benefits harvesting.
  - Close-out

It is of importance to note that the construction of the set of mitigating factors from the structured sequence of events, using a multimethodology approach and depicted hereunder as Figure 8.3 A-G, represent a culmination of all of the entities formulated from the multimethodology approach as presented in Figure 8.2. Repetitive Frames A, B and C forms an integral part of the process flows depicted in Figure 8.3 A-F, however reflected seperately as Figure 8.4 G for ease of reference.

Phase 1

Phase 1 Frame 1
Customer Problem and or Opportunity Statement

1.1 Describe the business problem or business opportunity.
1.2 Identify the stakeholders affected by the problem or opportunity.
1.3 Determine the impact of the problem or opportunity.
1.4 Determine some key benefits of a successful solution to the problem or opportunity.
1.5 Generate high level alternative solution options to the problem.

Phase 1 Frame 2
Customer Needs Statement

2.1 Determine at a high level, what the customer needs would be in terms of the problem and or opportunity statement. For example:

- Increase in income streams.
- Reduction in operating costs.

Phase 1 Frame 3
Customer Features List

3.1 Determine at a high level, what the customer requires as special features of the solution. For example:

- The solution must be Internet Browser based.
- The solution must automate the report generation process.

Phase 1 Frame 4
Customer Interface Requirements

4.1 Describe the customer interface requirements that are to be implemented by the solution.
4.2 Examine and define any hardware interfaces (architectural options), that are required to support the solution.
4.3 Describe any product interfaces to other components of the product system.
4.4 Describe any communication interfaces to other systems or devices.

Phase 1 Frame 5
Process Mapping

5.1 At a high level, map 'as is' (current) processes, which is about to be changed by the proposed development, should such processes not have been mapped previously.
5.2 At a high level map 'to be' (future/preferred/desired) processes in terms of the proposed development.
5.3 Determine the process 'gap', between the 'as is' and the 'to be' processes.

5.4 Develop potential solutions to bridge the process gap.

Phase 1 Frame 6
Customer Review

6.1 Obtain sign-off of all high level requirements formulated in Frames 1 to 4.
6.2 Provide estimated timelines for financial/risk analysis (Frame 7) and formulation of detailed business requirement functional specifications (Frame 8).
6.3 Obtain preliminary funding and resources to conduct financial/risk analysis and for the compilation of the detailed business requirement functional specifications.

Figure 8.3 A: Process flow model (Phase 1) - Construction of the set of mitigating factors from a structured sequence of events using a multimethodology approach.

PHASE 2

Phase 2 Frame 7
Financial/Risk Analysis

7.1 Complete a comprehensive cost analysis of known costs for the end to end development life cycle.
7.2 Provide cost estimates for all unknown costs for the end to end development life cycle.
7.3 Identify and quantify tangible and intangible benefits the proposed solution can provide the organisation as a whole.
7.4 Identify alternative avenues for the application of the proposed solution within the wider organisation, together with envisaged tangible and intangible benefits.
7.5 Identify all avenues open to benefits harvesting from the proposed development, not only from a functional perspective, but also from an organisation perspective, including the span of the useful life of the development for the organisation.
7.6 Perform a feasibility study from the data gleaned above, to determine if the proposed development would return a positive net present value and internal rate of return for the capital investment.
7.7 Perform a viability study to determine if the proposed solution is a viable proposition for the organisation as a whole and furthermore, if the development maps to the strategic business objectives and intent of the organisation.
7.8 Quantitatively determine the benefits to be gleaned from the development from a process improvement and quality perspective.

7.9 Draw a comprehensive risk analysis from a development perspective, and furthermore, determine the risks from an organisation perspective.

7.10 Obtain formal sanction for the development from the sponsor from a financial and strategic organisational perspective.

<u>Note:</u> The contents of Frames 1 to 4, and Frame 7, are normally juxtaposed into a single document, namely the Business Case, which in addition, contain the formal motivation for the initiative for sponsor approval.

Phase 2 Frame 8
Detailed Business Requirement Functional Specification Formulation

8.1 Compile and document in collaboration with customer, the detailed business requirement functional specifications consisting of detailed work-breakdown structures.

8.2 Ensure that the business requirement functional specifications map to the strategic business objectives and intent of the organisation.

8.3 Re-map high level 'to be' (future) processes into detailed process maps in terms of the detailed business requirement functional specifications.

8.4 Conduct regular (suggested every 2 weeks), reviews with the customer to accommodate any changes to the detailed business requirement functional specifications in terms of the directive contained within the ambit of Frame C.

8.5 Process any changes to the business requirement functional specifications in terms of the change request directive contained within the ambit of Frame A.

Phase 2 Frame 9
Formal Customer Review of Business Requirement Functional Specifications

9.1 Conduct customer review of the completed detailed (and documented) business requirement functional specifications.

9.2 Obtain customer sign-off of the detailed business requirement functional specifications.

9.3 Conduct a formal customer review in terms of the directives contained within the ambit of Frame B.

Figure 8.3 B: Process flow model (Phase 2) - Construction of the set of mitigating factors from a structured sequence of events using a multimethodology approach.

PHASE 3

Phase 3 Frame 10
Planning

10 All the planning listed in this section is to be undertaken in collaboration with the customer.

Phase 3 Frame 10.1
Planning: Training Requirements

10.1.1 List all parties /persons responsible for different components or areas of training

10.1.2 Determine method of training (How?).

10.1.3 Determine who should be trained (Who?).

10.1.4 Determine training rollout requirements (When?).

10.1.5 Determine training location requirements (Where?).

10.1.6 Determine all requirements on software required to train staff.

10.1.7 Determine all hardware requirements to fulfil training.

10.1.8 Determine on what environment the training should be conducted. For example:

- End to end test environment.
- Production environment.

Phase 3 Frame 10.2
Planning: Communication Requirements

10.2.1 Determine who is responsible for communication.

10.2.2 Determine method of communication (How?).

10.2.3 Determine who should be communicated to (Who?).

10.2.4 Determine communication rollout requirements (When?).

10.2.5 Determine communication location requirements (Where?).

Phase 3 Frame 10.3
Planning:Change Management Requirements

10.3.1 Role change requirements

Determine client role change requirements, namely:

- Which roles will change?
- How will roles change?
- How will role changes be facilitated?
- Who will facilitate the change in roles?

10.3.2 Restructuring requirements

Determine restructuring requirements, namely:

- What restructuring will be required?

- Draw organogram of old structure.
- Draw organogram of new structure.
- How will the restructuring take place?
- Who will be restructured?
- Who will facilitate the restructure?

10.3.3 Process audit requirements

Determine audit requirements, namely:

- Describe the nature of the audit required.
- Define the objective of the process audit.
- Determine when the audit should take place.
- Detemine who will do the audit.

10.3.4 Operationalisation requirements

Determine operationalisation requirements, namely:

- Determine operational target area accepting process changes.
- Determine recruitment requirements.
- Determine who should handle recruitment.

10.3.5 Rollout requirements

Determine rollout requirements, namely:

- Determine timing of rollout.
- Obtain client requirements on how the rollout of the processes should be evaluated.

10.3.6 Project resource requirements

Determine project resource requirement s, namely:

- Identify required knowledge and skills.
- Conduct resource capacity requirements.
- Tailor team structure.
- Assign resources formally

10.3.7 Compile project execution plan

- Create project execution plan
- Obtain signoff and commitment of all impacted parties.

Phase 3 Frame 11
Prelimenary Program Design (Pilot Model)

11.1 Document system overview.

11.2 Design database and processors.

11.3 Allocate subroutine storage.

11.4 Allocate subroutine execution times.

11.5 Describe operating procedures.

11.6 Evaluate if the model would be ‘the best’ solution for the problem and/or opportunity statement (refer Frame 1), and to bridge he gap between the ‘as is’ and ‘to be’ processes (refer Frame 5). This in addition would determine the gap between what the customer 'wants', and what can be 'delivered', thus facilitating and managing of customer expectations.

Phase 3 Frame 12
Formal Customer Review

12.1 Present the final model to the customer as the best solution to the problem and or opportunity statement (refer Frame 1) and obtain acceptance and sign-off.

12.2 Conduct a formal customer review in terms of the directives contained within the ambit of Frame B.

Figure 8.3 C: Process flow model (Phase 3) - Construction of the set of mitigating factors from a structured sequence of events using a multimethodology approach.

PHASE 4

Phase 4 Frame 13
Systems Analysis

13.1 Conduct a detailed systems analysis in terms of the directives contained within the ambit of the approved detailed business requirement functional specifications (refer Frame 8).

13.2 Conduct regular (suggested every 2 weeks), reviews with the customer to accommodate any changes to the detailed business requirement functional specifications.

13.3 Process any changes to the business requirement functional specifications in terms of the change request directive contained within the ambit of Frame A.

Phase 4 Frame 14
Formal Customer Review

14.1 Conduct a formal customer review in terms of the directives contained within the ambit of Frame B.

Figure 8.3 D: Process flow model (Phase 4) - Construction of the set of mitigating factors from a structured sequence of events using a multimethodology approach.

PHASE 5

Phase 5 Frame 15
Final Formal Sign-off of Customer and Sanction from Sponsor

15.1 Obtain final formal sign -off of all deliverables in terms of the detailed business requirement functional specifications, cost, timelines and risks from customer and sanction from sponsor to continue.

Phase 5 Frame 16
System Build (Coding)

16.1 Build system (coding).

16.2 Conduct regular (suggested every 2 weeks), reviews with the customer to accommodate any changes to the detailed business requirement functional specifications.

16.3 Process any changes to the business requirement functional specifications in terms of the change request directive contained within the ambit of Frame A.

Phase 5 Frame 17
Formal Customer Review

17.1 Conduct a formal customer review in terms of the directives contained within the ambit of Frame B.

Figure 8.3 E: Process flow model (Phase 5) - Construction of the set of mitigating factors from a structured sequence of events using a multimethodology approach.

PHASE 6

Phase 6 Frame 18
Testing

18.1 Design test cases and procedures.

18.2 Create test packs.

18.3 Create test scripts.

18.4 Conduct regular (suggested every 2 weeks), reviews with the customer to accommodate any change s to the detailed business requirement functional specifications in terms of the directive contained in Frame C.

18.5 Process any changes to the business requirement functional specifications in terms of the change request directive contained within the ambit of Frame A.

18.6 Execute unit testing.

18.7 Execute integration testing.

18.8 Execute system testing.

18.9 Execute integrated acceptance testing.

18.10 Execute user acceptance testing.

18.11 Evaluate test results.

18.12 Conduct a formal customer review in terms of the directives contained within the ambit of Frame B (exclude items B6 and B7 from process). Furthermore, obtain acceptance signoff from customer of test results and sanction for rollout.

Phase 6 Frame 19
Implementation of designed system and Rollout

19.1 Execute implementation and rollout in terms of planning schedules.

Phase 6 Frame 20
Benefits Harvesting

20.1 Conduct a benefits harvesting exercise in collaboration with the customer to ascertain if the proposed benefits contained within the ambit of the Business Case (refer Frames 1-4 and Frame 7), map to the realised benefits culminating from the implemented system, with respect to:

- Functionality.
- Quality.
- Process improvement.
- Net present value.
- Internal rate of return.
- Strategic business objectives.
- Organisation intent.

20.2 Establish the solution as a permanent standard for the environment.

20.3 Determine whether the improvements attained by the development have been achieved at the expense of another.

20.4 Determine the extent of the impact of the development and initiate remedial action if required.

20.5 Determine if there are any new processes at which the organisation must excel to meet customer and functional objectives, and raise a change request in terms of Frame A to achieve this objective.

20.5 Embark on a process of continuously reviewing and improving recent implemented processes.

Phase 6 Frame 21
Close-out

21.1 Conduct closeout review and obtain final signoff of development and acceptance from customer and sponsor.
21.2 Determine extent of customer satisfaction.
21.3 Determine extent of the quality of the delivery.
21.4 Determine if development culminates in customer retention.
21.5 Determine if development created the opportunity to gain additional customers.
21.6 Determine if development was profitable measured against the projected targets set at the beginning of the development.
21.7 Document learnings [12]

Figure 8.3 F: Process flow model (Phase 6) - Construction of the set of mitigating factors from a structured sequence of events using a multimethodology approach.

REPETITIVE FRAMES

Frame A
Change Request Process

A1 Determine if the customer require any changes to current business requirement functional specifications or any other changes to the development initiative. In addition, determine the nature of the scope change.
A2 Conduct analysis if customer change requirements will culminate in business benefit for not only the area of impact, but also for the organisation as a whole.
A3 Determine if the required change maps to the strategic business objectives and intent of the organisation.
A4 Determine cost and time impact of customer change requirement.
A5 Obtain user signof f and acceptance of proposed change.
A6 Include change requirements in design.
A7 Adjust timelines and cost extrapolations in respect of overall project plan.
A8 Adjust budget in respect of additional cost of change.

[12] Abel-Hamid and Madnick (1990a:39), proposes that 'only through experience and costly errors can managers develop effective intuitive judgement'. Boddy (1987:14) is in support of this view and is of the opinion that 'failure to learn from mistakes has been a major obstacle to improving software project management'.

A9 Obtain agreement from sponsor of timeline and cost impact perspective and obtain formal signoff and sanction for change.
A10 Maintain 'version control' procedures for all logged changes.

Frame B
Formal Customer Progress Review Process

B.1 Conduct customer progress review on all progress planned to date.
B.2 Conduct budget review with customer.
B.3 Conduct risk review with customer.
B.4 Conduct customer review of all proposed functional deliverables to ensure that there is compliance to user expectations from a process improvement and quality perspective.
B5 Formulate mitigating actions should any of the above deviates from the documented requirement.
B.6 Identify and document any changes to approved business requirement specifications or any other changes, which may be required by the customer.
B.7 Process change request in terms of change request directives contained within the ambit of Frame A.

Frame C
Customer Review Process

C1 Advise customer of any deviation from planned deliverables (cost and time).
C.2 Conduct customer review of all business requirement functional specification deliverables to ensure that there is compliance to user expectations from a process improvement and quality perspective.
C.3 Identify and document any changes to approved business requirement specifications or any other changes, which may be required by the customer.
C.4 Process change request in terms of change request directives contained within the ambit of Frame A.

Figure 8.3 G: Process flow model (Repetitive Frames) - Construction of the set of mitigating factors from a structured sequence of events using a multimethodology approach.

It is of importance to note that the partitioning of Frames A, B and C to be modelled into smaller subsystems, and the development of a policy-design based on many models representing these subsystems, were formulated in terms of the adapted directives from Saeed (1992:253) for 'problem-slicing considerations'.

Furthermore, of note the fact that the concept of a 'review process' as defined in Frames B and C, is supported by Royer (2003:5), who is of the opinion that the following of a 'well-defined review process is an absolute requirement for quality end results'.

The soundness of any model as measured by its ability to mirror reality according to Hall (1976:192), can be approached from two directions, namely:

- Either the validity of the assumptions built into the model can be tested.
- Or the ability of the model to predict outcomes can be demonstrated.

Both these criteria set by Hall (1976:192) in view of this author are met within the context of process flow model as depicted in Figure 8.3 A-G.

8.6 CLOSURE

In this chapter, the set of mitigating factors was formulated from a structured sequence of events. The chapter was introduced with a refocus on 'causal elements' as discussed in Chapter 2, which was followed by a philosophical perspective of this author on the concept of 'reasoning and thinking'. This concept maps to the 'reasoning and thinking' deployed within the formulation of the structured sequence of events. The initial reasons/objectives, which mooted this research, was briefly re-visited to set the scene for the set of mitigating factors to be formulated. A brief refocus on the interrelationship of core entities are introduced to focus the attention of the reader on the content of the construction process approach in Paragraph 8.4, and the actual formulation of the set of mitigating factors in Paragraph 8.5. Using a multimethodology approach, the mitigating factors was formulated from an extract of the key components identified in each of the system methodologies analysed in Chapter 4 (the Systems Approach), Chapter 5 (the Six Sigma methodology), Chapter 6 (the Capability Maturity Model) and Chapter 7 (the Balanced Scorecard). This formulation of the mitigating factors facilitates the answer to the research question and proves that:

> *"a set of mitigating factors can be developed, from a structured sequence of events, using a multimethodology approach, to facilitate the intervention and subsequent*

> *management of key factors (as identified), contributing to the failure of management information systems development projects undertaken in the financial services industry"*

Furthermore, Paragraph 8.5 also establishes a methodology (multimethodology) to prove that the research problem, which reads: 'No known methodology exists to address specifically the quality aspect of business requirement functional specifications and subsequent change to these requirements as failure factors within the ambit of management information system development projects undertaken in the financial services industry', is no longer valid.

Taking this integrated approach to software quality provides the opportunity to make breakthrough business performance happen by planning the innovation of products to meet market expectations and predictability delivering these products on schedule (Watson 2002:41). The quality management system, when properly structured, integrates with a development process to assure that the business objectives and market objectives are met. When an integrated approach to software quality is taken, quality is visible in the organisation's dual bottom lines, namely in 'business financial results' and 'customer satisfaction'.

In Chapter 9, of this thesis, there will be a refocus on the research problem, the research question and subsequent investigative questions, with supporting comments on each of the entities. This will be followed with a high level chapter and content analysis, which is in line with the research design and methodology described on Chapter 1, Paragraph 1.5. The significance of the research in terms of the formulation of the set of mitigating factors will be discussed with the key objectives of the research evaluated. The chapter, forming Part 4 of this thesis, will be concluded with the identification of avenues for further research.

Table of Contents: Chapter 9

Synopsis: Chapter 9

In Chapter 9, the research is consolidated with the analogy being drawn that all of the research contained within the ambit of this thesis had only one theme, namely 'a systems approach to unstructured complex phenomena'. Furthermore, that the outcome of this research is not as much *'an approach'*, as it is a *'set of principles to an approach'*, which in any particular situation within the financial services industry, have to be reduced to a method uniquely suitable to the particular situation, hence the applicability of the multimethodology approach utilising a spectrum of disciplines.

Chapter 9

Research Consolidation

> *"This is not the end. It is not even the beginning of the end. But it is, perhaps, the end of the beginning".*

Winston S. Churchill

9.1 INTRODUCTION

Chapter 2 of this thesis was introduced with a quote from the revered academic, Albert Einstein, which reads:

> *"The world that we have made as a result of the level of thinking we have done thus far creates problems that we cannot solve at the same level as they were created".*

Evaluating the proposed solution to the problem statement in this thesis against the quote from Einstein cited above, the analogy can be drawn that the single factor which unites all of the elements of the problem solving methodologies analysed in this thesis, is the fact that all were vehicles of the same concepts, namely:

> *"The development of principles concerning the use of system ideas in problem solving of real world situation. All the studies had in common – the 'systems approach' to unstructured complex phenomena".*

These facts culminate in the analogy that the outcome of this research is not as much *'an approach'*, as it is a *'set of principles to an approach'*, which in any particular situation within the financial services industry, have to be reduced to a method uniquely suitable to the particular situation, hence the applicability of the multimethodology approach utilising a spectrum of disciplines. It may be argued that the composition of the financial services industry giants in South Africa who have the technical infrastructures, financial means and intellectual capital capability, could with ease accommodate major process and quality improvement initiatives in the likes of the Capability Maturity Model and still successfully facilitate the requirement for global change management and training. This without having to compromise on full functionality which is offered by such a methodology or having to make use of a customised and structured multimethodology approach as proposed in this thesis. While these facts are acknowledged by this author, the call for the proposed customised solution as proposed to address the research problem, remains a feasible and viable solution. This statement viewed against the overwhelming evidence of project failures cited in this thesis from not only a general information technology development perspective as borne out by the numerous literature evidence presented, but also from the validation survey conducted, where the focus was centred on the financial services industry. The analytical process followed thus far is graphically depicted in Figure 9.1, which places the chapters in context of the overall thesis objectives, and furthermore indicates the relative positioning of this chapter.

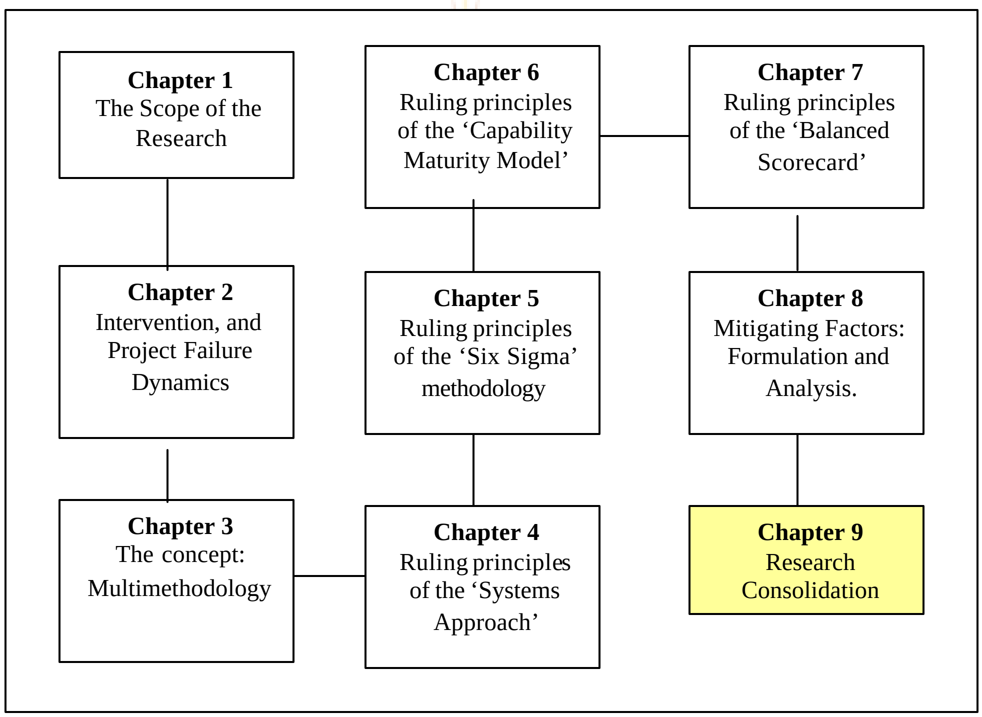

Figure 9.1: Chapters in context of the overall research

In this concluding chapter, there will be a refocus on the research problem, the research question and subsequent investigative questions, with supporting comment on each of the entities. This will be followed with a high level chapter and content analysis, which is in line with the research design and methodology described on Chapter 1, Paragraph 1.5. The significance of the research in terms of the formulation of the set of mitigating factors will be discussed with the key objectives of the research evaluated. The chapter will be concluded with the identification of avenues for further research.

9.2 THE RESEARCH PROBLEM

The research problem in this thesis was formulated into the following problem statement, namely: ‘No known methodology exists to address specifically the quality aspect of business requirement functional specifications and subsequent change to these requirements as failure factors within the ambit of management information system development projects undertaken in the financial services industry’.

With the formulation of the structured sequence of events in Chapter 8, the research problem in the opinion of the the author of this thesis, has been solved for organisations making up the financial services industry.

9.3 THE RESEARCH QUESTION

The research question, answered with the formulation of the formulation of Figure 8.3 A-G reads: ‘Can a set of mitigating factors be developed, from a structured sequence of events using a multimethodology approach, to facilitate the intervention and subsequent management of key factors (as identified), contributing to the failure of management information development projects undertaken in the financial services industry?’

9.4 INVESTIGATIVE QUESTIONS

The two investigative questions, which was posed in terms of the question hierarchy reads as follows:

- To what extent are multimethodology approaches used to structure the outcome of paradigm shifts introduced into the financial services industry with respect to technology development, and how do they contribute to overall process quality improvement?

- Is poor quality business requirement functional specifications and subsequent change to these specifications while the latter is still in progress of being developed limited to management information system development projects undertaken in the financial services industry, or is it a universal problem, which can be extrapolated to all management information development projects undertaken in the information technology development industry?

Both the investigative questions were answered in the validation survey conducted in the financial services industry both locally and abroad.

9.5 CHAPTER AND CONTENT ANALYSIS

The chapter and content analysis, which is in line with the Research Design and Methodology (refer Paragraph 1.5), provided the following details:

- **Abstract:** Provided the reader with a short synopsis of the extent of the research pertaining to the set of mitigating factors, formulated from a structured sequence of events.
- **Chapter 1 - The Scope of the Research:** Set the scene for the research contained within the ambit of the thesis. The chapter started with a brief introduction and background to the key factors (as identified), which contributed to the failure of management information system development projects undertaken in the financial services industry. This was followed with an introduction to the research problem, and subsequent research questions. The research process was explained feeding in to the overall research design and methodology, the demand for a qualitative research strategy and an overview of the thesis structure. The chapter furthermore provided detail of the chapter and content analysis of the thesis, and was concluded with the key research objectives and final conclusion.
- **Chapter 2 – Intervention and Project Failure Dynamics:** The objective of this chapter was to explain the core elements attributing to the research

problem and elements, which will ultimately facilitate the answer to the research question. The analysis dealt with the following elements:

- **Intervention:** This core 'remedial element' was analysed in terms of intervention types, with focus on planned and forced interventions.
- **Project Failure Dynamics:** These core 'causal elements' was analysed in terms of their general impact on information technology development, and also in terms of their impact on major projects and technology driven projects. It is of interest to note that the project failure dynamics as identified, invariably maps to the two failure factors as identified in this thesis namely:
- **The quality of business requirement functional specifications:** Change to business requirement functional specifications, while the latter is still in the process of being developed.
- **Business requirement functional specifications:** Business requirement functional specifications the key dynamic in this thesis, was analysed supported by related factors impacting the concept, namely quality and user focus.
- **Project management:** Project management was dealt with at a high level with the main focus centred on change dynamics, the latter forming a key element in the formulation of the set of mitigating factors. Of significant importance in this chapter was Paragraph 2.7.1, which provided clarity on the concept of 'change'. In this paragraph a powerful motivation was advocated in favour of 'change', which was taken forward into Chapter 8 in the formulation of the set of mitigating factors. 'Change' to business requirement functional specifications while in the latter was in the process of being developed would be allowed to take place, however with the clear *caveat*, that such changes should only take place under the most stringent conditions.

- **Chapter 3 – The concept: Multimethodology:** In Chapter 3, the main theme of the thesis, namely the concept 'multimethodology' was analysed in detail. This multimethodology approach was used to juxtapose the following elements to ultimately culminate in a structured sequence of events serving as mitigating factors to facilitate the management of key factors contributing to the failure of management information systems development projects, namely:

- Elements from the Capability Maturity Model.
- Elements from Six Sigma.
- Elements from the Balanced Scorecard.
- Elements from the Systems Approach.

- **Chapter 4 - Literature review of the 'Systems Approach':** This chapter provided a literature background to the ruling principles of the systems approach, and selected attributes of the concept applicable to the research, which formed the basis of the proposed set of mitigating factors. The systems approach was analysed from the following perspectives:
  - A general introduction to the systems approach methodology.
  - The concept 'system' defined.
  - The concept of the 'general systems theory' explained.
  - The concept 'systems approach' defined.
  - The concept 'cybernetics' defined.
  - The concepts 'closed and open systems' defined.
  - The roles of 'models' explained.
  - The impact of the notions '*weltanchauung*' and 'appreciative systems' explained.
  - 'Causal loop diagrams' and 'reinforcing and balancing processes' explained.

  For completeness of the overall research on the systems approach methodology, an analysis of the 'hard systems' approach and the 'soft systems' approach were included in Appendix A and Appendix B. In addition, a comparative analysis of the 'hard systems' approach and the 'soft systems' approach were contained within the ambit of Appendix C.
- **Chapter 5 - Literature review of the 'Six Sigma methodology':** This chapter provided a literature background to the ruling principles of the Six Sigma methodology. The Six Sigma methodology was analysed to provide insight into its core usability components.
- **Chapter 6 - Literature review of the 'Capability Maturity Model':** This chapter provided a literature background to the ruling principles of the Capability Maturity Model. Furthermore, in this chapter the Capability

Maturity Model was compared with the Six Sigma methodology to highlight tangent planes between the two entities.

- **Chapter 7 - Literature review of the 'Balanced Scorecard':** This chapter provided a literary background to the ruling principles of the Balanced Scorecard methodology.
- **Chapter 8 - In depth analysis of the construction elements of the set of mitigating factors:** This chapter was introduced with a refocus on 'causal elements' as discussed in Chapter 2, was followed by a philosophical perspective of this author on the concept of 'reasoning and thinking'. The initial reasons/objectives, which mooted this research, was briefly re-visited to set the scene for the set of mitigating factors to be formulated. In this chapter, considered to form the crux of the research, the set of mitigating factors were formulated to form a structured sequence of events to facilitate the intervention and management of key factors contributing to the failure of management information development projects undertaken in the financial services industry. Using a multimethodology approach, the mitigating factors were formulated from an extract of the key components identified in each of the system methodologies analysed in Chapter 4 (the Systems Approach), Chapter 5 (the Six Sigma methodology), Chapter 6 (the Capability Maturity Model) and Chapter 7 (the Balanced Scorecard). This important component of Chapter 8, specifically aimed at the academic reader, included the author's own contribution to the research problem and contained within the ambit of Appendix F. The process of formulating the set of mitigating factors within the context of a systems development lifecycle, is graphically depicted in Figure 9.2 for ease of reference.

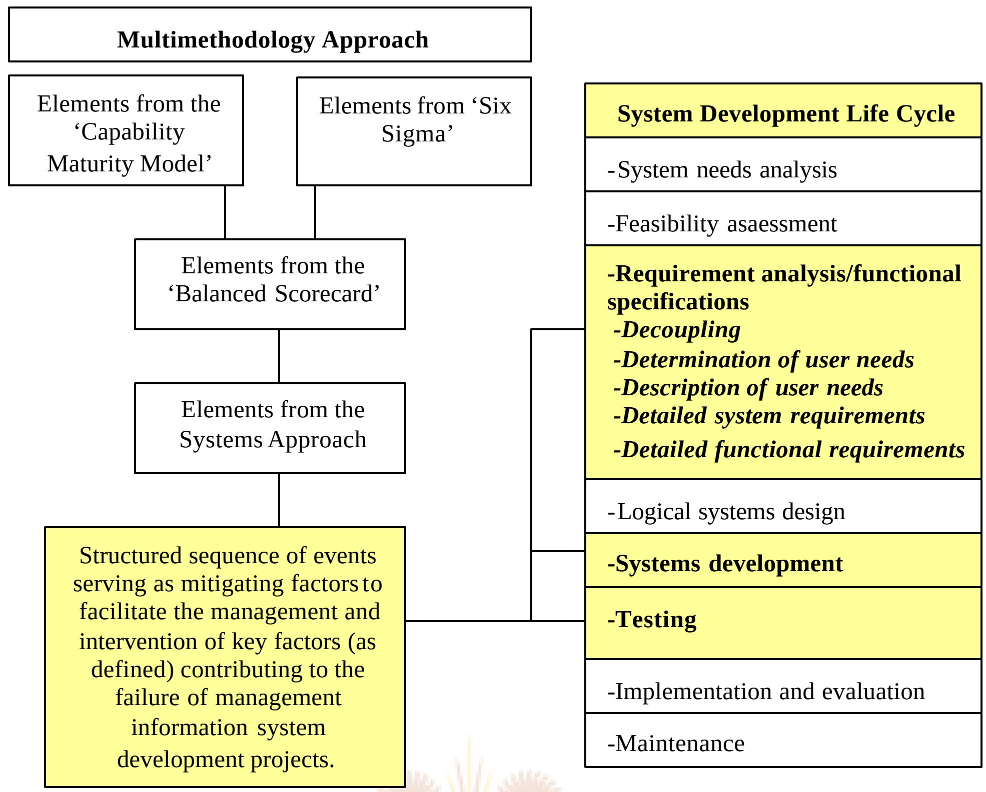

Figure 9.2: Interrelationship of core entities.

The chapter was concluded with a practical guide to the deployment of the mitigating factors in a real life environment.

9.6 SIGNIFICANCE OF THE RESEARCH

In the bibliography of this thesis, some 467 literature references are cited from some of the world's most revered academics encompassing the 20th and 21st Centuries. During the research for this thesis, some 100 more literature references were consulted over a 24-month research period, which is in line with the practice commonly associated with work of this nature.

The significance of this research is manifested in the fact that of all of the academic readings consulted for this research, it did not return a single reference:

- Where the following key factors are identified as primarily contributed to the failure of management information systems development projects undertaken in the financial services industry, or for that matter, mitigated by a single set of mitigating factors, formulated from a structured sequence of events.

- The quality of business requirement functional specifications.
- Change to business requirement functional specifications, while the latter is still in the process of being developed.

- Where these two entities were singled out or juxtaposed as being the most prevalent contributing factors associated with the failure of management information systems development projects. Neither for that matter, and more specific, for information system development projects undertaken in the financial services industry.
- Where these two entities were being mitigated by a single set of mitigating factors, formulated from a structured sequence of events.

The most significant and unique aspect of this research, perhaps is the fact that of all of the academic readings consulted, none returned a single reference where a multimethodology approach as proposed in this thesis were formulated from elements extrapolated from a diverse set of methodologies, which included the Systems Approach, the Six Sigma methodology, the Capability Maturity Model, and the Balanced Scorecard.

9.7 KEY RESEARCH OBJECTIVES

In the opinion of the author of this thesis, the key research objectives as stated in Chapter 1, Paragraph 1.10 has been attained with the research contained within the ambit of this thesis. The following serves as examples:

- That the research represents a significant contribution (add value) to the existing body of knowledge from the perspective of the academic reader.
- That the formulated set of mitigating factors using a multimethodology approach solves not only the research problem, but also facilitates the implementation thereof from a practical perspective by the average systems analyst.
- That the author's own contribution superimposed on those of revered academics of the 20th and 21st Century, culminate in effecting a paradigm shift in organisations who elect to use the formulated structured mitigating

factors, to intervene and manage information systems development projects in the financial services industry.

9.8 AVENUES FOR FURTHER RESEARCH

From a perspective of solving unstructured complex phenomena, within the financial services industry impacted by societal issues, which may emanate from a diverse range of sources, some of which may be the result of forced interventions, open a plethora of avenues for future research. The following are of particular interest:

- The 'soft systems approach' applied to societal issues as a result of the implementation of process and quality improvement initiatives undertaken in the financial services industry.
- The real impact (cost/time/money/change management/training) resulting from the implementation of process and quality improvement initiatives undertaken in the financial services industry.
- Research into the concept of 'methodological pluralism' and associated impact to facilitate paradigm shifts in the solving of unstructured complex phenomena.

Of particular interest, research on Hegel's dialectic as it maps to methodological pluralism as an approach to solve complex phenomena in the Information Technology industry.

9.9 FINAL CONCLUSION

In final conclusion then, this thesis, has been undertaken with the true belief that the years of 'thinking' and 'practising' a unique structured approach to management, can facilitate the task of every managing executive to the extent of solving unstructured complex phenomena. Furthermore, it is the conviction of the author of this thesis that this 'set of principles to an approach', which is based on the philosophies formulated by revered academics during the Twentieth Century, which includes the author's own contribution, can add value to the existing body of knowledge and the art of process and quality improvement.