Guidelines for the use of critical systems methodologies in business intelligence system development

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DECLARATION

I, Carin Venter, declare that

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is my own work and that all the sources I have used or quoted have been indicated and acknowledged by means of complete references.

Signature: ______________________ Date: ___________________________

ABSTRACT

The quality, timeliness and availability of appropriate information to appropriate decision makers determine the quality of decisions; it therefore also determines the subsequent effect of these decisions on organisations. Organisations that make better decisions quicker than their rivals are more agile and competitive. Well-informed decisions improve organisations' economic results and value; it improves planning processes and enables organisations to swiftly react to ever-changing business climates. Business intelligence (BI) systems enable organisational leaders to make decisions more effectively and efficiently; BI is a business differentiator in a world where organisations are becoming increasingly reliant on relevant, timeous, and intelligible information to improve their operational efficiency.

Traditional development approaches, for example the Kimball lifecycle approach or Inmon's corporate information factory, are used to develop BI systems. These traditional approaches are heavily influenced by the paradigm within which traditional software development approaches emerged, i.e. the hard systems thinking paradigm. The hard systems thinking paradigm is dominated by deterministic problem solving methodologies such as operational research and systems engineering; they focus on optimisation and design and are suitable for well-defined problem contexts. Traditional approaches enable the development of technically good and robust technological architecture and infrastructure (such as the data warehouse). However, BI systems are social artefacts as well as technical artefacts; they should aim to improve the organisational context of users, rather than merely automate existing business processes. Successful BI requires more than an appropriate data warehouse; it requires more than a data infrastructure and platform built to access existing/known information better and faster. Successful BI system development requires a critical reflective process that improves organisational decision making capabilities beyond what is imaginable, rather than merely automate what is easily observable.

The critical systems thinking (CST) paradigm aims to explore relevant social dimensions of a problem context and provide richer, more meaningful solutions.

CST aims to facilitate social improvement. CST is founded in critical and social awareness; methodological complementarism; and a dedication to human emancipation. Critical systems thinkers aim to emancipate the oppressed by exploring and removing supressing societal structures. This study views business users with unrealised business benefits as the oppressed; non-people oriented (traditional) BI system development approaches are viewed as the suppressing structures.

The CST paradigm does not render other paradigms, such as the hard systems thinking paradigm where BI development approaches emerged, invalid. Rather, within the CST paradigm the epistemological debate moved from the question of selection a single problem solving method, to recognising the value of combining different methods from different paradigms. This study explores the application of critical systems methodologies (such as critical systems heuristics) from the CST paradigm to complement a traditional BI system development approach. The researcher follows an action research approach to develop guidelines for the use of critical systems methodologies in BI system development.

This study concludes with guidelines to incorporate a critical systems methodology, i.e. critical systems heuristics (CSH), in BI system development. The researcher successfully applies CSH during the business requirements definition phase of the Kimball lifecycle BI development approach; she also contextualises the classic CSH boundary questions specifically for a BI context.

Keywords: business intelligence, data warehouse, critical systems heuristics, critical systems thinking, action research.

UITTREKSEL

Bestuurders kan slegs besluite van hoogstaande gehalte neem indien die nodige inligting intyds aan hulle voorsien word. Die kwaliteit van hierdie inligting bepaal dan ook die kwaliteit van sodanige besluite. Organisasies wat beter besluite vinniger as hul mededingers kan neem, is meer aanpasbaar; hulle is dus meer kompeterend. Weldeurdagte besluite verbeter organisasies se ekonomiese resultate, en verhoog dus ook hul waarde. Dit verbeter beplanningsprosesse en stel organisasies in staat om vinnig by snelveranderende besigheidsklimate aan te pas. Besigheids-intelligensie (BI) stelsels stel bestuurders in staat om gepaste besluite vinnig en doeltreffend te neem; hierdie besluite verbeter die operasionele doeltreffendheid van die organisasie.

Tradisionele ontwikkelingsmetodes, soos die Kimball lewensiklus benadering of Inmon se korporatiewe inligtingsfabriek, word gebruik om BI stelsels te ontwikkel. Hierdie tradisionele metodes is beinvloed deur die paradigma waarbinne tradisionele sagteware ontwikkelingsmetodes ontstaan het (die harde-stelselsdenke paradigma). Hierdie paradigma word gedomineer deur deterministiese probleemoplossings-metodes, soos operasionele navorsing en stelselingenieurswese, wat op optimisering and ontwerp fokus. Hierdie metodes is gepas vir goed-gedefinieerde probleemkontekste. Tradisionele metodes stel probleemoplossers in staat om goeie en robuuste tegnologiese argitektuur en infrastruktuur (soos die datapakhuis) te ontwikkel. BI stelsels is egter sosiale artefakte sowel as tegniese artefakte. BI stelsels moet ook die organisatoriese konteks van gebruikers verbeter. Suksesvolle BI sluit dus meer as slegs ’n toepaslike datapakhuis in. Suksesvolle BI stelsel-ontwikkeling vereis ‘n kritiese, reflektiewe benadering wat die totale organisatoriese besluitnemingsfeer verbeter.

Die kritiese-stelselsdenke paradigma poog om ook relevante sosiale dimensies van ’n probleemkonteks te ondersoek, en bied dus ryker, meer betekenisvolle oplossings. Hierdie paradigma fasiliteer sosiale verbetering. Dit is gefundeer in kritiese en sosiale bewustheid; metodologiese komplementarisme; en ’n strewe na emansipasie (bevryding en bemagting). Kritiese-stelselsdenkers poog om

onderdruktes te emansipeer deur onderdrukkende sosiale strukture te ondersoek en te verwyder. In hierdie studie word besigheidsgebruikers met ongerealiseerde besigheidsbehoeftes as onderdruk beskou; nie-sosiaal georienteërde (tradisionele) BI ontwikkelings-metodes word as onderdrukkende strukture beskou.

Die kritiese-stelselsdenke paradigma vervang nie ander paradigmas (soos die harde-stelselsdenke paradigma waarbinne BI ontwikkelingsmetodes onstaan het) nie; dit verklaar ook nie ander paradigmas as ongeldig nie. In die kritiese-stelselsdenke paradigma verskuif die epistemologiese debat vanaf die keuse van ‘n enkele probleem-oplossingsmetode, na die erkenning van die waarde van gekombineerde probleem-oplossingsmetodes vanuit verskillende paradigmas. Hierdie studie ondersoek die toepassing van kritiese-stelselsmetodes (soos kritiese-stelselsheuristieke) in die kritiese-stelsels paradigma om tradisionele BI stelsel ontwikkelingsmetodes te komplimenteer. Die navorser volg ’n aksienavorsing benadering om riglyne te ontwikkel vir die gebruik van kritiese-stelselsmetodes in BI stelselontwikkeling.

Die navorser slaag in hierdie studie daarin om riglyne vir die gebruik van ’n kritiese-stelselsmetode (kritiese-stelselsheuristieke) in BI stelselontwikkeling te ontwikkel. Die navorser pas die riglyne suksesvol toe tydens die besigheidsbehoefte-bepalingsfase van die Kimball lewensiklus benadering. Sy kontekstualiseer ook die klassieke kritiese-stelselsheuristieke vrae vir ’n BI konteks.

Sleutelwoorde: besigheidsintelligensie, datapakhuis, kritiese-stelselsheuristieke, kritiese-stelselsdenke, aksienavorsing.

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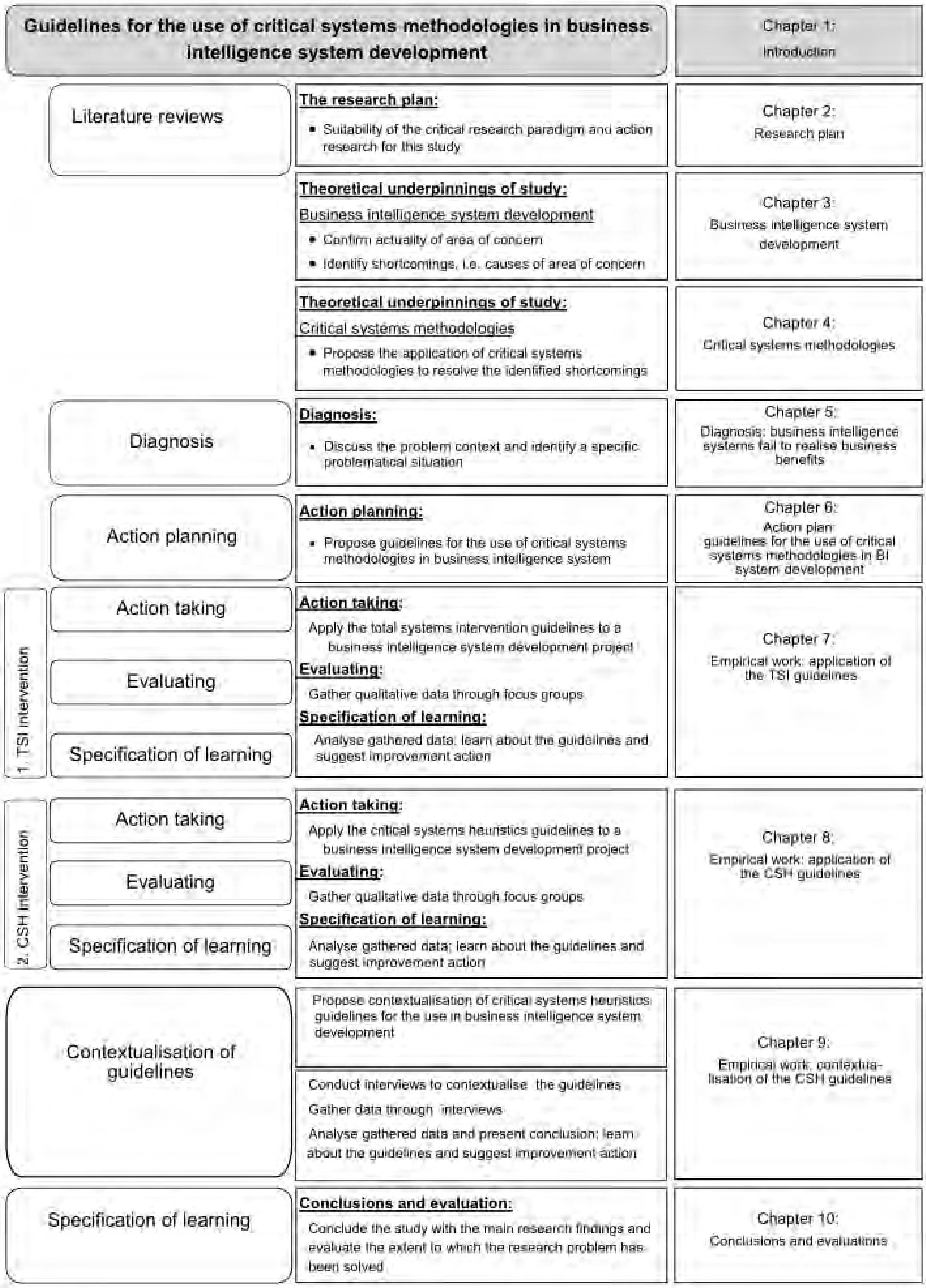
TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Glossary definitions

BI	Business intelligence
CSH	Critical systems heuristics
CST	Critical systems thinking
DW	Data warehouse
E/R	Entity-relationship
EPMS	Enterprise project management server
ETL	Extract, transform and load
IP	Interactive planning
IS	Information system
ISD	Information system/software development
KPIs	Key performance indicators
ODS	Operational data store
OLAP	Online analytical processing
OLTP	Online transactional processing
OR	Operational research
PMO	Project management office
PPD	Project portfolio database
SDLC	Software development lifecycle
SOSM	System of systems methodology
SSM	Soft systems methodology
TSI	Total systems intervention


Guidelines for the use of critical systems methodologies in business intelligence system development
Chapter 1: Introduction
Literature reviews
The research plan:
• Suitability of the critical research paradigm and action research for this study
Chapter 2: Research plan
Theoretical underpinnings of study:
Business intelligence system development
• Confirm actuality of area of concern
• Identify shortcomings, i.e. causes of area of concern
Chapter 3: Business intelligence system development
Theoretical underpinnings of study:
Critical systems methodologies
• Propose the application of critical systems methodologies to resolve the identified shortcomings
Chapter 4: Critical systems methodologies
Diagnosis
Diagnosis:
• Discuss the problem context and identify a specific problematical situation
Chapter 5: Diagnosis: business intelligence systems fail to realise business benefits
Action planning
Action planning:
• Propose guidelines for the use of critical systems methodologies in business intelligence system
Chapter 6: Action plan: guidelines for the use of critical systems methodologies in BI system development
1. TSI intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the total systems intervention guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data: learn about the guidelines and suggest improvement action
Chapter 7: Empirical work: application of the TSI guidelines
2. CSH intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the critical systems heuristics guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data: learn about the guidelines and suggest improvement action
Chapter 8: Empirical work: application of the CSH guidelines
Contextualisation of guidelines
Propose contextualisation of critical systems heuristics guidelines for the use in business intelligence system development
Conduct interviews to contextualise the guidelines
Gather data through interviews
Analyse gathered data and present conclusion: learn about the guidelines and suggest improvement action
Chapter 9: Empirical work: contextualisation of the CSH guidelines
Specification of learning
Conclusions and evaluation:
Conclude the study with the main research findings and evaluate the extent to which the research problem has been solved
Chapter 10: Conclusions and evaluations

Chapter 1 : Introduction

1.1 Introduction

The objective of this study is to develop guidelines for the use of critical systems methodologies to improve the development of business intelligence systems. This chapter gives an overview of the research problem. It also motivates the importance and relevance of this study.

Many organisations investigate business intelligence systems as a management tool to improve organisational performance and competitiveness (Işik *et al.*, 2013:48). Business intelligence is expected to enable effective decision making (Popovič *et al.*, 2012:729); it supports collection, integration, aggregation, and analyses of large amounts of data from multiple sources (Nazari *et al.*, 2012:1620). It is, however, a complex and expensive intervention that must be planned judiciously (Yeoh & Koronios, 2010:23). Software development approaches, including approaches that focus specifically on the development of business intelligence systems, often focus predominantly on the technological and technical aspects of developing the business intelligence software artefact and supporting hardware infrastructure; the human, social and organisational aspects are unfortunately seldom sufficiently taken into account when developing business intelligence systems (Işik *et al.*, 2013:13; Popovič *et al.*, 2012:738; Yeoh & Koronios, 2010:31). Consequently, business intelligence systems often do not realise intended business benefits (Dresner Advisory Services, 2012:15; Gartner, 2011:1; Hwang & Hongjiang, 2007:1) even though the systems may be technically appropriate (Clegg & Shaw, 2008:448; Avison & Fitzgerald, 2006:11).

This study explores the application of critical systems methodologies as part of business intelligence system development; this is to increase business intelligence system success by enabling sufficient inclusion of relevant human, social and organisational dimensions. The critical systems thinking paradigm is founded on critical and social awareness, complementarism at the methodological and theoretical level, as well as a dedication to human emancipation; critical systems methodologies, which are underpinned by critical systems thinking, aim to facilitate social improvement (Jackson, 1991:131). There are two strands of critical systems thinking in the literature, i.e. Flood and Jackson's total systems intervention strand that aims to facilitate critical methodology choice (Flood & Jackson, 1991a); and Werner Ulrich's critical systems heuristics strand that aims to promote reflective practice through discourse (Ulrich, 1983).

This chapter begins with a discussion of the concepts that are central to this study in Section 1.2. This is followed by the problem statement and motivation for the study in Section 1.3. Section 1.4 explains the objectives of the study. Section 1.5 discusses the research design and methodology. Section 1.6 notes the ethical considerations relevant to this study. Lastly, Section 1.7 outlines the chapter classification.

1.2 Concepts central to the study

Business intelligence (BI) systems and critical systems methodologies are the central concepts to this study. Firstly, this section explains why BI is important for contemporary organisations, gives an indication of BI success as per academic literature and market research and discusses the importance of people-oriented (as opposed to technically-oriented) BI development approaches. Secondly, this section explains critical systems methodologies, which are underpinned by the critical systems thinking (CST) paradigm in terms of awareness, complementarism and emancipation (Jackson, 1991:131). There are two dominant CST strands in the literature. CST is thus discussed as two separate strands: total systems intervention (TSI) and critical systems heuristic (CSH).

1.2.1 The importance of business intelligence

Present-day organisations are bombarded with increasingly large volumes and varieties of data to support management functions (Işik *et al.*, 2013:13). The quality of information, and hence the quality of decisions, determines the competitive advantage of organisations; unsuitable quality of information content may result in less suitable business decisions (Popovič *et al.*, 2012:737). The objective of BI is to enhance strategic decision making; it aims to enhance organisational decision making capabilities and improve the quality of decisions (Popovič *et al.*, 2012:729).

The implementation of a BI system is a very expensive and intensive organisational intervention (Yeoh & Koronios, 2010:23). Unfortunately, the implementation of BI systems often fails. The failure rate of BI systems was around 41% in 2003 (Hwang & Hongjiang, 2007:1). Since then, market research did not indicate improvement. Gartner reported that the level of BI adoption remained static from 2008 until 2011 – below 30% (Gartner, 2011:1). Dresner Advisory Services stated in their "Wisdom of Crowds™ Business Intelligence Market Study®" that only 41% of 859 organisations surveyed were satisfied that their BI implementations were successful in 2012 (Dresner Advisory Services, 2012:15).

1.2.2 The need for people-oriented business intelligence development

Various authors agree that it is important to measure the success and business value of software artefacts such as BI and even though they agree that it is difficult to measure BI success, they still propose some factors that impact BI success: For example, BI must be structured around the actual business needs of its users and the decision environment that it supports (Işik *et al.*, 2013:13; Popovič *et al.*, 2012:729; Yeoh & Koronios, 2010:23); business requirements and the key performance indicators that users need to make the important decisions in their organisations are an essential prerequisite for successful BI solutions (Kimball & Ross, 2010:2); and BI systems must provide comprehensive and concise information that supports managerial processes (Popovič *et al.*, 2012:738; Yeoh & Koronios, 2010:31). BI developers must therefore focus first and foremost on business needs and user requirements rather than to primarily focus on the technology and technical aspects (Popovič *et al.*, 2012:738; Yeoh & Koronios, 2010:31).

1.2.3 The need for critical business intelligence development

Problem solvers involved in organisational interventions, such as BI development and implementation projects, have a plethora of systems methodologies to choose from, ranging from hard (quantitative) to soft (qualitative) methodologies. However, choosing an appropriate methodology to solve a problem may be problematic (Clegg & Shaw, 2008:447). According to Ezell & Crowther (2007:271) the ontological and epistemological perspective of the person choosing a methodology to apply may lead to him/her choosing the wrong methodology or misapplying the chosen methodology. Hard (i.e. quantitative, positivist and reductionist) methodologies (e.g. traditional approaches to collect business and software requirements that mostly focus technical aspects) seem to be the preferred choice amongst software designers and developers; these are more often taught to students as the preferred method for systems requirements analysis (Ezell & Crowther, 2007:271). This does, however, not necessarily render the expected benefits and hence software projects fail as a result of low user acceptance rather than technical feasibility (Clegg & Shaw, 2008:448; Avison & Fitzgerald, 2006:44). A problem solver (in this case the BI designer/developer) must thus be aware of, and guard against, his/her own bias towards either side of the continuum (hard, soft and critical methodologies); the appropriate methodology for a problem context must be critically chosen with the single purpose: to suit the problem being investigated (Ezell & Crowther, 2007:275).

1.2.4 The need for people-oriented requirements collection

Kimball & Ross (2010:94) acknowledge the importance of business requirements; they also note that BI projects are increasingly driven by technical people that do not necessarily sufficiently understand the business world. Traditional software development approaches include steps to describe the services to be rendered by the artefact being developed, whilst software requirements collection approaches involve detailed requirements definitions and specifications (Sommerville, 2011:83). However, the ‘service’ that the software artefact is expected to provide as well as its ‘definition’ and ‘specification’ is rarely described in terms of the dynamic organisational goals and the subsequent decisions that must be enabled by the information supplied by the system; rather, it is defined (in technical terms) as if the provision of certain static pieces of information is the ultimate end goal of the system.

Traditional requirements collection approaches as described by authors such as Kimball & Ross (2010:132) and Sommerville (2011:83) are effective in deriving technical requirements. However, software development success is driven mainly by the degree to which the developer understands the user's business requirements (Leffingwell, 1997:51). Traditional requirements collection approaches attempt to incorporate business requirements; however, traditional approaches are often ineffective in incorporating the human, social and organisational context of the software artefact that is being developed. Thus, "in many of the information systems failures that have occurred, the conclusion has been placed squarely on human and organizational factors rather than technical ones" (Avison & Fitzgerald, 2006:44). Traditional approaches fail to deliver software artefacts that resolve real and relevant organisational issues; software artefacts are often "technically appropriate but culturally/organizationally infeasible or fail to meet user needs" (Clegg & Shaw, 2008:448). Hence, even though technically appropriate software is being developed, it may still not meet user needs and therefore may be rejected by users (Clegg & Shaw, 2008:448; Avison & Fitzgerald, 2006:44).

1.2.5 Total systems intervention

Total systems intervention (TSI) is a problem solving approach within the holistic domain of systems thinking; it adopts the stance that "all 'problem solving' methods can be arranged and operated successfully as an organised whole…by creatively 'surfacing' issues an organization faces and then by choosing a method(s) best equipped to tackle those issues effectively" (Flood, 1995b:174). TSI is a meta-methodology that operationalises critical systems thinking; it is positioned around *complementarism* (guiding the process to apply complementary and appropriate methodologies), *critical and social awareness* (through the examination of taken-for-granted assumptions), and *emancipation* (seeking to achieve maximum development of both individuals' and organisations' potential) (Flood & Jackson, 1991a:31-49).

The TSI meta-methodology includes three iterative stages, i.e. a creative, choice and implementation phase (Flood, 1995a:180). Metaphors are applied in the creative phase to surface dominant organisational issues; the machine, organic, and neuro-cybernetic metaphors focus on technical issues whereas the socio-cultural and socio-political metaphors focus on human/social activities (Flood, 1995b:181). Flood & Jackson (1991a:35) say that problem solvers use an ideal-type two-dimensional grid during the choice phase; the "system of systems methodologies" (SOSM) framework groups a problem context according to its systems dimension (the relative complexity of the systems involved is classified as simple or complex) and its participants dimension (the relationships between the individuals involved are classified as unitary, pluralist or coercive) – this is illustrated in Figure 1-1 below. The SOSM framework guides methodology choice to plan interventions as per Figure 1-2 below (Flood & Jackson, 1991a:43).

	Unitary	Pluralist	Coercive
Simple	simple-unitary	simple-pluralist	simple-coercive
Complex	complex-unitary	complex-pluralist	complex-coercive

Figure 1-1: Grouping types of the SOSM (Flood & Jackson, 1991a:35)

	Unitary relationship	Pluralist relationship	Coercive relationship
Simple system	Operational research Systems analysis System engineering System dynamics	Social systems design Strategic assumptions surfacing and testing	Critical systems heuristics
Complex system	Viable system diagnosis General systems theory Socio-technical systems thinking Contingency theory	Interactive planning Soft systems methodology	?

Figure 1-2: “System of Systems Methodology” (Flood & Jackson, 1991a:43)

1.2.6 Critical systems heuristics

Flood and Jackson (1991a:42) position critical systems heuristics (CSH) as a problem solving methodology in the TSI framework. However, Ulrich (2003:327) argues that CSH is not a self-contained methodology, but rather a conceptual framework for reflective practice that should precede methodology choice. Ulrich (1983:19) asserts that CSH rests on three pillars: firstly, *heuristic procedures* that serve to identify and explore relevant problem aspects, assumptions, questions or solution strategies; secondly, a *critical approach* that does not yield any single right answers and support processes of reflection and debate about alternative assumptions; and thirdly, *systems thinking* since all problem definitions, solution proposals and evaluations of outcomes depend on prior judgements about the relevant ‘whole system’ to be looked at.

Critical systems heuristics consists of twelve boundary questions to determine: *what* aspects of a situation are to be considered relevant; *who* should be involved in determining it; and *how* to handle conflicting views amongst relevant stakeholders in terms of four basic boundary issues, i.e. the basis of *motivation*; the basis of *power/control*; the basis of *knowledge*; and the basis of *legitimacy* (Ulrich, 1983:258). CSH’s methodological core principle is boundary critique, i.e. “a systematic effort of handling boundary judgements critically”; it can be used reflectively or emancipatory (Ulrich, 1983:191). According to Ulrich (1983:342) the twelve boundary questions must be asked in the ‘is-mode’ as well as the ‘ought-to mode’ to determine firstly the ‘actual’ situation, and secondly the ‘ideal’ situation.

Firstly, the questions to determine the *sources of motivation* are: “Who is (ought to be) the **client** or beneficiary? That is, whose interests are (should be) served?”; “What is (ought to be) the **purpose**? That is, what are (should be) the consequences?”; and “What is (ought to be) the **measure of improvement** or measure of success? That is, how can (should) we determine the consequences that can, when taken together, constitute an improvement?” (Ulrich, 2005).

Secondly, the questions to determine the *sources of power/control* are: “Who is (ought to be) the **decision maker**? That is, who is (should be) in a position to change the measure of improvement?”; “What **resources** and other conditions of success are (ought to be) controlled by the decision maker? That is, what conditions of success can (should) those involved control?”; and “What conditions of success are (ought to be) part of the **decision environment**? That is, what conditions can (should) the decision-maker *not* control (e.g. from the viewpoint of those not involved)?” (Ulrich, 2005).

Thirdly, the questions to determine the *sources of knowledge* are: "Who is (ought to be) considered a **professional** or further **expert**? That is, who (should be) involved as a competent provider of experience and expertise?"; "What kind of **expertise** is (ought to be) consulted? That is, what counts (should count) as relevant knowledge?"; and "What or who is (ought to be) assumed to be the **guarantor** of success? That is, where do (should) those involved seek some guarantee that improvement will be achieved – for example, consensus among experts, the involvement of stakeholders, the experience and intuition of those involved, political support?" (Ulrich, 2005).

Lastly, the *sources of legitimation* are determined by asking: "Who is (ought to be) **witness** to the interests of those affected but not involved? That is, who is (should be) treated as a legitimate stakeholder, and who argues (should argue) the case of stakeholders who cannot speak for themselves, including future generations and non-humans?"; "What secures (ought to secure) the **emancipation** of those affected from the premises/promises of those involved? That is, where does (should) legitimacy lie?"; and "What **worldview** is (ought to be) determining? That is, what different visions of 'improvement' are (should be) considered and how are they (should they be) reconciled?" (Ulrich, 2005).

1.3 Problem statement and motivation for the study

Business intelligence is important for organisations; it enables strategic decision making (Popovič *et al.*, 2012:729). However, the implementation of a BI system is typically an intensive and expensive intervention (Yeoh & Koronios, 2010:23). Unfortunately, it often fails to realise intended business benefits (Dresner Advisory Services, 2012:15; Gartner, 2011:1; Hwang & Hongjiang, 2007:1). Software artefacts such as BI systems are often technically good; yet, they still fail as a result of limited business benefits being realised and low user acceptance (Clegg & Shaw, 2008:448; Avison & Fitzgerald, 2006:11).

Traditional software requirements collection approaches attempt to incorporate business requirements in the software specification but often it does not effectively incorporate the human, social and organisational context (Avison & Fitzgerald, 2006:44; Clegg & Shaw, 2008:448). Software development approaches, including those aimed specifically at BI system development, are not people-oriented and hence the human, organisational and social aspects are often neglected and not incorporated in software development approaches and as part of the requirements collection (Avison & Fitzgerald, 2006:105). The complexity and importance of BI system development therefore necessitates a critical approach to successfully develop technically appropriate as well as usable (people-oriented) BI systems that realise business benefits and meet user needs. This study explores the use of critical systems methodologies to include the human, social and organisational aspects and hence improve BI system development.

1.4 Objectives of the study

This study aims to develop guidelines for the use of critical systems methodologies to improve the development of business intelligence systems. An overview of the primary objective and secondary objective of this study is given next.

1.4.1 Primary objective

The primary objective of this study is to:

- Develop guidelines for the use of critical systems methodologies to improve the development of business intelligence systems.

1.4.2 Secondary objective

This section discusses the secondary objective in terms of the theoretical objectives and empirical objective for this study.

1.4.2.1 Theoretical objectives

In order to achieve the primary objective, theoretical objectives are formulated for the study, i.e. to gain an understanding of key concepts in this study; it includes literature reviews for:

- research paradigms – discuss research paradigms that are prevalent in IS research; outline a research plan for the study (refer to Chapter 2);
- business intelligence system development – discuss the evolution of software development approaches; identify shortcomings in traditional BI development approaches (refer to Chapter 3); and
- the critical systems thinking paradigm and critical systems methodologies – discuss the evolution of systems thinking and the associated difficulties experienced by practitioners that worked within these systems thinking paradigms, which then led to the emergence of the critical systems thinking paradigm that is more people-oriented (refer to Chapter 4).

1.4.2.2 Empirical objective

The empirical portion of the study is done in the critical research paradigm through action research. The empirical objectives for this study are presented according to the phases of action research as discussed in Section 1.5 below. The objectives are to:

- diagnose shortcomings in current BI system development approaches;
- diagnose a specific instance where a BI system failed and users require a new BI system;
- develop an action plan to improve upon identified shortcomings through the application of critical systems methodologies:
    - create an action plan (initial TSI guidelines) whereby TSI guide the business requirements analysis phase of a BI system development project;
    - create an action plan (initial CSH guidelines) whereby CSH guide the business requirements analysis phase of a BI system development project;
- take action by implementing the action plans;
- evaluate the success of the respective interventions; and
- specify learnings from the interventions, in order to formulate guidelines for the use of critical systems methodologies in business intelligence system development.

1.5 Research design and methodology

1.5.1 Literature review

Secondary data sources that were used in this study include relevant textbooks, journal articles and the internet.

1.5.2 Structure of the study

This study is structured around an action research (AR) approach described by Checkland & Holwell (1998:23) for research in the information systems (IS) field. In their book, "Information, Systems and Information Systems" they describe the process of action research to include the steps:

1. Enter the problem situation (area of concern).
2. Whilst doing the research, rethink the following:
    - 2.1. Establishment of roles.
    - 2.2. Declaration of the methodology and framework of ideas.
    - 2.3. Taking part in the change process.
3. Exit.
4. Reflect on the experience and record learning in relation to the framework of ideas, methodology, and area of concern.

Checkland & Holwell (1998:27) explain that a methodology (M), which embodies a particular framework of ideas (F), is applied to investigate an area of concern (A) – this is referred to as the FMA illustration – refer to Figure 1-3 below. Checkland & Holwell (1998:27) say that a researcher involved in the process of research may learn about all these elements. Peter Checkland (1981) used this AR approach successfully for IS research; he also improved soft systems methodology (SSM).

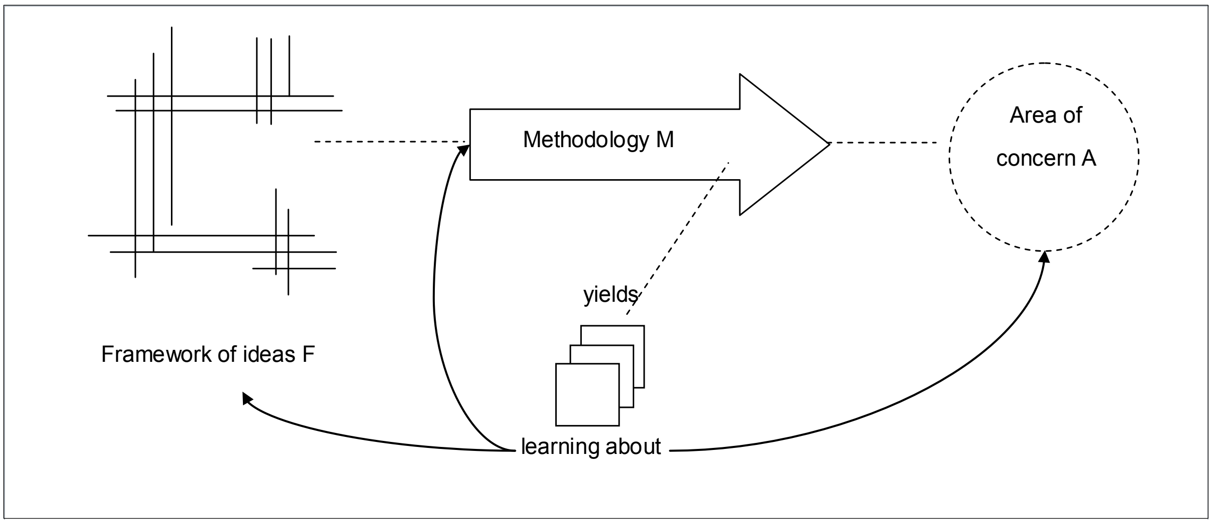


Figure 1-3: FMA illustration: elements in research (Checkland & Holwell, 1998:23)

Figure 1-4 below shows the structure for this study in terms of the FMA illustration – refer also to Figure 1-3 above.

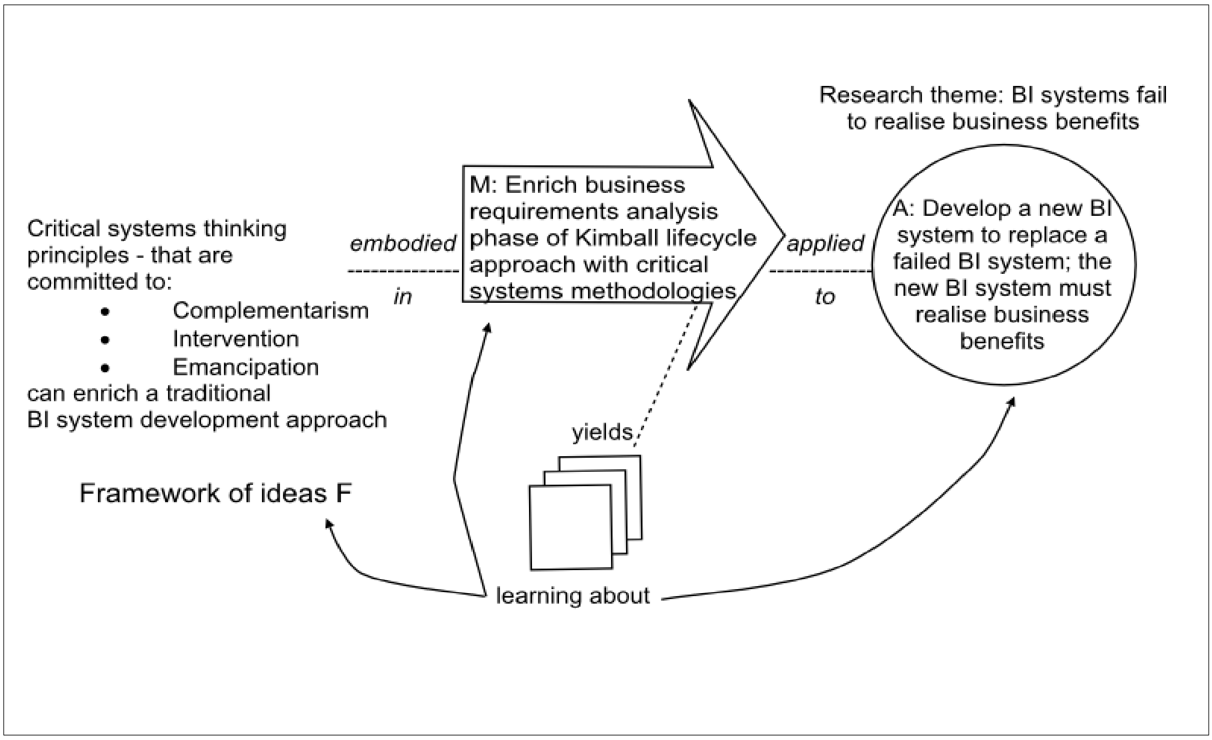


Figure 1-4: Proposed structure of the study

1.5.3 Research methodology

The research is performed within the critical research paradigm. Myers & Klein (2011:17) assert that critical research is well suited for information systems (IS) related research projects; IS research concerns the social issues relating to the development, use and impact of IS-related artefacts. A critical researcher takes a critical stance towards taken-for-granted assumptions about organisations and IS (Myers & Klein, 2011:17). Research performed in this paradigm is "characterized by an intention to change the status quo, overcome injustice and alienation, and promote emancipation" (Stahl, 2008:139). It has a critical intention, is founded in a critical theory (such as the philosophical lineage of critical philosophers), and requires the application of a critical methodology that is based on CST.

Myers & Klein (2011:11) assert that critical social research includes three inter-connected elements, i.e. insight; critique; and transformative redefinition. They explain these elements as follows: Firstly, *insight* is required to comprehensively understand, interpret and describe the current situation before engaging in critical analysis; secondly, *critique* is concerned with the descent of knowledge, the social practices of control and reproduction – it aims to reveal the normative basis of the current situation and the reasonable justification(s) for the current social order and power structures; and thirdly, *transformative redefinition* aims to develop critical, relevant knowledge and practical understandings to enable change and provide skills for new and improved ways of operating; it suggests improvements to the conditions of human existence, existing social arrangements and social theories.

Action research (AR) can be applied as a critical research approach. AR is ontologically based on action/intervention and enables organisational change (Shani *et al.*, 2012:25). It is suitable for this study. AR entails a cyclical process of action and reflection that "build on the past, take place in the present with a view to shaping the future" (Shani *et al.*, 2012:48). AR includes iterating five phases: diagnosis; action planning; action taking; evaluation; and specification of learning (Baskerville, 1999:13).

1.5.4 Contribution of the study

Since the literature revealed that BI systems do not always realise intended benefits, this study makes the following contribution: a set of practical guidelines for the use of critical systems methodologies in BI system development. This study proposes a critical approach to BI system development; critical systems methodologies are explored to guide BI system development and emancipate those involved with and affected by BI. This study is philosophically based on the lineage of critical social theorists and scholars such as Flood and Jackson as well as Ulrich (their work is based on the work of Habermas) – refer also to Figure 1-4 above.

1.5.5 Participants in the study

Participants (employees of the organisation where the research is conducted) for the intervention are selected as per the following criteria: senior management involved in strategic decision making in the organisation; operational employees that capture and manage source data; BI system developers; and business analysts that derive BI system requirements. An external BI consultant is also interviewed. Participants are discussed in the chapters that detail the empirical work where they participate. Refer to Chapters 7, 8, and 9.

1.5.6 Data collection methods

Qualitative data are collected through focus groups and structured interviews. Data collections for the interventions in this study are discussed in the chapters that detail the empirical work. Refer to Chapters 7, 8, and 9.

1.5.7 Rigour and evaluation of the method

The principles proposed by Heikkinen *et al.* (2012:8) to ensure that the research method is rigorously applied are adopted for this study:

1. The principle of historical continuity analyses: the history of action, i.e. how has the action evolved historically; and emplotment, i.e. how logically and coherently does the narrative proceed.

2. The principle of reflexivity determines: subjective adequacy, i.e. what is the nature of the researcher's relationship with the research object; ontological and epistemological presumptions, i.e. what are the researcher's presumptions of knowledge and reality; and transparency, i.e. how does the researcher describe material and methods used.
3. The principle of dialectics evaluates: dialogue, i.e. how has the researcher's insight developed in dialogue with others; polyphony, i.e. how does the research report present different voices and interpretations; and authenticity, i.e. how authentic and genuine are the protagonists of the narrative.
4. The principle of workability and ethics evaluates: pragmatic quality, i.e. how well does the research succeed in creating workable practices; criticalness, i.e. what kind of discussion does the researcher provoke; ethics, i.e. how are ethical problems dealt with; and empowerment, i.e. does the research make people believe in their own capabilities and possibilities to act and thereby encourage new practices and actions.
5. Lastly, the principle of evocativeness determines how well the research narrative evokes mental images, memories or emotions related to the theme.

1.6 Ethical considerations

The following ethical considerations are considered for this study:

- gaining permission to conduct the study at a particular organisation;
- ensuring that participation is voluntary;
- protecting the confidentiality of the data provided by the respondents; and
- allowing the participating organisation to review results.

1.7 Chapter classification

This research report includes the following chapters:

Chapter 1: Introduction

This chapter gives an overview of the research problem. It also motivates the importance and relevance of this study.

Chapter 2: Research plan

This chapter gives an overview of the main research paradigms in the field of information systems and the development of these paradigms. It also outlines how the research is performed in the critical social theory research paradigm using action research.

Chapter 3: Business intelligence system development

This chapter gives an overview of existing BI system and software development literature. It explores the history and evolution of information technology artefacts, which explains the dominant paradigm within which current development approaches evolved. It then evaluates the suitability of software development approaches to effectively develop appropriate software artefacts and BI systems. Requirements collection precedes development work since software artefacts are developed according to specified requirements; appropriate, people-oriented requirements collection is also discussed as a driver of software development success.

Chapter 4: Critical systems thinking and critical systems methodologies

This chapter gives an overview of the literature of the development and application of systems thinking. It discusses the paradigm shifts that occurred within systems thinking and the subsequent emergence of critical systems thinking and critical systems methodologies. It also discusses software development within the systems thinking paradigms.

Chapter 5: Diagnosis: business intelligence systems fail to realise business benefits

This chapter discusses the diagnosis phase of the study; this phase entails the diagnosis of an area of concern. This chapter discusses an identified failed BI system in an organisation that still requires BI capabilities; it also gives the background to the organisation where the research is conducted.

Chapter 6: Action plans: guidelines for the use of critical systems methodologies in business intelligence system development

This chapter discusses the action planning phase of the study. It proposes two action plans to improve the diagnosed area of concern: firstly, to enrich the business requirements definition phase of the Kimball lifecycle approach with TSI; and secondly, to enrich the business requirements definition phase of the Kimball lifecycle approach with CSH.

Chapter 7: Results from empirical work: application of the total systems intervention guidelines in a business intelligence development project

This chapter discusses the TSI intervention, i.e. the action taking, evaluation, and specification of learning phases of the intervention where the researcher applies the TSI guidelines in a BI system development.

Chapter 8: Results from empirical work: application of the critical systems heuristics guidelines in a business intelligence development project

This chapter discusses the CSH intervention, i.e. the action taking, evaluation, and specification of learning phases of the intervention where the researcher applies the CSH guidelines in a BI system development.

Chapter 9: Results from empirical work: contextualisation of the critical systems heuristics guidelines for business intelligence system development

This chapter discusses the contextualisation of the guidelines; the CSH boundary questions are contextualised for a BI context.

Chapter 10: Specification of learning: conclusions and evaluations

This chapter specifies the learning from this study; it concludes with the main research findings. It evaluates the study in terms of the principles described for AR. This chapter also evaluates the extent to which the research problem has been solved and states possible areas of future research.

1.8 Summary

This chapter gives an overview of the research problem. It also motivates the importance and relevance of this study. BI systems must enhance organisational decision making capabilities and the quality of decisions. However, BI systems often fail because the development approaches lack people-orientation and hence the human, social and organisational dimensions are not incorporated; this is viewed as social oppression. Critical systems methodologies, which are positioned in the CST paradigm, aim to facilitate social improvement and emancipate those that are socially oppressed. This study thus aims to develop guidelines for the use of critical systems methodologies to improve business intelligence system development.

The next chapter gives an outline of the research process for this study.

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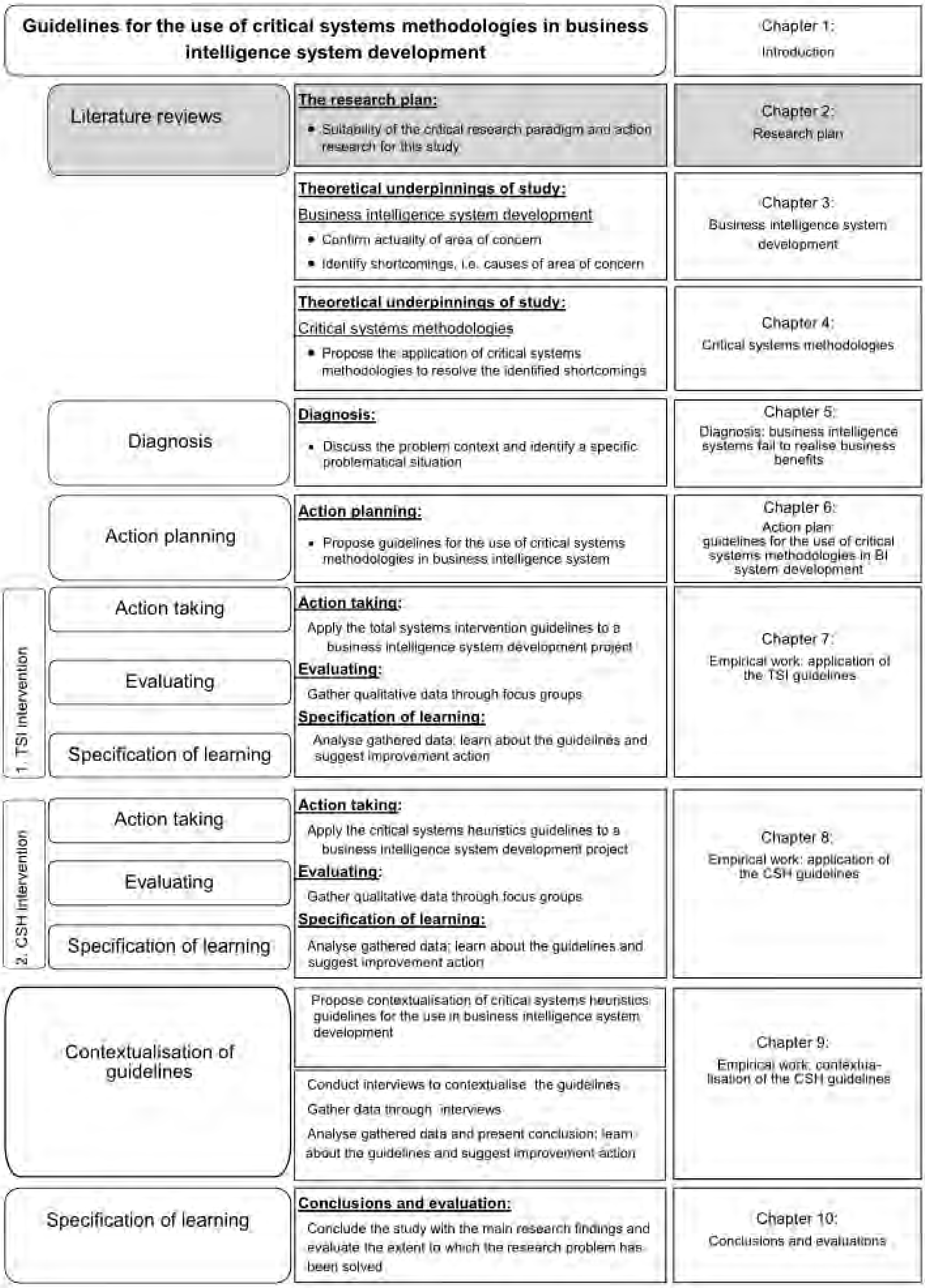

Guidelines for the use of critical systems methodologies in business intelligence system development
Chapter 1: Introduction
Literature reviews
The research plan:
Suitability of the critical research paradigm and action research for this study
Chapter 2: Research plan
Theoretical underpinnings of study:
Business intelligence system development
Confirm actuality of area of concern
Identify shortcomings, i.e. causes of area of concern
Chapter 3: Business intelligence system development
Theoretical underpinnings of study:
Critical systems methodologies
Propose the application of critical systems methodologies to resolve the identified shortcomings
Chapter 4: Critical systems methodologies
Diagnosis
Diagnosis:
Discuss the problem context and identify a specific problematical situation
Chapter 5: Diagnosis: business intelligence systems fail to realise business benefits
Action planning
Action planning:
Propose guidelines for the use of critical systems methodologies in business intelligence system
Chapter 6: Action plan: guidelines for the use of critical systems methodologies in BI system development
1. TSI intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the total systems intervention guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data: learn about the guidelines and suggest improvement action
Chapter 7: Empirical work: application of the TSI guidelines
2. CSH intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the critical systems heuristics guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data: learn about the guidelines and suggest improvement action
Chapter 8: Empirical work: application of the CSH guidelines
Contextualisation of guidelines
Propose contextualisation of critical systems heuristics guidelines for the use in business intelligence system development
Conduct interviews to contextualise the guidelines
Gather data through interviews
Analyse gathered data and present conclusion: learn about the guidelines and suggest improvement action
Chapter 9: Empirical work: contextualisation of the CSH guidelines
Specification of learning
Conclusions and evaluation:
Conclude the study with the main research findings and evaluate the extent to which the research problem has been solved
Chapter 10: Conclusions and evaluations

Chapter 2 : Research plan

2.1 Introduction

The objective of this study is to develop guidelines for the use of critical systems methodologies to improve the development of business intelligence systems. This chapter gives an overview of the main research paradigms in the field of information systems and the development of these paradigms. This chapter also discusses the research being performed in the critical research paradigm using action research. This chapter concludes with an outline of the process followed in this study.

The development of a software artefact, such as a business intelligence system, entails technical activities as well as social activities influenced by the organisational context (Goulielmos, 2004:363). Software artefacts are used by humans within an organisational context; the implementation of a software artefact changes the organisational context where it is implemented and therefore software developers must be aware of relevant human, social and organisational dimensions that may affect its success (Sommerville, 2011:108). Hirschheim & Klein (1994:83) argue that the success rate of software artefacts may be increased if development approaches embrace emancipatory principles. The critical research paradigm aims to intervene in and improve complex social contexts and processes; it also aims to emancipate those that are oppressed by such problematic social situations (Myers & Klein, 2011:19). Action research is chosen for this study; it is applied in the critical research paradigm. Action research is a "social scientific research method, ideally suited to the study of technology in its human context" (Baskerville & Wood-Harper, 1996:235).

This chapter starts with an explanation of how research paradigms are defined in Section 2.2. Section 2.3 discusses the positivistic research paradigm, its associated research practice and the application of positivism in information systems research. Section 2.4 discusses the interpretive research paradigm, its associated research practice and the application of interpretivism in information systems research. Section 2.5 discusses the design science research paradigm, its associated research practice and the application of design science research in information systems research. Section 2.6 discusses the critical social theory research paradigm and the application thereof in information systems research. Section 2.7 discusses action research as it is applied in this study. Section 2.8 discusses data collection methods.

2.2 Research paradigms

Kuhn (1962:23) defines a *paradigm* as "an accepted model or pattern"; however, he asserts that it can also be "an object for further articulation and specification under new or more stringent conditions". *Research* is defined as "the systematic investigation into and study of materials and sources in order to establish facts and reach new conclusions" (The Concise Oxford English Dictionary, 2002:1217). A paradigm thus represents the way that people perceive and explore their world whilst research involves the exploration of phenomena with the aim to produce new knowledge; therefore, a *research paradigm* is based on an underlying worldview that dictates how phenomena in the world are observed and analysed in order to learn about such phenomena. A research paradigm is defined by its ontology, i.e. what is perceived as reality, and its epistemology, i.e. how we learn about our perceived reality (Scotland, 2012:9).

Ontology is the way that people "specify terms of reference for existence"; it enables an understanding of "the theory of existence via an 'existence framework'" (Ezell & Crowther, 2007:269). Ontological assumptions are concerned with the belief of what constitutes reality, i.e. what is real (Scotland, 2012:9). The ontology of a research paradigm defines for example whether the researcher that works within that paradigm assumes the empirical world to be *objective*, i.e. reality exists independent of humans and human knowledge thereof, or *subjective*, i.e. reality exists through the action of humans that create and recreate it (Orlikowski & Baroudi, 1991:7).

Epistemology is defined as "the theory of knowledge" (Ezell & Crowther, 2007:269). Epistemological assumptions concern the way that knowledge is created, acquired, expressed and communicated (Scotland, 2012:9). Epistemology "allows us to explore new models and theories of knowledge acquisition so the best system-based methodologies can be deployed to solve complex system problems" (Ezell & Crowther, 2007:269).

The concept of a *paradigm shift* in scientific thinking was introduced by Thomas S. Kuhn (1962:92) in his book "The Structure of Scientific Revolutions"; he refers to paradigm shifts as "non-cumulative developmental episodes" whereby a new and incompatible worldview replaces the old worldview of a person or a group of people. The underlying worldviews, and thus the ontological and epistemological assumptions of researchers, shifted over time; hence, paradigm shifts occurred that defined different ways whereby researches were conducted. These shifts did not render the old paradigms invalid, but they introduced new and alternative paradigms. Different research paradigms have different philosophical bases, methodological approaches and research practices; these are underpinned by the ontological and epistemological assumptions of the research paradigms (Scotland, 2012:9). The ontology and epistemology as well as associated research practice of the four main research paradigms in the information systems field, i.e. positivistic research, interpretive research, design science research and critical research, are discussed in the next sections.

2.3 The positivistic research paradigm

Fields in the natural and physical sciences often display physical regularities that can be readily examined using empirical and reductionist methods (von Bertalanffy, 1972:409). Reductionist methods, such as methods that stem from the work of René Descartes (for example his book "Method of Reason" that was published in 1637), are thus generally applied in research that explore and attempt to understand natural and physical phenomena (Louth, 2011:69). Auguste Comte devised positivism in social sciences in the 1830s; he sought to study social sciences in ways comparable to that which were used to explore natural and physical sciences (Louth, 2011:69). Positivistic research in the social sciences stemmed from Comte's "search for laws of social life that could stand as equivalents to the natural laws of the physical sciences" (Pascale, 2010:156).

2.3.1 The ontology and epistemology of positivism

The ontological stance of the positivistic research paradigm is realism and its epistemological stance is objectivism (Scotland, 2012:10). Positivists presume that an objective reality exists beyond the human mind; reality is assumed to be independent of human knowledge thereof (Scotland, 2012:10). They also presume that there is only one true reality and hence aim to determine the "one, and only one, correct logic for scientific inquiry" (Pascale, 2010:156). According to positivists the researcher remains independent of the phenomena that he/she investigates; the researcher does not influence or affect the outcome of the research or the research subjects (Orlikowski & Baroudi, 1991:5). Within the positivistic research paradigm human action is considered to be similar to research subjects in the natural and physical sciences fields, i.e. predictable, intentional and rational; it also presumes that human interaction is relatively stable and orderly without significant conflict and contradiction (Orlikowski & Baroudi, 1991:10).

The Concise Oxford English Dictionary (2002:1117) defines positivism as recognisant of "only that which can be scientifically verified or which is capable of logical or mathematical proof". From a positivistic perspective a theory can only be declared 'true' if empirical events repeatedly verify it or fail to falsify it; only empirical data can produce true knowledge (Orlikowski & Baroudi, 1991:5). Positivistic researchers draw "inferences about a phenomenon from the sample to a stated population" using for example statistical analysis techniques and typically includes structured instruments such as experiments, questionnaires and surveys; positivistic research aims to increase a general understanding of phenomena so as to accurately predict and regulate future behaviour (Orlikowski & Baroudi, 1991:5).

2.3.2 Information systems research in the positivistic paradigm

Positivistic approaches were predominantly applied to explore science and technology in the 18th and 19th century (Checkland, 1981:47). Similarly, early social sciences also employed primarily positivistic approaches for enquiry (Pascale, 2010:156). Naur & Randell (1969) state that information systems (IS) and information systems/software development (ISD) were recognised as social phenomena that were “integrated into the central activities of modern society” at the very first conference dedicated to this topic in the late 1960s already. Yet, it was not unexpected when Orlikowski & Baroudi (1991:7) found that the positivistic research paradigm initially dominated research in the information systems (IS) field as well. Despite the argument of Paucar-Caceres & Wright (2011:594) that the supremacy of positivistic research in the IS field was already challenged in the late 1970s and early 1980s, Orlikowski & Baroudi (1991:7) still found that a positivistic approach was applied to 96.8% of empirical research articles that were published between 1983-1988 in leading IS journals.

According to Chen & Hirschheim (2004:197) this trend diminished only marginally in the 1990s; their research showed that positivist research still accounted for 81% of empirical research that was published between 1991 and 2001 in leading IS journals. However, Chen & Hirschheim (2004:198) warn that such a “paradigmatic and methodological skewing in a research community might not be healthy”. Orlikowski & Baroudi (1991:7) argue that the IS research community’s over-reliance on positivism “has limited what aspects of information systems phenomena we have studied, and how we have studied them”. Orlikowski & Baroudi (1991:11) make a case for pluralism in IS research since “information systems research enters into the very constitution of the phenomena it studies…a major goal of information systems research is to have an impact on information systems practice; that is, the findings of information systems research are intended to inform and improve the development and use of information systems in organizations”.

2.3.3 Suitability of the positivistic research paradigm for this study

The researcher’s aim is to develop improved business intelligence (BI) systems that realise business benefits, whilst the developed software artefacts still adhere to high technological standards. The researcher is part of the research situation and the research is conducted in an organisational (social) context. This study thus aims to intervene and improve the organisational context where the research is conducted, rather than develop a general understanding of the research situation. Positivistic research is therefore not suitable for this study.

2.4 The interpretive research paradigm

Research in the human and social sciences fields was significantly influenced by Wilhelm Dilthey; he introduced an alternative (non-positivist) method to understand human action through for example his 1883 publication "Introduction to the human studies" and also his 1900 publication "The rise of hermeneutics" (Brown, 1976:206). The interpretive research paradigm developed out of Dilthey's quest to "understand our fellow men" and "interpret the meaning and significance of human works" (Brown, 1976:208). Interpretive research practices in the social sciences is based on the philosophical perspective of hermeneutics and the concept of the hermeneutic circle, which suggests that understanding of a complex whole emanates from the preconceptions that the observer has about the meanings of the individual parts of the complex whole, as well as the interrelationships between these parts (Klein & Myers, 1999:68). Human understanding can thus only be achieved by iterating between considering the interdependent meaning of the parts that make up the whole, as well as the whole that is formed by the interrelated parts (Klein & Myers, 1999:72). Research that is conducted in the interpretive paradigm aims to increase in-depth understanding of phenomena within their cultural and contextual setting and to interpret the meanings that people assign to phenomena (Orlikowski & Baroudi, 1991:5).

2.4.1 The ontology and epistemology of interpretive research

The ontological stance of the interpretive research paradigm is relativism (Scotland, 2012:12). The epistemology of interpretivism is subjectivism, i.e. reality is perceived as subjective and based on phenomena in the real world (Scotland, 2012:12). An interpretive researcher accepts that subjective meanings are created by people in their interaction with their surrounding world (Orlikowski & Baroudi, 1991:5). Interpretivists examine social phenomena in their natural settings; they consider the different perspectives of all the participants and refrain from imposing "their outsiders' a priori understanding on the situation" (Orlikowski & Baroudi, 1991:5).

Interpretivism accepts reality and the knowledge of reality as social products; reality can thus not be understood independent of the human actors that construct reality and also make sense of that constructed reality (Orlikowski & Baroudi, 1991:13). Interpretivists use for example ethnographic studies and case studies to gain knowledge of reality through social constructions such as language, consciousness, shared meanings and documents (Klein & Myers, 1999:69). Interpretivists also use methodologies such as grounded theory, which aims to “develop a well-integrated set of concepts that provide a thorough theoretical explanation of social phenomena under study” (Corbin & Strauss, 1990:5).

2.4.2 Information systems research in the interpretive paradigm

Walsham (1995:376) argues that interpretivism gained support as a relevant research paradigm for IS in the 1990s; he suggests that interpretive research “is a valuable approach to studying IS in organizations, or more strongly that it is a better method than positivism for this purpose”. Chen & Hirschheim (2004:197) state that 19% of empirical IS research published in the 1990s was interpretive; it is a 15.8% increase since the comparative data of 1980s that was reported by Orlikowski & Baroudi (1991:7). Interpretive research yields “deep insights into information systems phenomena” (Klein & Myers, 1999:67). Unfortunately, Orlikowski & Baroudi (1991:18) argue that interpretive research may fail to examine (external) conditions that give rise to meanings and experiences; it may also fail to explain unintended consequences of action that often have a significant effect on social reality. Also, interpretivism fails to address structural conflicts and explain historical change, i.e. in what way a social order became what it is and how it varies over time (Orlikowski & Baroudi, 1991:18).

Klein & Myers (1999:72) derived seven principles for interpretive research to overcome some of these shortcomings and to ensure rigorous research in the interpretive paradigm. They asserted that: interpretive researchers must adhere to the fundamental principle of the hermeneutic circle; the researcher must understand “the social and historical background of the research setting” so that he/she can understand how the current research setting emerged; the researcher must critically reflect on how the interaction between him/her and participants socially construct the research data; data interpretation must reveal idiographic details through the application of the first and second principles; the researcher must portray dialogical reasoning; the researcher must be sensitive to possible different interpretations among different participants; and the researcher must be suspicious regarding “biases” and “distortions” in collected narratives.

2.4.3 Suitability of the interpretive research paradigm for this study

Interpretive research aims to observe, interpret and comprehensively understand phenomena rather than intervene in order to improve social situations. It is thus not suitable for this study, which aims to intervene in organisational contexts and develop improved BI systems that realise business benefits as well as adhere to high technological standards.

2.5 The design science research paradigm

Arnott & Pervan (2012:924) position the design science research paradigm as “an alternative, or complement, to the natural-behavioural science approach that is dominant in information systems research”. Within the design science paradigm “the researcher is interested in developing “a means to an end”…to solve a problem” (Holmström *et al.*, 2009:67). The purpose of design science research is thus to “invent new technologies…to change (and hopefully improve) the world” (Myers & Venable, 2014:801). The design science researcher first *creates* the phenomenon that he/she wants to evaluate; he/she then evaluates the phenomenon in order to improve it. Design science focuses on solving a problem through the creation and positioning of an artefact (Baskerville, 2008:442). Design science researchers thus construct and then explore artificially created phenomena (such as technology artefacts), rather than explain natural phenomena as in the case of interpretive research (Holmström *et al.*, 2009:68).

Design science research aims to improve through intervention; however, initial evaluation of the artefact developed in the design science paradigm is typically done in a laboratory or experimental context, rather than in a real-world situation (such as a problematical organisational context) (Iivari, 2007:54). Where an IS artefact (such as the data warehouse component of a business intelligence system) is developed, this technical artefact will thus in the first instance typically be evaluated for its technical feasibility, rather than in terms of how such an artefact influences the organisational context where it will be implemented and used.

2.5.1 The ontology and epistemology of design science research

Iivari (2007:42) argues that Popper's three worlds provide a sound ontological basis for the design science research paradigm: Popper's first world considers the objective material nature; his second world considers the subjective consciousness and mental states; whilst his third world includes objective (man-made) human artefacts, institutions and theories. This perspective leads to a "pluralist form of realism", which recognises different types of relevant knowledge are created (Gregor & Hevner, 2013:342). These influence each other, i.e. conceptual (theoretical) knowledge; descriptive (what) knowledge relating to natural phenomena and interactions; and prescriptive (how) knowledge relating to human-built artefacts (Gregor & Hevner, 2013:342). The epistemology of design science research is thus constructivism, i.e. design science researchers create new prescriptive knowledge by constructing IS artefacts; they also create new descriptive and conceptual knowledge by evaluating the effect of the constructed artefacts on its users.

2.5.2 Information systems research in the design science research paradigm

Design science research has been applied in the IS field since its inception in the 1970s (Arnott & Pervan, 2012:923). It entails the development of technology-based solutions, for example, the construction of decision support and socio-technical IS artefacts (Gregor & Hevner, 2013:337). The focus of design science research in the IS field is on the creation and evaluation of artefacts; these artefacts are aimed at the resolution of identified organisational problems (Arnott & Pervan, 2012:924). These technology artefacts are used by humans, and hence may potentially affect them. Therefore, Myers & Venable (2014:803) emphasise the importance of researchers adhering to relevant ethical principles when conducting IS research in this paradigm. They derive four ethical principles that design science researchers must adhere to, i.e. researchers must ensure privacy of the users of the new technology; gathered information must be accurate; intellectual property rights of the artefact and gathered information must be defined and adhered to; and the developer must ensure that access to the system and gathered information is appropriately controlled (Myers & Venable, 2014:803). Design science research focuses on the creation and evaluation of an artefact, which aims to resolve specific organisational problems. However, even though such artefacts aim to resolve specific organisational problems, Iivari (2007:54) argues that artefacts developed in this paradigm should not generally be tested *first* “in the real situation”, so as to immediately evaluate the effect of the artefact (or its development process) in the organisational context.

2.5.3 Suitability of the design science research paradigm for this study

Iivari (2007:53) argues that “design science research has its roots in engineering; [e]ven though [design science research] may be informed by practical problems, design science research, both the construction of new artifacts and their initial evaluation (testing), is usually done in laboratories that are clearly separated from potential clients”. The focus of this study is to develop guidelines for the use of critical systems methodologies to improve BI system development. This research includes the development of a BI system; the researcher aims to improve the development of BI systems by applying critical systems methodologies as part of the development process. However, the focus of this research is more on the improvement of the development process whereby BI systems/artefacts are created, than on the created BI artefact itself. It is the realisation of business benefits, rather than only technical feasibility, which will be evaluated in this study. This study aims to appropriately elicit business requirements, so that the created and implemented BI system realises business benefits, and as such improves the organisational context of its users. Design science research is thus not suitable for this study.

2.6 The critical social theory research paradigm

Richardson & Robinson (2007:263) refer to critical research as praxis-oriented since it combines theory and action; critical research is philosophically based on a critical social theory and it also aims to intervene in and improve the research situation. Myers & Klein (2011:19) therefore state that critical research in the information systems field is also always based on a philosophical foundation and underpinned by a critical theory; researchers in the information systems (IS) fields have drawn from various philosophical foundations for critical IS research. Myers & Klein (2011:20) give an overview of IS research conducted using the philosophical lineage of for example Foucault's theory of disciplinary power, Bourdieu's concepts of habitus and forms of capital, Bourdieu's practice theory as well as Habermas' critical theory. However, authors such as Richardson & Robinson (2007:262) and Brooke (2002:271) argue that critical research in IS fields are most often associated with Jürgen Habermas' critical theory. Habermas' theory regarding rational practical discourse is concerned with social transformation (Mingers, 1980:41). His work is in the Frankfurt School tradition of critique, i.e. "normative critique", which is concerned with human emancipation (Delanty, 2011:72). For example, Habermas aims to eliminate social injustice and emancipate the oppressed from societal repression through rational and consensual communicative practices (Mingers, 1980:41).

To intervene in and improve problematical social situations critical research includes three interconnected elements, i.e. *insight*, *critique* and *transformative redefinition* (Myers & Klein, 2011:19). Firstly, it requires *insight* to understand the situation in its current form; insight requires that the researcher comprehensively understands, interprets and describes the problem situation prior to engaging in critical analysis (Myers & Klein, 2011:11). Secondly, it requires critical analysis, i.e. *critique*, to reveal the normative basis of the current situation as well as reasonable justifications for the current social order and power structures (Myers & Klein, 2011:11). Critical analysis of the research context includes three aspects, i.e. the organisation of data collection and analysis around core concepts and ideas of critical social theorist(s); the researcher must take a value position, i.e. a defensible ethical stance in social political matters; and the researcher must identify important beliefs and social practices and challenge it with potentially conflicting arguments and evidence in order to determine what should count as relevant knowledge and information and how it can be appropriately used (Myers & Klein, 2011:11). Thirdly, it requires *transformative redefinition* that aims to develop critical, relevant knowledge and practical understanding for new and improved ways of operating regarding human existence, social arrangements and social theories; is concerned with the development of knowledge and understandings to enable change (Myers & Klein, 2011:11). Transformative redefinition includes three aspects, i.e. the researcher must assume a value stance with some of the problematic human practices in the domain being investigated with the aim to identify possibilities for improvement; improvements may filter down to a societal level and improvements may occur in a society as a whole and not only on individual level; and theoretical knowledge may grow and improve and hence the underpinning social theories may be improved through the research intervention as well (Myers & Klein, 2011:11). The application of these principles in this study is discussed later in this chapter.

2.6.1 The ontology and epistemology of critical research

The ontological position of the critical social theory research paradigm is critical realism (Delanty, 2011:75). The term *critical realism* is the result of an elision of two philosophical concepts, i.e. *transcendental realism* and *critical naturalism*; Roy Bhaskar devised these concepts (Harvey, 2002:164). Roy Bhaskar (1975:100) defines transcendental realism as “the thesis that the objects, of which in the social activity of science knowledge is obtained, both exist and act independently of men, and hence of human sense-experience”. It is thus based on the presumption that an independent and realistic reality exists, i.e. reality exists “out there”, independent of human knowledge and the ability of humans to perceive knowledge (Wynn & Williams, 2012:790). Reality is perceived as an “open system” that is “beyond our ability to control directly” (Wynn & Williams, 2012:792). Bhaskar (2005:3) defines naturalism as “the thesis that there is (or can be) an essential unity of method between the natural and social sciences”; he further argues that naturalism can be *critical* if it “can do justice to the proto-scientific intuitions of both positivism and its hermeneutical foil” (Bhaskar, 2005:23). The concept of critical naturalism accepts that different types of objects of knowledge exist, i.e. physical, social and conceptual; these different types of knowledge differ in terms of their ontology and epistemology and hence research that involves different types of knowledge benefit from methodological pluralism, i.e. the (theoretically well-informed and efficacious) application of various research approaches in the same study (Mingers *et al.*, 2013:795).

Wynn & Williams (2012:793) state that the epistemological assumption of critical realism is “mediated knowledge”, which implies that knowledge is “value aware and theoretically informed, derived from multiple value-aware perceptions of a single independent reality". Researchers in the critical paradigm accept that knowledge is socially constructed and influenced by power relations within society (Scotland, 2012:13). Critical researchers accept that humans cannot experience reality in full; humans can only experience a portion of reality at a time (Wynn & Williams, 2012:792). Still, they are concerned with *totality*, i.e. the idea that things cannot be treated as isolated items; therefore, critical researchers acknowledge "the reality of interdependence of parts with the whole" and accept "that organizations cannot be studied in isolation of the industry, society, and nation within which they operate, and which they in part constitute" (Orlikowski & Baroudi, 1991:23).

Critical social theory research aims to explain, intervene and emancipate rather than merely predict or understand (Wynn & Williams, 2012:793). The purpose of critical research is to transform and improve society through intervention and human emancipation (Delanty, 2011:75). The critical social researcher wants to expose "deep-seated, structural contradictions with social systems…transform these alienating and restrictive social conditions" by revealing the "historical, ideological, and contradictory nature of existing social practices" and ultimately free those that are subjected to societal oppression (Orlikowski & Baroudi, 1991:6). The critical social researcher thus attempts to intervene in problematical social situations in order to improve such situations where he/she: takes a value position with regard to the situation; aims to reveal and challenge prevalent dogmas; aims to emancipate those that are oppressed; and aims to improve society as well as social theories (Myers & Klein, 2011:19).

2.6.2 Information systems research in the critical social theory paradigm

Information systems research must purposefully improve the development and use thereof (Orlikowski & Baroudi, 1991:11). According to Richardson & Robinson (2007:252) critical research in the IS field is emerging and growing; they state that "recent years have seen the growth of IS research that consciously takes a critical perspective".

2.6.3 Suitability of the critical social theory research paradigm for this study

The development of software artefacts, such as BI systems, entail technical *and* social activities (Goulielmos, 2004:363). BI is enabled by a technological infrastructure, i.e. a data warehouse (DW); the development of a BI system is thus a complex, expensive and technology-intensive project (Yeoh & Koronios, 2010:23). However, the purpose of BI is to enhance organisational decision making capabilities and improve organisations (Inmon, 2005:60). Successful BI is a "business differentiator" that improves organisations' competitiveness (Marinela & Anca, 2009:382). Authors such as Avison & Fitzgerald (2006:11) and also Clegg & Shaw (2008:448) argue that the majority of unsuccessful software artefacts do not fail based on technical feasibility; rather, unsuccessful software artefacts fail due to neglect of relevant human, social and organisational factors. Failure of BI systems – refer for example to BI failure rates of 30%-59% reported by Dresner Advisory Services (2012:3), Gartner (2011:1) and Hwang & Hongjiang (2007:1) – are thus a result of social issues rather than technical issues. BI alters the social dimensions of an organisation; the development of business intelligence must thus be managed as a social process as well as a technical process.

The purpose of this study is to improve BI system development and hence the adoption rate of BI systems; this study explores how critical systems methodologies can be applied to ensure that relevant human, social and organisational factors are also incorporated in the development process so that BI systems realise business benefits as well as adhere to high technological standards. The researcher of this study agrees with the statement of Brooke (2002:280) that it is imperative that "critical IS research strives to promote self-awareness and enable the assumptions that underpin management goals to be made explicit"; she also agrees with the argument of Myers & Klein (2011:17) that a critical research approach is well suited for IS research, such as software development research projects, which involve social issues related to the development, use and impact of the software artefact being developed. Critical research aims to intervene in and improve social situations; it is thus suitable for this study.

2.7 Action research

Baskerville & Wood-Harper (1996:236) describe action research (AR) as follows: “It is empirical, yet interpretive. It is experimental, yet multivariate. It is observational, yet interventionist.” AR is a research method that focuses on solving problems “through social and organisational change” (Baskerville, 2008:442). AR can be applied from the perspectives of all the paradigms described previously. For example, Myers (1997) discusses the application of AR from the perspectives of positivism, interpretivism and critical social theory, whilst Holmström *et al.* (2009:65) discusses AR from a DSR perspective. In this study AR is performed from a critical social research perspective. The next sections discuss AR in terms of its origins; the AR process, its suitability for this study; and rigorous application of AR.

2.7.1 The origins of action research

Action research was developed in response to immense social changes in the social sciences research field that was brought on by the tragic aftermath of World War II (Baskerville & Wood-Harper, 1996:236). For example, scientists at the Tavistock Clinic (later referred to as the Tavistock Institute) developed a method that was applied to treat patients that suffered from psychological and/or social disorders caused by the stress of World War II (Baskerville & Wood-Harper, 1996:236). Simultaneously, yet independently, scientists Massachusetts Institute of Technology applied a similar method in social interventions (Lewin, 1946:34).

The term action research was introduced by Kurt Lewin (1946:34) to describe “a comparative research on the conditions and effects of various forms of social action, and research leading to social action”; it developed out of the belief that social phenomenon could be best understood by attempting to change it in a real-life situation since changing it would reveal its underlying dynamics. Lewin (1945:126) asserts that the AR method was further developed and refined at the Research Center for Group Dynamics at the Massachusetts Institute of Technology to foster “a better understanding of group life for solving practical day by day problems of modern society”.

Susman & Evered (1978:582) explicitly linked AR to systems theory in the late 1970s. In the early 1980s Peter Checkland published work that showed how he extensively applied AR to develop soft systems methodology (SSM) Checkland (1981). Later on Checkland & Holwell (1998) successfully applied SSM through an AR approach to bring about improvements in the IS field. The successful application of AR, as a critical research method, in the IS field has been documented by various authors (Myers & Klein, 2011:33; Baskerville, 1999:3; Checkland & Holwell, 1998).

2.7.2 The action research process

Action researchers join a problem situation; they take part in discussions to plan and execute improvement actions and they critically reflect on expressed learnings (Checkland & Holwell, 1998:26). Since action researchers directly experience and interact in the problem situation being researched, they may understand the problem situation better and hence suggest improved solutions (Bentley *et al.*, 2013:455). Checkland & Holwell (1998:11) argue that AR allows researchers to study social phenomena best since "thinking about the world and having experiences in it cannot properly be separated…experiences are interpreted by, but also serve to create, ideas and concepts which in turn make sense of (new) experience". Action researchers study complex social systems as whole entities (Baskerville, 1999:3). Therefore, AR enables social contexts, such as organisations, to improve as a whole and in its entirety (Shani *et al.*, 2012:56).

The book "Information, Systems and Information Systems", written by Checkland & Holwell (1998), contains a detailed discussion of the successful application of AR in the IS field. In this book they explain that the researcher: enters the problem situation (i.e. an area of concern); takes part in change process whilst reflecting on the experience and recording learning in relation to the framework of ideas, methodology as well as the area of concern (Checkland & Holwell, 1998:25); performs the research based on the establishment of roles as well as a declared-in-advance methodology and intellectual framework of ideas; and exits the research situation.

Myers & Klein (2011:33) state that AR encapsulates the following principles: it questions taken-for-granted assumptions and extends the scope of the research from the organisational to the societal level to include the social dimension as well; it embraces fundamental criticism and allows questionable social and/or human conditions to be surfaced; it enables intervention in the real world; and the inclusion of organisational and social dimensions add richer meanings to results.

According to Baskerville & Wood-Harper (1996:237) Kurt Lewin's original AR method included six stages, i.e. analysis, fact-finding, conceptualisation, planning, implementation of action and evaluation. The AR method described by Susman & Evered (1978:582) and later on by Baskerville (1999:14), which is widely accepted for IS research, is still essentially similar; they describe the action research cycle to include the iteration of the following five phases: diagnosis, action planning, action taking, evaluation and specification of learning.

Baskerville (1999:14) describes the phases as follows: first, the diagnosis phase involves the identification of the primary reason(s) that necessitates changes, holistic interpretation of the problem situation and the development of theoretical assumptions about the problem context; second, the action planning phase includes determining the actions to relieve the problem, including the approach for change; third, the planned actions are implemented in the action taking phase; fourth, the outcomes of the implemented actions and the extent to which the problem was resolved are assessed in the evaluation phase; and fifth, the specification of learning phase is concerned with the recognition of new knowledge gained (Baskerville, 1999:14).

The cyclical nature of the AR process enables researchers to continuously receive feedback and hence determine the level of effectiveness of introduced changes and the impact thereof on the participants (Sterman, 1994:331). During the AR process the effects of decisions that alter the world can also be observed; it can be used to revise our understanding of the world (Sterman, 1994:331). Figure 2-1 below illustrates the cyclical and iterative nature of AR according to Baskerville (1999:14);

this is also a simplified adaptation from the illustration provided by Susman & Evered (1978:588).

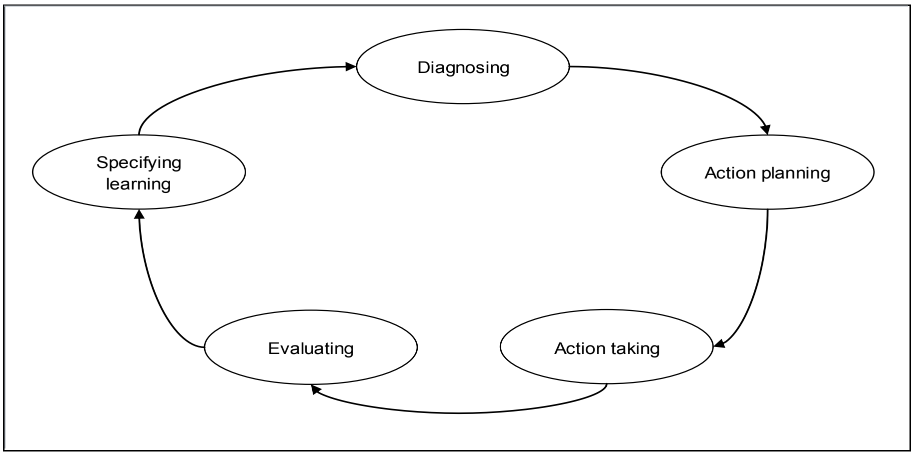


Figure 2-1: Action research cycle (Baskerville, 1999:14)

The cyclical action research process described by Baskerville (1999:14) aligns well with the action research process described by Checkland & Holwell (1998:25) in that the researcher: identifies an area of concern (A); establishes roles; and declares methodologies (M) and the intellectual framework of ideas (F) during the diagnosis and action planning phases. Then, the researcher takes part in change process during the action taking phase when he/she also performs the research based on the establishment of roles as well as a declared-in-advance methodology and intellectual framework of ideas. Lastly, the researcher reflects on and records learnings during the evaluation and specification of learning phases in terms of F, M, and A. This process may be repeated several times as the researcher gains insight through the research process and learns about F and M. Therefore, during the research process the researcher "tries to make sense of the accumulating experience"; he/she may then re-think earlier stages and declare that in terms of F and M (Checkland & Holwell, 1998:26).

Checkland & Holwell (1998:25) state that a researcher must find a "real-world situation which seems relevant to research themes which he or she regards as significant"; this constitutes the area of concern (A) of the research study. The role of the researcher must then be negotiated with the people involved in this real-world situation so that the researcher can enter the problem situation to attempt to improve the area of concern (A). Whilst doing the research according to the declared methodology (M) and within the defined framework of ideas (F), "the researcher tries to make sense of the accumulating experience, doing so using the declared F and M"; consequently, "re-thinking of earlier stages" may occur whereby the researcher then declares this in terms of F and M (Checkland & Holwell, 1998:26).

Checkland & Holwell (1998:25) state that (during the evaluation and learning phases) the critical and iterative nature of the AR process may lead to an area of concern (A), i.e. the identified problem being resolved, the applied methodology/(ies) (M) being improved and the philosophical framework (F) being altered as part of the research process. Figure 2-2 below illustrates the approach by Checkland & Holwell (1998:27) that includes the elements relevant to research, i.e. its declared methodology (M), framework of ideas (F) and the area of concern (A); this is referred to as the FMA illustration.

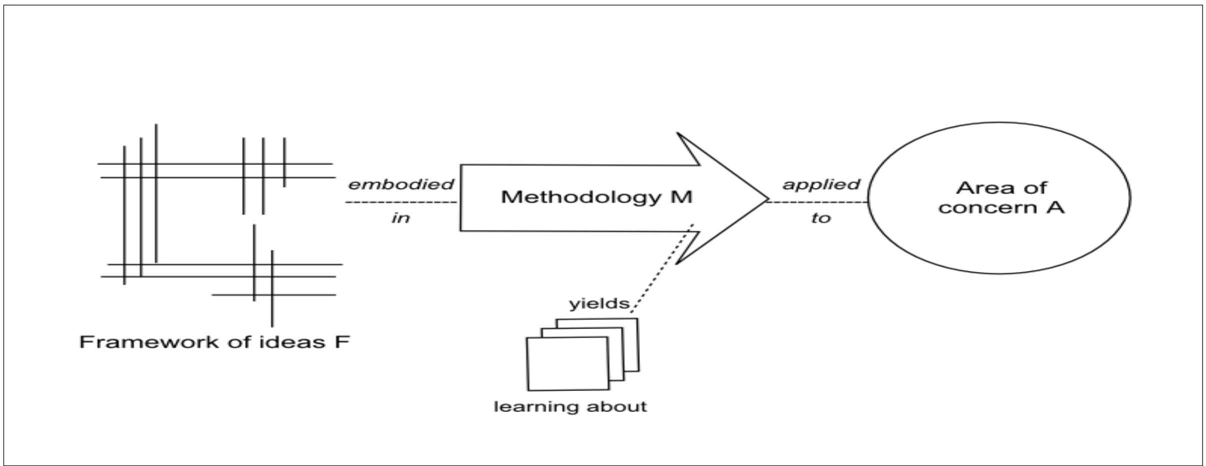


Figure 2-2: FMA illustration: elements in research (Checkland & Holwell, 1998:27)

2.7.3 Application of the action research process in this study

This study is similarly structured to the critical AR approach followed by Checkland & Holwell (1998:27) – refer also to Figure 2-2 earlier in this chapter. The research theme for this study is that BI systems have low success rates as they often do not realise expected business benefits. Chapter 3 discusses the documented success rate of BI systems as well as its importance for modern organisations and strategic decision making; it also discusses identified shortcomings in approaches used to elicit requirements for BI systems and develop BI systems. The researcher identifies a practical instance of this theme, i.e. an area of concern (A); she identifies a failed BI system in an organisation.

Chapter 5 contains a discussion on the diagnosis phase of the study; it also discusses the background to the failed system. The aim of the failed BI system is to support decisions of investment managers in the project gate keeping business process.

To relieve diagnosed problems, an action researcher develops an action plan whereby he/she applies methodologies (M) to the area of concern (A). In this study, the researcher aims to develop guidelines so that an improved (successful) BI system can be developed for the organisation where the failed BI system is identified. She therefore plans to incorporate critical systems methodologies as part of the business requirements analysis phase of a traditional BI system development approach (the Kimball lifecycle approach) to enable users to critically reflect on and surface their real requirements for the new system. Critical systems methodologies are applied to the research problem in this study to enrich a traditional BI development approach, i.e. the Kimball lifecycle approach. Critical systems methodologies are positioned within the critical systems thinking paradigm; they embody philosophical ideas (F) of critical scholars such as Werner Ulrich, Robert Flood, and Michael Jackson – these are discussed in Chapter 4. So, for this study, M is as follows: enrich the Kimball lifecycle approach with critical systems methodologies during the business requirements analysis phase.

To plan the action, the researcher proposes that either TSI or CSH can be applied during the business requirements analysis phase; she therefore proposes two separate action plans. Chapter 6 provides details of these action plans.

In the action taking phase the researcher applies the action plans. She firstly attempts to apply the TSI guidelines – refer to Chapter 7; thereafter, she applies the CSH guidelines – refer to Chapter 8. Chapters 7 and 8 includes a discussion on the evaluation of these interventions; learning is also specified in terms of the FMA illustration (refer also to Figure 2-2 earlier in this chapter). Figure 2-3 below illustrates the structure of this study.

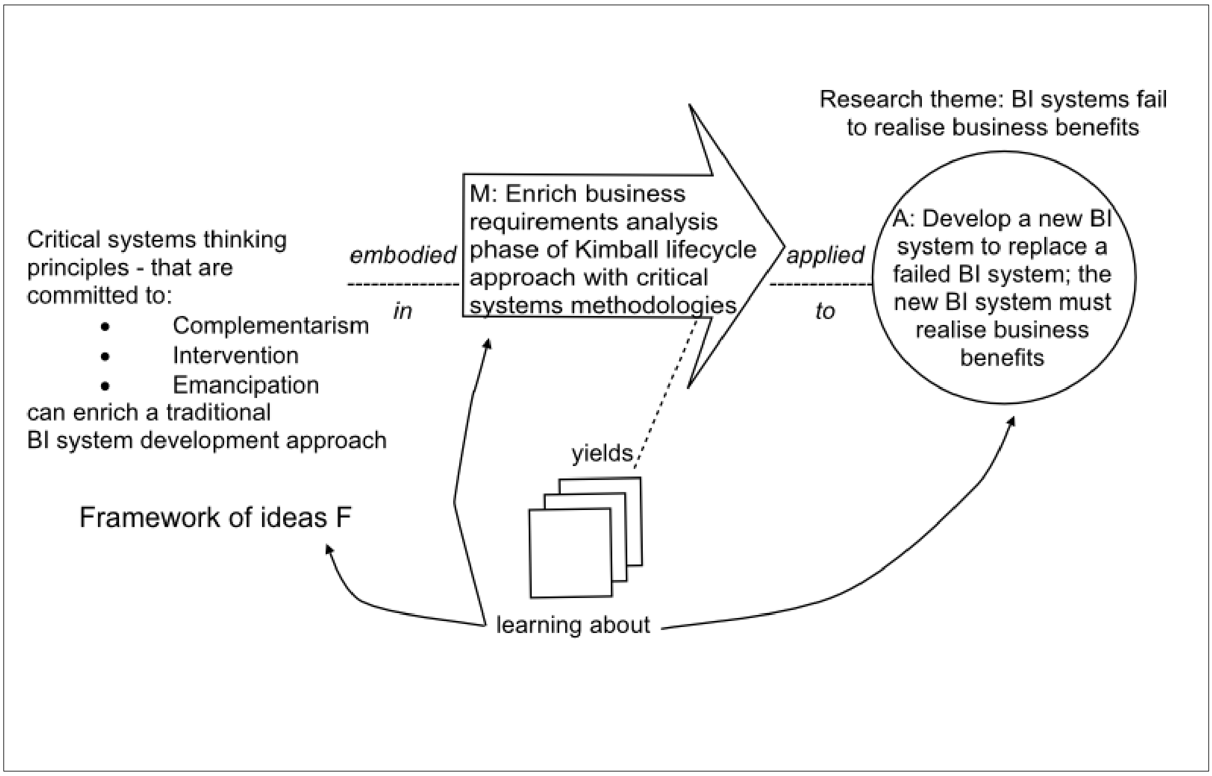


Figure 2-3: Structure of the study

Upon reflection on the CSH intervention (refer to Chapter 8), the researcher contextualises the CSH boundary questions for a BI context; this is discussed in Chapter 9.

2.7.4 Rigorous application of action research

Mathiassen *et al.* (2012:348) argue that action researchers are confronted with a dual goal: they must develop a solution to a practical (specific) problem (A) that is valuable to the recipients of their solution (such as organisational employees); simultaneously, they must also develop theoretical knowledge that is valuable to a research community that are interested in the broader problem context (the research theme). The practical problematical situation represents the broader problem context (research theme); the researcher relieves the practical problems (A) to also learn about the problem context (research theme) in general. Mathiassen *et al.* (2012:349) therefore argue that action researchers engage in a *problem-solving cycle* (to relieve the problematical situation) as well as a *research cycle* (to learn about the broader problem context) to improve an identified area of concern. The problem solving as well as research cycle of this study is discussed in detail in Chapter 5.

Since this action research study is conducted from a critical social research perspective, the principles for critical social research in information systems of Myers & Klein (2011:23) may be use to guide the intervention.

2.7.4.1 Insight in the problem situation

Myers & Klein (2011:23) suggest that the critical social theory researcher should have insight into the research situation, i.e. he/she should understand and describe the research context prior to engaging in research activities. The researcher applies action research to understand and describe the research context; the action research process is discussed earlier in this chapter. The researcher conducts a literature review to confirm the actuality of the diagnosed area of concern, i.e. the research problem: The researcher confirms in Chapter 3 that BI is important for organisation; however, success rates of BI systems remain low. In an attempt to identify the cause(s) for low success rates of the BI system, the researcher identifies shortcomings in development approaches as well as in requirements collection approaches; this is discussed in Chapter 3.

2.7.4.2 Critique the research situation

Secondly, Myers & Klein (2011:23) suggest that the researcher critiques the research situation. He/she should aim to “reveal the normative basis of the current situation found in the research site and the forms of legitimation that justify the current social order”, i.e. the researcher should aim to identify power structures

(Myers & Klein, 2011:23). The critical researcher should organise data collection and analysis around core concepts and ideas of critical social theorist(s) (Myers & Klein, 2011:25). These social theories should be used to orient the researcher's data collection and interpretation processes; still, the social theories should ultimately also be evaluated and may then possibly be improved (Myers & Klein, 2011:31).

This study applies the philosophical lineage of critical scholars (e.g. Flood and Jackson as well as Ulrich, which embody the work of Jürgen Habermas) and their approach to critical systems thinking, in terms of complementarism, awareness and emancipation, to the identified research problem. The researcher applies critical systems methodologies, which are positioned in the critical systems thinking paradigm, to the research problem. Chapter 4 discusses the philosophical stance and application of critical systems methodologies.

Whilst still critiquing the research situation, Myers & Klein (2011:25) also state that the researcher takes a value position since values are an important object of inquiry by which to compare competing value sets and hence determine a defensible ethical stance in social political matters. The researcher of this study believes that efficacious BI systems emancipate organisations in that they improve strategic decision making; BI system developers must also apply enquiry processes (e.g. during business requirements elicitation) that enable the end users of such software artefacts to articulate their requirements appropriately so that systems can be developed to be technically feasible as well as realise their intended business benefits and improve their decision making processes. For this study, the researcher believes that this will result in individual as well as organisational emancipation: individuals (organisational users of BI systems) are emancipated when they are empowered to voice their requirements appropriately through a process that enables them to surface their real (normative) requirements; software developers are emancipated when they can develop systems with high success and adoption rates; and organisations are emancipated when implemented BI systems realise real (normative) business benefits and hence improve organisational decision making processes and ultimately its decisions. She therefore applies critical systems methodologies to emancipate the participants in this research study.

Then, the last component that is aimed at critiquing the research context, Myers & Klein (2011:25) assert that the researcher must identify important beliefs and social practices; he/she must then challenge these beliefs and practices with potentially conflicting arguments and evidence to determine what counts as legitimate knowledge and information and the appropriate uses thereof. For example, BI systems may alter power balances in an organisation by making critical (and objective) information available and easily accessible to all organisational members; BI systems may also possibly affect hierarchical management structures when objective information becomes freely available and expose, for example, performance-related issues in real-time. In this study, the researcher aims to identify possibilities for improvement on an individual and organisational level and also in terms of the applied critical systems methodologies and their underlying social theories. This study incorporates two critical systems thinking strands, i.e. total systems intervention and critical systems heuristics. Chapter 6 proposes theoretical guidelines, derived from the literature, for the use of critical systems methodologies, i.e. total systems intervention and critical systems heuristics, in business intelligence system development. Chapters 7 and 8 discuss the application of these guidelines to a diagnosed problem situation (discussed in Chapter 5). Chapter 9 discusses the contextualisation of the critical systems heuristics guidelines for a business intelligence context.

2.7.4.3 Improve the research situation through transformative redefinition

Thirdly, Myers & Klein (2011:24) argue that transformative redefinition implies that the organisational context must be improved through the development of "critical, managerially relevant knowledge and practical understandings"; transformative redefinition refers to individual emancipation, improvements in society as well as improvements in social theories, i.e. transformative redefinition is the result of the research activity. Improved BI systems emancipate organisations in terms of improved decision making capabilities, whilst appropriate requirements elicitation processes emancipate users to articulate their real business requirements to ensure that developed artefacts realise user's real business benefits.

The application of critical systems methodologies, which aim to surface oppressing structures, results in improvements in society; in this study society refers to the organisational context where the business intelligence system is implemented. For example, Myers & Klein (2011:28) refer to the work Flood & Jackson (1991a), i.e. the total systems intervention methodology, which they maintain can be applied as an emancipatory information systems/software development approach. The researcher also explores the critical systems heuristics strand of critical systems thinking, i.e. the work of Ulrich (1983), in this study.

Myers & Klein (2011:28) argue that research interventions also result in "growth and improvement of theoretical knowledge"; social theories embodied in applied methodologies may thus also evolve as a result of research activities. Checkland & Holwell (1998:25) agree that critical research practices also yield improvements in the underlying social theories, i.e. the framework of ideas embodied in the applied methodologies and hence the methodologies are also improved.

2.7.5 Principles for action research

Rigorous application of action research necessitates that it encapsulates five principles, i.e. the principle of historical continuity; the principle of reflexivity; the principle of dialectics; the principle of workability and ethics; and the principle of evocativeness (Heikkinen *et al.*, 2012:8). These principles are applied to ensure rigour in this study; the application thereof is evaluated in Chapter 10. The principles are as follows:

- *Historical continuity* refers to the way that the history of action evolved historically as well as the logical and coherent manner in which the narrative proceeded (Heikkinen *et al.*, 2012:8).
- *Reflexivity* refers to three elements, i.e. the nature of the researcher's relationship with the research object (subjective adequacy); the researcher's presumptions about knowledge and reality (ontology and epistemology); and

extent to which the researcher describes material and methods used transparently (Heikkinen *et al.*, 2012:8).

- *Dialectics* includes the elements of dialogue, i.e. the way in which the researcher's insight developed in dialogue with others; polyphony, i.e. the extent to which the research report presents different voices and interpretations; and the authenticity of the protagonists of the narrative (Heikkinen *et al.*, 2012:8).
- *Workability and ethics* evaluate the following: pragmatic quality, i.e. the extent to which the research succeeded in creating workable practices; criticalness, i.e. the kind of discussion that the researcher provokes; ethics, i.e. the manner in which the researcher deals with ethical problems; and empowerment, i.e. the extent to which the research enables people to believe in their own capabilities and possibilities to act and thereby encourage new practices and actions (Heikkinen *et al.*, 2012:8).
- *Evocativeness* reflects the extent to which the research evokes mental images, memories or emotions related to the theme.

2.8 Data collection methods

Baskerville & Wood-Harper (1996:242) confirm the empirical nature of action research; however, they caution that data collected during the action research process "may be very unstructured". Therefore, to ensure rigorous and credible research, they suggest that "action researchers plan methodical data collection methods" (Baskerville & Wood-Harper, 1996:242). This study includes the collection of qualitative data through interactive focus groups and structured interviews. The researcher also uses official documents from the organisation where the research is conducted. These are discussed in the next sections.

2.8.1 Interactive focus groups

Interactive focus groups are used "to acquire as much information as possible from a group of experts on a given topic" and to "extract expertise and insights from the participants" (Sutton & Arnold, 2013:82). The use of an interactive focus group enables a researcher to gather data in a relatively short period of time and "provide a synergistic output"; the researcher can gather all relevant information in a session lasting between one and two hours (Lederman, 1990:120). A focus group is similar to a group interview; it may produce more rapid results and provides an opportunity to observe interactions amongst participants (Shelly *et al.*, 2003:106). However, a dominant individual at a group interview may also hinder results if he/she intimidates other participants (Shelly *et al.*, 2003:106). The researcher must only involve participants with appropriate expertise in the focus groups; this is to ensure that gathered data are usable (Sutton & Arnold, 2013:86). A focus group guide should be used as an agenda during the sessions; this ensures that discussion is structured and that all the required data are gathered (Lederman, 1990:122).

2.8.2 Structured interviews

Interviews allow for effective and efficient gathering of data within any research paradigm and method. Successful interviews require some pre-work, i.e. decide on the extent of the study's scope and the proposed length of interviews; draw up the interviewee list; define the appropriate degree of structure of the interviews; and schedule the interviews (Newman & Lamming, 1995:94). Interviews cannot be done successfully in isolation; the interviewer must obtain some knowledge regarding the domain he/she is investigating in order to understand the context of the problem situation being investigated (Newman & Lamming, 1995:98). Interview questions may vary between open-ended, close-ended or range-of-response questions (Shelly *et al.*, 2003:107). Interviews should only be conducted with the interviewee's (written) consent; for example, the interviewee must be assured of confidentiality and also understand that he/she may choose to withdraw from the study at any stage (Jacob & Furgerson, 2012:7). The researcher may choose to record data using "written notes or a tape recorder" (Hoepfl, 1997:52). Audio recordings ensure accurate data capturing; however, it may be perceived as intrusive (Hoepfl, 1997:53).

2.8.3 Analysis of qualitative data

Hoepfl (1997:55) argues that: "Qualitative analysis requires some creativity, for the challenge is to place the raw data into logical, meaningful categories; to examine them in a holistic fashion; and to find a way to communicate this interpretation to others". She asserts that the researcher must firstly identify themes that emerge from raw data; secondly, he/she must re-examine the data to determine links between the identified themes; and thirdly, he/she must convert the data into a story-line (Hoepfl, 1997:55).

In the study data collection and analysis is used in the action taking phases reported in Chapters 7 and 8 as well as in the contextualisation of the guidelines presented in Chapter 9.

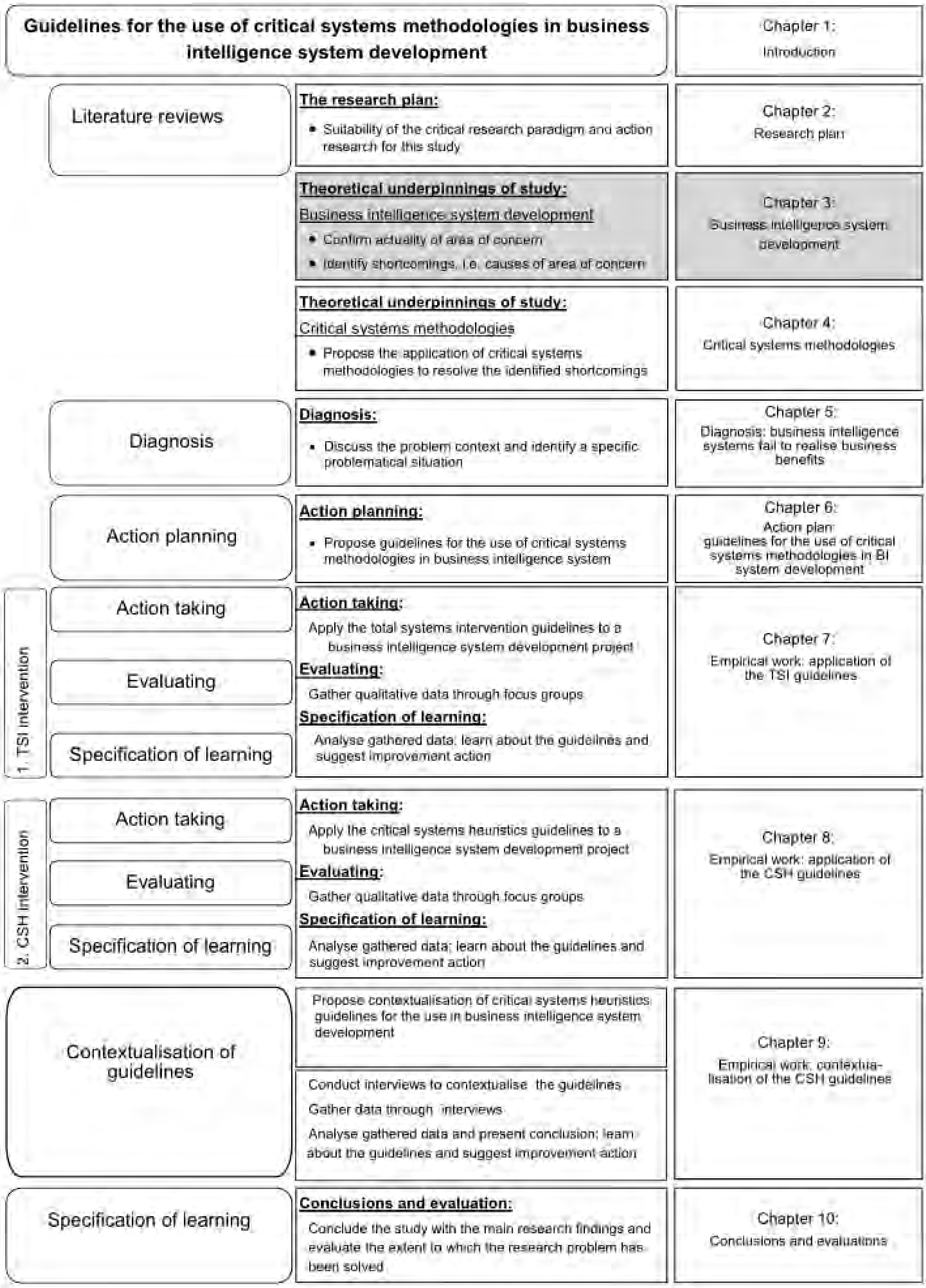
2.9 Summary

A research paradigm is defined by its ontology, i.e. what constitutes reality, and its epistemology, i.e. how we learn about reality (Scotland, 2012:9). The four main research paradigms in information systems research are the positivistic research paradigm, the interpretive research paradigm, the design science research paradigm, and the critical social theory research paradigm. These paradigms have different strengths and are suitable for different types of studies, i.e. positivistic research is suitable for studies that aim to develop a general understanding of phenomena (Orlikowski & Baroudi, 1991:5); interpretivist research is suitable for studies that aim to understand human action and humans' different perspectives (Orlikowski & Baroudi, 1991:5); design science research is suitable for studies that entail the construction and evaluation of technology-based solutions to resolve specific organisational problems (Gregor & Hevner, 2013:337); and critical research aims to intervene in social contexts and emancipate the oppressed (Wynn & Williams, 2012:793; Myers & Klein, 2011:19).

This study aims to aims to improve BI system development approaches; it aims to emancipate BI users on an individual and organisational level by applying critical systems methodologies as part of the development process. This study is performed in the critical social theory research paradigm. Action research is applied as a critical research approach that enables a researcher to join a research context; it has been successfully applied in information systems research (Myers & Klein, 2011:33; Baskerville, 1999:3; Checkland & Holwell, 1998). The researcher is part of the research context where she attempts to intervene; the research methodology that is applied in this research is thus action research.

The diagnosis phase is aimed at understanding the problem situation or business context and the shortcomings of the current systems (refer Chapter 5). The action plans in this study entail enriching the business requirements definition phase of the BI development lifecycle with the use of TSI and CSH (refer to Chapter 6). Chapters 7 and 8 report on the respective implementations of the TSI and CSH guidelines. The CSH guidelines are contextualised in Chapter 9. This overall process is depicted on the diagram that is given at the beginning of every new chapter (see next page).

The theoretical underpinnings of this study, i.e. BI system development and critical systems methodologies, are discussed in the next chapters.


Guidelines for the use of critical systems methodologies in business intelligence system development
Chapter 1: Introduction
Literature reviews
The research plan:
Suitability of the critical research paradigm and action research for this study
Chapter 2: Research plan
Theoretical underpinnings of study:
Business intelligence system development
Confirm actuality of area of concern
Identify shortcomings, i.e. causes of area of concern
Chapter 3: Business intelligence system development
Theoretical underpinnings of study:
Critical systems methodologies
Propose the application of critical systems methodologies to resolve the identified shortcomings
Chapter 4: Critical systems methodologies
Diagnosis
Diagnosis:
Discuss the problem context and identify a specific problematical situation
Chapter 5: Diagnosis: business intelligence systems fail to realise business benefits
Action planning
Action planning:
Propose guidelines for the use of critical systems methodologies in business intelligence system
Chapter 6: Action plan: guidelines for the use of critical systems methodologies in BI system development
1. TSI intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the total systems intervention guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data; learn about the guidelines and suggest improvement action
Chapter 7: Empirical work: application of the TSI guidelines
2. CSH intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the critical systems heuristics guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data; learn about the guidelines and suggest improvement action
Chapter 8: Empirical work: application of the CSH guidelines
Contextualisation of guidelines
Propose contextualisation of critical systems heuristics guidelines for the use in business intelligence system development
Conduct interviews to contextualise the guidelines
Gather data through interviews
Analyse gathered data and present conclusion; learn about the guidelines and suggest improvement action
Chapter 9: Empirical work: contextualisation of the CSH guidelines
Specification of learning
Conclusions and evaluation:
Conclude the study with the main research findings and evaluate the extent to which the research problem has been solved
Chapter 10: Conclusions and evaluations

Chapter 3 : Business intelligence system development

3.1 Introduction

The objective of this study is to develop guidelines for the use of critical systems methodologies to improve the development of business intelligence systems. This chapter gives an overview of existing business intelligence systems and software development literature. It explores the history and evolution of information technology artefacts, which explains the dominant paradigm within which current software development approaches evolved.

It then evaluates the suitability of software development approaches to effectively develop appropriate software artefacts such as business intelligence systems. Software development approaches are mostly grounded in the functionalist paradigm, i.e. it focuses predominantly on technological aspects of software development. However, business intelligence systems are used in a specific organisational context and have a social impact on its users. The purpose of this chapter is thus to identify shortcomings in current software development approaches that may be resolved by complementing technical-oriented software development approaches with critical (people-oriented) systems methodologies to also incorporate relevant human, organisational and social aspects. Requirements collection precedes software development since software artefacts are developed according to specified requirements; hence, appropriate and people-oriented requirements collection is also discussed as a driver of software development success.

This chapter is structured as follows: It starts with a discussion on the importance of business intelligence for contemporary organisations in Section 3.2. Section 3.3 briefly explores the relatively short but rapid evolution of computer hardware technology resulting in the subsequent development of structured, technologically oriented software development approaches fitting mostly within the functionalist paradigm.

Section 3.4 discusses the origin and process of traditional software development approaches such as sequential development, evolutionary development, risk-driven development and agile development. It considers the people orientation of each process, i.e. the extent that human, social and organisational factors are incorporated in the process, as well as its suitability to develop business intelligence systems.

Section 3.5 gives an overview of the data warehouse as the technological infrastructure that enables business intelligence. It discusses the origin, process and people orientation of specific business intelligence development approaches. It also discusses whether these approaches enable the development of *business intelligence* in addition to the data warehouse infrastructure that is required to enable business intelligence.

Section 3.6 gives a comparative summary of the approaches discussed in Sections 3.4 and 3.5. Section 3.7 discusses identified shortcomings in software development approaches. Section 3.8 discusses whether the criteria that are used to determine the quality of software artefacts and software development processes are people oriented and hence support the delivery of technically good as well as functional and fit-for-purpose, i.e. efficacious, software.

Section 3.9 discusses software requirements collection and the importance of appropriate business requirements in addition to technical requirements. It gives an overview of requirements collection approaches as well as identified shortcomings in these approaches. This chapter concludes by suggesting a critical requirements collection approach to enrich software development approaches and hence improve BI system development.

3.2 The importance of business intelligence

Large volumes and varieties of data are available to support organisational decision makers (Işik *et al.*, 2013:13). Decision makers that influence organisations' performance are distributed throughout organisations (Liautaud & Hammond, 2001:19). *Data* are unstructured and must still be processed and interpreted to become valuable and meaningful *information* whilst information becomes *intelligence* only when the majority of employees share insights into their collective business processes and subsequently take suitable actions to improve the organisation (Liautaud & Hammond, 2001:5). The quality, timeliness and availability of appropriate information to appropriate decision makers determine the quality of decisions and hence also the subsequent effect thereof on the organisation (Popovič *et al.*, 2012:737; Yeoh & Koronios, 2010:23). Well-informed decisions improve organisations' economic results and value since it improves planning and enables organisations to swiftly react to changing business climates (De Leon *et al.*, 2012:11). To remain competitive, organisations must therefore make better decisions quicker than its rivals; organisations must be "faster, more agile, and crucially, more *intelligent*" (Liautaud & Hammond, 2001:4).

Business intelligence (BI) provides an organisation with decision making capabilities by providing "a single version of the truth" to act upon (Inmon, 2005:60); it is a "business differentiator" that can improve decision making and operational efficiency (Marinela & Anca, 2009:382). BI includes the "skills, processes, technologies, applications and practices for business decision making…a broad category of technologies and applications for gathering, storing, analysing, and providing access to data to help enterprise users make better choices" (Liu *et al.*, 2011:326). BI is built on technological infrastructure such as the data warehouse (DW); however, it entails more than a single analytical tool, but rather a range of processes and systems to create intelligible information that can enhance organisational decisions and hence ultimately improve organisations (Inmon, 2005:60). BI must *enhance* organisational decision making; it must not merely automate current decision making processes (Gardner, 1998:55).

Business intelligence is an important focus area for many organisations. Gartner's "2013 Gartner Financial Executives International CFO Technology Study" indicates that 59% of organisations want to improve their analysis and decision making capabilities; however, organisations still struggle to progress with BI and BI success and adoption rates remains relatively low (Gartner, 2013b). The failure rate of 41%

that was reported in 2003 did not improve as was expected (Hwang & Hongjiang, 2007:1) and failure rates of 30% and 59% were reported for 2011 (Gartner, 2011:1) and 2012 respectively (Dresner Advisory Services, 2012:15).

3.3 The evolution of information technology

This section explores possible causes for the relatively low success rate of business centric software such as BI systems; it analyses the origin and subsequent advancement of mostly technically-oriented software development approaches, as opposed to holistic and critical approaches that are typically used during its design and development. The rapid, almost explosive, evolution of computers and the subsequent, however relatively slower in comparison, advancement of software development over the past few decades enlightens us as to why current software development approaches are more technically focused; traditional approaches tend to neglect the information systems' (IS) human, organisational and social dimensions (people orientation) that are essential for increased success and adoption rates (Iivari *et al.*, 2000:186). This section thus briefly explores the history and evolution of computers and software as technical artefacts and subsequently leading to the emergence of software development as a mostly technically-oriented discipline.

3.3.1 The evolution of computer hardware technology

The general-purpose programmable computer and its accompanying software program theoretically originated in 1834 with the conceptual work of Charles Babbage and Ada Lovelace: inspired by the idea to employ mechanical machinery for complex technical calculations, Babbage designed the "Analytical Engine" (Babbage, 1864:106) that would have been the first general-purpose programmable computer had he been able to build his invention (Wilkes, 1992:21). Lovelace wrote a program (albeit only an algorithm) for Babbage's invention when she added commentary to a description of the analytical engine in 1842 (Menabrea, 1843). It was however not until about a century later that sufficient resources were available to build programmable computers; still not originally designed for private or even public use it was built for use by government and military organisations and adapted for civil use after World War II (Zuse, 1980:139).

During World War II three countries (Germany, Britain and the United States of America) were simultaneously, however separately and without knowledge of each other's work, busy with computer technology studies; their respective designs were quite similar and mostly inspired by Babbage's work (Aiken & Hopper, 1946:384; Eckert *et al.*, 1952:6; Flowers, 1983:239; Zuse, 1980:239). After the war computer technology advanced at an astonishing pace – from the "51 feet long and 8 feet high" Mark I computer intended to be used solely by the government (Aiken & Hopper, 1946:386) to inexpensive, minute in comparison, single-chip microprocessor architecture (Boone, 1973) that resulted in portable and personal computers that are used in government and military organisations, businesses, schools and private homes alike, in less than three decades. Computer technology market penetration evolved globally from only 845 computers sold in 1981 (Collins, 1984:76) to 295.8 million computers sold in 2011 (Marketline, 2012:7); with the exponential growth and universal use of computers, together with the commercialisation of the internet and electronic communication in the 1980s (Kahn *et al.*, 1997:147), information technology became indispensable and also inevitably intermingled with the social structures of its consumers, as was foreseen in the 1960s already (Naur & Randell, 1969). Allan Kay's (1972:1) speculative vision about the "science fiction" of "personal, portable information manipulators" to be used merely as an educational tool became a reality in the education sector, but vastly more so in the business and private sectors.

Looking forward, Gartner (2013a) predicts that "smart machines" will have the capability to replace knowledge workers by 2020, by 2024 10% of potentially harmful human activities will require mandatory use of some sort of a "smart system" that can automatically respond to external events and by 2017 10% of computers will be "learning rather than processing". This can, however, only realise when the art of designing and developing software artefacts evolves in parallel with the technological advancement of the hardware artefacts that it supports, whilst taking cognisance of its influence on modern society and vice versa (Alkobaisi *et al.*, 2012:63; Checkland & Holwell, 1998:7; Naur & Randell, 1969). Technological innovation and the evolution of hardware technology on its own cannot make a system "smart"; the enabling software must be designed appropriately to enable systems to perform suitably and according to its user's need, i.e. to be efficacious. This is especially true for business centric systems such as BI that must enable its users to "do a better job" (Kimball & Ross, 2010:107). Unfortunately, software development approaches did not advance as rapidly as the hardware technology that it supports and still encompass reductionist assumptions, i.e. decisions are assumed to be rational and driven by technical criteria and that software applications merely exist to resolve systematic problems (Sommerville *et al.*, 2012:74). Checkland & Holwell (1998:9) rightly argue that "the rate at which thinking about the field has developed has not matched that which the technology has changed".

3.3.2 The evolution of software engineering and development approaches

Programming languages and software became necessary to support the programmable hardware that was being developed from the 1940s onwards; for example, Konrad Zuse developed an algorithmic language (the "Plankalkül") for the first commercial Z4 computer in Germany (Zuse, 1980:240). Zuse's Plankalkül language was, as many others that followed, algorithmic and based on Boolean logic as described by George Boole (1847). Following the commercialisation and wider use of computers, programmers such as Hopper & Mauchly (1997:470) acknowledged the need for standardisation in the programming field. Consequently, Grace Hopper completed the first compiler program in 1952 (Hopper & Mauchly, 1997:470). Still, the software development method mostly consisted of repetitive code-and-fix activities until Herbert D. Benington (1983:350) presented the first formal description of sequenced software development activities in 1956 at a symposium dedicated to "*advanced programming methods for digital computers*". Benington's (1983:350) proposed software development method included activities such as operational planning, machine-and-operational and program specifications, coding specifications, coding, parameter testing, assembly testing, shakedown and system evaluation. However, the term "software engineering", which gave birth to modern software development approaches was introduced only a decade later as the "deliberately provocative" title for the first conference on this topic; "software engineering" was introduced by Professor Fritz Bauer at the first NATO software engineering conference in 1968 (Randell, 1996).

According to Randell (1996) the NATO software engineering conference followed upon the realisation that an informal approach to software development was no longer sufficient for increasingly complex information systems; therefore, discussions included topics such as software design, production, implementation, distribution as well as difficulties that developers may encounter in keeping to specifications and schedules. The organisers of the first software engineering conference recognised software artefacts and information systems as an integral part of the community that it serves when they referred to "data systems which are becoming increasingly integrated into the central activities of modern society"; information systems, software and software development processes were recognised in the late 1960s already as an intricate part of the modern social world and thus to be explored as part of prevalent social structures (Naur & Randell, 1969). As a result, one may think that software engineering and software development approaches would have naturally developed as a social science since this first conference on the topic. A fleeting yet comparative look at a high level time line of computer-related technology and software development process advancements also leaves the reader with an impression that there were more or less an equal amount of advancements in both fields over the past few decades; Figure 3-1 below illustrates the evolution of hardware and software development approaches that are most widely discussed in the literature.

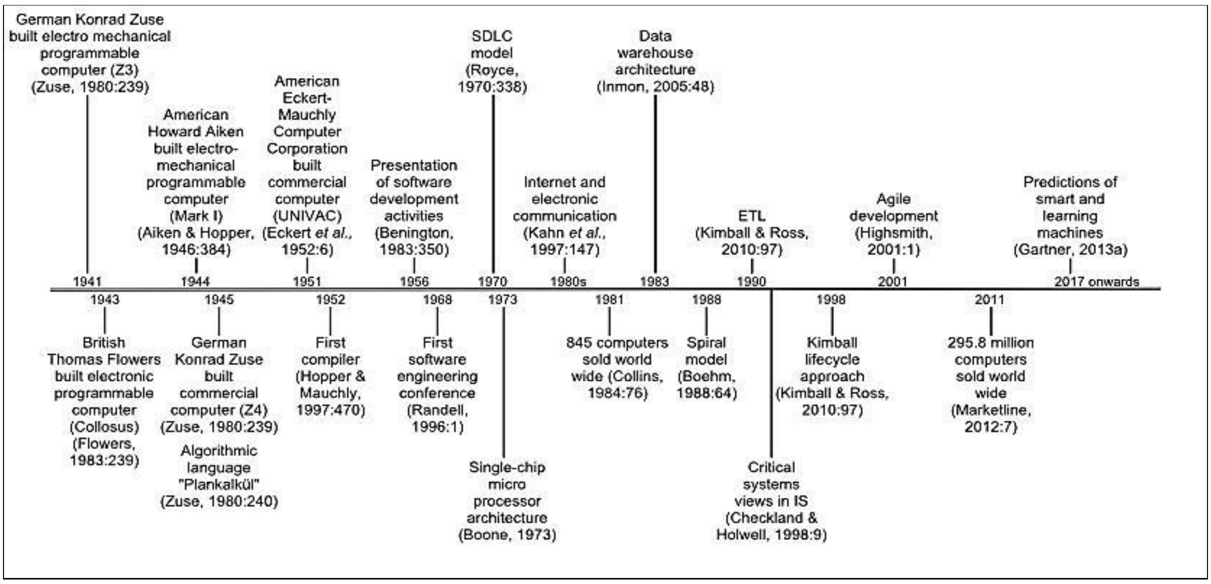


Figure 3-1: High level time line: the evolution of computer technology

The idea of information technology as a social science emerged formally in the 1990s (Checkland & Holwell, 1998:9); the "challenge to build reliable computers, networks and complex software" resulted in a stagnant engineering view dominating from the 1940s until the 1980s (Denning & Freeman, 2009:28). From the 1990s onwards some authors questioned the value of formal development methods in its entirety (Wynekoop & Russo, 1995:70) whilst others cautioned against abandoning formal methodologies (Avison & Fitzgerald, 2003:81) and critical systems views developed in IS fields (Checkland & Holwell, 1998:9; Iivari *et al.*, 1998:164). Still, this is not yet fully entrenched in the practices of software development where practitioners have limited time and resources (Gasson, 1995:1), as can also be seen in the next section dedicated to traditional software development approaches. Most of the traditional software development approaches that are used in practice, including BI system development approaches, still focus mainly on technological aspects and tend to neglect the social, human and/or cultural dimensions, regardless of attempts to incorporate critical system views (Iivari *et al.*, 2000:168).

3.4 Software development approaches

An information system (software) development (ISD) methodology consists of phases that encompass "procedures, techniques, tools, and documentation" to aid developers to "plan, manage, control, and evaluate IS projects" (Avison & Fitzgerald, 2006:24). A *methodology* differs from a recipe-like *method* in the sense that a methodology is an *approach* that is based on a philosophical view (Avison & Fitzgerald, 2006:24). According to Iivari *et al.* (2000:186) an ISD approach refers to a collection of specific ISD methods with some shared features pertaining to its goals, guiding principles and beliefs, fundamental concepts as well as the process principles. Iivari *et al.* (2000:186) classify ISD approaches as being grounded in either the functionalist or non-functionalist paradigm; functionalist approaches focus mostly on the technological aspects of ISD whereas non-functionalist approaches attempt to at least become aware of relevant social, human and/or cultural aspects with regard to ISD (Iivari *et al.*, 2000:186). They also note that non-functionalist approaches are not as readily documented in the literature as the functionalist approaches, and also not as readily used. Table 3-1 below summarises the approaches as classified by Iivari *et al.* (2000:191-194).

Table 3-1: ISD approaches (Iivari *et al.*, 2000:191-194)

Functionalist approaches	Non-functionalist approaches
1. Structured approach e.g. waterfall model, prototyping. 2. Information modelling. 3. Decision support systems/software (mostly semi-structured) e.g. evolutionary (adaptive) development. 4. Sociotechnical approach. 5. Object-oriented approach e.g. iterative, incremental development. 6. Infological approach.	1. Interactionist approach. 2. Speech-act (SA) based approach. 3. Soft systems methodology (SSM) approach. 4. Trade unionist approach. 5. Professional work practice approach.

Traditional software development approaches that originated in the 1960s, 1970s and 1980s, including approaches aimed at BI development (decision support systems), are according to Iivari *et al.* (2000:192) grounded within the functionalist paradigm.

For the remainder of this chapter, the researcher focuses on approaches mostly documented and used: Sommerville (2011:29) discusses generic software development process models (he refers to these as paradigms) and mentions the following: the waterfall model (sequential development); incremental (evolutionary) development; and reuse-oriented software development (integration of pre-developed components). He also discusses agile software development as an incremental development approach used in environments where the user requires software to be deployed in a short space of time (Sommerville, 2011:56), and Boehm's risk-driven spiral model (Sommerville, 2011:56). Sequential, evolutionary, agile, and spiral development approaches are generic models and can therefore be applied to develop any software system, including BI systems; these are thus discussed later in this chapter. Reuse-oriented development focus on the integration of predeveloped components, rather than on the development process; since it is therefore not regarded strictly a development process it is not discussed further in this chapter.

Additionally, in the literature on data warehousing and BI, the most prominently discussed approaches are for example the Kimball lifecycle approach (Kimball & Ross, 2010:97), Inmon's corporate information factory (Inmon *et al.*, 2001:7), and Linstedt's data vault method (Linstedt, 2002).

In summary, the following approaches are discussed in the next sections:

- Sequential development such as the waterfall method that cascades linearly from one phase to the next (Bell & Thayer, 1976:62).
- Evolutionary approaches that focus on interactive and continuous requirements development as part of the software production process (Randell & Zurcher, 1968:867).
- The spiral method encompasses any other method(s) and is inherently a risk-driven approach (Boehm, 1988:61).
- Decision support system/software development approaches focus on developing the data warehouse (DW) and BI. It includes for example the Kimball lifecycle approach (Kimball & Ross, 2010:97), Inmon's corporate information factory (Inmon *et al.*, 2001:7) and Linstedt's data vault method (Linstedt, 2002).
- Agile development does not appear in the classification Iivari *et al.* (2000:192); agile development was introduced in 2001 (Highsmith, 2001:1) – and thus after the publication of Iivari *et al.* (2000:192) – to develop software more rapidly and at a lower cost (Green *et al.*, 2010:144; Prakash *et al.*, 2012:458). The principles of agile methods are to a certain degree similar to that of evolutionary development.

This section discusses current software development approaches and associated software development methods and illustrates that very little have changed since its origin. Even though authors such as Avison & Fitzgerald (2006:11), Iivari *et al.* (2000:192) as well as Checkland & Holwell (1998:9) support the incorporation of methodologies that explore social and cultural dimensions when developing information systems, it is not yet generally applied in practice. Software development approaches, including approaches that specifically aim to develop BI, did not advance in parallel and as rapidly as its hardware counterparts in order to holistically support the social nature of information system development as well; it appears to have remained predominantly functionalistic (Denning & Freeman, 2009:28; Iivari *et al.*, 2000:191). These approaches are discussed further in terms of: the origin of the approach; the process that is followed when applying this approach in a software development project; the people orientation of the process, i.e. the extent to which the approach is cognisant of the human, social and organisational context of the software artefact being developed; and its suitability for BI development. Soft systems methodology (SSM) is listed by Iivari *et al.* (2000:192) as a non-functionalist ISD approach. SSM is, however, discussed in this chapter as a requirements collection methodology since it is aimed at understanding organisational context (Checkland & Holwell, 1998:173) rather than developing software artefacts per se.

3.4.1 Sequential development

3.4.1.1 The origin of sequential development

The software development lifecycle (SDLC) is often referred to as the traditional software development approach (Avison & Fitzgerald, 2006:35). The SDLC greatly influenced the way that software is being developed (Avison & Fitzgerald, 2006:44). Dr Winston W. Royce (1970:338) is widely recognised for his formal representation of the SDLC in his well-known paper on the management of large software development projects published in 1970. Figure 3-2 below is a summarised illustration of the SDLC described by Royce (1970:338); it includes activities such as system and software requirements, design and analysis, coding, testing, and operations. Royce's model is, however more generally termed, similar to a description of software development activities that was published in 1956 by Benington (1983:350).

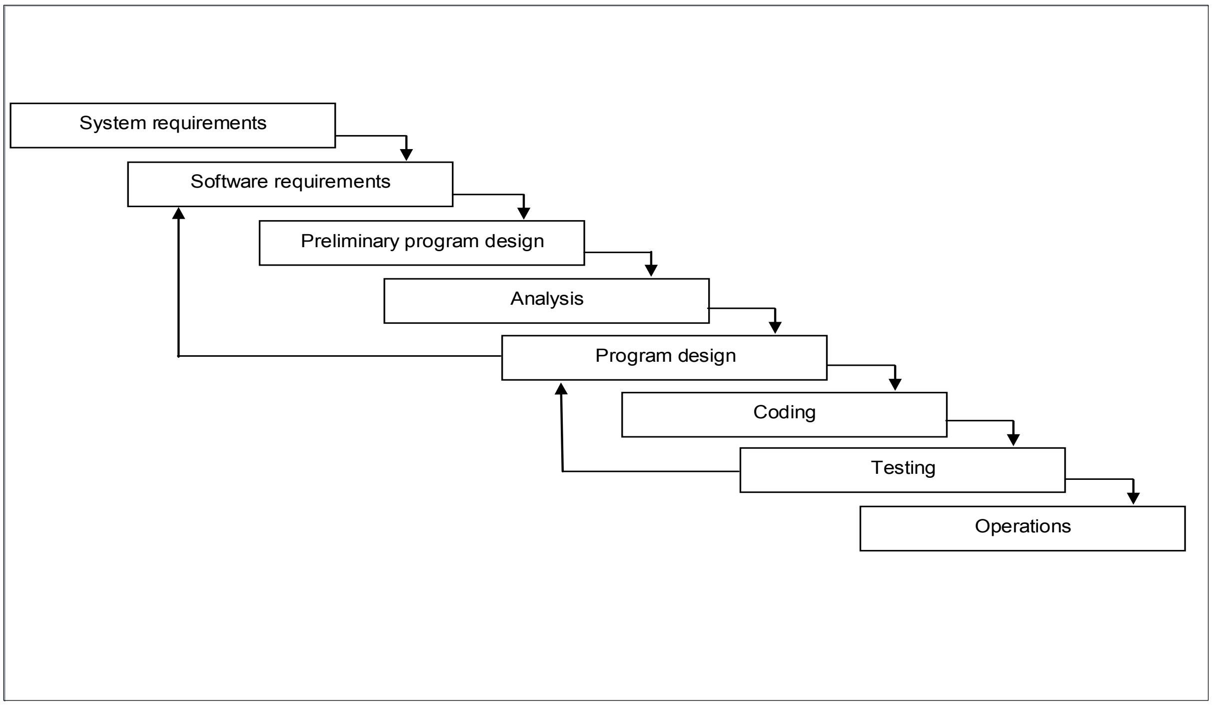


Figure 3-2: The software development lifecycle (adapted from Royce, 1970:338)

The waterfall method is a well-known example of a structured sequential lifecycle approach. It is the oldest and most widely used for large and complex software development projects (Shukla & Saxena, 2013:20). Even though Winston W. Royce is associated with sequentially phased software development (Hina Gull *et al.*, 2011:255; Sommerville, 1996:269), Royce (1970:328) stated that successive development phases ideally be iterated at least twice prior to proceeding to the next phase to minimise development risks, rather than following the steps strictly sequentially. The term “waterfall” was first formally introduced by Bell & Thayer (1976:62) where they refer to Royce’s model as a “top-down approach” suggesting that “software is developed in the disciplined sequence of activities”

3.4.1.2 The sequential development process

The waterfall method includes phases such as system and software requirements, design, coding, testing, operations and maintenance; all phases are executed sequentially and must thus be completed prior to moving to the next phase. Figure 3-3 below illustrates a pure waterfall approach to software development as described by Bell & Thayer (1976:67).

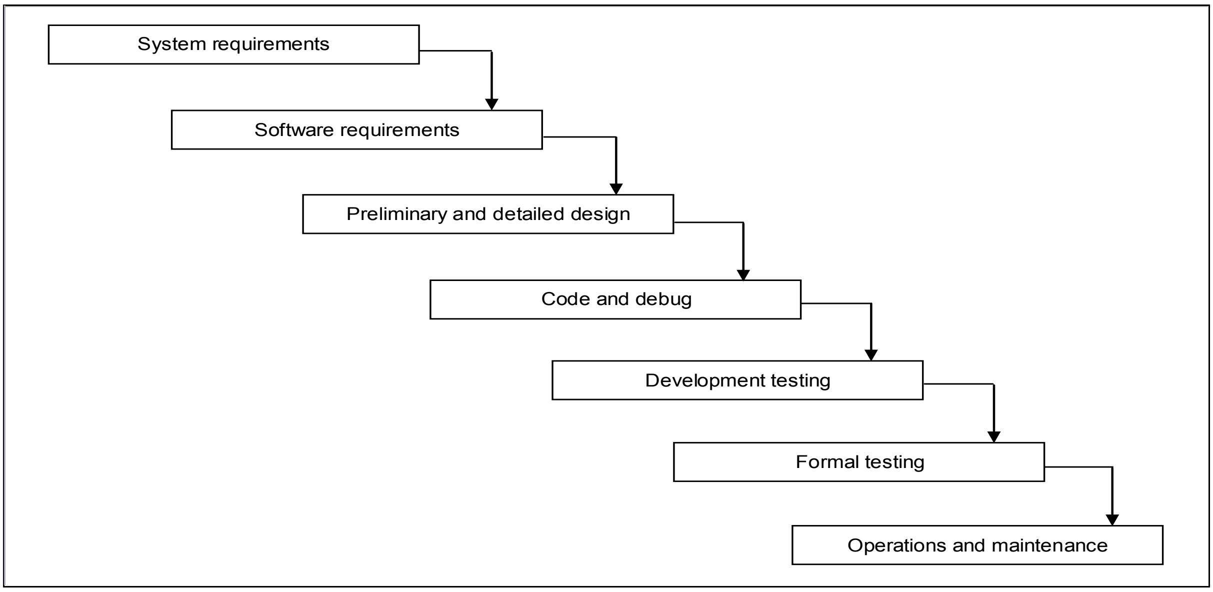


Figure 3-3: A waterfall model (adapted from Bell and Thayer, 1976:67)

3.4.1.3 People orientation of sequential development

The philosophical underpinning of the SDLC is not explicitly stated but may be derived as "computer systems are usually good solutions to organizational problems and processing" (Avison & Fitzgerald, 2006:35). The waterfall method's sequential nature presumes that requirements are clear, well known and can be accurately gathered at the beginning phases of a software development project (Prakash *et al.*, 2012:457). This method lacks feedback from the previous phase to the next (Sommerville, 1996:269). The sequential SDLC cannot accommodate new and/or changing requirements: it does not allow stages to overlap; quality assurance is lacking during the development phases; the different stages can take long to complete resulting in poor resource estimations; and there is no working product until late in the process (Hijazi *et al.*, 2012:9). It does not take the human, social and organisational context of the artefact being developed into account since Bell & Thayer (1976:67) illustrates that it starts with the definition of technical *system* and *software* requirements rather than *user* and *business* requirements. Even though technically appropriate software artefacts may be produced with this method, the pure sequential approach lacks people orientation.

3.4.1.4 Suitability of sequential development for business intelligence

The waterfall method is still the most eminent method for large projects (Shukla & Saxena, 2013:20). However, Kimball & Ross (2010:107) argue that a strict sequential development approach is not suitable to develop a BI system; they say that this method's rigid, lengthy process inhibits the incorporation of new/changing business requirements that is inherently part of BI system development.

3.4.2 Evolutionary development

3.4.2.1 The origin of evolutionary development

According to Larman & Basili (2003:2) Walter A. Shewhart laid the foundation for general iterative and incremental development work when he described the first problem-solving concept upon which the "plan-do-check-act cycle", i.e. the four basic quality improvement process steps, was based; this was done in his 1939 book "Statistical Method From the Viewpoint of Quality Control" (Edmund, 2010:21). With regard to iterative and incremental software development processes: Randell & Zurcher (1968:867) described the concept of iterative and incremental software development at a congress in 1968 where they recommended that an evolutionary approach may result in better quality software systems since most software and system related problems can only be detected once software has been built and used; by designing, building and evaluating software systems iteratively and incrementally problems can thus be detected and resolved prior to proceeding to a next (more complex) level of design.

3.4.2.2 The evolutionary development process

Prototyping is a well-known evolutionary software development approach; it can be used exploratory (software design and specifications evolve as the software is developed) or simply to develop specifications (throw-away prototyping) (Avison & Fitzgerald, 2006:124). Even though Royce (1970:334) is mostly associated with sequential software development he actually promotes a prototyping approach to develop and refine specifications. He says that it is preferred "that the version finally delivered to the customer for operational deployment is actually the second version insofar as critical design/operations areas are concerned"; the preliminary program design step (the third step in Figure 3-4 below) must include a complete, however relatively scaled-down, iteration of the remaining six development phases: the *first* iteration provides a simulated model and "the entire process done in miniature, to a time scale that is relatively small with respect to the overall effort" to develop better-quality specifications and the *second* iteration provides the final product (Royce, 1970:334). Figure 3-4 below illustrates the preliminary design step that includes an iteration of the last six steps to build a "simulation" (prototype) of the product prior to proceeding to the fourth step to continue to develop and implement a final product.

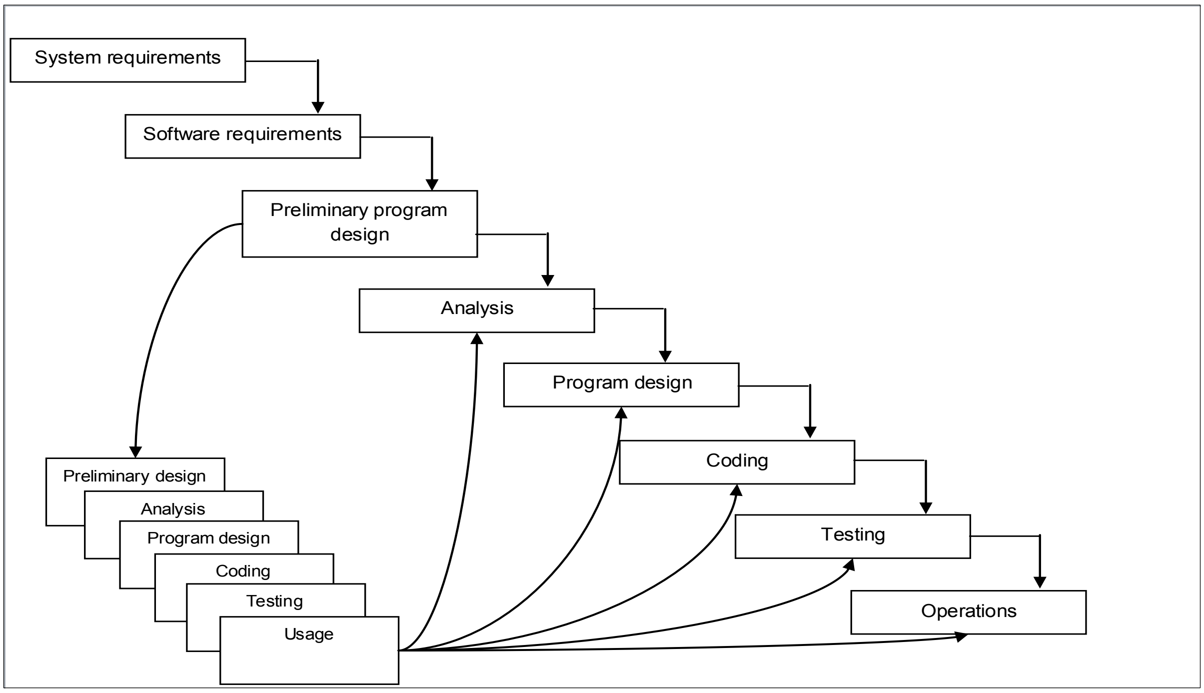


Figure 3-4: "Step 3: Attempt to do the job twice…" (Royce, 1970:334)

3.4.2.3 People orientation of evolutionary development

The objective of exploratory development is to engage with a customer to explore requirements whilst delivering a final software artefact; it focuses strongly on end-user requirements by rapidly developing prototype(s) of the software from abstract specifications whilst the artefact evolves as new features are proposed by the customer and added by the developer of the software (Sommerville, 2011:38). Prototype(s) are evaluated by end users and improved by incorporating user feedback (Sommerville, 1996:270). An evolutionary development approach attempts to accommodate changing and evolving requirements as part of the development process since a prototype is developed, evaluated and reworked until all stakeholders are satisfied (Hina Gull *et al.*, 2011:256). The evolutionary approach integrates the specification, design and implementation phases and hence leads to products that better suit end-user's requirements (Sommerville, 2011:38).

The exploratory nature and strong user involvement of evolutionary development allows the developer to incorporate the human, social and organisational context during the development phases of the software artefact since it allows users to clarify that their business requirements are met by the technical design (Hina Gull *et al.*, 2011:256; Sommerville, 2011:46). It may however neglect critical organisational requirements; constant software changes may result in a product that is poorly structured and hence difficult to maintain; the process is not visible; and progress may be difficult to manage (Sommerville, 1996:270; Sommerville, 2011:47). Evolutionary development approaches are thus people oriented; however, the development process must be astutely managed to also incorporate the advantages of structured development to also develop technologically good and stable software artefacts.

3.4.2.4 Suitability of evolutionary development for business intelligence

Kimball & Ross (2010:107) suggest that successful BI necessitates an incremental development approach such as evolutionary development approaches. Sommerville (2011:48) argues that an evolutionary development approach is mostly suited for relatively small systems, systems with short lifetime expectancy or development of systems as part of a larger system where detail cannot be specified in advance. Still, MacCormack (2001:76) reasons that evolutionary development provides the most success and can be used for large and complex projects as well; providing an initial low-functionality version of the final product (or at least a portion thereof in the case of large and complex software) for customers to evaluate early in the development lifecycle dramatically increases the quality of the final product. An evolutionary development approach can thus be suitable for BI development.

3.4.3 Risk-driven development

3.4.3.1 The origin of risk-driven development

Risk-driven development aims to identify risks and formulate cost effective strategies to resolve identified risks continuously throughout the software development life cycle (Boehm, 1988:61). The spiral method was proposed by Barry W. Boehm in 1988 as a risk-driven, rather than a document/code-driven, software development approach that can incorporate any method or combination of methods (Boehm, 1988:61). The spiral software development method is an incremental method that is suitable for complex software projects (Shukla & Saxena, 2013:18). This method attempts to integrate evolutionary and specification based development approaches (Sommerville, 1996:270).

3.4.3.2 The risk-driven development process

The spiral method takes the form of a spiral with each loop representing a (non-prescribed) phase of the software process; each loop is split into four sectors i.e. objective setting, risk assessment and reduction, development and validation, and planning (Boehm, 1988:64). The spiral method is not evolutionary in the sense that it iterates implementations; it simply revisits each phase until final implementation of the product to manage/reduce risks associated with the project (Avison & Fitzgerald, 2006:123). Figure 3-5 below illustrates the spiral model (Boehm, 1988:64).

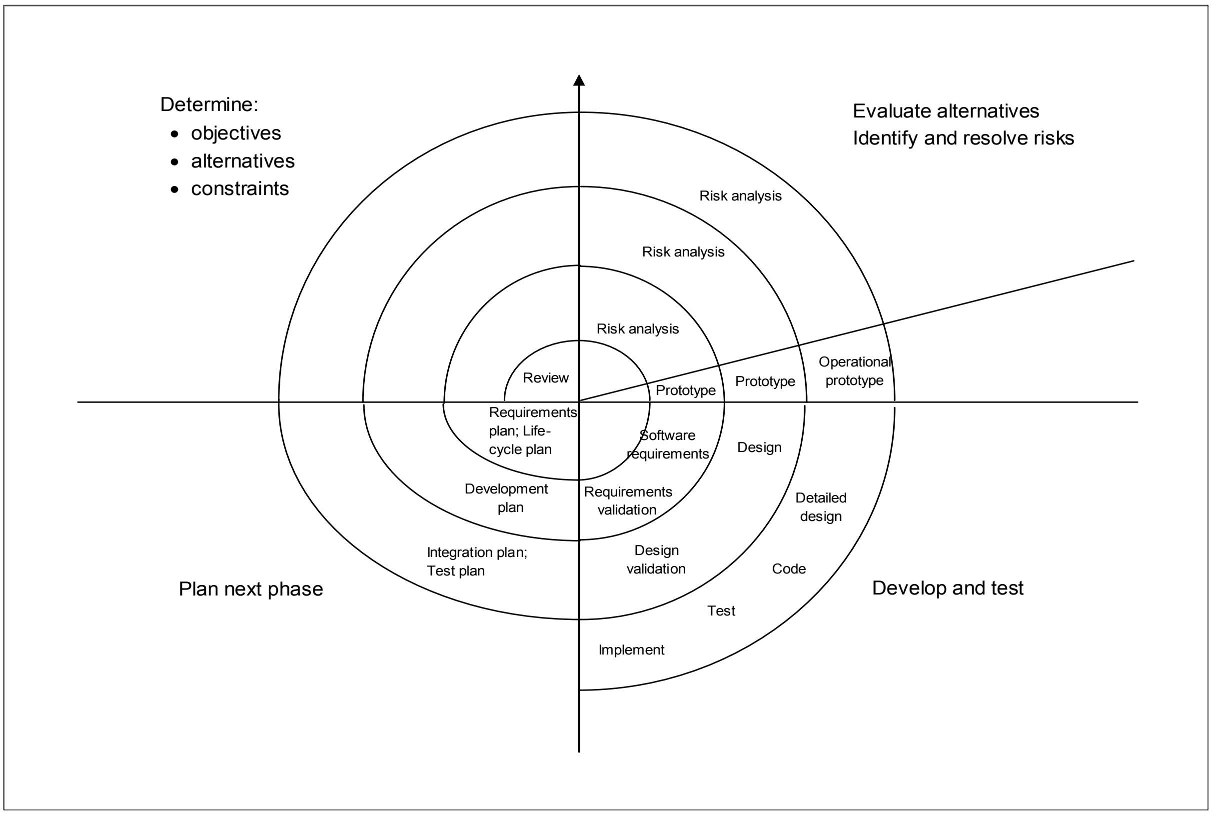


Figure 3-5: A spiral model (adapted from Boehm, 1988:64)

3.4.3.3 People orientation of risk-driven development

The spiral method encompasses other process method/(s); its orientation towards the involved and affected people will therefore be inherited from the method(s) utilised within this approach. Its main focus is risk-reduction (Sommerville, 2011:48).

3.4.3.4 Suitability of risk-driven development for business intelligence

The spiral method may encompass any other process model or a combination of methods and hence also the advantages and disadvantages of such method(s); it focuses mostly on reducing risk (Sommerville, 2011:48). It's suitability for the development of BI thus depends on the method(s) that it encompasses.

3.4.4 Agile development

3.4.4.1 The origin of agile development

Traditional software development approaches (as described above) can be time-consuming; modern organisations change rapidly and hence require supporting software development processes that can change equally rapidly (Boehm, 2002:64; Sommerville, 2011:13). Highsmith (2001:2) states that agile ("light") development techniques were introduced in 2001 as an alternative to traditional ("heavy") development methods.

3.4.4.2 The agile development process

An agile development cycle consists generically of four systematically segregated and distinct phases (Green *et al.*, 2010:146):

1. Phase I: planning, architecture and high level design – all the desired product requirements are stated at some level and captured through user stories;
2. Phase II: analysis and prioritisation – the product owner and software development team analyse backlog actions and prioritise desired features for iteration;
3. Phase III: design and code – design and coding continually evolve; and
4. Phase IV: integration, test, document and release – design and coding continues but now also includes testing, documentation, release and deployment of the software and finally product demonstration.

Since software is developed iteratively and incrementally, whilst continuously verifying requirements and evolving products accordingly, agile development methods resemble evolutionary development approaches (Hijazi *et al.*, 2012:11). There are a number of agile methods that are increasingly used in organisations e.g. extreme programming, feature-driven development, the crystal clear method, the scrum framework, the dynamic systems development method and adaptive software development (Highsmith, 2001:1). For example, the scrum framework, which is widely used, is defined as "a management framework for incremental product development using one or more cross-functional, self-organizing teams"; projects that follow scrum are organised around small teams of about seven people each

(James, 2012). Each team uses iterations (sprints) to develop a portion of the artefact (James, 2012). Within every sprint the team aims to develop the final version of a product increment; a sprint starts with the setting of sprint goals, which includes the functionality to be delivered at the next release (Bates & Yates, 2008:14).

3.4.4.3 People orientation of agile development

According to the manifesto for agile software development, all agile methods focus on four core values (Beck *et al.*, 2001a:1): firstly, agile development favours individuals and the interactions between them over processes and tools; secondly, developers aim to produce working software rather than comprehensive documentation; thirdly, according to agile developers customer collaboration is more important than lengthy contract negotiations; and fourth, developers choose to respond rapidly to change rather than to strictly follow a plan.

Nerur *et al.* (2005:77) argue that the principles of agile development methods are similar to concepts in critical systems methodologies such as Peter Checkland's soft systems methodology and Russel Ackoff's interactive planning, thus placing it in the non-functionalist paradigm. However, Lee & Xia (2010:87) warn that agile software development literature is still largely anecdotal and lacks empirical evidence and a theoretical foundation to support its principles and practices.

Agile methods' team approach is people oriented since an appropriate team of developers is regarded as more important than the chosen processes, models or tools used to develop the required software; still the activity steps included in the phases are similar to the activities of traditional approaches (Avison & Fitzgerald, 2006:143). Agile development's people orientation towards users is similar to evolutionary development's people orientation since agile methods are adaptive due to an incremental and iterative approach; increments are short and developers continuously interact with customers to verify requirements and adopt required changes (Hijazi *et al.*, 2012:11).

3.4.4.4 Suitability of agile development for business intelligence

Agile approaches are suitable for BI implementations since it is recommended that the business users rather than technical developers own BI projects (Kimball & Ross, 2010:107). However, agile methods are more suited for smaller, standalone development projects than for large and complex development projects (Prakash *et al.*, 2012:458). Still, agile approaches can be adopted for large BI projects by using the first few releases as architectural guidelines rather than working code (Kimball & Ross, 2010:107). Agile development requires minimal formal planning activities and stakeholders are highly involved; however, scope creep is a real danger due to the lack of formal planning and the high reliance on the probable expertise of the development team also poses a risk (Hijazi *et al.*, 2012:11). Similar to evolutionary development approaches, agile development may thus be appropriate for BI development.

3.5 Business intelligence development approaches

The data warehouse (DW) is a key component of BI development as it is the technological infrastructure that enables BI. This section thus gives an overview of the DW infrastructure. It then discusses approaches that specifically focus on development of the DW and BI, i.e. the Kimball lifecycle approach (Kimball & Ross, 2010:97), Linstedts' data vault model (Linstedt, 2002) and Inmon's corporate information factory (Inmon *et al.*, 2001:7). Similar to the previous section, the approaches are discussed in terms of the following: the origin of the approach; the process that is followed when applying this approach; the people-orientation of the process, i.e. the extent to which the approach is cognisant of the human, social and organisational context of the software artefact being developed; and its suitability for complete BI development, rather than only the DW component of BI, since investment in a DW and BI can only be justified if it enables better business decision making (Kimball & Ross, 2010:99). Even though the DW is crucial for BI, Inmon (2005:60) rightly argues that *business intelligence* entails more than a single analytical tool, but rather a range of processes and systems that are applied to *create intelligible information* that can *enhance* organisational decisions and hence ultimately *improve* organisations.

3.5.1 The data warehouse

The technological infrastructure that enables BI is the data warehouse (DW). Inmon (2006:8) defines a DW as a *“su j c r , gr , v v r ”* data source to be used for *“ g ’s c s r c ss s”.* Similarly, Kimball & Ross (2010:104) refer to a DW as *“ h f r f r f r s f us ss intelligence*”.

The DW infrastructure supports information exploration using software applications such as a decision support system/software (DSS) and data mining applications; data warehousing analysis activities are more strategic of nature and therefore differs from routine online transactional processing (OLTP) (Inmon, 1996:31). OLTP systems manage rapidly changing data; OLTP accept millions of transactions and atomic processing requests daily whilst a DW manages large static sets of data (Kimball & Ross, 2010:37).

Figure 3-6 below illustrates the DW components according to Kimball & Ross (2010:64), i.e. legacy systems, a staging area, a presentation area and clients:

- Legacy systems include the production transaction processing systems; they are sources of data in the DW. Legacy systems should be managed separately from the DW.
- The staging area cleans, conforms and combines production data that are extracted from various sources. It then delivers data to the presentation area. The staging area uses two data structures: the flat file and the normalised entity-relationship (E/R) schema.
- The presentation area presents the required data (per subject area) to the business users. It uses two data structures: the dimensional database schema and the online analytical processing (OLAP) data cube.
- The DW clients are the users that extract information using query tools and report writers. Specific high-end analytical tools such as data mining and forecasting tools may also use data from the DW. These specialised tools should not be continuously supported from the DW presentation area; the

users of these tools must rather receive a specific set of observation data once-off to perform their manipulations/calculations separately from the DW.

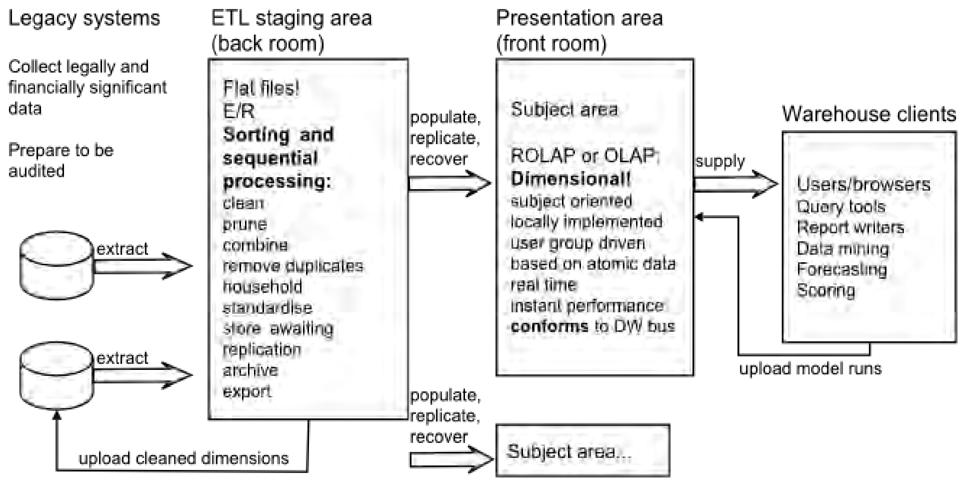


Figure 3-6: Data warehouse architecture (Kimball & Ross, 2010:51)

3.5.2 The Kimball lifecycle approach

3.5.2.1 The origin and process of the Kimball lifecycle approach

The Kimball lifecycle approach was first published in 1998; it focusses specifically on implementing BI solutions (Kimball & Ross, 2010:97). It therefore includes activities to gather business requirements as well as design and develop the DW architecture as illustrated above in Figure 3-6. Figure 3-7 below illustrates the Kimball lifecycle approach where the project is executed in three streams: the first stream develops and deploys the technical architecture (products); the second stream designs and develops the means for data processing; and the third stream designs and develops the front end applications used by the business users (Kimball & Ross, 2010:97).

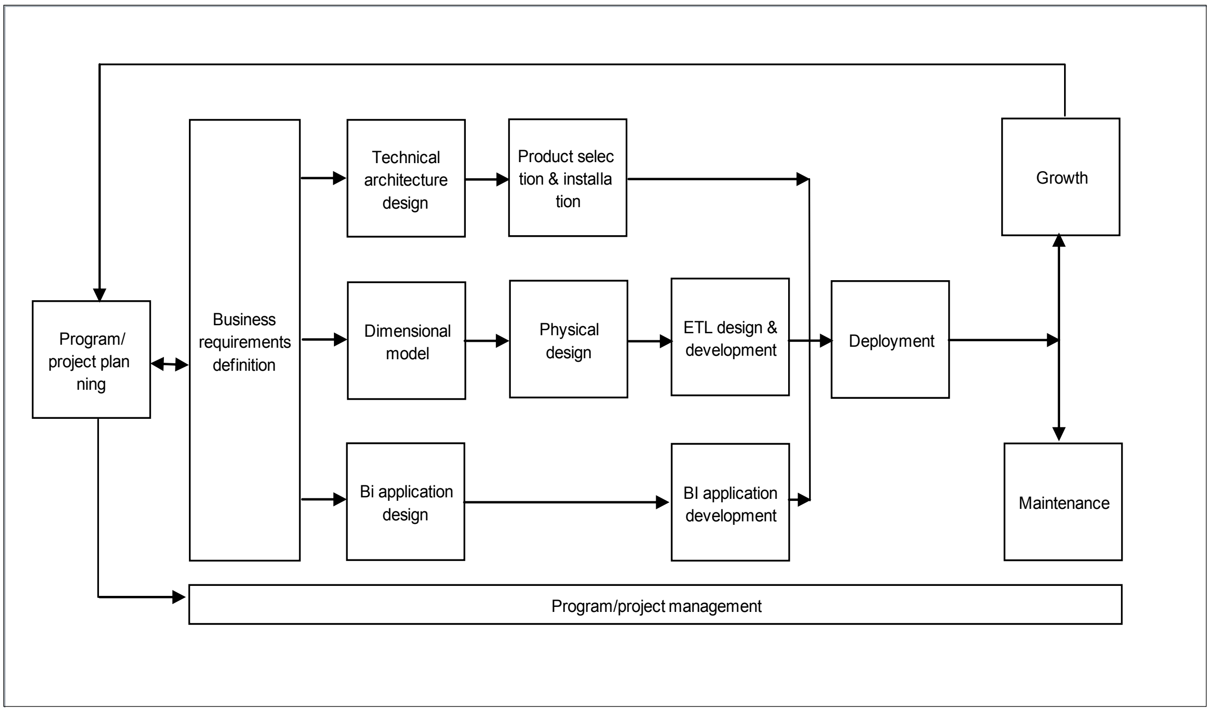


Figure 3-7: The Kimball lifecycle diagram (Kimball & Ross, 2010:97)

3.5.2.2 People orientation of the Kimball approach

Kimball & Ross (2010:98) include the definition of business requirements as a key task and collect business requirements by analysing user's activities in terms of three tracks, i.e. the technology track that includes the technological architecture design; the data track that entails the dimensional data model design; and the BI track that includes the development of applications such as standardised reports, dashboards, score cards, analytical models and interfaces to navigate the applications. Kimball & Ross (2010:101) emphasise that it is important to appropriately interview business users and to listen to business users' requirements. The Kimball approach is thus holistic in the sense that it includes business aspects as well. However, the business requirements are still viewed only in the context of the technology required for BI and not in terms of the potential impact on the users on an organisational and social level.

3.5.2.3 Suitability of the Kimball approach for business intelligence

The Kimball approach includes the collection of business requirements in addition to the development of the DW infrastructure; however, it still views BI merely as applications, associated interfaces and a representation of currently used key performance indicators to drive business decision making capabilities (Kimball & Ross, 2010:97). The Kimball approach lacks the incorporation of processes that Inmon (2005:60) refers to that is required to create intelligible information to enhance decisions prior to the development of the architecture. It also does not allow users to creatively explore new and improved key performance indicators to enhance decisions; it still allows business users to restrict themselves within the performance limitations of current systems and hence use only current and known information (Gardner, 1998:55). The Kimball approach is suitable to develop the appropriate DW infrastructure once the business processes are suitably defined to create the applicable intelligible information.

3.5.3 Inmon's corporate information factory

3.5.3.1 The origin and process of the corporate information factory

The corporate information factory (CIF) was introduced in the early 1980s by William Inmon; it is uniquely customised according to an organisation and supports its information processing in its entirety (Inmon *et al.*, 2001:7). Figure 3-8 below illustrates how the CIF is central to business (Inmon *et al.*, 2001:6).

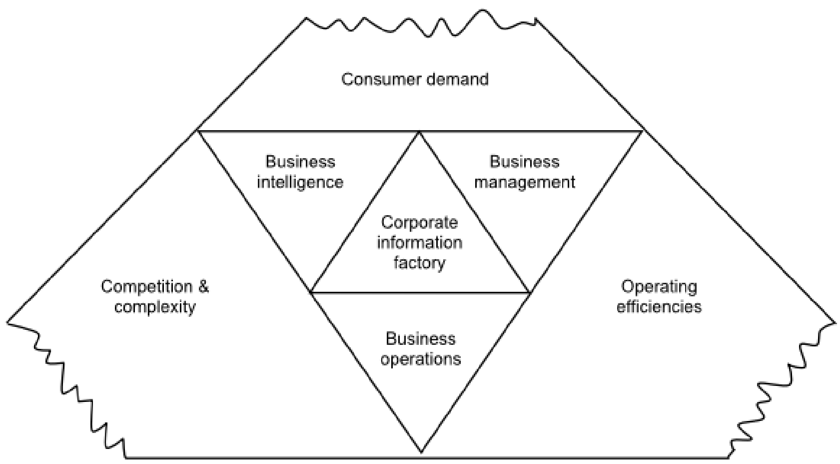


Figure 3-8: The CIF central to business (Inmon *et al.*, 2001:6)

Inmon *et al.* (2001:6) states that the CIF allows organisations to understand and exploit information technologies and constructs in support of: *business operations* including systems automating day-to-day business processes; *business intelligence* including systems supporting strategic planning; and *business management* including systems integrating with business operations and business intelligence that direct management decisions. The CIF is structured around the external world whereby data is acquired, stored, managed and delivered to users for analysis and decision support. Figure 3-9 below illustrates the CIF (Inmon *et al.*, 2001:13).

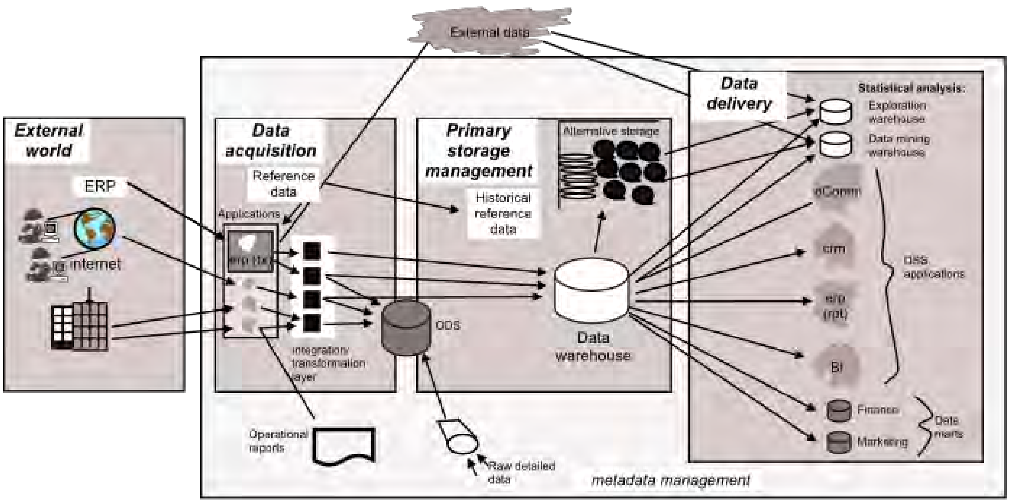


Figure 3-9: Basic structure of the CIF (Inmon *et al.*, 2001:13)

Inmon *et al.* (2001:42) argue that a CIF emerges iteratively from the information systems. Inmon *et al.* (2001:47) state that the DW is built first, the data marts second, and the ODS last: the *data warehouse* contains historical integrated information and represents the essence of the organisational data; *data marts* are customised and summarised subsets of data for different departments in the organisation; the *operational data store (ODS)* supports and integrates informational (DSS) and operational (transactional) processing; and *metadata* are used to describe the logic of transformation that occurs in the integration and transformation (I&T) layer, i.e. the software that dictates how data is captured, transformed and moved from applications to the ODS and DW.

3.5.3.2 People orientation of the CIF

The CIF is claimed to be structured around the business and allows business users to extract centrally stored information (Inmon *et al.*, 2001:6). However, the CIF process does not make provision for business requirements to be gathered prior to its design and implementation. It is entirely focused on the development of DW infrastructure. The CIF does not explain how it supports business operations, business intelligence and business management; it also does not concern itself with the human, social or organisational context of the users of the DW.

3.5.3.3 Suitability of the CIF for business intelligence

The CIF illustrates effectively how to structure and build the DW architecture, but does not include the collection of business requirements in support of BI prior to it being designed, developed and implemented.

3.5.4 Linstedt's data vault method

3.5.4.1 The origin and process of Linstedt's data vault method

According to Linstedt (2002) he developed a method that can be used to build BI where business-representative data is received from a source; it is then delivered firstly to a staging area, secondly to a data vault, and thirdly to a data mart, whilst collecting metrics and metadata in respective repositories, prior to publishing information on a portal. Linstedt's (2002) method was patented in 2002 and includes areas for data cleansing, data loading, business rules and integration processing, data propagation and data aggregation. Figure 3-10 below illustrates the technical activities that are, according to Linstedt (2002), required to build a BI system.

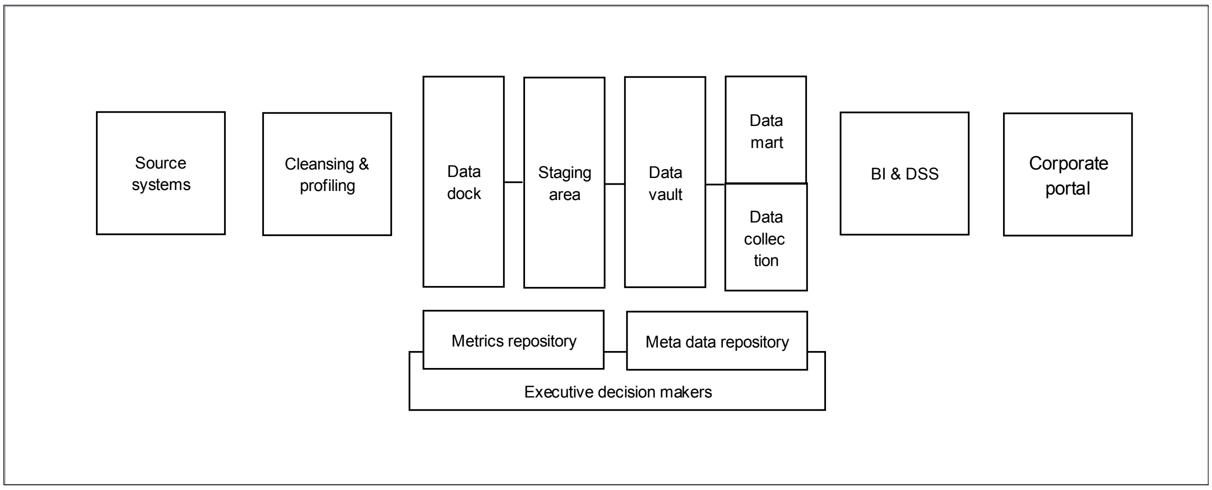


Figure 3-10: Linstedt's data vault method (Linstedt, 2002)

3.5.4.2 People orientation of Linstedt's data vault method

Linstedt's (2002) model includes DW components and is comparable to the DW architecture described by Kimball & Ross (2010:51) – refer also to Figure 3-6 above. Linstedt's (2002) data vault method includes a metrics repository that collects statistical information regarding, for example growth and usage patterns of the DW, used to quantify future upgrades to the hardware and retire data not being used. He refers to BI but does not expand on this component; this method explains how the DW may be structured but does not concern itself with the human, social or organisational context of the users of the DW.

3.5.4.3 Suitability of Linstedt's method for business intelligence

The data vault method is useful to build the DW architecture. However, it does not include the collection of business requirements in support of BI prior to the design, development and implementation of the DW.

3.6 Comparison of software development approaches

Traditional software development encompasses formalised theories, methods and tools to develop and produce software within organisational and financial constraints (Sommerville, 2011:5) that typically stem from the phases and activities described by Benington (1983:350) and Royce (1970:338). Even though organisations develop software according to their own specific software development methods and processes, such processes typically follow a structured, more abstract and generic process model (Sommerville, 1996:269) that comprises the following four steps, albeit in different ways and at different levels of detail: first, define the software functionality and operational constraints; second, develop the software to specification; third, validate the software in terms of end-user requirements; and fourth, continuously improve the software to meet changing or evolving customer requirements (Sommerville, 2011:28) that can be recognised in the described software development approaches. For example, the waterfall method prescribes that activities be implemented sequentially (Bell & Thayer, 1976:62), evolutionary and agile methods iterates specified activities (Randell & Zurcher, 1968:867); the terminology used in the Kimball lifecycle approach (Kimball & Ross, 2010:97) is specifically focused on BI but can still be generically described as plan the project, define the requirements, design the architecture and application, develop according to specifications, deploy the artefact and maintain the artefact whilst Linstedt (2002) and Inmon *et al.* (2001:7) focus mostly on the technical elements of the BI infrastructure, i.e. the DW.

Table 3-2 below provides a high-level comparison of the software development approaches discussed in this chapter: it excludes spiral development since spiral development does not prescribe process steps but rather encompasses any of the other methods' process steps (Boehm, 1988:61); and it includes the Kimball lifecycle approach (Kimball & Ross, 2010:97) as representative of the described BI system development approaches (since the Kimball approach is the only BI development approach that explicitly includes business requirements to be gathered).

Table 3-2: Comparison of structured software development approaches

Generic process model (Sommerville, 2001:28)	**Waterfall method (Bell & Thayer, 1976:67)**	**Evolutionary development (Royce, 1970:334)**	**Kimball lifecycle (Kimball & Ross, 2010:97)**	**Agile development (Green *et al.*, 2010:146)**
Define software functionality and operational constraints.	System and software requirements. Preliminary and detailed design.	System and software requirements. Preliminary and detailed design (build the prototype). Analyse (the prototype). Program design.	Business requirements definition.	Planning, architecture and high level design. Analysis and prioritisation.
Develop software to specification.	Code and debug. Development testing.	Coding.	Technical architecture design, product selection and installation. Dimensional model, physical design and ETL design, and development. BI application design and development.	Continual evolution through: Design and code; and integration, test, document and release.
Validate software in terms of end-user requirements.	Formal testing.	Testing.	Deployment.	
Continuously improve software for changing or evolving customer requirements.	Operations and maintenance.	Operations.	Growth. Maintenance.	

3.7 Shortcomings in current development approaches

The section on software development and BI development approaches portrays that the various approaches are quite similar and the process activities are generically comparable. Approaches that facilitate evolutionary development are favoured as it allows the development team to respond to changing/evolving requirements (Beck *et al.*, 2001a:1; Hijazi *et al.*, 2012:11; Kimball & Ross, 2010:107). Stakeholders are often unable to anticipate real needs in advance and hence specified requirements inevitably change during development (Sommerville, 1996:269). The question that arises is whether user's requirements really change or evolve in the relative short period of time that a software system is being designed, developed and deployed; or does more successful approaches such as evolutionary and agile development merely allow users' real business requirements to surface by revealing portions of the software's functionality to them and allowing them to adjust their expectations concurrently and incorporate human, social and organisational dimensions impacting on usage as they start to experience what is possible, rather than only what they were aware of or were able to imagine earlier in the process.

Kimball & Ross (2010:97) recommend an incremental, agile BI development approach where business requirements are elicited "by focusing on what business users do… or want to do…" and to "give the users what they want". They refer to *business requirements* rather than merely technical software/system requirements. Again, the question arises whether users are able to accurately portray what they *want* from a software system without critical reflection on what it is that they actually *need* from a software artefact, i.e. to *improve*, even beyond what is imaginable, rather than merely *automate* what is easily observable. Business users restrict themselves within the performance limitations of current systems and hence use only current information; they request only automation of current information when questioned regarding potential actions for improvement (Gardner, 1998:55). Inmon (2005:55) appropriately states that BI users "operate in a mode of discovery…cannot tell what the information needs are until they see the possibilities".

Inmon (1996:144) states that the design of a DW begins with the design of a data model; this is true for architecture and infrastructure design and since the DW enables BI it must be designed to be granular, accessible and support strategic decision making. However, BI is about the ability to make *intelligent, appropriate and timeous business-related* decisions (Liautaud & Hammond, 2001:5) and hence requires more than only appropriate architecture and infrastructure, but also supporting and enabling processes (Inmon, 2005:60). Successful BI encompasses *improvement, new functionalities* (Newman & Lamming, 1995:150) and the ability to *swiftly react to changing* business climates (De Leon *et al.*, 2012:11) rather than merely automating current processes (Gardner, 1998:55).

Popovič *et al.* (2012:738) as well as Yeoh & Koronios (2010:31) also encourage BI professionals to focus firstly on the business needs and user requirements rather than to primarily focus on the technology and technical aspects; developers must be able to develop software that supports business objectives, its management structure, its business needs, as well as the organic nature of the organisation, the environment within which the organisation operates, and what the organisation requires to stay competitive in that environment. Hirschheim & Klein (1994:83) rightly argue that software development approaches must embrace emancipatory principles, i.e. it must be people oriented. Similarly, BI development approaches must be people oriented; it must include the human, social and organisational context to enable the development of an efficacious BI system, in addition to building the appropriate DW infrastructure.

3.8 People orientation of software development quality criteria

Software designers and developers aim to develop good products using the most effective and efficient methods; the main objective of software development processes is to develop software artefacts cost effectively (Sommerville, 2011:5). However, Kimball & Ross (2010:58) state that “we designers are genetically selected because we have an unusual tolerance for complexity”; they also argue that this unfortunately results therein that “our designs are too intricate and too complicated” since “features” are being presented to users instead of “solutions”. Within the functionalist paradigm good software products are described as maintainable, dependable and secure, efficient, and acceptable; these product characteristics are defined in Table 3-3 below (Sommerville, 2011:5).

Table 3-3: Product characteristics (Sommerville, 2011:5)

Product characteristic	Description
Maintainability	Software can evolve to incorporate changing needs.
Dependability	Software is reliable, secure and safe to use. Safety refers to physical and economical safety in the event of a system failure.
Efficiency	Software makes optimal use of resources; it must be responsive.
Acceptability (usability)	Software is usable by the type of user for whom it was intended; it includes an appropriate user interface and adequate documentation.

It is noteworthy that only one of the product characteristics, i.e. usability, refers exclusively to the human context of the software artefact. The other three characteristics also impact indirectly on the user's experience when using the software, but they are still described more in terms of technical aspects such as optimal resource usage and system failure.

Kimball & Ross (2010:101) argue that business users will use information systems appropriately "only if a killer application is waiting to beckon them". Users thus want software that complies with principles such as user familiarity, consistency, minimal surprise and recoverability; users want to be guided intuitively when using new software (Sommerville, 2011:328). Usability refers to the user interface and is one of the most important elements determining information system success in terms of user acceptance; Kimball & Ross (2010:101) regard a BI system as successful if the users still use it six months after implementation. It entails more than merely designing an appealing screen interface; from a user's perspective a successful information system fits the physical and cognitive strengths/limitations of its user's and it satisfies its user's both visually and emotionally (Ping *et al.*, 2005:512). Kimball & Ross (2010:58) assert that the most challenging constraint for the developers of BI is to ensure that the business user is presented with screens that are “immediately understandable, simple, recognizable, and intuitive”. Avison & Fitzgerald (2006:81) also agree that the user interface must be visible, simple, consistent and flexible; these interface characteristics are defined in Table 3-4 below.

Table 3-4: User interface characteristics (Avison & Fitzgerald, 2006:81)

Interface characteristic	**Description**
Visible	Users must understand and be able to control the application; users must know what happens when the application runs.
Simple	Information must be well-structured and choices easy-to-make.
Consistent	Information presentation is similar throughout.
Flexible	The interface is adaptable according to user’s requirements.

In addition to the interface characteristics described above, Sommerville (2001:558) says that software development processes also impact upon the success of the software artefact being developed; he argues that software development processes can be generically evaluated according to the following process characteristics: the process must be easy-to-understand, visible, supportable, acceptable, reliable, robust, maintainable and it must allow for rapid development and deployment. Table 3-5 below provides definitions for these process characteristics.

Table 3-5: Process characteristics (Sommerville, 2001:558)

Process characteristic	Description
Easy-to-understand	The process is explicitly defined and the ease at which the process definition can be understood.
Visibility	Process activities result in clear outcomes; progress is visible.
Supportability	The extent to which computer-aided software development tools can support the process activities.
Acceptability	The extent to which the process can be accepted and used by the developers that must produce the software.
Reliability	The extent to which the process is designed to trap or avoid process errors before they cause product errors.
Robustness	The extent to which the process can continue regardless of unexpected problems.
Maintainability	The extent to which the process can adapt to changing or evolving organisational requirements or identified improvements with regard to the process.
Rapidity	The speed at which a software artefact can be delivered from a given specification.

Similar to the product characteristics, these process characteristics apply mostly to the extent to which the process enables the production of technically good software and systems; the process characteristics are not concerned with the incorporation of the human and organisational context of the product and thus fit well within the functionalist paradigm.

The group of people responsible for the development of agile software development methods, i.e. “The Agile Alliance”, claim that agile development recognises “values and culture”; agile software development is “about delivering good products to customers by operating in an environment that does more than talk about “people as our most important asset” but actually “acts” as if people were the most important” (Highsmith, 2001:1). To provide high quality software agile developers abide by twelve principles; the principles consider the quality of the software artefact, effective and efficient incorporation of customer requirements as well as effective and efficient team work (Beck *et al.*, 2001b:1). Beck *et al.* (2001b:1) define the twelve principles behind the agile manifesto as follows:

1. "Our highest priority is to satisfy the customer through early and continuous delivery of valuable software."
2. "Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage."
3. "Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale."
4. "Business people and developers must work together daily throughout the project."
5. "Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done."
6. "The most efficient and effective method of conveying information to and within a development team is face-to-face conversation."
7. "Working software is the primary measure of progress."
8. "Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely."
9. "Continuous attention to technical excellence and good design enhances agility."
10. "Simplicity – the art of maximizing the amount of work not done – is essential."
11. "The best architectures, requirements, and designs emerge from self-organizing teams."
12. "At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly."

The agile principles lean towards people orientation and advocates effective and efficient teamwork; however, the activities listed in the agile development phases are concerned with the technical development of the software and does not specify how customer requirements can be appropriately elicited, other than through an evolutionary development approach.

3.9 Requirements collection

The most important aspect that drives software development success is the degree to which the developer understands the user's business requirements (Leffingwell, 1997:51). Sawyer *et al.* (1997:19) quote a European survey (ESPITI 1996) stating that the principal problem areas in software development, thus the reasons for unsuitably produced software, are the inappropriate specification and management of customer's requirements i.e. requirements do not reflect real customer needs, inconsistent and/or incomplete requirements, expensive late changes to requirements as well as misunderstandings between customers, requirements analysts and software developers. Software developers thus require an accurate understanding of user's requirements to be able to deliver quality software artefacts on time and within budgetary constraints (Green *et al.*, 2010:144). With regard to DW projects, user's requirements must also be elicited and their needs modelled to improve success thereof (Maté *et al.*, 2014). Keating *et al.* (2008:24) argue that, since user adoption is a crucial indication of success, *r r c c f us r's requirements is the most critical part of software development.* Appropriate requirements collection is necessary to avoid that "those specifications were based upon the designers' ignorance before they started the job" (Naur & Randell, 1969:32).

Appropriate requirements specification involves more than merely designing the automation of current functions; implemented software must yield new functionalities and ultimately improvements in current work processes (Newman & Lamming, 1995:150). The introduction of a new software artefact results in an adjusted social context for its users since it "stirs things up, introduces uncertainties, gets people perceiving their world in a new way" (Checkland & Holwell, 1998:7). Software is intricately part of the social structures where it is applied; a software artefact can thus not be developed in isolation but must be explored as part of the bigger social (organisational) system that it will ultimately belong to and in terms of the individuals that it will impact upon (Naur & Randell, 1969:3). Appropriate requirements thus include verification by the users as well as incorporation of the human, social and organisational dimension in addition to the technical requirements. This section discusses the importance of requirements verification as well as traditional approaches to collect requirements and approaches that aim to incorporate the organisational context, i.e. ethnographic techniques (Viller & Sommerville, 2000:170), an approach named “coherence” (Viller & Sommerville, 1999:9) and soft systems methodology (Checkland, 1981).

3.9.1 Requirements verification

Modifications applied to operational software as a result of defective requirements are exponentially more expensive than fixing requirements upfront – Figure 3-11 below illustrates the relative cost to fix requirements deficiencies during later stages (McConnell, 1996:42).

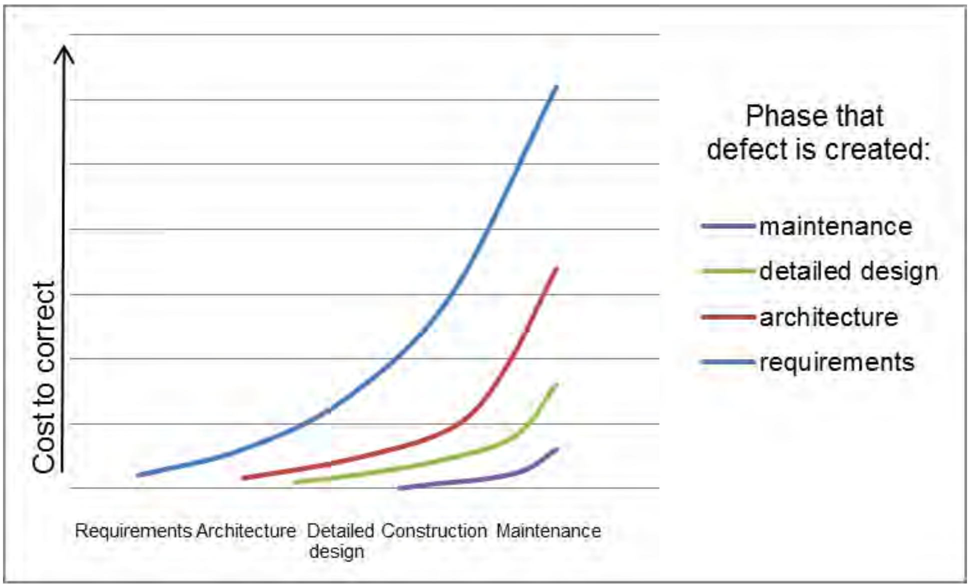


Figure 3-11: Cost to fix defective requirements (adapted from McConnel, 1996:42)

Once organisational requirements are identified, analysed and ready to be included in the software requirements specification it must thus be verified. Sommerville (2001:137) suggests that requirements be verified in terms of validity, consistency, completeness, realism and verifiability. Table 3-6 below provides definitions for these requirements verification characteristics.

Table 3-6: Requirements verification characteristics (Sommerville, 2001:137)

Requirement characteristic	Description
Validity	All appropriate and relevant functions are included; the user community may have to compromise if it is very diverse.
Consistency	Requirements do not conflict, i.e. no contradictory constraints or descriptions.
Completeness	All functions and constraints intended by the user are defined.
Realism	Requirements can be implemented within budget, time and technological constraints.
Verifiability	Include assessment criteria that can confirm that the implemented artefact meets requirements.

Requirements verification characteristics confirm typically the technical suitability of specified requirements. The requirements characteristic "validity" confirms whether all appropriate and relevant functions (i.e. users) have been included, but not whether the specified requirements are the appropriate requirements for the intended user(s), thus assuming that users can clearly articulate their requirements and are fully aware of what might be technically available to solve their specific problems; unfortunately this is rarely the case (Gardner, 1998:55; Newman & Lamming, 1995:150).

3.9.2 Traditional software requirements collection

The collection of software requirements traditionally includes four stages i.e. feasibility study, requirements analysis, requirements definition and requirements specification (Sommerville, 2001:98). Various techniques are used to analyse requirements. Electronic surveys may be used to gather general information quickly whilst interview(s), meeting(s) and/or workshop(s) may be conducted with specific groups to gather specific information; once all requirements are gathered requirements are collated, documented and presented back to interviewees for final sign-off (Avison & Fitzgerald, 2006:97). Traditional requirements collection techniques assume that requirements can be conceptually discovered from users; it can capture most requirements but does not necessarily incorporate the human dimension and requirements will eventually change/evolve as is required according to Avison & Fitzgerald (2006:105).

3.9.3 Kimball's business requirements collection

Kimball & Ross (2010:2) state that "understanding the business requirements is the most fundamental and far reaching" aspect of DW/BI development. They explain that business requirements include key performance indicators that drive organisational decisions; user communities' abilities to use applications such as spreadsheets and reporting tools; and user expectations in terms of implementation time horizons. Kimball & Ross (2010:98) suggest "focusing on what business users do today…want to do in the future". They provide a comprehensive list of guidelines for the interview process (Kimball & Ross, 2010:113-128) and recognise that user's future requirements may be different from what they currently have (Kimball & Ross, 2010:98); however, the process that they prescribe still seems to presume that users are able to accurately conceptualise such future requirements and that it can be discovered through interviews. The output of the requirements collection process is a "cross-organizational understanding of the present state of data…" in the form of an "enterprise data warehouse business matrix" (Kimball & Ross, 2010:132). Figure 3-12 below illustrates the two-dimensional matrix that summarises the business processes and associated data sources.

	Date	Policy holder	Coverage	Policy	Claim	Payee
Underwriting transactions	X	X	X		X	
Policy premium billing	X	X	X	X		
Agent commissions	X		X	X		
Claims transactions	X			X	X	X

Figure 3-12: Enterprise DW bus matrix (adapted from Kimball & Ross, 2010:129)

3.9.4 Ethnographic techniques

Sommerville (2011:108) suggests that the collection of software requirements can be improved using ethnographic techniques to incorporate the prevalent social and organisational context. Ethnographers observe humans in their natural environment; in this context "natural environment" refers to the organisation where the software artefact will ultimately be implemented and "humans" refer to the users of the software (Viller & Sommerville, 2000:170). Software developers thus observe users in their work place to understand software requirements. Ethnographic studies may be useful in that it provides insight into the social facets of work including the situation(s) where new software will be introduced; unfortunately such studies can be difficult to incorporate, difficult to interpret from a technical perspective, time consuming to conduct appropriately and hence not fit tight development schedules (Viller & Sommerville, 2000:170).

3.9.5 Coherence

Sommerville (2001:126) also suggests that software requirements be analysed from relevant viewpoints where viewpoints may overlap or conflict; he later referred to this as concern-oriented requirements engineering (Sommerville, 2011:577). Viewpoint analysis is not a new concept; traditionally software is analysed from a data flow/transformation viewpoint or an object oriented viewpoint (Newman & Lamming, 1995:124). Viller & Sommerville (1999:9) propose a different type of viewpoint analysis approach, named coherence, to include ethno-methodological analyses, in an attempt to incorporate social and organisational context in design. Viller & Sommerville (2000:174) suggest in their coherence approach that requirements be analysed from three social viewpoints i.e. “distributed coordination”, “plans and procedures” as well as “awareness of work”. They recommend that each viewpoint be described in terms of its focus (what is the viewpoint’s perspective), concerns (what are the organisational goals and constraints driving the analysis process), sources (information sources e.g. people or documents), and requirements (analysis of the software system from the viewpoint’s focus); it must then be represented in sequence and class diagrams, as used in Unified Modelling Language (since UML is an industry standard notation for object-oriented design), to translate the social analysis and hence make it accessible to software developers. A distributed coordination viewpoint refers to the coordination activities of people and tasks in order to do work; a plans and procedures viewpoint refers to the way in which plans and procedures organise daily activities; and an awareness of work viewpoint refers to the organisation of activities that make them “visible” or “intelligible” (Viller & Sommerville, 1999:13). The coherence approach may be useful in describing the current organisational processes as they are and hence effectively model its automation, but will not necessarily describe the required software in terms of new and improved functionalities as is suggested by Newman & Lamming (1995:150) or result in interventions that resolve organisational problems and introduce changes required as suggested by Goulielmos (2004:383).

3.9.6 Soft systems methodology

Avison & Fitzgerald (2006:507) suggest that Peter Checkland’s soft systems methodology (SSM) (Checkland, 1981) be used to understand the organisational dimension of software to be developed. Iivari *et al.* (2000:186) also refer to SSM as an information system/software development (ISD) approach. Checkland & Scholes (1990:309) say that a set of purposefully linked activities, described relatively according to a specific worldview, can be regarded as a “human activity system” and modelled as such using SSM. SSM has been used by Checkland & Holwell (1998:173-213) in the information systems field to understand the organisational context. Figure 3-13 below outlines the SSM process.

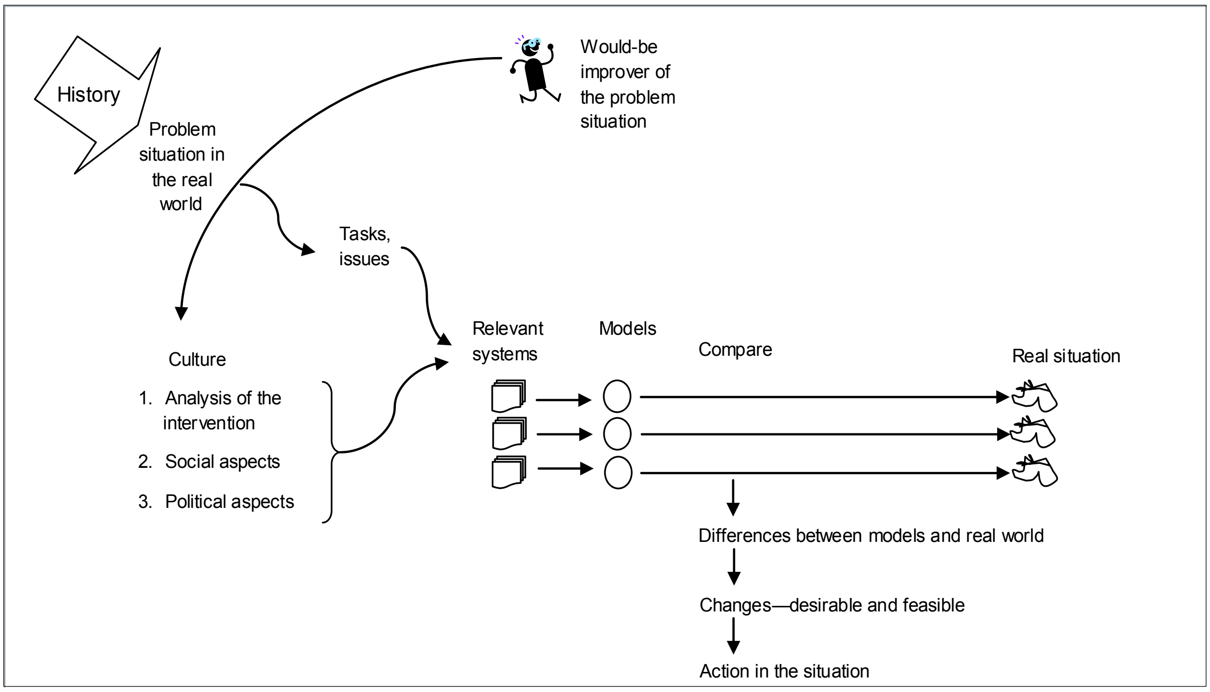


Figure 3-13: SSM process (adapted from Checkland & Scholes, 1990:310)

Figure 3-14 below shows the suggested ISD process (Checkland & Holwell, 1998:106); it includes an analysis of how organisational employees view their world (elements 1 and 2) and an analysis of accepted purposes and intentional actions that follow to pursue identified purposes be defined (elements 3 to 5).

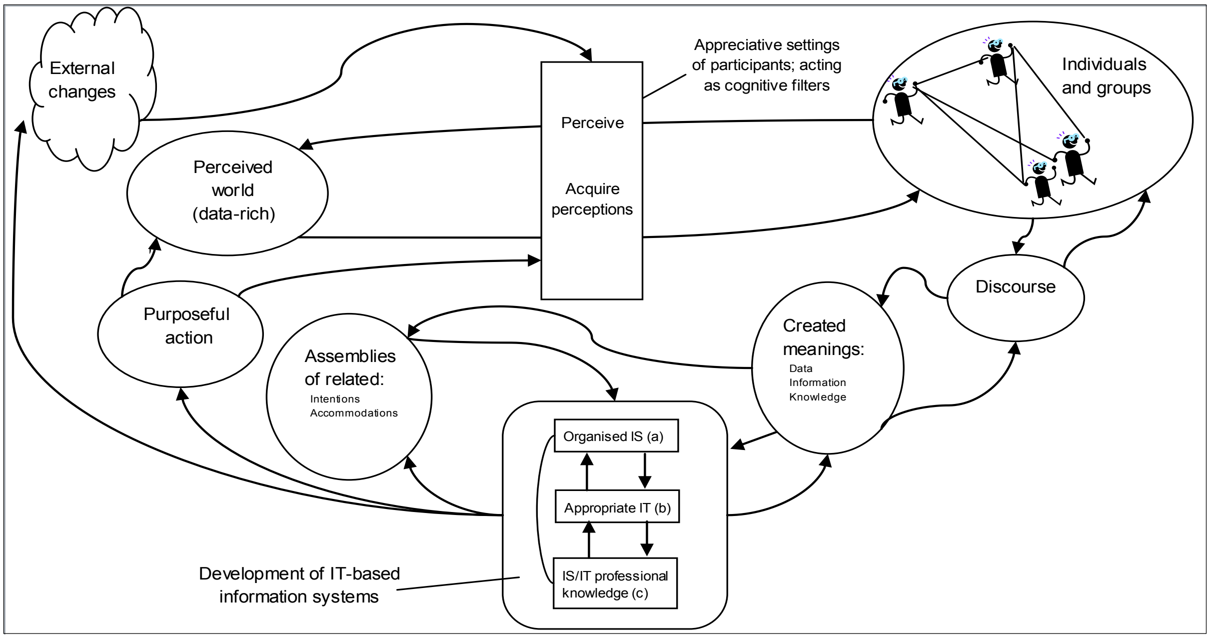


Figure 3-14: ISD development (adapted from Checkland & Holwell, 1998:106)

3.9.7 Shortcomings in requirements collection approaches

Traditional requirements collection approaches as well as the Kimball approach to requirements collections are not people oriented since requirements collection techniques assume that requirements can be conceptually discovered from users; it can capture most requirements but does not necessarily incorporate the human dimension that is required according to Avison & Fitzgerald (2006:105).

Sommerville suggests the use of ethnographic techniques and viewpoint (concern oriented) requirements analyses as people oriented alternatives (Sommerville, 2001:126; Sommerville, 2011:577); however, these techniques can be time consuming and resource intensive (Viller & Sommerville, 2000:170). Checkland & Holwell (1998:173) suggest that the organisational dimension of information system (IS) related development work, such as software to be developed, be modelled using SSM. They also provide some useful examples of how they applied SSM in the IS field to explore the organisational context but do not explicitly link their process with requirements design for ISD.

3.10 Summary

The literature reported 41% failure rate in 2003 (Hwang & Hongjiang, 2007:7), lower than 30% adoption rate in 2011 (Gartner, 2011:1) and 59% failure rate in 2012 (Dresner Advisory Services, 2012:15) for BI. Software fail mostly due to low user acceptance and neglect of human, social and organisational factors during requirements collection, rather than based on its technical feasibility (Clegg & Shaw, 2008:448; Avison & Fitzgerald, 2006:11).

The literature revealed that software development processes have been acknowledged as an integral part of societal activities since its origin (Naur & Randell, 1969:3). However, practical applications of software development methods appear to have stagnated (Denning & Freeman, 2009:28) within the functionalist paradigm and alternative approaches are not yet widely applied (Iivari *et al.*, 2000:191). Software development approaches, software development quality criteria for product and process characteristic described in this chapter are useful to produce technically good systems, but such systems may not necessarily be usable and user acceptance may thus still be low (Clegg & Shaw, 2008:448; Avison & Fitzgerald, 2006:11). This is not surprising when one explores the rapid, almost explosive, development and technological advancement of computer hardware technology since its origin and over the past few decades.

Software engineering (development) is a relatively young discipline that emerged as a result of the rapid development of computers and computer-related technology and until very recently software development was mostly concerned with the "automation of information processes in engineering, science and business" (Denning & Freeman, 2009:28). Given the machinist nature of early computers the engineering stance of software development approaches "was probably historically inevitable"; however it "has changed dramatically…while the thinking which structures its acquisition and use has moved only slowly" (Checkland & Scholes, 1990:308). It is, however, unfortunate that current software development approaches did not advance as rapidly as its hardware counterpart and still presumes that a single (technical) owner control development entirely and ultimately enforce all design decisions; decisions are rational and driven by technical criteria; and the problem to be resolved by the software artefact is definable purely according to its system boundaries (Sommerville *et al.*, 2012:74). Since software development approaches are grounded in principle within the hard systems thinking paradigm, it assumes all problems are quantifiable and can be optimally and predictably solved (Nerur *et al.*, 2005:74). It is therefore increasingly difficult to ensure successful software using the traditional ISD paradigm.

Software development entails not only technical activities, but also complex social activities influenced by the organisational context (Goulielmos, 2004:363). Thus, to increase the success rate of software artefacts, such as BI, ISD approaches must deviate from functionalism; it must embrace people oriented, emancipatory principles (Hirschheim & Klein, 1994:83) and incorporate the organisational context when designing requirements (Sommerville, 2011:108). Enhanced, people oriented requirements collection processes, within the non-functionalist paradigm, may lead to improved software development and hence higher success rates. Appropriate requirements collection processes are the most critical prerequisite for successful software development (Keating *et al.*, 2008:24) and must include the human, social and organisational dimension as it is used by humans and within an organisational environment that will ultimately dominate the specified requirements (Sommerville, 2011:108).

The next chapter discusses the evolution of the systems thinking paradigms. It also discusses the positioning of critical systems methodologies in the critical systems paradigm.

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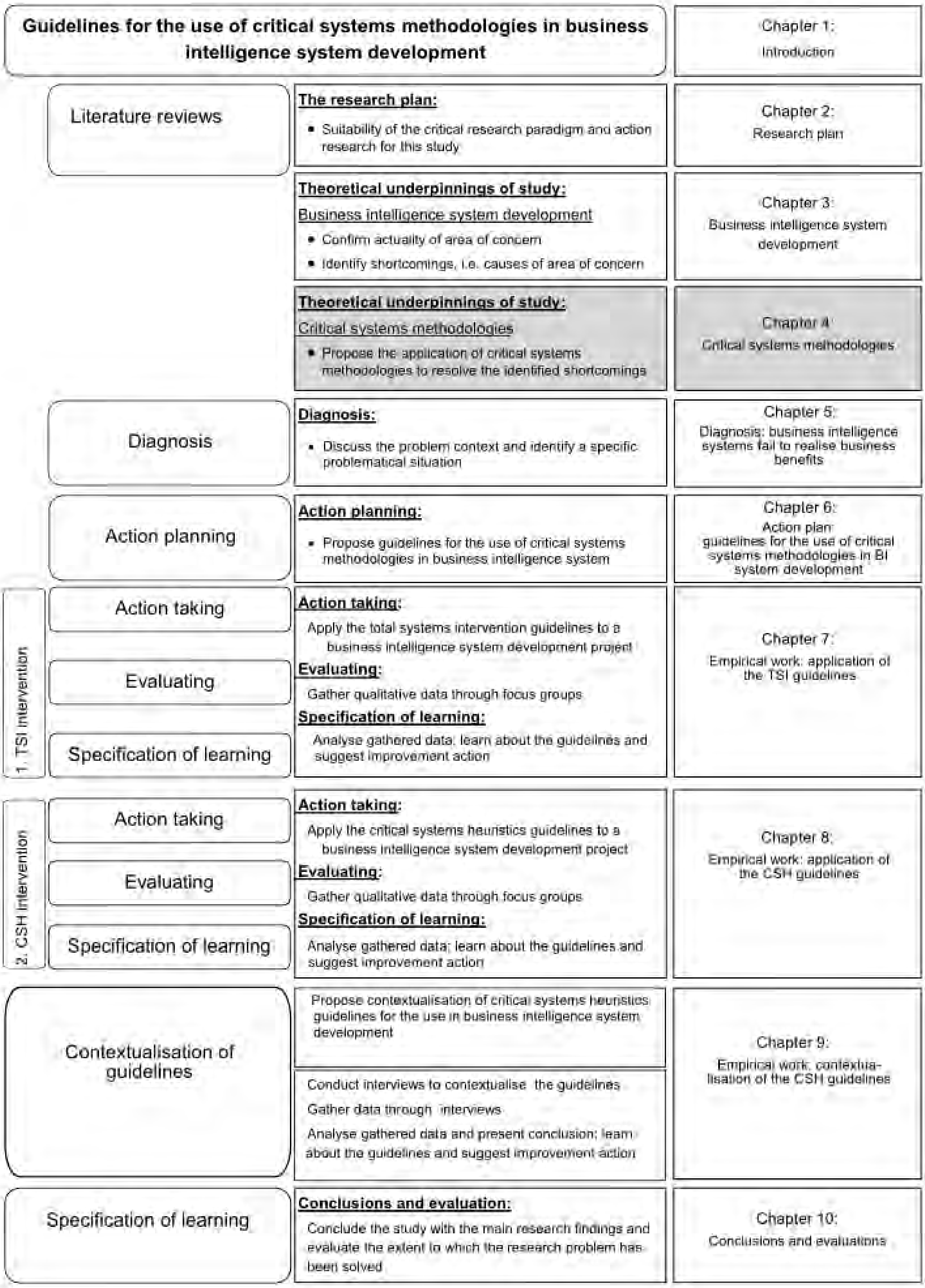

Guidelines for the use of critical systems methodologies in business intelligence system development
Chapter 1: Introduction
Literature reviews
The research plan:
Suitability of the critical research paradigm and action research for this study
Chapter 2: Research plan
Theoretical underpinnings of study:
Business intelligence system development
Confirm actuality of area of concern
Identify shortcomings, i.e. causes of area of concern
Chapter 3: Business intelligence system development
Theoretical underpinnings of study:
Critical systems methodologies
Propose the application of critical systems methodologies to resolve the identified shortcomings
Chapter 4: Critical systems methodologies
Diagnosis
Diagnosis:
Discuss the problem context and identify a specific problematical situation
Chapter 5: Diagnosis: business intelligence systems fail to realise business benefits
Action planning
Action planning:
Propose guidelines for the use of critical systems methodologies in business intelligence system
Chapter 6: Action plan: guidelines for the use of critical systems methodologies in BI system development
1. TSI intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the total systems intervention guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data: learn about the guidelines and suggest improvement action
Chapter 7: Empirical work: application of the TSI guidelines
2. CSH intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the critical systems heuristics guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data: learn about the guidelines and suggest improvement action
Chapter 8: Empirical work: application of the CSH guidelines
Contextualisation of guidelines
Propose contextualisation of critical systems heuristics guidelines for the use in business intelligence system development
Conduct interviews to contextualise the guidelines
Gather data through interviews
Analyse gathered data and present conclusion: learn about the guidelines and suggest improvement action
Chapter 9: Empirical work: contextualisation of the CSH guidelines
Specification of learning
Conclusions and evaluation:
Conclude the study with the main research findings and evaluate the extent to which the research problem has been solved
Chapter 10: Conclusions and evaluations

Chapter 4 : Critical systems thinking and critical systems methodologies

4.1 Introduction

The objective of this study is to develop guidelines for the use of critical systems methodologies to improve the development of business intelligence systems. This chapter gives an overview of the literature of the development and application of systems thinking. It discusses the paradigm shifts that occurred within systems thinking and the subsequent emergence of critical systems thinking and critical systems methodologies. It also discusses software development within the systems thinking paradigms.

The critical systems thinking paradigm, and accordingly also the critical systems methodologies that are positioned within the critical systems thinking paradigm, are committed to emancipation, awareness and complementarism; critical systems methodologies aim to enable problem solvers to analyse complex social problems in order to successfully intervene in such complex societal problem contexts (Jackson, 2001:233).

The objective of business intelligence is to enhance strategic decision making; it aims to enhance organisational decision making capabilities and improve the quality of decisions (Popovič *et al.*, 2012:729). Business intelligence systems aim to support decision makers and improve organisational decision making processes (Inmon, 2005:60; Marinela & Anca, 2009:382). Business intelligence systems are technical software artefacts that are used by people in an organisational context to support strategic decision making. The development of such software artefacts includes technical activities as well as complex social activities (Avison & Fitzgerald, 2006:105). These technical and social activities are influenced by the organisational context whilst the implementation of business intelligence ultimately influences the organisational context of the recipient organisation as well. A business intelligence system development project is thus a complex social intervention that may be enhanced by the application of critical systems methodologies.

This chapter starts by defining what a system is in Section 4.2. Section 4.3 discusses the theoretical development of systems thinking. Section 4.4 discusses the practical application of systems thinking to resolve problems; systems thinking is discussed within the paradigms that are most prominent in the literature, i.e. Section 4.5 discusses systems thinking within the hard systems thinking paradigm; Section 4.6 discusses systems thinking within the soft systems thinking paradigm; and the critical systems thinking paradigm is discussed in Section 4.7. Critical systems methodologies are discussed, in accordance with Ulrich (2003:327), as two separate strands of critical systems thinking, i.e. total systems intervention and critical systems heuristics. Total systems intervention is discussed in Section 4.8 and critical systems heuristics is discussed in Section 4.9; these sections also explore documented applications of the critical systems thinking strands in software development.

4.2 Definition of a system

The word “system” is widely used for many different concepts. The Concise Oxford English Dictionary (2002:1453) provides three complementary definitions of a system; a system is defined as:

1. “a complex whole; a set of things working together as a mechanism or an interconnecting network”;
2. “an organised scheme or method”; and
3. “the prevailing political or social order, especially when regarded as oppressive and intransigent”.

These definitions relate to the concept of systems as mechanisms; they are descriptions of tangible entities that exist in the world (Checkland & Scholes, 1990:23). These definitions represent the conventional application of the systems concept where systems are representations of orderly entities and systems can be broken down into recognisable individual elements that make up the entities. For example, the first definition refers to a system as “a set of things”, “a mechanism” or “an interconnecting network”, i.e. objects that consist of individual parts and can therefore also be broken down into the individual parts; the second definition refers to a “scheme or method” that is “organised”, i.e. it is something that is systematically arranged in an orderly manner and can therefore also be systematically and logically analysed; and the third definition refers to a “political or social order”, i.e. a regulative body that prescribes rules and regulations to maintain uniformity. These definitions emphasise the mechanistic systems viewpoint where the objectives of a system can be accurately defined and the system can then be constructed to achieve the defined objectives; problematical systems can be systematically analysed and engineered to resolve problems (Checkland, 2012:468). However, these definitions fail to capture the holistic viewpoint of systems thinking, especially from the 1980s onward, where the systems concept is applied to intervene in and seek to improve problematic (messy) social situations that involve unpredictable human participants and which cannot be easily reduced to recognisable parts.

There is thus also a complementary viewpoint, i.e. the “soft systems” view, where a system is a concept of coherent whole entities rather than a description of something that exists in the world (Checkland, 2012:467). A system is then an abstraction in that it describes the way in which people conceptually organise their thoughts *about* the world, rather than *what* the world consist of (Flood & Jackson, 1991a:2). Systems can be used to holistically understand people’s divergent perceptions of their world, i.e. their different worldviews (Mingers, 1980:41). From this perspective a system is regarded as a conceptual tool to be applied to explore social situations, describe social contexts and assist in understanding the status quo (Vickers, 1983:209). The soft systems concept provides a process of enquiry whereby complex problem situations can be explored (Checkland & Scholes, 1990:22).

Checkland (1981:173) provides a definition for a system concept; he says that a system contains the following minimum characteristics: an ongoing purpose/mission; a measure of performance signalling progress/regress in pursuing its purposes; a decision making process in the form of a role (which may be occupied by many people in a given system); interconnected components (that interact and are also systems in itself, i.e. containing all the characteristics of a system); existence within wider systems and/or environments with which it interacts; a boundary separating it from its wider systems/environments (which is formally defined by the area in which the decision-taking process has power to instruct actions to be taken); physical and abstract resources that are at the decision making process' disposal; and a guarantee of continuity. He was influenced by the work of C. West Churchman on inquiring systems (Churchman's book "The Design of Inquiring Systems" was published in 1971) (Checkland, 1981:173). According to Churchman (1970:B-43) a system consists of the following: the total system's objectives, i.e. the performance measures of the whole system; the environment of the system, i.e. its fixed constraints; the resources of the system; the components of the system including activities, goals and measures of performance; and the management of the system. This perspective also reflects the systems ideas of Kant, i.e. systems as normative intellectual concepts of critical reason, and the critical systems thinking paradigm (Ulrich, 1983:23).

Checkland (1981:4) states that systems thinking "makes conscious use of the particular concept of wholeness captured in the word 'system', to order our thoughts". Checkland (1981:95) differentiates between two "streams" of systems thinking, i.e. the theoretical development of systems thinking and the application of systems thinking to resolve real-world problems. The theoretical development of systems thinking is discussed in Section 4.3. The practical application of systems thinking, consistent with the main systems thinking paradigms, are discussed in the remainder of this chapter in Sections 4.4 to 4.9.

4.3 The theoretical development systems thinking

Ludwig von Bertalanffy (1972:407) argues that the basic system problem was already defined by the ancient Greek philosopher Aristotle when Aristotle said that *the whole is more than the sum of its parts*. The Aristotelian worldview was holistic. Aristotelians perceived their universe as organic, living, spiritual and teleological; the universe was regarded as mystical and purposeful by nature. The Aristotelian comprehensive world picture remained intact for more than twenty centuries until it was overthrown by the scientific revolutions, which introduced a different view of the world (Checkland, 1981:75). According to Thomas S. Kuhn (1962:92) the scientific revolutions introduced paradigm shifts in the way the people perceived and explored their world. Kuhn (1962:92) refers to the scientific revolutions as "those non-cumulative developmental episodes in which any older paradigm is replaced in whole or in part by an incompatible new one".

The scientific revolutions, brought on by the work of scientists such as Galileo Galilei, Francis Bacon, René Descartes and Isaac Newton, lead to a mechanistic worldview. The scientific revolutions lead to the "traditional" scientific viewpoint, i.e. a positivist position whereby the world can be understood and explained by science, emerged (Louth, 2011:64). It resulted in a mechanical picture of the universe against which Aristotle's teleological (i.e. goal-seeking) outlook seemed tainted by non-essential metaphysical speculation; consequently, phenomena in the universe were no longer explained purely by their perceived purposefulness, but rather by their hypothesised causes (Checkland, 1981:75). The scientific revolutions resulted in a universe that is perceived as mechanical and deterministic; it resulted in a paradigm whereby the universe is governed by mathematical and mechanical laws. The methodology of rationalism and scientific exploration through reductionist methods, that stems from the work of René Descartes (for example his 1637 publication "Method of Reason") as well as positivism (a term coined by Auguste Comte in the 1830s, meaning that knowledge is only recognised if it can be scientifically verified by for example mathematical proof), is still predominantly the manner whereby scientists explore scientific knowledge (Louth, 2011:69).

Positivistic and reductionist scientific research approaches served scientific undertakings in fields with physical regularities well and therefore it was not challenged until the 20th century (von Bertalanffy, 1972:409). Checkland (1981:92) refers to the systems movement, i.e. the emergence of a systems approach to problem solving, as well as the generalisation of diverse ideas related to holistic thinking, which lead to the conceptual development of *systems thinking*. Systems theorists, from originally separate fields for example biology and cybernetics, identified with the systems approach; they united into an intellectual movement and aimed to provide a trans-disciplinary exploratory framework, i.e. a *systems theory* (Lilienfeld, 1975:638). Systems theory is discussed in Section 4.3.1.

4.3.1 Systems theory

The emergence of the systems concept and systems approach led to interdisciplinary studies of systems in general; these studies aimed to reveal universal principles about systems in general and led to the emergence of systems theory. According to Banathy (1967:281) the systems concept and the systems approach emerged since World War II "as new ways of organizing thinking about problem solving, evaluation, and the planning for the development of complex organisms". Banathy (1967:281) refers to systems as "man-made, synthetic organisms" and defines the systems approach as "the methodological application of the systems concept to the deliberate planning and development of man-made, synthetic organisms". Lilienfeld (1975:638) argues that the systems approach presented a different worldview, i.e. one "which transcends the limitations of any scientific discipline, and recasts the problems of sociology, psychology, ethics, cosmology, and the physical sciences", whilst bringing "a new understanding of man and his environment"; it also emphasises the importance of systems thinking, i.e. thinking about systems as whole entities (Lilienfeld, 1975:638). Major contributories of systems theory include for example biologist Ludwig von Bertalanffy's general systems theory and mathematician Norbert Wiener's cybernetics; these are discussed in Section 4.3.2 and Section 4.3.3.

4.3.2 General systems theory

Biologist Ludwig von Bertalanffy (1950:139) formulated the idea of a generalised theory about systems, i.e. general systems theory (GST), in the 1940s. The theory is concerned with inferring universal rules about systems, which can then in principle be applied generically to all systems, regardless of the branch of science it belongs to; he therefore refers to GST as a theory about systems in general that applies to all sciences that are concerned with systems (von Bertalanffy, 1950:139). General systems theory stems from the biology of living organisms as systems that are open to inputs from its environment and also provide outputs to its environment; it deduces "system laws" that manifests themselves as "logical homologies", i.e. analogies of laws; these laws, as general systems concepts, remain identical when applied to different phenomena and also when they appear in different disciplines (von

Bertalanffy, 1972:413). These general systems concepts can thus be transfered from one field to another; GST is “a model of certain general aspects of reality…also a way of seeing things which were previously overlooked or bypassed…tries to give its answer to perennial problems of philosophy” (von Bertalanffy, 1972:424). The application of GST to organisations rejected the traditional closed-system and mechanistic view of social organisations and provided a new paradigm for the study and management thereof (Kast & Rosenzweig, 1972:447).

4.3.3 Cybernetics

Cybernetics focuses on how a system generally communicates and controls its actions in order to improve its performance; the word cybernetics originates from the Greek term that means “steersman”. It was developed by Norbert Wiener (1950:2) in the 1940s; it is concerned with “the general study of communication and the related study of control in both machines and in living things”. The central notion of cybernetics is feedback, as it is applied in engineering control systems (Wiener, 1950:3). Cybernetics is based on the idea that the return of information into a system can guide the system so that the system uses information about its own performance to guide and correct its own action (Wiener, 1950:3). From a cybernetic perspective a system thus has the potential to become “intelligent” over time as it “learns” from its past behaviour by keeping record of it; therefore, from a statistical viewpoint a system’s performance improves. Cybernetics is widely applied in fields such as biomedical systems, artificial intelligence systems, robotics and adaptive systems (Mingers & White, 2010:1148)

4.4 Systems thinking to resolve real-world problems

The development of theories about systems established principles in thinking about systems, i.e. systems thinking; provided a paradigm within which to study and explore systems. Systems theories laid the foundation for the development of systems methodologies to resolve real-world problems. Systems methodologies evolved as thinking about systems evolved. Similar to the scientific revolutions that resulted in paradigm shifts in the way that people perceived and explored their world (Kuhn, 1962:92), the development and subsequent evolution of systems thinking to resolve real-world problems also resulted in paradigm shifts. Systems thinking evolved from the traditional hard systems thinking paradigm into the holistic and enquiring soft systems paradigm and also the holistic and interventionist critical systems paradigm. The paradigms differ based on an ontological worldview, i.e. a theory of what the world is/contains, as well as its epistemological understanding of the world, i.e. a theory of how knowledge can be obtained and expressed (Ezell & Crowther, 2007:271). The paradigms are also associated with problem solving methodologies that provide problem solvers with a "structured set of guidelines for activities to undertake to improve the effectiveness of an intervention" within the paradigms (Mingers, 1997:1).

4.5 The hard systems thinking paradigm

The hard systems thinking paradigm perceives the world as consisting of systems, i.e. entities that exist in the world; it includes problem solving methodologies that aim to optimise systems where the objective(s) of such systems are well-defined (given) (Checkland, 2011:511). The concept of systems thinking was dominated by positivism and functionalism until the 1970s; until then system thinkers presumed that all systems could be empirically recognised, divided into separate parts (whilst assuming that such a separation will not lead to distortion of the phenomenon being examined), analysed through positivistic methods and ultimately manipulated to better fulfil the purpose it was designed to serve (Jackson, 2001:235). Checkland (1981:47) argues that, since positivistic and reductionist approaches dominated virtually all scientific and technological undertakings in the 18th and 19th centuries, and reductionism was not challenged until late in the 20th century, it is not surprising that this hard systems thinking paradigm initially dominated systems thinking as well; it provided systems thinking with a basis to begin to think about and explore systems.

4.5.1 Methodologies within the hard systems thinking paradigm

Checkland (1981:277) says that hard systems methodologies "have a built-in positivist ontology". The ontological stance of positivism is realism and the positivist epistemology is objectivism; the positivist researcher is thus independent from the entities that he/she research (Scotland, 2012:10). Problem solving methodologies in the hard systems thinking paradigm focus on optimisation and design (Checkland, 1985:757). The hard systems thinking paradigm includes traditional problem solving methodologies such as operational research (also referred to as operations research) that uses systems ideas in support of decision-making, as well as (hard) systems engineering and systems analysis, which are applied to develop, analyse and optimise engineering-type systems (Checkland, 1981:96). These methodologies are discussed further in the next sections.

4.5.2 Operational research

According to Schlager (1956:65) operational research (OR) practitioners aim to optimise organisational performance. OR activities dates, in theory, back to the early 1800s since some of the principles of OR can be recognised in work done by Charles Babbage: for example, Babbage (1864:447) describes in his autobiography how he analysed the cost of transportation and sorting of mail for the British postal service, upon which he derived some general principles for the optimal pricing of postal/mail services. He also refers to "experiments" that he conducted in 1838-1839 for a British railway company, i.e. the Great Western Railway, to determine the most effective track gauge (the distance between the railway tracks of trains) to be used in their railways (Babbage, 1864:320). However, OR was only formally established as a discipline in 1940 when it stemmed from work done by civilian scientists to help the military effectively plan operations during World War II; they used information provided by (at that time newly developed) radar technology to optimise military strategies (Morse, 1986:15).

Larnder (1984:474) describes how OR contributed to Britain's success in the 1940 "Battle of Britain" illustrates how OR was successfully applied in war operations. After the war organisations in the public sector began to incorporate OR to optimise their organisational decision making and hence its performance (Schlager, 1956:65). Checkland (1981:72) refers to OR as the management science that is the closest "to having a hard scientific core" since it applies scientific methods to intervene in complex managerial problems; however, he argues that "it can hardly generate the kind of irrational decision which, in a management situation, often turns out to be a good one". Ackoff (1979:189) therefore suggested that "the predict-and-prepare paradigm employed by OR be replaced by one directed at designing a desirable future and inventing ways of bringing it about, and that OR replace its problem-solving orientation by one that focuses on planning for and design of systems"; he subsequently developed a "softer" OR approach and "planning paradigm", i.e. interactive planning (IP), for this purpose. The IP methodology is discussed, within the soft systems paradigm, in Section 4.6.3 of this chapter.

4.5.3 Systems engineering

There are similarities between systems engineering and operational research; however, the objective of systems engineering activities are to manufacture and optimise *systems*, rather than to improve organisational decisions and performance as is the case with operational research (Schlager, 1956:65). Systems engineering evolved as a result of "the increased complexity of systems being developed" in the post-war era in the late 1940s; even though systems engineering was applied in a number of organisations, the origin of the term "systems engineering" can be traced back to "The Bell Telephone Laboratories" where it was used extensively to optimise their complex and integrated systems (Schlager, 1956:64).

According to Hall (1969:157) the structure and form of systems engineering was developed by applying a morphological analysis technique whereby a general problem/system is decomposed into its basic variables. Hall (1969:157) presents systems engineering as a two-dimensional model containing a number of phases that can be summarised to include the following: program planning, project planning, system development, production, distribution, operations and retirement; within the phases a number of steps such as problem definition, development of objectives, collection and invention of alternatives as well as systems analysis must be iterated. Systems engineering gave birth to software engineering and software development approaches within the hard systems thinking paradigm. Software development within the hard systems thinking paradigm is briefly discussed in Section 4.5.5 of this chapter; software development approaches are discussed in detail in Chapter 3.

4.5.4 Systems analysis

Systems analysis entails the systematic examination of a problem, where the analyst attempts to make every step of the analysis explicit (Hoag, 1956:1). Systems analysis is a reductionist approach to problem solving; the term “analysis” comes from classical Greek where it can literally be translated as “to loosen up” and hence is applied to “break down an intellectual or substantial whole into parts or components” with the purpose to understand it (Ritchey, 1991:1). Systems analysis in organisational contexts emerged in the post-war era in the 1940s; in a write-up of a speech given to a military group visiting the RAND Corporation, Hoag (1956:1) describes organisational systems analysis as “an outgrowth” of the operational research that developed during World War II. “Hard” systems analysis approaches, that entails quantitative analysis techniques, are widely applied when developing software to gather software requirements (Ezell & Crowther, 2007:272). Chapter 3 contains a detailed discussion on software requirements collection approaches.

4.5.5 Software development in the hard systems thinking paradigm

After World War II, when problem solving methodologies such as operational research, systems engineering and systems analysis were widely adopted by organisations to optimise their performance, computers were adopted for commercial use and optimisation purposes as well; with the commercial adoption of computer technology in the early 1950s software development activities inevitibly emerged and subsequently evolved into software development approaches that were influenced by the type of problem solving methodologies that were generally applied at the time. For example, the automation of basic data processing activities and repetitive code-and-fix activities whereby software was developed in the early 1950s (Hopper & Mauchly, 1997:470) soon evolved into formal sequenced software development activities as was presented in 1956 (Benington, 1983:350). Software engineering, based on the methodology of systems engineering, was formally established as a discipline in 1968 (Randell, 1996) whilst the publication of the traditional software development lifecycle (SDLC), which also stems from systems engineering, was widely adopted since its publication in 1970 (Royce, 1970:338). The systems engineering type approaches, such as the SDLC method, influenced software development approaches greatly (Avison & Fitzgerald, 2006:44). Adoption of engineering type software development approaches “was probably historically inevitable, given that the early computers were large machines…the initial importation of thinking from the world of engineering projects was not foolish” (Checkland & Scholes, 1990:308). Hence, the engineering view dominated software development approaches until the 1980s (Denning & Freeman, 2009:28) and software development approaches, including business intelligence systems development approaches, remained grounded within the hard systems thinking paradigm that focuses mostly on technological aspects (Iivari *et al.*, 2000:192). Chapter 3 discusses the evolution of computer technology as well as the evolution of software development and business intelligence systems development approaches in more detail.

4.5.6 Critique against the hard systems thinking paradigm

Ackoff (2001b:344) argues that hard systems methodologies are useful for deterministic systems since it enables successful intervention in well-defined problem contexts. Phenomena in fields with physical regularities, for example physical science or chemistry, where the focus is mainly on the method to resolve pre-defined problems (*how*), rather than on the definition of the problem itself (*what*) are successfully studied within the hard systems thinking paradigm (Checkland, 1981:144). However, the implication of applying approaches from the hard systems perspective is potentially a disregard of social facets in favour of elements that are more easily modelled using reductionist methods (Ezell & Crowther, 2007:272). For example, Ezell & Crowther (2007:271) argue that systems analysis may be applied from different viewpoints but most often fits the hard systems paradigm since it is predominantly taught to students “in exactly *one* way with emphasis on quantitative analysis”; hence “the empirical analysis of functions and architecture get studied and the social systems get put aside because the realist cannot observe or empirically measure it”.

Córdoba (2009:124) argues that software are social artefacts and hence software development is a social process. Hard systems methodologies are less successful when applied to seemingly more complex social phenomena that can potentially be interpreted in many possible ways and has individual human beings that actively participate in (and hence potentially alter the outcome of) the phenomena being investigated (Checkland, 1981:69). Avison & Fitzgerald (2006:11) state that "in many of the information systems failures that have occurred, the conclusion has been placed squarely on human and organizational factors rather than technical ones". Software developers therefore came to the realisation that traditional approaches, such as the SDLC, have many strengths but also many weaknesses (Avison & Fitzgerald, 2006:44). Therefore, the need for alternative methodologies followed upon the realisation that these "harder systems methodologies are not entirely appropriate because of their over reliance on mechanistic hierarchical decomposition" and hence may render software that "may be technically appropriate but culturally/organizationally infeasible or fail to meet user needs" (Clegg & Shaw, 2008:448).

4.6 The soft systems thinking paradigm

A paradigm shift occurred in the 1980s when soft systems thinking emerged to address problematical (human/social) situations that arise from multiple worldviews; systems thinking evolved to embody phenomenology and interpretivism (Checkland, 2011:510). Checkland (2012:468) defines the paradigm shift between hard and soft systems based on its attribution of systemicity: hard systems thinking assumes systemicity to be in the world; soft systems thinking assumes systemicity to be a systemic process, i.e. a learning system, whereby the complexity of world can be explored. Within this paradigm system thinking embrace the notion that the world is complex, ill-structured, problematical and mysterious; yet, it can be explored through a systemic process of enquiry (Checkland, 1981:241). Ulrich (2013:314) refers to soft systems thinking as a "qualitative, interpretive…perspective and mode of analysis". Methodologies, i.e. soft systems thinking and interactive planning, as well as software development in this paradigm are discussed next..

4.6.1 Methodologies within the soft systems thinking paradigm

The soft systems thinking paradigm includes interpretative methodologies. Scotland (2012:11) refers to the ontological stance of interpretivism as relativism, i.e. "the view that reality is subjective and differs from person to person”; the intepretive epistemology is “subjectivism which is based on real world phenomena”. The soft systems thinking paradigm includes problem solving methodologies such as Peter Checkland’s soft systems methodology (Checkland, 1981) and Russel Ackoff’s softer approach to operational research, i.e. interactive planning (Ackoff, 2001a). The process and outcome of soft systems methodology and the interactive planning methodology are discussed in the next sections.

4.6.2 Soft systems methodology

Peter Checkland’s soft systems methodology (SSM) emerged within the soft systems thinking paradigm upon the realisation that the complexity and subjectivity of the world makes it difficult to define objectives precisely within the objective and realistic hard systems thinking paradigm (Hirschheim & Klein, 2012:199). SSM was developed by Peter Checkland for ill-structured complex (messy) problem situations where participants generally agree on objectives but the means to achieve them are still to be selected (Checkland & Scholes, 1990:1). SSM presumes that social reality continuously changes as it is constantly re-created through never-ending social developments due to purposeful activity of participants; it aims to explore models of purposeful activity coherently rather than merely describe it (Checkland & Holwell, 1998:157). It assists problem solvers to understand the world that they aim to intervene in by understanding people’s perceptions of their world, i.e. their respective worldviews (Mingers, 1980:41). SSM is a learning system that is aimed at “action to improve” (Checkland, 2012:468). According to Checkland (2011:509) SSM gives epistemological guidance in order to explore the appreciative settings in situations that are regarded as requiring “action-to-improve”.

Checkland (1981:161) states that SSM is a *methodology* (rather than a *method*) in that it is “a set of *principles of method* which in any particular situation have to be reduced to a method uniquely suitable to that particular situation”. A methodology is a “collection of procedures, techniques, tools, and documentation aids”; however, a methodology is not a recipe-like method since a methodology is based on a philosophical viewpoint (Avison & Fitzgerald, 2006:24). Checkland (1981:264) refers to SSM as a methodology that operationalises Churchman’s philosophical analysis of enquiring systems and provides a formal method to initiate and consciously reflect upon the process embodied in Vickers' idea of appreciative systems; it aims to understand social processes that characterises human affairs. It is "a methodology for operating the endless cycle from experience to purposeful action…to change real situations constructively" (Checkland & Scholes, 1990:3).

4.6.2.1 The soft systems methodology process

Checkland & Scholes (1990:3) refer to the "experience-action cycle" where humans attribute meaning to their experienced world; in response they then take purposeful action towards perceived improvement whilst learning about their world and hence potentially adjust their actions. Purposeful activity entails that a problem solver engages in a cyclical process where he/she: learns about a concerning real-world situation; selects relevant human activity systems and makes models of them; uses the models to question the real-world situation through comparison; and uses the debate that was initiated by the comparison to define purposeful action to improve the original problem situation (Checkland & Scholes, 1990:6) – Figure 4-1 below illustrates this basic process of purposeful activity embedded in SSM.

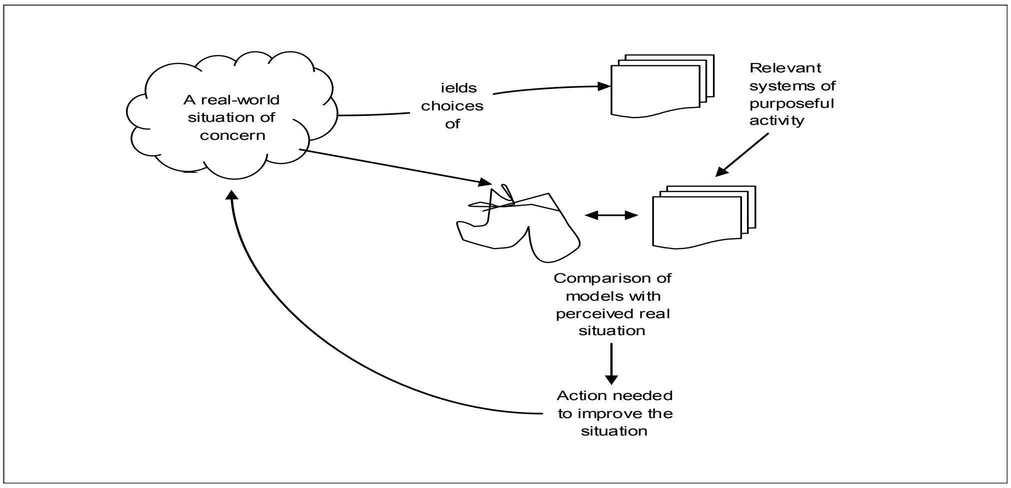

Figure 4-1: Basic form of SSM (Checkland & Scholes, 1990:7)

A number of aspects must be considered for an intervention to be successful when faced with a problematical situation that should be managed in order to improve it, i.e. the "whats and hows of the improvement" and the people "through whose eyes ‘improvement’ is to be judged” as well as the history of the situation “of which there will always be more than one account” must be considered; this is achieved by logically analysing people’s perception of various purposeful actions (tasks) as well as the various things about which people disagree (issues) and comparing it with perceptions of the portion of the real world that is being examined; the purpose of these comparisons are to initiate and structure debate about change (Checkland & Scholes, 1990:28). The logical-based stream of enquiry in SSM starts with an expression of a purposeful activity system’s core purpose where the problem solver derives the transformation’s “root definition” in that the problem solver considers the elements of “CATWOE”: where “C” represents the customers, i.e. the victims or beneficiaries of the transformation; “A”, represents the actors, i.e. those who will execute the transformation; “T” represents the transformation, i.e. the conversion of input into output; “W” represents the applicable “Weltanschauung”, i.e. the worldview that makes the transformation meaningful; “O” represents the owners i.e. those who could stop the transformation; and “E” represents the environment, i.e. the environmental constraints that are given elements outside the system (Checkland & Scholes, 1990:35).

A problem situation has a cultural dimension as well; the cultural stream of analysis in SSM consists of examinations of the problem situation in terms of the intervention itself, the situation as a social system and the situation as a political system (Checkland & Scholes, 1990:29). The intervention in a problem situation, which is regarded as problematical in itself, entails three roles: the client, the would-be problem solver and the problem owner (Checkland & Scholes, 1990:48). The first model built in SSM is a model that consists of a structured set of activities that the problem solver wants to turn into real-world action; this role-analysis is referred to as “Analysis One” (Checkland & Scholes, 1990:48). According to Checkland & Scholes (1990:49) the second analysis in SSM, also referred to as “Analysis Two”, is based on the work of Vickers (1968) on “appreciative systems”. It assumes that a social system involves continually changing interactions between three elements, i.e. roles, norms and values, where each element is continually defined, redefined and in itself defined by the other two; the nature of a social system is not likely to emerge from direct questions; it must rather be inferred indirectly based on interactions with relevant role players (Checkland & Scholes, 1990:49). According to Checkland & Scholes (1990:50) the third cultural-based analysis, i.e. “Analysis Three”, explores the political dimension by determining how power is expressed, for example “formal (role-based) authority, intellectual authority, personal charisma, external reputation, commanding access (or lack of access) to important information, membership” etc.; this analysis reflects the Greek philosopher Aristotle’s view on politics in that it regards politics as the process by which differing interests reach accommodation and that rests on dispositions of power.

The detailed and cyclical process of enquiry embedded in SSM, which includes the process of enquiry entailing the logical-based stream of enquiry as well as the cultural-based stream of enquiry, is illustrated below in Figure 4-2 (Checkland & Scholes, 1990:29).

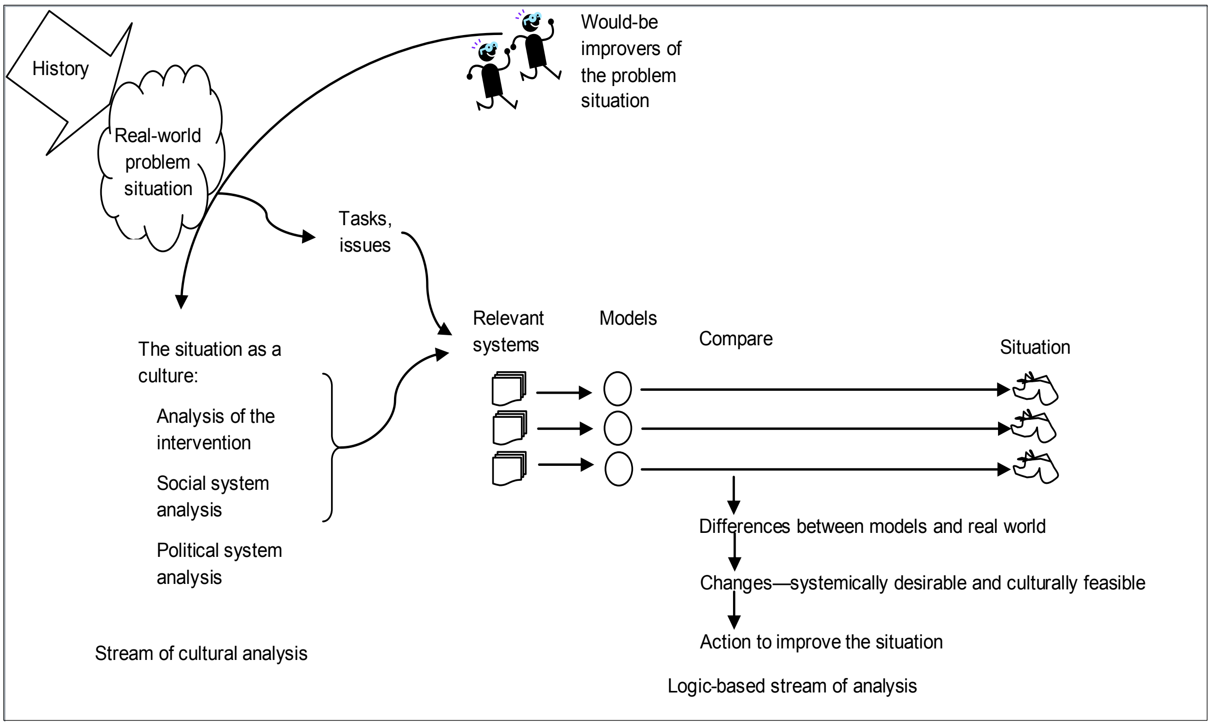

Figure 4-2: SSM process (adapted from Checkland & Scholes, 1990:29)

The application of the SSM process allows problem solvers to present a problem situation in the form of a “rich picture” by examining elements of its structure and process as well as its climate (Checkland, 1981:7). Checkland (1981:317) defines a rich picture as an “expression of a *problem situation* compiled by an investigator, often by examining elements of *structure*, elements of *process*, and the situation *climate*”. SSM allows problem solvers to question real-world situations through comparison and uses the debate that was initiated by the comparison to define purposeful action (Checkland & Scholes, 1990:6) The outcome of SSM when applied in problematic social situations is improvement through purposeful change actions (Checkland & Scholes, 1990:3). According to Checkland (2011:504) SSM is an epistemology that helps problem solvers to structure engagement with a problematical situation being addressed; it also enables the user to remain situation-oriented rather than methodology-oriented. Mingers & White (2010:1151) refer to SSM as “the most widely used and practical application of systems thinking”; it is used in diverse fields such as ecology, public services, business applications and information systems.

4.6.2.2 Critique against soft systems methodology

Checkland (2012:468) defines the operationalisation of soft systems thinking, i.e. SSM, as a methodology that is “a learning system aimed at ‘action to improve’”, and thus as having a critical and interventionist stance rather than a purely interpretive and enquiring stance. However, the systems thinkers that position themselves in the critical systems thinking paradigm disagree, i.e. Ulrich (2013:314) refers to soft systems thinking as a purely interpretive paradigm and Jackson (2001:236) also positions Peter Checkland’s soft systems thinking strand within a purely “interpretive paradigm” with guiding assumptions that are “subjective” and “regulative”, which subsequently “constrain the ability of soft systems practitioners to intervene”. Bentley *et al.* (2013:453) also agree that SSM may not effectively enable intervention in coercive social contexts and where there are conflicting objectives

Checkland (2011:510) asserts that problem solving methodologies positioned in the soft systems thinking paradigm does not stand opposite methodologies in the hard systems thinking paradigm; soft systems thinking aim to enrich the understanding of complex social contexts and may still include the application of other (“hard”) problem solving approaches once the problem solver understands the complexity of the problem situation; it thus supports complementarism and critical awareness.

However, Bentley *et al.* (2013:453) argue that SSM does not enable a problem solver to combine multiple approaches. The soft systems thinking paradigm and Flood (1995b:183) positions SSM as a methodology to be applied to explore and acknowledge differences in perceptions about *what* should be done rather than to resolve potential power struggles and emancipate participants.

4.6.3 Interactive planning

Russell Ackoff refers to interactive planning (IP) as the soft side of operational research; he developed IP to remove self-imposed and/or imaginary constraints that prevent people to achieve their desired future; it facilitates the continuous improvement of plans, learning (on an organisational and individual level), adaptation and development (Ackoff, 1981:25). IP enables people to plan and design in order to solve problems; it also enables participants to deal with organisations as a whole and as part of a larger system (Ackoff, 1979:189). Ackoff (1981:22) argues that IP attempts to intervene in problem situations by focusing on "the management of messes"; it aims to emancipate people from the principle obstruction between them and their desired future, i.e. make them aware that the constraints that they believe to be imposed on them are either within themselves or not real, before enabling them to plan for the desired future.

4.6.3.1 The interactive planning process

According to Russell Ackoff (1979:189) IP is based on three operating principles, i.e. a *participative* principle, a principle of *continuity* and a *holistic* principle. The *participative* principle is based on the belief that participants benefit from planning by engaging in it; the principle of *continuity* states that planning should be continuous rather than cyclical; and the *holistic* principle asserts that all the parts and levels of a system should be planned for concurrently as well as interdependently (Ackoff, 1979:189). The principles are operationalised through a number of interdependent phases: the formulation of the "mess" that involves analysing the current situation; planning of the "ends" to determine the ideal situation; planning of the "means" to address the gaps between the current and ideal situations; planning of resources required to address the gaps and move from the current to the ideal situation;

designing of the implementation plan to implement the ideal situation; and finally the actual implementation of the pursuit. Table 4-1 below presents the phases in more detail (Ackoff, 2001a:5).

Table 4-1: Interactive planning phases (Ackoff, 2001a:5)

Phase	**Phase activities**
Formulate "the mess" to conceptualise the organisation's problems/prospects and the relationship between them as a system and as it is at the moment of capturing (the as-is state).	• Systems analysis: analyse how the system currently operates. • Obstruction analyses: identify the characteristics and properties of the organisation that obstructs it progress. • Reference projections: project the future assuming no change. • A reference scenario: a description of how/why the organisation would destroy itself if the assumptions above are true.
Plan "ends" to create a design of a desired future; invent ways to closely resemble it, including objectives and ideals and the means to pursue them (desired to-be state). The idealised design assumes the organisation being planned for was destroyed but its environment remained intact; hence the idealised design is to replace the destroyed organisation.	• Describe the ideal, constrained only by technological feasibility and operational viability. The idealised design must be a learning, adaptable organisation. It involves formulating a mission statement, specified properties of the designed organisation and the design of an organisation comprising all the specified properties. • Determine gaps between ideal and reference scenario organisation.
Plan the resources.	• Determine and acquire resources (people, facilities, materials, money and information resources) to move from "as-is" state to the "to-be" state.
Plan the organisation and management of the pursuit.	• Plan effective execution, organisational learning and adaptation.
Implement and control the pursuit.	• Manage performance, diagnose delinquency and correct where required.

The implementation of an idealised design as derived through IP facilitates a qualitative change in an organisation (Ackoff, 2001a:15). IP does not prescribe specific methodologies to be employed in order to implement the identified change effort(s) but allows for multiple methodologies to be utilised as required (Ackoff, 1981:24). IP is, similar to SSM, and enquiring and interpretative approach that aims to explore and understand different perceptions of reality in order to affect change in the world.

4.6.3.2 Critique against interactive planning

Flood & Jackson (1991a:158) refer to IP as "an ambitious attempt to handle simultaneously both the complexity of the problem situations facing modern organisations and the pluralisms which inevitably follows from their serving diverse stakeholders"; they argue that IP is dependent upon a consensus worldview and does not deal effectively with coercion. Flood (1995b:183) positions IP with SSM as a methodology to be applied to explore and acknowledge differences in perceptions about *what* should be done rather than to resolve potential power struggles and emancipate participants. However, Ackoff (2001a:15) argues that the application of IP facilitates change and thus intervenes in problematical organisational situations; IP thus also has a critical and interventionist stance rather than a purely interpretive and enquiring stance.

4.6.4 Software development in the soft systems thinking paradigm

Córdoba (2007:910) argues that the scope of software development approaches are widened by the soft systems thinking paradigm. The idea to explore the development of software artefacts within the realm of social sciences and within the "softer" systems thinking paradigm emerged formally in the 1990s (Checkland & Holwell, 1998:9). The two soft systems methodologies described in the previous sections are interactive planning (IP) and soft systems methodology (SSM). IP is mostly applied to organisational management planning problems and not explicitly in software development. SSM is regarded by various authors as useful in developing software: Iivari *et al.* (2000:191), Clegg & Shaw (2008:447) as well as Avison & Fitzgerald (2006:508) list SSM as a software development approach. However, Córdoba (2007:910) argues that software developers must remain cognisant of the fact that the ultimate goal of organisational software artefacts is “to meet business objectives” and that software development processes necessitate that the goals of a “soft” approach be balanced with the goals of “hard” profit-seeking business objectives; the intrinsic conflict posed by the technical goals to be reached versus the human, social and organisational aspects that inherently affect software development projects’ success must be explored and incorporated. The application of SSM in software development is discussed in Chapter 3.

4.7 The critical systems thinking paradigm

This section discusses the critical systems thinking (CST) paradigm. Section 4.7.1 discusses the epistemology and ontology of the CST paradigm; Section 4.7.2 discusses emancipation in CST; and Section 4.7.3 describes the development of two CST strands. The CST strands are discussed in detail in Sections 4.8 and 4.9.

4.7.1 The epistemology and ontology of critical systems thinking

Mingers & White (2010:1152) argue that CST revolves around two meanings of ‘critical’: They refer to the first dimension as epistemological as it is viewed to be “concerned with the nature and limits of knowledge” in that CST investigates the assumptions and limitations of the hard systems paradigm as well as the soft systems paradigm. They argue that the second dimension is a politically-oriented dimension that considers the nature and role of problem solving approaches within society as a whole; the epistemological debate moved from the question of selecting a single method to recognising the value of combining different methods from the hard and soft paradigms, i.e. pluralism, that allows problem solvers to address different phases of an intervention with appropriate problem solving methodologies from the hard and/or soft paradigm.

Flood & Jackson (1991a:131) state that CST emerged to facilitate social improvement through: critical and social awareness, i.e. the examination of taken-for-granted assumptions; methodological and theoretical complementarism, i.e. the theoretically coherent application of various methods; as well as a dedication to human emancipation, i.e. improvement in oppressive social conditions. Critical systems thinkers view the world as full of contradictions and conflict that requires intervention. Critical systems methodologies are positioned within this paradigm; they aim to identify domineering structures and also enable problem solvers to intervene with the purpose to overcome it (Flood & Jackson, 1991a:191).

Problem solvers within the critical paradigm accepts that knowledge is socially constructed and also influenced by the power relations from within society (Scotland, 2012:13). Ulrich (1983:111) refers to such power relations as one of the basic modes of social organisation that constructs “ideological and institutional barriers to emancipation from oppression”. The CST paradigm’s ontological position is critical realism, i.e. it “seeks to promote a transformational as opposed to an affirmative account of the social world” (Delanty, 2011:75). The aim of CST is to combine philosophy with social science, so as to advance emancipatory change and subsequently liberate people from oppressive social structures such as unnecessarily restrictive identity formations, assumptions, traditions, and power relations; such oppressive social structures restrain opportunities for autonomy and the clarification of genuine needs, and ultimately hinders greater and lasting gratification amongst individuals and collective groups (Alvesson & Willmott, 1992:435).

4.7.2 The emancipatory nature of critical systems thinking

Critical systems thinking is derived from systems thinking and critical social theory, i.e. the work of critical social theorists such as Habermas (Jackson, 2001:233); for example, Habermas aims to emancipate people from societal repression and he attempts to achieve the possibility of rational consensus through appropriate communication (Mingers, 1980:41). Habermas’ work is in the Frankfurt School tradition of critique; Delanty (2011:72) refers to the Frankfurt School tradition as “normative critique” based on its concern with human emancipation, i.e. “it was constructed on the basis of a vision of an alternative – even if it could not be precisely named – to the prevailing social and political order” and “concerned social transformation and the elimination of social injustice”.

Alvesson & Willmott (1992:432) assert that "[e]mancipation describes the process through which individuals and groups become freed from repressive social and ideological conditions, in particular those that place socially unnecessary restrictions upon the development and articulation of human consciousness". Ulrich (1983:257) argues that constraints, such as costs and risks, can only be legitimately imposed on autonomous individuals and collective groups in a democratic society if they all voluntarily accept those constraints. The constraints imposed upon individuals and collective groups must ideally be outweighed by the benefits of receiving (a system) that they (autonomously) need *and want*; such a system must ultimately fulfil the *real* needs of the individual and the group in such a way that they *want* it, and that it provides them with great and lasting gratification.

Critical theorists aim to facilitate clarification of what it means if people need to expand their autonomy in their personal and social (and by implication thus also their organisational/work) life (Alvesson & Willmott, 1992:432). On an organisational level emancipation inevitably entails a "struggle" where affected organisational employees (individually and collectively) actively participate to progress towards autonomy; it therefore necessitates that these organisational employees actively resist identified socially unnecessary restrictions – they must actively embark on a journey that includes both critical self-reflection and associated self-transformation (Alvesson & Willmott, 1992:433). Those that are merely affected by the decisions and/or actions of others that have more organisational power than themselves, must thus be granted an opportunity to emancipate themselves through a facilitated process of emancipatory self-reflection (Ulrich, 1983:257). Such subjugated individuals (and groups) must therefore be granted a fair opportunity to emancipate *themselves* from being treated as mere instruments for the purposes of other (Ulrich, 1983:257).

Ulrich (1998:2) says that "industrial democracy (democracy at the workplace)" is an "idea [that] has remained scarcely developed in our actual practice of democracy". Ulrich (1983:308) initially argued that a truly rational and democratic planning process must "start with a practical discourse among the involved and the affected" (refer to Section 4.9 for a discussion on the definitions of the involved versus the affected stakeholders in systems design), where "the affected must not be required to submit to the rationality standards of the involved but must be entitled to argue polemically”, i.e. he/she is not required to have theoretical knowledge or competence in support of his/her argument. However, he later pointed out that there may inevitably be an ever increasing gap between the democratic civil rights of the affected, and their *actual* capability to participate; consequently “the necessary rights of participation and democratic control is not enough to ensure effective participatory chances to them; if the issues are beyond their understanding, how can they argue their concerns in a competent manner?” (Ulrich, 1998:3).

Researchers appreciate that “the value of science, including social science, resides in its potential to develop conditions (material and symbolic) that are beneficial to human beings…the promise of applying critical powers of reason to expose and remove contemporary forms of unreason, superstition, and dogmatism” (Alvesson & Willmott, 1992:436). To fully realise the ideals of the critical paradigm “social structures must be radically changed so that they actively support and facilitate, rather than selectively and instrumentally exploit, expansion of purposiveness, creativity, and rationality” (Alvesson & Willmott, 1992:437). However, radical change is not necessarily practically achievable in large organisational contexts and within a short space of time. Consequently, Alvesson & Willmott (1992:446) emphasise “*cr c*”; it focuses on concrete activities, forms, and techniques that serves as vehicles for liberation where “processes of emancipation are understood to be uncertain, contradictory, ambiguous, and precarious” and “loopholes” can be found where power techniques are operational. The emancipatory idea is therefore not portrayed as one large grandiose project, but rather as a group of smaller projects, where each smaller project is “limited in terms of space, time, and success” (Alvesson & Willmott, 1992:447).

4.7.3 The critical systems thinking strands

Jackson (2001:236) says that CST draws upon traditional (hard) systems thinking as well as “newer systems approaches, methodologies, models and methods developed, in the 1970s and early 1980s, by those who found hard systems thinking…too limiting”; he refers for example to Peter Checkland’s soft systems thinking and Werner Ulrich’s critical systems heuristics as these “newer systems approaches" and believes that CST is encapsulated in the meta-methodology total systems intervention that supports methodological pluralism. However, Ulrich (2013:314) describes CST as "a development of systems thinking that aims to support good practice of all forms of applied systems thinking and professional intervention". He believes that CST is encapsulated in critical systems heuristics since CST uses systems thinking to reflect on the status quo to ultimately enable improvement; systems thinking requires critique to recognise underpinning boundary judgements and associated normative implications whilst critique requires systems thinking to ensure that improvement actions are rationally applied within justified boundaries (Ulrich, 2003:327).

Jackson (2001:236) argues that CST has been developed since 1979 at the University of Hull, whilst Ulrich (2003:326) argues that CST emerged in the late 1970s at the University of Berkeley. According to Jackson (2001:236) the total systems intervention meta-methodology was the initial "operationalising of critical systems ideas" whilst Ulrich (2003:327) states that his critical systems heuristics framework "represented the first systematic attempt at providing both a philosophical foundation and a practical framework for CST". These two strands of CST, i.e. the total systems intervention (TSI) strand and the critical systems heuristics (CSH) strand, seemed to have developed simultaneously yet separately. The TSI strand represents "a meta-methodological framework for facilitating critical (i.e. theoretically informed and justified) methodology choice" and the CSH strand represents a "discursive framework for promoting reflective (i.e. transparent and self-critical) practice" (Ulrich, 2013:316). The two CST strands, i.e. the TSI strand and the CSH strand, are discussed in the next sections.

4.8 Total systems intervention

This section discusses total systems intervention (TSI). It looks at the development of TSI, the theoretical underpinnings of TSI, the TSI process and outcome, critique against TSI, and TSI in software development.

4.8.1 The development of total systems intervention

The TSI strand of CST emerged at Lancaster University in the 1970s as a result of a critique of Peter Checkland's soft systems thinking (Jackson, 2003:1225). According to Jackson (2001:237) TSI, as a practical meta-methodology that operationalises CST, was developed by Bob Flood and Mike C. Jackson in the 1980s; it is based on a theoretical tool called the "system of systems methodologies" (SOSM), which applies an ideal-type grid of problem contexts whereby systems methodologies are classified based on their assumptions about these problem contexts. In a later reconstitution of TSI Flood (1995b:183) recommends that a simpler complementarist framework can replace the SOSM framework. The complementarist framework links systems methodologies directly, based on the purposes of the methodologies, to the metaphorical analysis of dominant organisational issues (Flood, 1995b:183).

4.8.2 The critical nature of total systems intervention

Flood & Jackson (1991a:46) argue that TSI operationalises CST. TSI facilitates critical awareness since it informs methodology choice based on the strengths, weaknesses and theoretical underpinnings of available systems methodologies (Flood & Jackson, 1991a:133). TSI categorises problem contexts according to the relative complexity of the problem's system dimension and nature of the relationships of involved stakeholders to inform methodology choice (Flood & Jackson, 1991a:33). The potential informed use of different systems methodologies in TSI is based on Habermas' work that supports theoretical and methodological complementarism (Flood & Jackson, 1991a:133). Jackson (1985:881) refers to the Habermas' work as "Utopian"; still, its principles are found to be useful.

Habermas' theory of knowledge-constitutive interests refers to two fundamental conditions, i.e. *work* and *interaction*, which underpin the socio-cultural form of human life: firstly Habermas refers to *work* as "technical interest" which enables people to achieve materialistic goals through social labour; and secondly, Habermas refers to *interaction* as "practical interest" that is concerned with securing and expanding possibilities for mutual understanding amongst those that are involved in social settings, in order to reproduce social life (Flood & Jackson, 1991b:200). Further, Habermas also refers to an additional “emancipatory interest” that humans have to free themselves from constraints imposed on them by power relations that can prevent open and free discussion that successful interaction requires, so that people can participate freely in democratic discourse (Flood & Jackson, 1991b:200). Habermas’ work that refers to the technical, practical and emancipatory interests of humans is an important foundation for pluralism in management science since “his anthropological based cognitive interests of the human species, hard and cybernetic approaches could support the technical interest, soft approaches the practical interest, and critical approaches what Habermas defined as an emancipatory interest” and thus directed TSI’s commitment to emancipation (Flood & Jackson, 1991a:133). Hard (cybernetic) systems approaches support the technical interest, softer methodologies support the practical interest and the emancipatory interest may be served by critical methodologies in the SOSM framework of TSI (Flood & Jackson, 1991b:200).

The SOSM framework theoretically informs methodology choice; however, a problem solver must also be socially aware and consider the potential consequences of applying certain methodologies; he/she must recognise organisational and societal pressures that led to specific methodologies being popular to guide particular interventions (Flood & Jackson, 1991a:133). The TSI meta-methodology supports organisations to increase efficiency and effectiveness as well as improve the social conditions of dominated employees (Flood & Jackson, 1991a:237). TSI aims to be systemic and reflective; at the same time it also aims to achieve meaningful participation and ultimately emancipation (Flood, 1995a:198).

4.8.3 The total systems intervention process

According to Flood & Jackson (1991a:50) the following principles are embedded in the TSI methodology:

- Organisations are too complex to understand using only one management model and organisational problems are too complex to resolve using “quick fix” methods; organisations and their organisational problems must therefore be decontextualised and contextualised during the creativity phase to allow problem solvers to resolve manageable portions of problems before repeating the process for the next portion of identified problems.

- A range of metaphors should be applied to investigate organisations and its organisational strategies and difficulties; the metaphors guide problem solvers during the creativity phase to identify dominant organisational problems that must be resolved first.
- The metaphorical analysis of organisations and the subsequent identification of relevant systems metaphors can guide interventions during the choice phase by linking it to appropriate systems methodologies;
- Different systems metaphors and methodologies can be used complementarily;
- Strengths and weaknesses of different systems methodologies can be related to organisational concerns through the application of the SOSM framework;
- Iteration back and forth between the TSI phases results in a systemic cycle of enquiry as is indicated by the recursive nature of TSI; and
- All stakeholders must be engaged in all stages of the TSI process.

Flood (1995a:174) states that TSI facilitates the creative surfacing of organisational issues and then allows problem solvers to choose and apply appropriate problem solving methodology/(ies). The TSI methodology comprises three main phases: the creativity phase, the choice phase and the implementation phase (Flood, 1995a:180). Flood & Jackson (1991a:52) explain that the problem solver firstly analyses and defines the problem context, i.e. the identified problems to be managed, during the creativity phase; secondly, he/she identifies an appropriate dominant problem solving methodology, with supporting problem solving methodologies, during the choice phase; and thirdly, the problem solver implements the chosen methodologies during the implementation phase.

The three main phases also co-exist in a recursive structure within each main phase where it includes three sub-activities; the sub-activities are also named creativity, choice and implementation (Flood, 1995a:180). The recursive nature of the TSI methodology implies that the problem solver should, for example, creatively seek, select and apply (implement) an idea-creating method during the main creative phase; similarly, a problem solver must creatively seek appropriate problem solving methodologies, select the appropriate methodologies and implement them; lastly, a problem solver should creatively develop change plans, choose appropriate change plans and implement the chosen change plans during the implementation phase (Flood, 1995b:35). Figure 4-3 below illustrates the recursive TSI phases and sub-activities according to Flood (1995a:35).

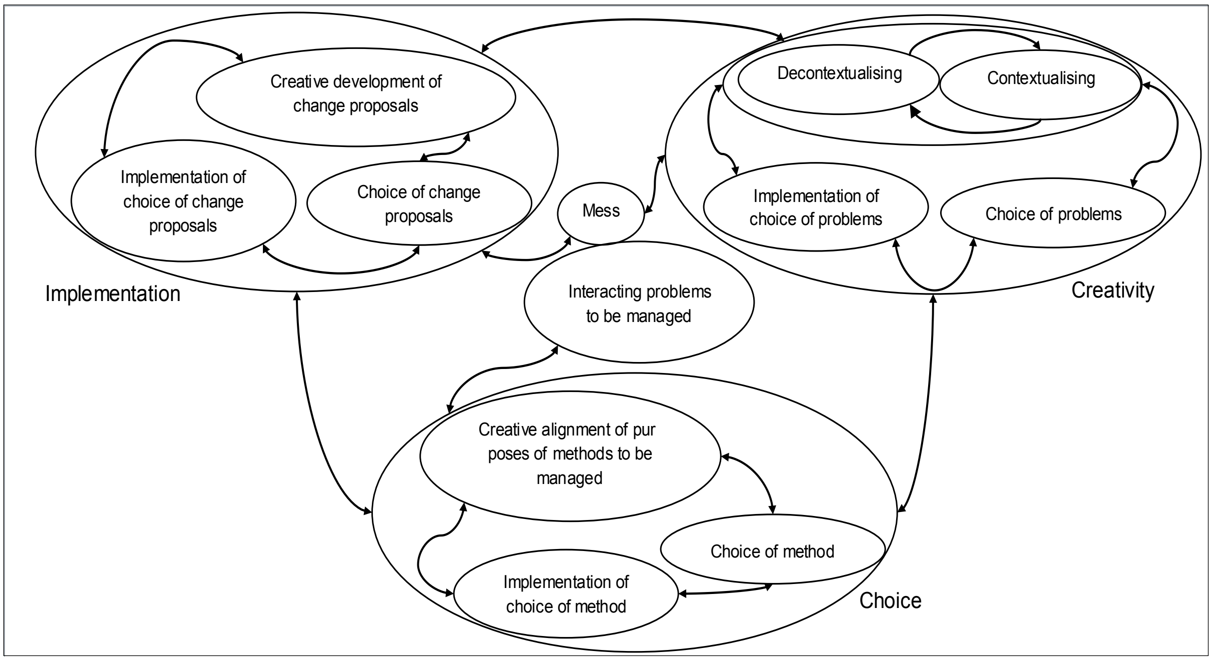

Figure 4-3: TSI phases and sub-activities (adapted from Flood, 1995a:35)

4.8.3.1 The system of systems methodology framework

The “system of systems methodology” (SOSM) is a theoretical tool that was developed in 1983/1984 at the University of Hull by Paul Keys and Mike C. Jackson (1984:473). The SOSM classifies systems methodologies in a two-dimensional grid of “ideal-type” problem contexts (Jackson, 2001:237). The system of systems methodology (SOSM) framework enables organisations to (iteratively) plan interventions and guide methodology choice (Flood & Jackson, 1991a:31). They argue that the SOSM framework enables the problem solver to define an environment (the problem context consisting of problems chosen that requires immediate intervention) during the creativity phase; the problem solver engages with organisational stakeholders to draw a boundary around a richly interactive group of elements (the system). Flood & Jackson (1991a:31) explain that the system that is drawn to define the problem context contains processes and elements; the processes are characterised by feedback that influences the behaviour of the elements, inputs are transformed into outputs, and inputs from and outputs to its environment may also occur.

Flood & Jackson (1991a:35) further explain that a problem context is then categorised according to its *system* dimension, i.e. the relative complexity of the systems involved, as well as its *participant* dimension, i.e. the relative complexity of the relationship between the participants involved in the intervention. The system dimension may be described as simple or complex, whilst the relationship dimension may be described as unitary, pluralist or coercive. Table 4-2 below summarises how Flood & Jackson (1991a:33-35) define a simple versus a complex system; Table 4-3 below summarises how Flood & Jackson (1991a:33-35) define relationships as having unitary, pluralist or coercive characteristics.

Table 4-2: Characteristics of systems (Flood & Jackson, 1991a:33-35)

Simple system	**Complex system**
Does not evolve over time. Unaffected by behaviour-influences. Largely closed to the environment. Predetermined attributes. Behaviour governed by exact laws. Small number of elements; few highly organised interactions between elements.	Evolves over time. Affected by behaviour-influences. Largely open to the environment. Attributes are not predetermined. Behaviour is probabilistic. Large number of elements; many loosely organised interactions between elements.

Table 4-3: Relationship characteristics (Flood & Jackson, 1991a:33-35)

Unitary relationship	**Pluralist relationship**	**Coercive relationship**
Common interests. Participate in decision making. Agreed objectives. Shared values. Full agreement.	Share some interests. Participate in decision making. Agreed objectives. Divergent values. Disagree; may compromise.	No common interests. Some are coerced to accept decisions. Disagree re objectives. Conflicting values. Disagree; no compromise.

Flood & Jackson (1991a:35) state that by combining the relative complexity of the involved systems and the relative complexity of the relationships of the involved participants in a two-dimensional matrix, the problem context can be categorised as one of six grouping types, i.e. simple-unitary, simple-pluralist, simple-coercive, complex-unitary, complex-pluralist or complex-coercive (refer to Figure 4-4 below).

	Unitary	**Pluralist**	**Coercive**
Simple	simple-unitary	simple-pluralist	simple-coercive
Complex	complex-unitary	complex-pluralist	complex-coercive

Figure 4-4: Grouping types of SOSM (Flood & Jackson, 1991a:35)

The categorisation of the problem context according to the defined grouping types enables the problem solver to appropriately allocate problem solving methodologies to the problem context; for this purpose Flood & Jackson (1991a:31) developed the SOSM framework to guide methodology choice. Table 4-4 below illustrates how the SOSM framework systems allocate methodologies (Flood & Jackson, 1991:42).

Table 4-4: “System of Systems Methodology” (Flood & Jackson, 1991:42)

	Unitary relationship	**Pluralist relationship**	**Coercive relationship**
Simple system	Operational research Systems analysis System engineering System dynamics	Social systems design Strategic assumptions surfacing and testing	Critical systems heuristics
Complex system	Viable system diagnosis General systems theory Socio-technical systems thinking Contingency theory	Interactive planning Soft systems methodology	?

4.8.3.2 The use of metaphors

During the main creativity phase TSI employs a range of metaphors that represent key organisational management theories to surface issues and encourage creative thinking about the organisation and its challenges. The first account of TSI, as written up by Flood & Jackson (1991a), allows consideration of five metaphors to identify organisational issues and problems, i.e. a machine, organism, brain, cultural or political metaphor; the outcome of the creativity phase is then a dominant metaphor that surfaces the core organisational issues (Flood & Jackson, 1991a:50). According to Flood & Jackson (1991a:53) specific metaphors relate to specific problem solving methodologies; Table 4-5 below shows how the metaphors relate to problem solving methodologies.

Table 4-5: Methodologies and metaphors (Flood & Jackson, 1991a:53)

Problem solving methodology	**Metaphor(s)**
System dynamics	Machine
Viable system diagnosis	Organic and neuro-cybernetic
Strategic assumption surfacing and testing	Machine and socio-cultural
Interactive planning	Neuro-cybernetic and socio-cultural
Soft systems methodology	Organic and socio-cultural
Critical systems heuristics	Machine, organic and socio-political

The second "reconstituted" account of TSI, as written up by Flood (1995b; 1995a) also allows for the use of metaphors, i.e. a machine, organic or neuro-cybernetic metaphor is used where the focus is on technical issues and a socio-cultural or socio-political metaphor is used where the focus is on human activities, but the creativity phase has been enriched to also permit problem solvers to create their own images by employing inventive techniques such as brainstorming and lateral thinking.

Torlak (1999) studied and aimed to improve TSI when he completed his PhD thesis "Improving Total Systems Intervention through Theory and Practice"; he argues that metaphors are useful to organise thoughts about social reality and also guide problem solvers and participants to develop insightful appreciations of problem contexts; the use of metaphors should be simplified rather than abandoned (Torlak, 2001:456). Torlak (2001:458) suggests that a list of questions be utilised to simplify the use of the metaphors in the creative phase of TSI. Table 4-6 below summarises the questions proposed by Torlak (2001:459) as well as the main characteristics that defines the metaphors according to Flood (1995a:181). Torlak (2001:458) suggests that these questions must be asked in the "is" and "ought to" mode to reveal the organisation's normative content; he derives this idea from Ulrich (1983).

Table 4-6: The TSI metaphors

Metaphor	Characteristics (Flood, 1995a:181)	Questions (Torlak, 2001:459):
Machine	Standardised parts; routine and repetitive operations; predetermined activities, goals, and objectives; efficiency; rational approach; internal control; and a closed system view.	Is this a well-designed machine, i.e. founded in bureaucracy, design of the total organisation, design of individual jobs and management by objectives?
Organic	Some needs to be satisfied; survival; open system; adaptation; organisation; feedback; self-regulation; open system view; and passive control.	Is this a well-designed organism, i.e. founded in organisational needs, organisation-environment relations, species of organisations, population-ecology view of organisation and organisational ecology?
Neuro-cybernetic	Similar to organic but also includes learning and control; information prime; law of requisite variety; viable system; learning to learn; and getting the whole into the parts.	Is this a well-designed brain i.e. founded in information-processing capability, learning, organisational holographic character and a "whole in parts" principle?
Socio-cultural	Collaboration; shared characteristics in terms of language, history, dress etc.; shared reality in terms of values, beliefs, norms; social practices; and a culture (emphases on norms, values) or team (unitary political system).	Does this give appropriate attention to cultural issues i.e. founded in culture as an environmental variable, corporate culture and subcultures and organisational reality?
Socio-political	Coercive conflict; domination; whose interests are served; power central issue; people are politically motivated; power as a consequence of structure; disintegration; and a coalition (pluralist political) or prison (coercive political).	Does the organisation give consideration to the political system i.e. founded in organisational interests, organisational conflict and power?

In the later reconstitution of TSI where Flood (1995b:183) recommends that a simpler complementarist framework replace the SOSM framework in the choice phase, it links systems methodologies directly to metaphors based on the main purposes of the methodologies, which are classified as designing, debating or disemprisoning. Flood (1995b:183) states that the methodologies are linked to the metaphors as follows: the machine, organic and neuro-cybernetic metaphors relate to process and organisational design activities and therefore these metaphors relate to design-oriented systems methodologies that determines *how* to resolve problems whilst presuming that participants agree on what should be done, i.e. methodologies within the hard systems thinking paradigm; the culture metaphor relates to debating and therefore relates to methodologies that acknowledge differences in perceptions about *what* should be done, i.e. methodologies in the interpretive soft systems thinking paradigm; and the political metaphor relates to methodologies that recognises disagreement and potential power struggles and that aim to emancipate participants, i.e. methodologies that are aimed at disemprisoning. Table 4-7 illustrates how this framework links methodologies directly to metaphors (Flood, 1995b:183).

Table 4-7: TSI complementarist framework (Flood, 1995b:183)

	Designing	**Debating**	**Disemprisoning**
Metaphors	• Machine • Organic • Neuro-cybernetic	• Socio-cultural	• Socio-political
Methods	• Traditional operational research • System dynamics • Viable system diagnosis	• Strategic assumption surfacing and testing • Interactive planning • Soft systems methodology	• Critical systems heuristics

Flood & Jackson (1991a:52) describe the creative and choice phases to include the following: the SOSM framework and/or relevant metaphors guide methodology choice and the problem solver chooses suitable methodologies; the outcome of the creative phase is a dominant metaphor with supporting metaphors and the outcome of the choice phase is a dominant methodology with supporting methodologies. Flood & Jackson (1991a:52) describe the implementation phase to include the application of the chosen methodologies; the outcome is a co-ordinated change effort.

4.8.4 Critique against total systems intervention

Ulrich (2013:316) recognises TSI as “meta-methodological framework for facilitating critical (i.e. theoretically informed and justified) methodology choice”. However, he argues that boundary critique must precede methodology choice “since the emancipatory interest is methodologically constitutive of critical enquiry and design, its importance cannot be restricted to coercive context” (Ulrich, 2003:327). He further warns that TSI may support “*shallow methodological complementarism* or pluralism*”* rather than uphold critical enquiry and practice since he claims that unitary and pluralist problem solving contexts also require critical handling of boundary judgements; the application of the CSH strand of CST must therefore precede the application of the TSI strand of CST to ensure critical awareness and emancipation rather than only methodological pluralism (Ulrich, 2003:337). However, according to Jackson (2003:1225) the TSI strand of CST “is theoretically richer and more relevant in practice” than the CSH strand of Werner Ulrich; he further argues that critical awareness and emancipation are “just as much a methodological feature…as it is of Ulrich’s version”.

4.8.5 Total systems intervention in software development

Warren & Adman (1999:224) applied the TSI methodology to develop an improved design for the “front-end” of an university’s information system support centre, i.e. the “help desk”. They say that the creativity phase revealed permeable system boundaries between the information services/systems support unit and the rest of the university (the system’s customers) that impacted negatively on information flows between these two entities; they also found it difficult to map the problem situation onto the SOSM as the displayed relationship characteristics did not clearly fit the relationship characteristics as defined in SOSM (Warren & Adman, 1999:232).

According to Warren & Adman (1999:238) the use of the TSI methodology in this instance proved to be difficult and quite cumbersome; also, they mention that the metaphorical analysis was not useful. Still, they regard the design phase, which was the focus of their research, of the project as successful and acknowledge the contribution of critical systems thinking to the success of the project and they argue that critical systems thinking can add value as “a useful position, philosophy or way of thinking”.

4.9 Critical systems heuristics

This section discusses CSH. It discusses the development of CSH, the theoretical underpinnings of CSH, the CSH process and outcome, critique against CSH, and its application in software development projects.

4.9.1 The development of critical systems heuristics

Werner Ulrich (1983:15) states that the crucial questions in planning are practical rather than theoretical/technological; hence, he says that dealing rationally with questions regarding rational practical planning (again) raises the philosophical problem posed more than two hundred years ago by Immanuel Kant: *“H w c w r y fy jus fy h r v c f ur c s?”* He therefore developed CSH as an Advanced Research Scholar of the Swiss National Science Foundation during the period 1976-1980; he aimed to provide both planners and individuals (in the context of his work as a planner he refers to individuals as ‘citizens’) with heuristic support to confront the problem of practical reason *practically* rather than theoretically (Ulrich, 1983:15). He developed CSH in the late 1970s but it became known only upon its formal publication in the early 1980s (Ulrich, 2013:416). He applied CSH extensively since its publication.

Flood & Jackson (1991a:198) say that Werner Ulrich developed CSH to assist in deciding what ought to be done, rather than how to do what needs to be done, by critically reflecting on the normative content and boundaries of design. They explain CSH as a tool whereby ordinary people can engage in rational discourse and surface imbalanced premises of social systems; CSH therefore assists in dealing with issues of power and domination i.e. coercive social contexts. However, Ulrich (2003:326) dissociates himself from perfect and complete rationality that is, according to him, ideally comprehensive yet practically unachievable. Ulrich (2003:326) refers specifically to, for example, Habermas as pursuing such ideal concepts of rationality; he accepts the principles of Habermas' theory but refers to it is being Utopian.

Habermas' theory conceptually divides human behaviour into purposeful-rational action and communicative action: purposeful-rational action refers to work activities that are governed by technical rules and which applies to determine the chosen means that will be used to realise the predetermined goals; communicative action refers to the symbolic interaction between people that is governed by consensual norms or expectations and which are expressed in inter-subjective language (Mingers, 1980:41). Purposeful rational action can be acquired by learning skills and it aims to enable people to solve problems; communicative action can be acquired by the internalisation of role expectations and it aims to enable people to specify and maintain socially valid norms (Mingers, 1980:41).

Ulrich (2003:326) aims to promote discursive dialogue rather than consensual decisions i.e. "not the unity of reason...but the *unity of critique*" and states that it is idealistic yet impossible to completely resolve issues surrounding for example power and domination in order to ultimately obtain a single version of the "truth"; practical discourse can only realise when both the involved and affected individual have an equal opportunity to present his/her view. The "involved" individuals are defined as "those who are *involved* in the planning process", such as the planner, experts, and political decision makers (Ulrich, 1983:237). Ulrich (1983:119) defines the "affected" individuals as "all others", which include "all those actually or potentially affected by a decision or plan" but that are "rarely…able to participate in a rational discourse". Those that are affected by the social reality that was 'improved' by the (involved) planners, have no other choice as to live the 'improved' social reality without necessarily being able to participate in practical rational reasoning and discourse (with the aim to ultimately reach a practical rational consensus regarding *what morally ought to be done*, rather than only what *can* be done) during the planning process.

Ulrich (1983:176) acknowledges that Habermas' model of rational practical discourse can be used theoretically as a critical standard to reflect on "sources of deception contained in any factual consensus", but says that it is in practice based on idealistic and impracticable conditions. He argues that the problem with formal rational motivation is that the formal requirements for such rational argumentation can only ever be met by a relatively small minority of people; however, this does not render the large majority's viewpoints invalid or irrational (Ulrich, 1983:167). Dismissal of the concerns of individuals that are unwilling or 'not competent' to argue rationally (according to Habermas' ideal speech situation) is unjust and discriminatory; *all* involved and affected individuals' concerns must be incorporated when seeking to improve their human and social conditions "regardless of whether or not he is able to argue his case rationally" (Ulrich, 1983:167). Ulrich (2013:416) therefore developed CSH to emancipate affected individuals and inform socially rational critical practice in all dimensions of life.

4.9.2 The critical nature of critical systems heuristics

Ulrich (2013:416) argues that CSH is not a self-contained systems methodology; CSH is "an approach that should inform all critical professional practice, whatever specific methodology is used". CSH embodies a conceptual framework to trace delusions in rational planning; CSH aims to be critical "against present conceptions of "rational" planning" by employing the systems idea heuristically – practically and through discovery – rather than theoretically (Ulrich, 1983:19). CSH is a framework for reflective practice that is based on both practical philosophy and systems thinking; it rests on three pillars, i.e. heuristic procedures, a critical approach and systems thinking (Ulrich, 1983:19). CSH is concerned with identifying boundary judgements concerned with concepts referred to as systems in social reality, rather than aimed at 'fixing' these 'problematic' systems; the concept of boundary judgements is discussed in Section 4.9.2.1 below. CSH is also concerned with the enablement of practical rational reason so as to enable practical rational planning; this is achieved through critical (reflective) and heuristic practice – refer to Section 4.9.2.2 below. CSH incorporates systems ideas – refer to Section 4.9.2.3 below.

4.9.2.1 Boundary judgements in CSH

Ulrich (1983:223) follows the reasoning of Kant in using the concept of totality, rather than the concept of a system, to refer to "the whole set of relevant conditions in a given situation of inquiry"; a totality of conditions inevitably also includes all the preceding conditions of the given appearance as a given, i.e. *a priori* conditions. He argues that a system, in Kantian sense, refers to the *result* of reason's reflection on the totality of conditions, where the task of reason is to understand; understanding can emerge only through reflection on the totality of conditions that flow(ed) into it. Ulrich (1983:225) asserts that the 'system' can never be understood as a whole, i.e. the totality of *a priori* conditions can never be absolutely and completely presupposed, and therefore, in applying the systems concept to a section of the "real world" (social reality), one must make assumptions (*a priori* judgements) regarding the properties of the system itself, and the properties of the system's environment.

To draw a boundary of a system in a meaningful way one must apply, in addition to value judgements, also empirical knowledge. *A posteriori* judgements, on the other hand, are derived from experience; *a posteriori* concepts are abstracted from a number of particular, yet comparable, perceptions (Ulrich, 1983:190). The incorporation of these judgements in bounding a system is referred to as whole systems judgements or *boundary judgements* – Ulrich (1983:248) says that the social system (S) is to be bound according to the social actors (the *involved* versus *affected*) that defines the normative content of S; it must also be bound versus its environment. These are two basic kinds of boundary judgements, as is illustrated in Figure 4-5 below.

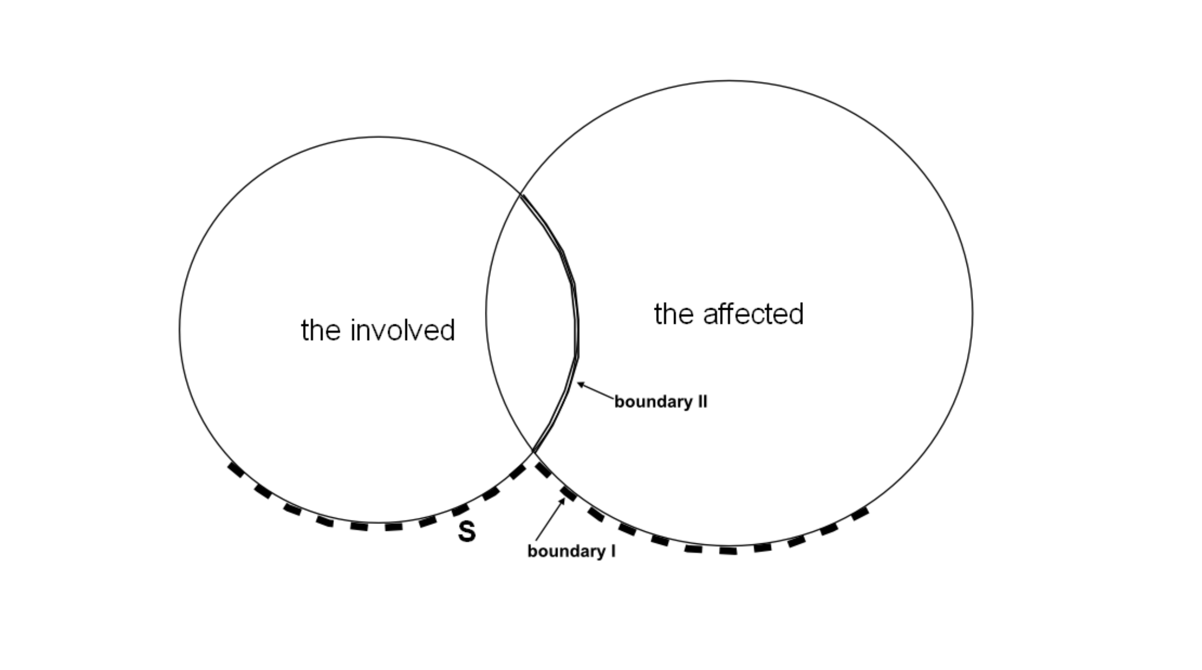

Figure 4-5: Basic kinds of boundary judgements (Ulrich, 1983:248)

Ulrich (1983:250) suggests that a planner, when starting to plan for social improvement, must attempt to bound the involved as well as the affected groups by breaking the associated social categorical roles down into subgroups: He firstly defines the subgroups for the involved category as the following: sources of motivation that "contribute (ought to contribute) the necessary sense of direction"; sources of control that "contributes (ought to contribute) the necessary means, resources and decision authority"; and sources of expertise that "contributes (ought to contribute) skills and necessary knowledge" (Ulrich, 1983:250). He then defines the subgroup for the affected category, i.e. sources of legitimacy, as the witness that "by virtue of their own affectedness, they can bear witness to the ways in which all those who cannot voice their concerns may be affected – their feelings, their suffering, their moral and political consciousness, their ways of expressing dissent, their ways of *living* the social reality in question, their vision of their own future" (Ulrich, 1983:252). Refer to Section 4.9.2.3 later in this chapter for a more detailed discussion on the derived categories.

4.9.2.2 The meaning of critical heuristics in CSH

Ulrich (1983:19) asserts that *heuristic procedures* are procedures that can be used to identify and explore relevant problems/solutions, assumptions or questions for example: "what is the problem to be solved and what kind of change would represent an improvement"; a (Kantian) *critical approach* is an approach that does not produce the right answers but rather support reflective processes and debates (Ulrich, 1983:19). Practical reasoning can thus merely aim to enable participants to critically explore possible solutions for problem situations. To be truly critical implies that a person (in the role of a planner/designer of a social system) must be self-reflective regarding his/her presuppositions that may potentially cloud his/her judgements; this applies in the search for knowledge, as well as when seeking to act rationally (Ulrich, 1983:20).

According to Ulrich (1983:334) CSH is critical about the idea of rational planning; it aims to enable the practice of practical reason in the Kantian sense where reason can only be practical if is based on persuasive arguments with regard to normative validity claims. Practical reasoning thus depends on rational argumentation (Ulrich, 1983:175). However, rational justification can only *realise* when those that are involved and those that are affected have equal opportunity to participate in dialogue and rational justification can only be *valid* if it secures improvement (Ulrich, 1987:276). Practical dialogue can thus only practically realise when those that are involved and those that are affected by a system are allowed to participate and question the underlying judgements of the whole system; only then can communication be improved and differences between involved and affected stakeholders become transparent enough to enable the formulation of alternative problem solving routes that are beneficial to all stakeholder groups (Ulrich, 1983:313). CSH is therefore intended to enable participative debate and emancipate affected stakeholders that may be socially dominated by the designers (planners) of systems.

Ulrich (1983:21) argues that use of the term heuristics implies that one seeks to discover, aims to discover, and teaches how to discover; it "helps to discover problem-relevant questions and problem-relevant knowledge" and also "serves to discover deception". From a Kantian viewpoint, heuristics thus serve as a source of discovery whilst simultaneously is considered as source of deception. Ulrich (1983:299) cautions that, in *social rationality*, the critically-heuristic purpose of systems thinking should remain intact to also ensure *systems rationality*; one is reminded to consider the problem as "the system" and "the boundary judgements constitutive of it" rather than "the problems of the system". The focus should thus remain on the bounded system as a means for investigating social reality.

4.9.2.3 Systems ideas in CSH

Systems thinking assent that all problem definitions, solution proposals and evaluated outcomes depend on prior (*a priori*) judgements about the whole system in question that is being looked at (Ulrich, 1983:19). CSH is founded on "a partial reconstruction of Kantian a priori science" and "a critical reinterpretation of the "systems approach" to planning" (Ulrich, 1983:15). Ulrich (1983:21) applies the systems concept in the Kantian sense as representative of "the totality of relevant conditions on which theoretical or practical judgements depend, including basic metaphysical, ethical, political, and ideological a priori judgements"; he argues that, even though one can never claim to know the whole system, it continues to serve as a reminder "of the unavoidable incomprehensiveness and selectivity of every definition of a system, and hence of the need for reflecting on the normative content of the *a priori* whole systems judgements flowing into our systems concepts". Ulrich (1983:334) defines a purposeful system as "self-reflective with respect to its own normative implications, seen from the point of view not only of the involved but also of the affected…has at least partial autonomy in determining its client, its purposes, etc.".

Ulrich (1983:245) also based CSH on Churchman's conceptualisation of inquiring systems where Churchman lists conditions for purposeful social systems. According to this list purposeful social systems have the following nine characteristics (or conditions): a system is teleological, i.e. it exists to serve the *purpose* that it was created for; it has a *measure of performance*; it exists to serve a *client*; it has teleological *components* that coproduce its expected performance; it has a clearly defined (bordered) *environment*; it has a *decision maker* that can change the system;

it has a designer (*planner*) with the intention to maximise the system's value for its client; it is *implemented* in its environment; and the system is assumed (*guaranteed*) to be stable (Ulrich, 1983:245). These nine conditions therefore imply nine categories to be applied to trace the normative content of social systems design, i.e. a client; a purpose; a measure of performance; a decision maker; components; an environment; a planner; implementation; and a guarantor (Ulrich, 1983:246).

Ulrich (1983:247) then translated Churchman's nine categories into sub-categorical roles of those that are *involved* in systems design; role-specific concerns for each of the roles; and the crux of the role-specific concerns of the respective roles. So, Ulrich (1983:258) presents the client, decision maker, and planner as the sub-categorical social roles that are involved in systems design: The client is the *motivator* of the system; the decision maker *controls* the system; and the planner provides *expertise*. He also presents the role-specific concern of the client as the *purpose* of the system; the role-specific concern of the decision maker as the *components* of the system; and the *implementation* of the system as the role-specific concern of the planner. Lastly, he presents the crux of the role specific concern of the client as the system's *measure of performance*; the crux of the role specific concern of the decision maker as the system's *environment*; and the crux of the role specific concern of the planner as the *guarantor* of the system. In applying these categories, Ulrich (1983:247) found that the following categories offered greatest initial heuristic value: client; purpose; measure of performance; decision maker; components; environment; planner; and guarantor.

Further, Ulrich (1983:251) added a self-reflective dimension in the categorical social role of those that are *affected* by the system to legitimise the social improvement of the planned system; here, the relevant social role is that of the *witness* with a role-specific concern of *emancipation*, where the crux for the legitimation category lies in the fact that fundamentally conflicting concerns of those that are involved as well as those that are affected, are rooted in their fundamentally different *worldviews*.

Ulrich (1983:258) therefore derived four basic groups (social roles, i.e. *who?*) that are either involved with or affected by social systems design; he coupled each group with two auxiliary categories representative of the respective social roles' concerns (*why?*) and crux (*so what?*) as follows:

The sources of motivation of a social system (S) are:

1. *Client*
2. Purpose
3. Measure of improvement

The sources of control of a social system (S) are:

4. *Decision maker*
5. Components
6. Environment

The sources of expertise of a social system (S) are:

7. *Planner*
8. Expertise
9. Guarantor

The sources of legitimation of a social system (S) are:

10. *Witness*
11. Emancipation
12. Worldview

The sources of motivation, control, and expertise represent those that are involved, whilst the sources of legitimation represent those that are affected by the social system being designed; these derived categories give a designer an instrument whereby he/she can explore the boundary judgements of a social systems' map.

4.9.2.4 Actual and ideal mapping

Ulrich (1983:259) follows Kant's formulation of the three basic questions motivating man's search for knowledge; he says that all the interests of reason combine in these three questions: firstly: "What can I know?"; secondly: "What ought I to do?"; and thirdly: "What may I hope?". The first question is speculative; yet, in the systems idea, it "provides the necessary standard for reflection on the deceptiveness of social maps in accordance with the principle of reason" (Ulrich, 1983:260). Therefore, the question “What can I know?” becomes a means for discovering sources of deception in these social (planning) maps and enables reflection on the inevitable lack of comprehensiveness. The second question “What ought I to do?” serves as a moral compass for the planner; it hints at the need for reflection on underlying whole systems judgements and their implied moral implications (Ulrich, 1983:261). The third question “What may I hope for?” reflects the planner’s need for guarantee(s) to ensure that improvement actually come about when he/she pursues his/her plans in a morally responsible way. However, design necessarily involves a built-in lack of guarantee; this implies that the planner must aim to design so as to ensure that improvement is guaranteed, whilst reflecting on the inevitable *lack* of guarantee, as if there was a built-in guarantor of design (Ulrich, 1983:261).

The question regarding validation of boundary judgements arises; derived boundary judgements cannot be validated logically or empirically, and are therefore considered as relatively *a priori*, synthetic judgements that represent the idealist component of the CSH approach (Ulrich, 1983:282). Meaningful (whole) synthetic judgements include both *a priori* and *a posteriori* judgements. The affected and involved share the role to unfold the *“ c c f x r s c ”* made up by *a priori* judgements of both sides, but also includes *a posteriori* judgements from both sides (Ulrich, 1983:209). Ulrich (1983:301) asserts that “[r]ationality is a process of mediation between *a priori* and *a posteriori* concepts”. The categories – refer to Section 4.9.2.3 above – must therefore be explored from an empirical perspective (is-mode) as well as a normative perspective (ought to-mode); the empirical perspective examines assumptions of *actual* facts and values (actual mapping), whilst the normative perspective examines assumptions of facts and values that *should* inform (ideal mapping) the social design. The results of the actual and ideal mappings then “represent the reference system that conditions our perception of a problem situation as well as the claims we raise with respect to it” (Ulrich, 2005:8).

4.9.3 The critical systems heuristics process

According to Ulrich (1983:258) the methodological core principle of CSH is boundary critique, i.e. a systematic effort to critically deal with boundary judgements that can be used reflectively or emancipatory. Refer to Section 4.9.2.1 earlier in this chapter for a discussion on boundary judgements in CSH. Ulrich (1983:19) also asserts that heuristic procedures are employed to explore the problem to be solved and the kind of change that would represent an improvement; this necessitates a critical and reflective approach - refer to Section 4.9.2.2 above. Then, Ulrich (1983:19) follows a Kantian approach in incorporating systems ideas in CSH and derives twelve basic categories for describing the normative content when exploring and designing improved social systems - refer to Section 4.9.2.3 above. The categories are to be explored from an actual as well as ideal perspective – refer to Section 4.9.2.4 above. As a result, a checklist of boundary questions to be asked in the 'is' (actual mapping) and the 'ought to' (ideal mapping) mode is used to describe the normative content of a systems map and design.

The boundary questions aim to help a designer to determine *what* aspects of a situation are to be considered relevant, *who* should be involved in determining it and *how* to handle conflicting views amongst relevant stakeholders in terms of four basic categories to describe the normative content of social systems (Ulrich, 1983:258):

1. The basis of *motivation* indicates the clients that are the sources of motivation of the system to be designed; they are involved during system design, concerned with the purpose of the system and interested in possible improvements by means of the system.
2. The basis of *power* indicates the decision makers as the sources of control; they are involved during system design to determine sources of control within (the components) as well as beyond (the environment) the system and account for the way in which system improvements depend on both.
3. The basis of *knowledge* indicates the planners that are the sources of knowledge, experience and/or skill; they are the implementers of the system that should aim to guarantee its success.
4. The basis of *legitimacy* indicates the witnesses that are affected by the system but would not usually be involved in its design or implementation; they are a potentially large group that hold the three involved stakeholders mentioned above ethically responsible, yet may have conflicting worldviews amongst them that need to be reconciled.

The checklist for CSH boundary questions contains twelve questions to be asked in the ‘is’ (actual mapping) and ‘ought to’ (ideal mapping) mode to determine the following: firstly, the sources of actual (and ideal) motivation; secondly, the sources of actual (and ideal) power; thirdly, the sources of actual (and ideal) knowledge; and lastly, the sources of actual (and ideal) legitimacy (Ulrich, 1983:342; Ulrich, 2005). The questions asked in the “ought to” mode reveal the ideal situation, i.e. the ideal mapping; the questions asked in the “is” mode reveal the actual situation, i.e. the actual mapping (Ulrich, 1983:342). These questions reflect four categorical social roles that are involved with (the client, decision maker, and planner) and affected by (the witness) social planning. These social roles are described primarily in terms of their social basic roles (who?), and then in terms of their (auxiliary) social role-specific concerns (what?), and the crux (so what?) regarding the boundary judgements in questions (Ulrich, 1983:258).

Firstly, the questions to determine the sources of motivation are: “Who is (ought to be) the **client** or beneficiary? That is, whose interests are (should be) served?”; “What is (ought to be) the **purpose**? That is, what are (should be) the consequences?”; and “What is (ought to be) the **measure of improvement** or measure of success? That is, how can (should) we determine the consequences, taken together, constitute an improvement?” (Ulrich, 2005).

Secondly, the questions to determine the sources of power are: “Who is (ought to be) the **decision maker**? That is, who is (should be) in a position to change the measure of improvement?”; “What **resources** and other conditions of success are (ought to be) controlled by the decision maker? That is, what conditions of success can (should) those involved control?”; and “What conditions of success are (ought to be) part of the **decision environment**? That is, what conditions can (should) the decision-maker *not* control (e.g. from the viewpoint of those not involved)?” (Ulrich, 2005).

Thirdly, the questions to determine the sources of knowledge are: “Who is (ought to be) considered a **professional** or further **expert**? That is, who (should be) involved as competent provider of experience and expertise?”; “What kind of **expertise** is (ought to be) consulted? That is, what counts (should count) as relevant knowledge?"; and "What or who is (ought to be) assumed to be the ***guarantor*** of success? That is, where do (should) those involved seek some guarantee that improvement will be achieved – for example, consensus among experts, the involvement of stakeholders, the experience and intuition of those involved, political support?" (Ulrich, 2005).

Lastly, the sources of legitimation are determined by asking: "Who is (ought to be) **witness** to the interests of those affected but not involved? That is, who is (should be) treated as a legitimate stakeholder, and who argues (should argue) the case of stakeholders who cannot speak for themselves, including future generations and non-humans?"; "What secures (ought to secure) the **emancipation** of those affected from the premises/promises of those involved? That is, where does (should) legitimacy lie?"; and "What **worldview** is (ought to be) determining? That is, what different visions of 'improvement' are (should be) considered and how are they (should they be) reconciled?" (Ulrich, 2005).

Critical systems heuristics informs "critical professional practice"; CSH is not a self-contained methodology and it does not prescribe methodology choice (Ulrich, 2013:416). CSH facilitates transparent and self-critical discourse amongst involved and affected stakeholders (Ulrich, 2013:316). CSH provides those that are involved as well as those that are affected by system design and implementation "the heuristic support they need to *practice* practical reason…lay open, and reflect on, the normative implications of systems designs, problem definitions, or evaluations of social programs" (Ulrich, 1987:277). Boundary judgements are *whole system judgements* since "we are dealing not with a given totality of conditions but with a projected unity, and this projection is dependent upon the planning purpose on the planner's own standpoint vis-à-vis the system" (Ulrich, 1983:244).

The application of the twelve boundary questions of CSH enables a problem solver to unfold and question the problem's boundary judgements; it enables system designers to determine the relevant aspects of a situation, the stakeholders and participants that should be involved in determining the relevant aspects and it allows system designers to explore how to handle conflicting views amongst relevant stakeholders by exploring the situation in terms of where the relevant motivation, power, knowledge and legitimacy lies from the perspectives of those that are involved as well as those that are affected by the system (Ulrich, 1983:258).

4.9.4 Critique against critical systems heuristics

Midgley (1997:37) refers to Ulrich's work on CSH as "the first comprehensive attempt to establish an alternative, emancipatory systems paradigm"; however, he argues that CSH can merely complement other systems methods in dealing with coercion, but cannot replace any of them. According to Jackson (1985:880) the work of Ulrich allows reflection only upon the ideas that enter into social systems design; however, he argues that CSH does not allow reflection upon material conditions that gave rise to such ideas and which lead to certain ideas being dominant. Jackson (1985:881) refers to Ulrich's work as "Utopian" and negligent regarding "the structural aspects and the development of social systems".

4.9.5 Critical systems heuristics in software development

Practical applications of CSH in software development are not widely documented. For example, Petkova & Petkov (2002:239) present a framework to measure software development productivity using CSH, but do not focus on the development process itself. Ulrich (2001:55) uses CST and CSH to propose "a critical approach to information systems definition, design, and development (ISD) grounded in discourse theory, semiotics, practical philosophy and critical systems thinking"; this paper is aimed at identifying and scrutinising diverse issues that IS researchers and practitioners may face in an ISD project. Goede (2005:232) proposes a theoretical framework that incorporates CST in data warehousing, in order to maximise user involvement. Goede (2012) also reviews the influence of CST on the literature of ISD, and comments on the potential use of CST in ISD.

Bentley *et al.* (2013:451) documented how they applied critical systems thinking to improve the effectiveness of an electronic student-record-system at an university in the United Kingdom; the university had 12,000 students at the time of the study and consisted of two main campuses and a number of satellite campuses. The project concerned the improvement of the (unintegrated) systems used to hold and retrieve student information across the university. To gather information about the system Bentley *et al.* (2013:460) asked a number of “is” and “ought-to” mode questions to identified stakeholders. They did not explicitly apply the twelve boundary questions contained in CSH; still, they summarised their results “in the sense of critical systems heuristics” in terms of “is” and “ought-to” issues that they’ve identified through the interviews (Bentley *et al.*, 2013:463). They argue that the investigation of what “is”, as well as what “ought-to” have been, uncovered organisational issues such as the organisational structure, organisational values and resource management, that were the underlying causes of problems relating to the student-record system; resolution of identified problems on a strategic level (e.g. developing an information strategy for the university) led to an updated and improved student-record system (Bentley *et al.*, 2013:463).

4.10 Summary

The word “system” is generally used to refer to a system as a mechanism and descriptions of tangible entities in the world (Checkland & Scholes, 1990:23). The mechanistic view of a system does not reflect the holistic viewpoint of the softer and critical systems thinking paradigms that emerged from the 1980s onwards where a system is a concept that provides a process of enquiry to explore complex problem situations (Checkland, 2011:510; Ulrich, 1983:23). Systems thinking evolved from systems theory and the work of systems theorists such as general systems theory (von Bertalanffy, 1950:139) and cybernetics (Wiener, 1950:2) as well as social theory and the work of social theorists such as Habermas (Flood & Jackson, 1991a:200; Ulrich, 2003:326). These theories established principles regarding systems thinking as well as a paradigm within which to explore systems; they provided a foundation for the development of systems methodologies to resolve problem situations in organisational contexts

Systems thinking that is applied to resolve real-world problems emerged within three paradigms, i.e. the hard systems thinking paradigm, the soft systems thinking paradigm and the critical systems thinking paradigm. The hard systems thinking paradigm includes positivistic, functionalistic and reductionist problem solving methodologies such as operational research, systems engineering and (hard) systems analysis; these are successfully applied to deterministic systems and successfully intervene in well-defined problem situations. The literature revealed that software development approaches emerged within the hard systems thinking paradigm (Benington, 1983:350; Hopper & Mauchly, 1997:470; Randell, 1996; Royce, 1970:338; Avison & Fitzgerald, 2006) and that the engineering perspective dominated software development approaches until the 1980s (Denning & Freeman, 2009:28). Consequently, software development approaches remained grounded within the hard systems thinking paradigm (Iivari *et al.*, 2000:192).

The soft systems thinking paradigm emerged in the 1980s for ill-structured complex problem situations that includes human and social dimensions; soft systems thinkers aim to understand the world and the divergent perceptions of those in the world (Checkland, 2011:510). The soft systems thinking paradigm includes methodologies such as soft systems methodology (Checkland & Scholes, 1990) and interactive planning (Ackoff, 2001a). These methodologies are positioned as within the soft systems thinking paradigm but have a critical stance as well; they also aim to intervene and improve. Softer approaches such as SSM widened the scope of software development approaches; however, software developers must remain cognisant of the fact that the ultimate goal of organisational software artefacts is "to meet business objectives" and that software development processes necessitate that the goals of a "soft" approach be balanced with the "hard" goals of profit-seeking business objectives (Córdoba, 2007:910).

The critical systems thinking paradigm also emerged in the 1980s (Flood & Jackson, 1991a; Ulrich, 1983). Critical systems thinkers aim to intervene in order to improve problematical social situations (Flood & Jackson, 1991a:191). Critical systems thinking is derived from systems thinking and social theory (Jackson, 2001:233). Critical systems methodologies are positioned within the critical system thinking paradigm; they aim to emancipate the oppressed through critical awareness and complementarism (Flood & Jackson, 1991a:131). The critical systems thinking paradigm developed as two separate strands, i.e. the total systems intervention strand (Flood & Jackson, 1991a; Flood & Jackson, 1991b) and the critical systems heuristics strand (Ulrich, 1983). Critical systems thinking may enhance software development (Warren & Adman, 1999:224) since software development processes must foster "inclusion and critical reflection" and hence individuals that are involved in software development processes, as well as individuals that will be affected by developed software, must be given the opportunity to critique and the concerns of all involved and affected stakeholders, i.e. end-users, managers as well as software designers and developers, must be incorporated (Córdoba, 2007:909).

As was indicated in Chapter 3, the nature of BI system development, where the problem is mostly concerned with users' business and information requirements that needs to be elicited appropriately before software development can commence, necessitates a critical systems methodology to determine *what* needs to be done before engaging in discussion of *how* to proceed; various participants involved in determining BI system requirements also requires appropriate handling of conflicting views amongst them in order to arrive at a practical solution to be implemented. BI is implemented on a technological infrastructure; however, BI is only useful if it enables its users to create intelligible information. Hence, the development of a BI system is a technical process whilst the creation of and value attribution to information is a human/social process.

The next chapter discusses the first step in the action research process followed in this study, i.e. the diagnosis phase.

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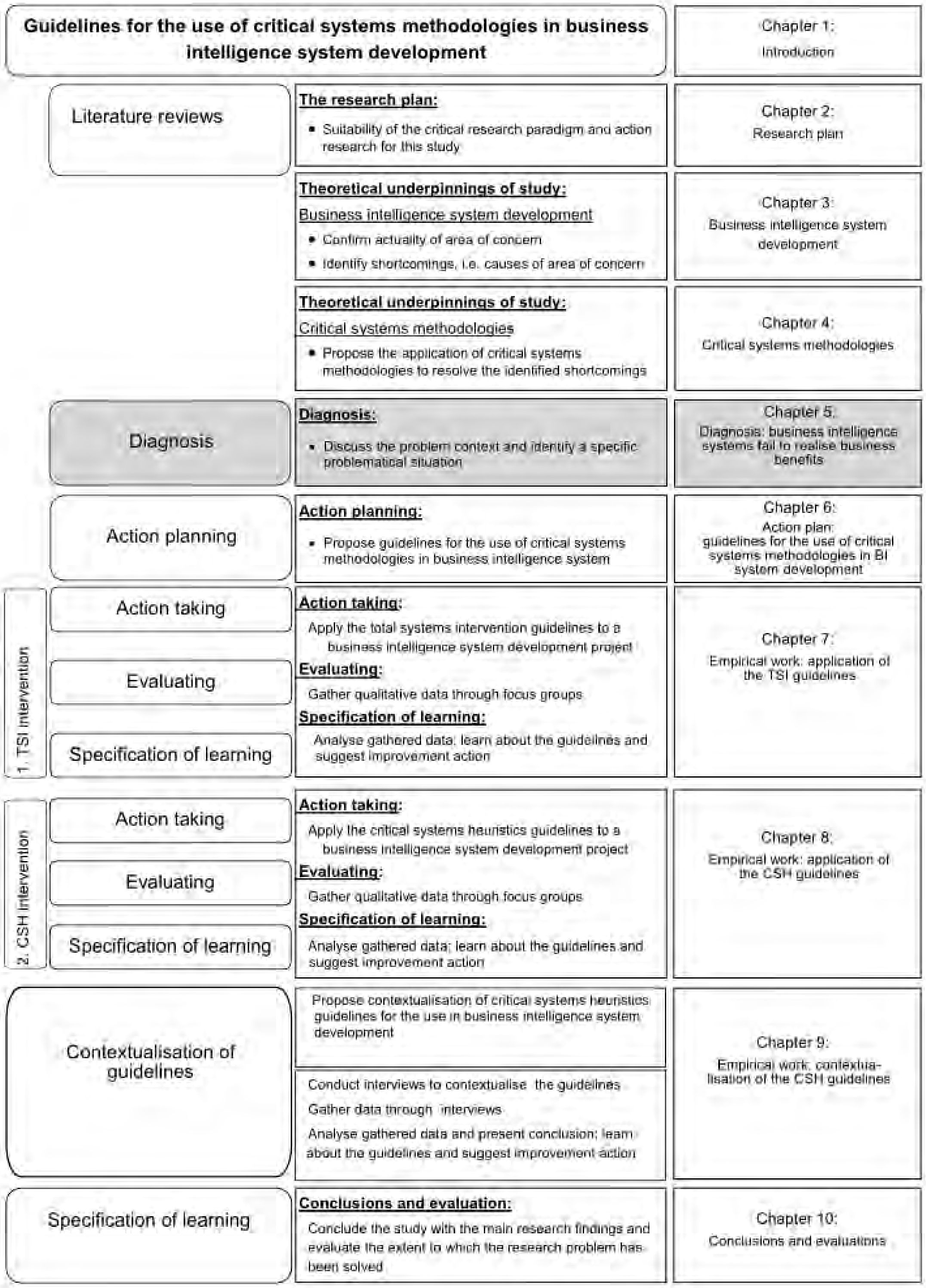
Guidelines for the use of critical systems methodologies in business intelligence system development
Chapter 1: Introduction
Literature reviews
The research plan:
Suitability of the critical research paradigm and action research for this study
Chapter 2: Research plan
Theoretical underpinnings of study:
Business intelligence system development
Confirm actuality of area of concern
Identify shortcomings, i.e. causes of area of concern
Chapter 3: Business intelligence system development
Theoretical underpinnings of study:
Critical systems methodologies
Propose the application of critical systems methodologies to resolve the identified shortcomings
Chapter 4: Critical systems methodologies
Diagnosis
Diagnosis:
Discuss the problem context and identify a specific problematical situation
Chapter 5: Diagnosis: business intelligence systems fail to realise business benefits
Action planning
Action planning:
Propose guidelines for the use of critical systems methodologies in business intelligence system
Chapter 6: Action plan: guidelines for the use of critical systems methodologies in BI system development
1. TSI intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the total systems intervention guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data; learn about the guidelines and suggest improvement action
Chapter 7: Empirical work: application of the TSI guidelines
2. CSH intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the critical systems heuristics guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data; learn about the guidelines and suggest improvement action
Chapter 8: Empirical work: application of the CSH guidelines
Contextualisation of guidelines
Propose contextualisation of critical systems heuristics guidelines for the use in business intelligence system development
Conduct interviews to contextualise the guidelines
Gather data through interviews
Analyse gathered data and present conclusion; learn about the guidelines and suggest improvement action
Chapter 9: Empirical work: contextua-lisation of the CSH guidelines
Specification of learning
Conclusions and evaluation:
Conclude the study with the main research findings and evaluate the extent to which the research problem has been solved
Chapter 10: Conclusions and evaluations

Chapter 5 : Diagnosis: business intelligence systems fail to realise business benefits

5.1 Introduction

The objective of this study is to develop guidelines for the use of critical systems methodologies to improve the development of business intelligence systems. The researcher adopts an action research approach to achieve the study's objective. Action research entails the iteration of five phases, i.e. diagnosis, action planning, action taking, evaluating, and specification of learning (Baskerville & Wood-Harper, 1996:238). This chapter discusses the diagnosis phase of this study.

The first action research phase entails the diagnosis of a research theme for the study, as well as specific problem context that is related to the research theme of the study; this constitutes the area of concern (A). Therefore, during this phase the researcher identifies the primary reason(s) that necessitates changes, holistically interprets the problem situation, and develops theoretical assumptions about the problem context (Baskerville, 1999:14). The researcher also identifies a specific problematic situation that is representative of the research theme; the researcher then intervenes and acts as a change agent to improve the practical concerns of those involved in the specific problematic situation (Mathiassen *et al.*, 2012:349).

The research theme for this study is that business intelligence systems fail to realise business benefits; the researcher identified shortcomings in this regard – refer to Chapter 3. As a specific instance of the research theme, the researcher identified a problematic situation that fits within the research theme; she identified a failed business intelligence system in an organisation; this organisation still requires business intelligence capabilities and thus a new business intelligence system is to be developed for the organisation. This chapter starts by restating the structure of this study in Section 5.2. Section 5.3 discusses the area of concern (A).

5.2 The structure of this study

This study is structured similarly to the critical action research approached followed by Checkland & Holwell (1998:27) – refer to Figure 5-1 below – where an action researcher enters a problem situation, i.e. an area of concern (A); takes part in change process; performs the research based on the establishment of roles as well as a declared-in-advance methodology (M) and intellectual framework of ideas (F); and exits the research situation whilst reflecting on the experience and recording learning in relation to the framework of ideas (F), methodology (M) as well as the area of concern (A). In the diagnosis phase the researcher expands A.

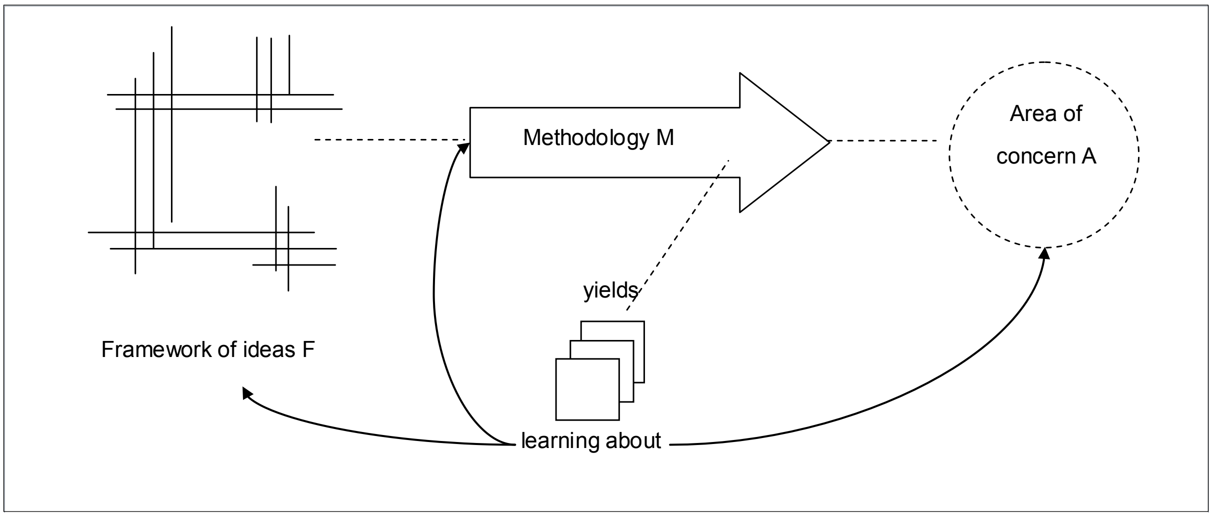

Figure 5-1: Elements of action research (Checkland & Holwell, 1998:27)

5.3 The area of concern

When attempting to resolve an identified area of concern (A), Mathiassen *et al.* (2012:348) assert that action researchers are confronted with a dual goal: they must develop a solution to a practical (specific) problem that is valuable to the recipients of their solution (such as organisational employees); simultaneously, they must also develop theoretical knowledge that is valuable to a research community that are interested in the broader problem context. The practical problematic situation is a representative instance of the broader problem context (i.e. the research theme); the researcher relieves the practical problems to also learn about the problem context in general. Mathiassen *et al.* (2012:349) therefore argue that action researchers engage in a *problem-solving cycle* (to relieve the problematic situation (i.e. the representative problematic instance) as well as a *research cycle* (to learn about the broader problem context, i.e. the research theme) to improve an identified area of concern; these cycles proceed interactively but have different focuses:

- During the research cycle action researchers apply theoretical knowledge to solve practical problems; the research cycle focuses on *research* outcomes.
- During the problem solving cycle action researchers gain practical insights from the problem setting and actions taken to discover new theoretical knowledge that can be applied to inform future research; the problem solving cycle focuses to produce practical outcomes.

The next sections discuss the area of concern for this study in terms of the planned *research cycle* as well as the *problem solving cycle.*

5.3.1 The research cycle

According to Mathiassen *et al.* (2012:349) the area of concern of an action research study is primarily associated with the research cycle; it reflects the interest of the researcher and is represented by a body of knowledge within the literature. The identified area of concern for this study is that software artefacts, such as business intelligence (BI) systems, often fail to realise intended business benefits. Industry experts refer, for example, to Gartner (2013b); they report that organisations increasingly focus to improve their analysis and decision making capabilities. BI capabilities are thus becoming increasingly important for organisations; refer also to Section 3.2 of Chapter 3 for a discussion on the importance of BI. However, the literature also reports high failure rates and low adoption rates for BI systems; for example Gartner (2011:1) and Dresner Advisory Services (2012) reported recent failure rates of between 30%-59% in the BI systems domain. Therefore, the researcher identified probable causes for these high failure rates; she identified shortcomings in development approaches and business requirements collection processes (refer to Chapter 3 of this study for a detailed discussion). The identified shortcomings are summarised below.

5.3.1.1 Summary of identified shortcomings

Firstly, current software development approaches, including approaches specifically aimed at the development of BI systems, are generically comparable. They share similar process steps that are executed either sequentially or iteratively. However, *sequential development approaches lack sufficient people-orientation, whilst iterative (evolutionary) development approaches lack sufficient planning.* The motivations behind these statements are listed below*:*

1. Sequential development approaches assume that all requirements are known and can thus be accurately gathered at the beginning of the development project (Prakash *et al.*, 2012:457). It is rigid and does not allow developers to easily accommodate requirements that (inevitably) change or evolve; it does not take the human, social and organisational context of the artefact into account (Hijazi *et al.*, 2012:9).
2. Iterative (evolutionary) methods are favoured (and seem to deliver more successful artefacts) when developing smaller and less complex artefacts; evolutionary development approaches allow for changing and evolving requirements to be incorporated (Sommerville, 2011:47). Evolutionary methods are thus people-oriented. However, BI systems are large and complex systems (Yeoh & Koronios, 2010:23) and continuous incorporation of changing requirements during the developing process may result in poorly structured artefacts that are difficult to maintain (Sommerville, 1996:270; Sommerville, 2011:47).
3. Agile development processes claim to be people-oriented as they favour individuals over processes and applications; they also regard customer collaboration as more important than lengthy contract negotiations (Beck *et al.*, 2001a:1). However, the literature on agile software development is still anecdotal and lacks empirical evidence; its people-orientation focuses more on internal teamwork whilst user requirements are still elicited by following an evolutionary development approach (Lee & Xia, 2010:87).

Secondly, *current development approaches do not actively enable users to critically reflect and become aware of their real requirements; requirements should be elicited in such a manner that it steers the development of the BI system towards organisational improvement, rather than only the development of a good technical artefact*. The motivations behind this statement are listed below:

1. Business intelligence development approaches (such as the Kimball lifecycle approach (Kimball & Ross, 2010:97), the corporate information factory (CIF) (Inmon *et al.*, 2001:13), and Linstedt's data vault method (Linstedt, 2002)) focus primarily on the development of the data warehouse (DW). The DW is crucial for BI; it is the technological infrastructure that enables BI. However, successful BI requires *more* than a good DW. Successful BI entails a range of processes and systems applied to create intelligible information and enhance organisational decisions; BI must ultimately *improve* an organisation (Inmon, 2005:60). Both the Kimball lifecycle approach and the CIF emphasise the importance of gathering appropriate business requirements. However, neither of these approaches guides the developer to emancipate users to *discover* new requirements that will *improve* the organisation. BI users "operate in a mode of discovery…cannot tell what the information needs are until they see the possibilities" (Inmon, 2005:55). BI development approaches do not explicitly guide the BI system developer to enable users to reflect in such a mode of discovery prior to or during the development of the BI artefact.
2. The degree to which a developer understands a user's requirements drives the success of the developed artefact (Leffingwell, 1997:57). Defective requirements that need to be fixed during later stages of development are exponentially more expensive than fixing requirements upfront (McConnell, 1996:42). Traditional requirements collection approaches focus predominantly on the collection of technical requirements and does not incorporate the human dimension; requirements will thus inevitably change and evolve later on in the development process (Avison & Fitzgerald, 2006:105).
3. 'Alternative' requirements collection approaches proposed in the literature, such as ethnographic techniques are time consuming and resource intensive (Sommerville, 2011:108). Peter Checkland's soft systems methodology

(SSM) are also advocated as useful in software development; however, it is not yet widely adopted for this purpose (Avison & Fitzgerald, 2006:507; Iivari *et al.*, 2000:186; Checkland & Holwell, 1998:173).

5.3.1.2 Summary of the problem context

In summary, the identified shortcomings are: Firstly, sequential development approaches lack sufficient people-orientation, whilst iterative (evolutionary) development approaches lack sufficient planning. Secondly, current development approaches do not actively enable users to critically reflect and become aware of their real requirements; requirements should be elicited in such a manner that it steers the development of the BI system towards organisational improvement, rather than only the development of a good technical artefact.

5.3.2 The problem solving cycle

An action researcher also aims to resolve a practical real-world problem. This real-world problem is a specific representation of the problem context where the researcher engages with people in the immediate problem situation; he/she then acts as a (consultative) change agent to improve the problem situation (Baskerville & Wood-Harper, 1996:237; Mathiassen *et al.*, 2012:349). For this study, the researcher identified such a real-world problem situation: She identified a failed BI system to be improved upon; an organisation requires a new BI system to be developed to replace their failed BI system. Section 5.3.2.1 discusses the background to the organisation. Section 5.3.2.2 discusses the background of the failed BI system.

5.3.2.1 Organisational background

The organisational background of the identified problem context is a business unit, i.e. the technology division, of a large South African based petrochemical organisation. The organisation also has an international footprint; it currently has operations in 37 countries. The organisation continually sustains, improves and grows its asset base to remain competitive within its industry; sustenance, improvement and growth activities are undertaken in its local as well as its international operations. The organisation's sustainability and growth – locally and internationally – therefore depends largely upon its ability to execute sustainability and growth projects effectively and efficiently. These projects are resource intensive in terms of both capital and human resources. Thus, to accelerate sustainable growth the organisation strives towards world-class project planning and execution processes and systems.

The organisation requires business intelligence capabilities to make strategic investment decisions, i.e. appropriate resource allocations to appropriate projects; continuation/recycling of projects during its planning phases; and trends in terms of poorly performing project portfolios and project streams. They therefore require a BI system to inform their capital project-related investment decisions; it entails decisions to stop/continue/recycle project work, and also allocate monetary as well as human resources to continuing projects. It is important for them since their international capital projects cost billions of dollars to complete and are executed over a number of years. Some of the key strategic drivers that were recently identified within the organisation were cost optimisation, simplicity and reduced bureaucracy; yet, projects still ought to be executed and delivered within budget and on schedule whilst consistently adhering to quality standards. The organisation used a BI system for this purpose; however this BI system failed the organisation – this is discussed in the next section.

5.3.2.2 Background: a failed business intelligence system

The researcher of this study was an employee at this organisation at the time when the research was conducted. She was requested to analyse root causes of the perceived inefficiency of the BI system that the organisation used to inform strategic project-related investment decisions; she was also requested to oversee the improvement of the organisation's capability to effectively and efficiently make these investment decisions, i.e. the design and development of a new BI system.

The as-is situation, i.e. the failed (historical) BI system, is discussed in the next sections. It is discussed in terms of: the business process that it supports; the practical concerns of the users of the BI system (i.e. the case of change); the operational system used to gather data in support of this business process; and the decision support information that the data warehouse provides to this business process.

The supported business process: the capital project gate keeping process

The business process supported by the BI system in question entails the following: The organisation's sustainability and growth projects are planned and executed according to a standardised project management methodology. It has been customised for the organisation; yet, it is still fundamentally based on the project lifecycle approach prescribed by the Project Management Body of Knowledge (PMBOK) of the Project Management Institute (PMI, 2013). Accordingly, the organisation's projects are planned and executed using a stage-gated approach; projects are evaluated at three pre-defined evaluation points ("gates") during planning phases; the objective of these evaluations are to determine the project's health/performance relative to its phase in the project's lifecycle. The outcomes of these evaluations are combined with information from other business processes and then applied to inform project investment decisions.

The organisation refers to the decision points at the end of each stage as "gates" or "gate decisions". Thus, each project's lifecycle consists of a number of phases with fixed decision points where strategic (investment) decisions are informed based on the outcome of the "gate" evaluation; at these decision points senior investment managers decide whether to allocate resources to continue to the next phase of the project. This process is formally applied to all projects that adhere to minimum criteria in terms of probable complexity and cost. The gate decision process is illustrated in Figure 5-2 below; the process is repeated thrice during the lifecycle of a project.

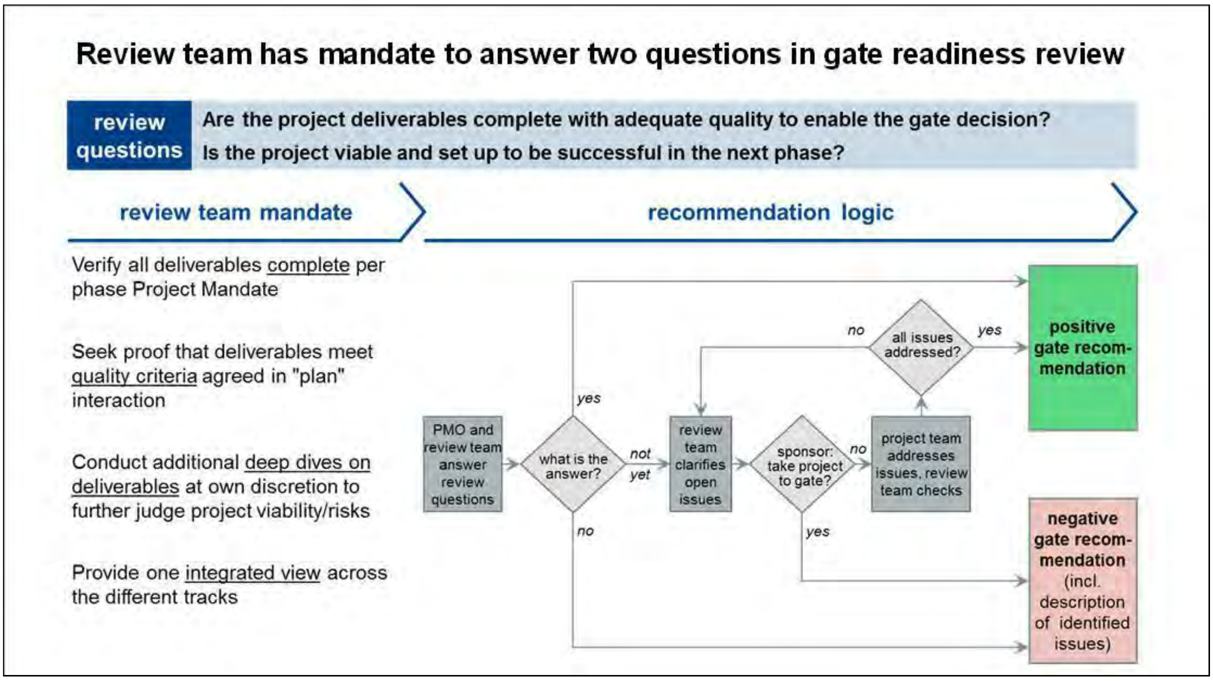

Figure 5-2: Gate decision process

The outcomes of these gate evaluations are one of the following: continue the project as-is and hence allocate resources (positive recommendation); recycle the project, i.e. do more work prior to continuation, so resource allocation is delayed (negative recommendation); or terminate (stop and/or shelve) the project due to lack of maturity and/or viability (negative recommendation). Investment managers use these outcomes on a per project basis to inform further investment decisions, i.e. decisions to allocate human and monetary resources to the projects so that they can be developed and refined further.

They also use historical data in the data warehouse to identify trends such as poorly performing project portfolios or project streams; the data is also used to identify individual project teams that perform poorly. Each project is executed by team members that attribute to one of three streams in the project, i.e. the technical (engineering) stream, the business stream, or the project stream. This business process is governed by an organisational department called the project management office (PMO). The process is illustrated in Figure 5-3 below.

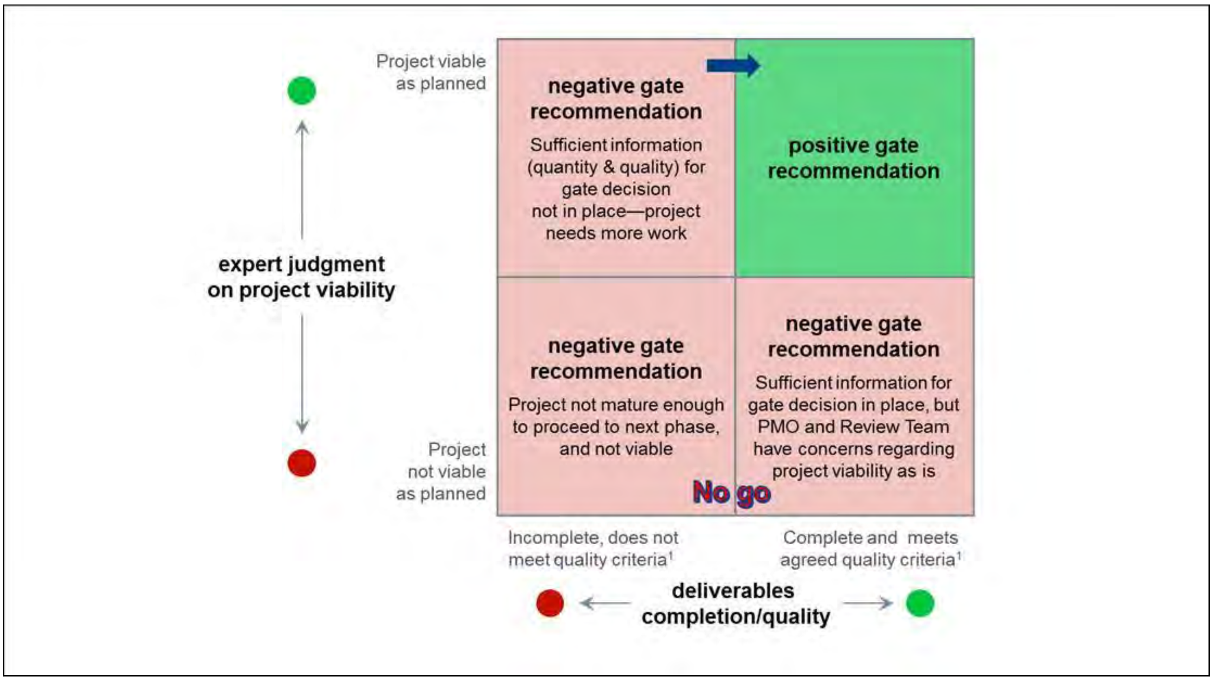

Figure 5-3: Possible outcomes of gate evaluations

The practical concerns of the users of the BI system (the case for change)

The investment managers (decision makers on these capital projects) became increasingly uncomfortable with the quality of reporting information that stemmed from the BI system. They started to question whether it accurately informed their investment decisions. Doubt was instilled particularly when an independent (external) benchmarking company benchmarked the organisation's overall project planning and execution performance and found it to be sub-optimal when compared to the organisation's typical peers/competitors in terms of schedule competitiveness and cost competitiveness. They argued that the organisation based their strategic decisions in this regard on inappropriate information.

Contrary to the information that the BI system provided, the benchmarking company found that projects were not planned effectively and efficiently. As a result, re-work during execution phases lead to an estimated loss of 6.3% internal rate of return (IRR) and, on average, schedule overruns of 23% across its portfolio of projects. Investment managers (the decision makers) therefore requested that the associated

BI system (both the front end of the operational gate keeping process' system and the data warehouse) be analysed and improved.

The operational front-end system used to gather data

The business process is supported by an operational decision support front-end application that gathers the operational data; data is then fed into the project portfolio data base (PPD) and then into the central data warehouse where it is combined with data from other business processes to provide strategic decision support information. For the BI system to accurately inform decisions it must be populated with accurate and appropriate information via its front-end applications. The data capturing process for the gate keeping process is discussed next.

Figure 5-4 illustrates an input screen in the operational front-end application pertaining to the gate keeping process.

Business Track - PDRI Evaluation			2008/03/10 00:00
Element		Score	Evaluation Comments
Business Strategy and Strategic Fit	Answer Questionaire	0.0	
Business and Ownership Structure	Answer Questionaire	0.0	
Cross - Business Impact Analyses	Answer Questionaire	1.0	
Management Structure and Organization design	Answer Questionaire	2.0	
Industry Analysis and Competitive Advantages	Answer Questionaire	0.0	
Competitor Analysis and Value Chain Comparisons	Answer Questionaire	0.0	
Plant Capacities	Answer Questionaire	1.0	
Market Strategy	Answer Questionaire	4.0	
Market - Volumes (Products and By-products)	Answer Questionaire	4.0	

Figure 5-4: Extract of the user interface in the operational front-end application

The person that captures the input data clicks on the "Answer Questionnaire" button and is then presented with a screen such as the example shown in Figure 5-5 below. This screen then presents the data-capturer with possible responses for a particular element; a response is indicated by selecting the radio button next to the response that best described the level of development for the particular element.

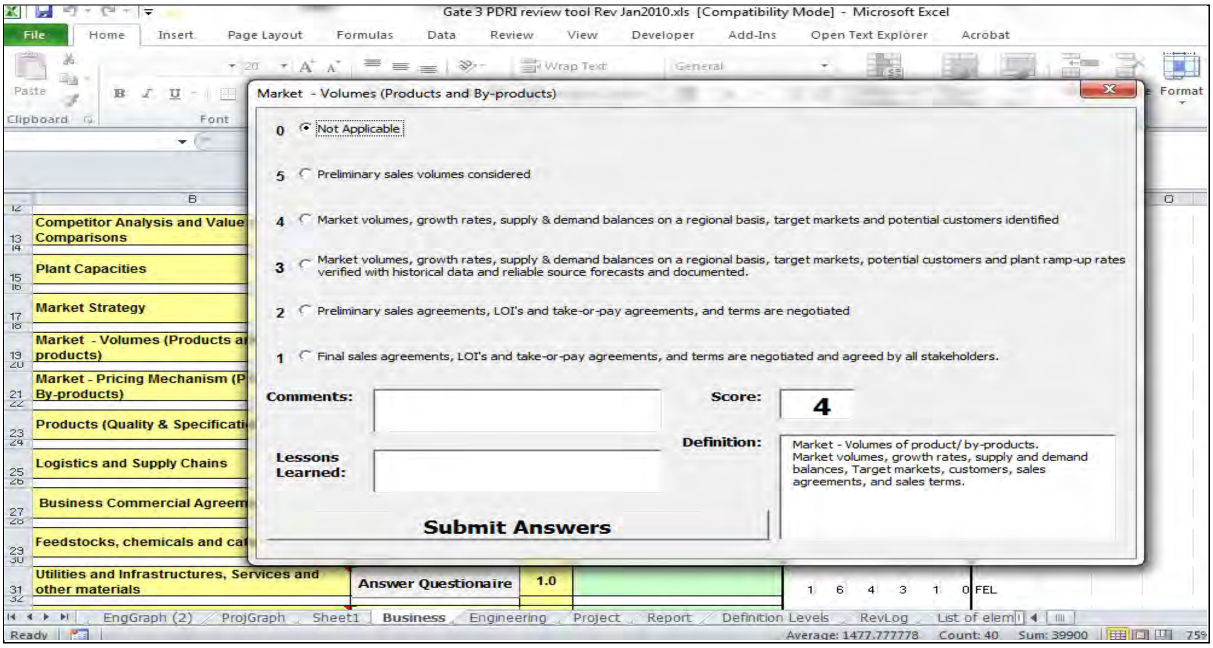

Figure 5-5: Possible response levels in the historical front-end application

The responses for each element are coupled to a score that is used to generate output graphs. When a response is chosen the block marked “Score” automatically updates with the numeric score coupled to the response. Figure 5-6 and Figure 5-7 show examples of the scores that are coupled to possible responses. Refer to the column marked “Level scoring” in Figure 5-6 and Figure 5-7 below where response levels indicate an increased level of completeness, with level 1 being the most complete and level 5 being the least complete, has a lower numeric score coupled to it. The scores are not allocated to the different response levels of the various elements in the same way – an element that is regarded as more important has higher numeric scores coupled to it. For example the level 5 (least complete) response in Figure 5-7 is allocated a numeric score of 18 whilst the level 5 (least complete) response in Figure 5-6 is allocated a numeric score of 6 only. This implies that the element “Engineering Track Quality Management” (Figure 5-7) is considered to be more important for the project’s success than the element “Market – Volumes (Products and By-products)” (Figure 5-6). Figure 5-6 also illustrates that the response levels at the maximum level of development (level 1) was in some instances zero, thus not adding any numeric value to the total for the work stream and the total for the project. The maximum level of development (level 1) of each element does not necessarily indicate the *best* (ideal) level of development. For example, the ideal level of development for the elements illustrated in Figure 5-6 and Figure 5-7 are both at the second level; additional (non-value) adding level(s) are added to the bulk of the elements.

BT33	Market - Volumes (Products and By-products)	Level scoring
0	Not Applicable	0
5	Preliminary sales volumes considered	6
4	Market volumes, growth rates, supply & demand balances on a regional basis, target markets and potential customers identified	4
3	Market volumes, growth rates, supply & demand balances on a regional basis, target markets, potential customers and plant ramp-up rates verified with historical data and reliable source forecasts and documented.	3
2	Preliminary sales agreements, LOI's and take-or-pay agreements, and terms are negotiated	1
1	Final sales agreements, LOI's and take-or-pay agreements, and terms are negotiated and agreed by all stakeholders.	0

Figure 5-6: Example of scoring per level in the front-end application

ET47	Engineering Track Quality Management	Level scoring
0	Not Applicable	4
5	ETQP compiled for the current phase, but with limited stakeholder involvement or with only general description of activities and responsibilities.	18
4	ETQP compiled for the current phase, but not all stakeholders involvement or specific plans, activities and responsibilities only defined for some engineering disciplines.	12
3	ETQP compiled for the current phase with involvement of most stakeholders, specific plans, activities and responsibilities for all engineering disciplines, but with limited effectiveness of tracking system and review of the ETQP to incorporate feedback.	8
2	ETQP fully defined for current phase with involvement of all stakeholders and specific plans, activities and responsibilities for all disciplines, but ETQP lack alignment across all disciplines such that there may be uncertainty regarding conformance of work at interfaces between engineering disciplines. Formal tracking and feedback system not fully applied for all disciplines.	3
1	ETQP for current phase was in place early in the phase. ETQP was compiled with effective involvement of all stakeholders and plans,activites and responsibilities defined and reviewed with feedback. Formal tracking and feedback system implemented. There is general confidence that all discipline work and the engineering work overall is all complete as planned, technically correct, technically aligned and aligned with the business intent/objectives.	3

Figure 5-7: Example of scoring per level in the front-end application

The responses of all the scores are tallied up and a total score is obtained for each work stream. A work stream's score has to be within a certain pre-defined numeric range to be "acceptable". The scoring in the front-end application is applied as follows: a lower score indicated a better level of development and a higher score indicated a lower level of development. The three streams' scores are tallied up to obtain a total score for the project. The total score also has to be lower, rather than higher, to indicate an acceptable or better than acceptable ("overdeveloped") level of development; the total score also had to fall within a pre-defined numeric range to be "acceptable". Each work stream as well as the total for the project has a pre-defined "target score" within the pre-defined numeric range that indicated optimal development; this was however, not clearly indicated on the output report.

Figure 5-8 below shows an example of the output graph generated by the system. The column named "Score" in Figure 5-8 below indicates the results obtained for a project based on the input responses received on the input screen (Figure 5-5 above) that are tallied up (as per Figure 5-6 and Figure 5-7 above) to determine the level of development for the work streams (refer to the column named "Track" in Figure 5-8 below) and the total for the project; the total score for each track and for the total for the project has to fall within pre-defined ranges to indicate an ideal level of development in the output graphs in the example illustrated in Figure 5-8 below. The predefined ranges for ideal development differ between the three input sheets that make up the front-end application; for the different work streams it ranges between numerical values of approximately 75 to 240 – as is indicated in the example illustration in Figure 5-8 below.

Track	Score	Index	Comment			Key
Total	401	100	Acceptable			Overdeveloped
Business	75	100	Acceptable			Acceptable
Engineering	240	100	Acceptable			Underdeveloped
Project	86	101	Acceptable			Risky

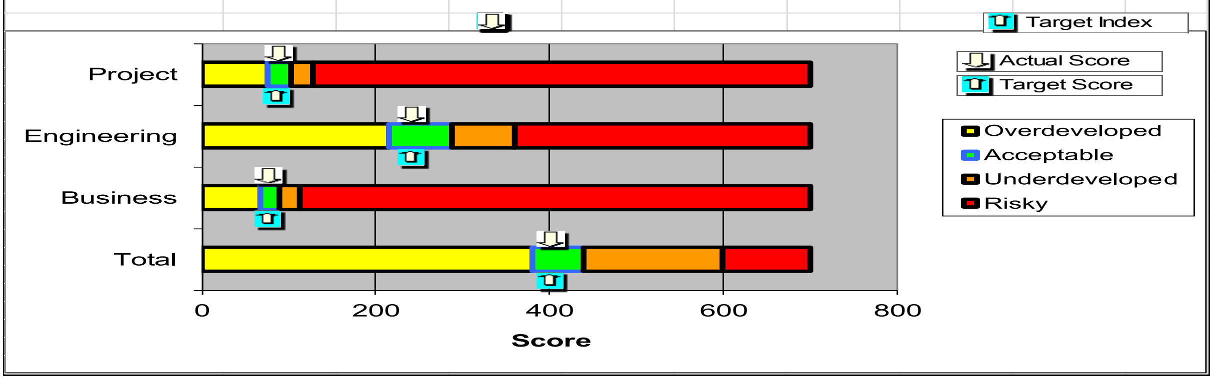

Figure 5-8: Example of output report generated for a project

Decision support information from the data warehouse

The data that stem from these evaluations are stored in a database, i.e. the "project portfolio database" (PPD). This database then feeds into a central DW that also retrieves information from other business processes such as project planning (Microsoft Enterprise Project Management Server, i.e. EPMS), project costing (Primavera), project business case analysis (custom built applications), and project forecasting (Primavera and Microsoft Excel).

Investment decisions are based on reports periodically distributed from the integrated DW (for the full project portfolio), and from individual operational systems (on a per-project basis). Reports are distributed monthly (via collaboration systems, i.e. LiveLink, SharePoint and e-mail), but can also be requested/retrieved *ad hoc*.

The data warehouse contains information from other business processes as well; it should give a holistic picture of the general health of all projects and all project portfolios. It should also provide information on specific improvement actions required to improve project planning and execution performance; project portfolios are periodically evaluated to determine whether general improvement actions are required on a portfolio, a combination of portfolios, or within specific disciplines and/or business areas (such as business planning, planning, forecasting, technical development work, project planning/execution, capital effectiveness etc.) involved in projects.

Summary of the identified problematical situation

In summary, the investment managers' decisions are not sufficiently enabled by the historical system in support of this business process. The historical front-end application that supports this business process is very complex. It is very difficult to determine how the data that is being fed into the PPD database (and ultimately into the DW) is calculated and interpreted. It is thus very difficult to determine whether the decision support information provided by this BI system is an accurate portrayal of the organisation's project planning and execution performance. Investment managers in the organisation therefore requested that a new BI system be developed; they requested that the front-end application be simplified and reporting from the BI system automated as far as possible, as they felt that these shortcomings in the historical system were the main causes of failure. Data capturers complained that they did not understand the input mechanisms and therefore may capture inappropriate data. Reporting information was also edited off-line prior to sending it on to decision makers. The business users thus initially requested a pure automation project – as is often the case – refer for example to Gardner (1998:55) and Newman & Lamming (1995:150); however, business requirements should be surfaced that improve the organisation (Newman & Lamming, 1995:150; Inmon, 2005:55) – refer also to Section 3.7 of Chapter 3. The researcher therefore suggested to the sponsor of the project that the business requirements analysis phase of this project be enriched with critical systems methodologies to surface users' real requirements – the action plan to incorporate critical systems methodologies as part of the Kimball lifecycle approach (a traditional BI development approach), is discussed in the next chapter.

5.4 Summary

This chapter discusses the diagnosis phase of the action research study. It starts by reiterating the research theme of the area of concern (A). To provide the theoretical underpinnings of the problem context, it summarises the identified shortcomings in current development approaches. It then discusses diagnosis of a specific representation of the area of concern (A), i.e. a failed BI system in an organisation that requires a new BI system to be developed.

This chapter explains the background to the organisation where the failed BI system was identified. It also discusses the background of this failed BI system that needs to be improved upon. The system is discussed in terms of the associated business process, the practical concerns of the users, the operational front-end system, and decision support information that stem from the failed system.

This chapter also highlights that the scope of this intervention initially entailed automation of reporting and simplification of data capturing mechanisms; however, the researcher requested from the project's sponsor to apply a critical approach during the business requirements analysis phase to enable users to surface requirements that would constitute real improvement in their decision making capabilities and, as such, ultimately in the organisation.

The next chapter discusses the planned actions to relieve the problematical situation and improve the problem context.

Guidelines for the use of critical systems methodologies in business intelligence system development			Chapter 1: Introduction
	Literature reviews	**The research plan:** • Suitability of the critical research paradigm and action research for this study	Chapter 2: Research plan
		Theoretical underpinnings of study: Business intelligence system development • Confirm actuality of area of concern • Identify shortcomings, i.e. causes of area of concern	Chapter 3: Business intelligence system development
		Theoretical underpinnings of study: Critical systems methodologies • Propose the application of critical systems methodologies to resolve the identified shortcomings	Chapter 4: Critical systems methodologies
	Diagnosis	**Diagnosis:** • Discuss the problem context and identify a specific problematical situation	Chapter 5: Diagnosis: business intelligence systems fail to realise business benefits
	Action planning	**Action planning:** • Propose guidelines for the use of critical systems methodologies in business intelligence system	Chapter 6: Action plan: guidelines for the use of critical systems methodologies in BI system development
1. TSI intervention	Action taking	**Action taking:** Apply the total systems intervention guidelines to a business intelligence system development project	Chapter 7: Empirical work: application of the TSI guidelines
	Evaluating	**Evaluating:** Gather qualitative data through focus groups	
	Specification of learning	**Specification of learning:** Analyse gathered data; learn about the guidelines and suggest improvement action	
2. CSH intervention	Action taking	**Action taking:** Apply the critical systems heuristics guidelines to a business intelligence system development project	Chapter 8: Empirical work: application of the CSH guidelines
	Evaluating	**Evaluating:** Gather qualitative data through focus groups	
	Specification of learning	**Specification of learning:** Analyse gathered data; learn about the guidelines and suggest improvement action	
	Contextualisation of guidelines	Propose contextualisation of critical systems heuristics guidelines for the use in business intelligence system development	Chapter 9: Empirical work: contextualisation of the CSH guidelines
		Conduct interviews to contextualise the guidelines Gather data through interviews Analyse gathered data and present conclusion; learn about the guidelines and suggest improvement action	
	Specification of learning	**Conclusions and evaluation:** Conclude the study with the main research findings and evaluate the extent to which the research problem has been solved	Chapter 10: Conclusions and evaluations

Chapter 6 : Action plans: guidelines for the use of critical systems methodologies in business intelligence system development

6.1 Introduction

The objective of this study is to develop guidelines for the use of critical systems methodologies to improve the development of business intelligence systems. The researcher adopts an action research approach to achieve the study's objective. Action research entails the iteration of five phases, i.e. diagnosis, action planning, action taking, evaluating, and specification of learning (Baskerville & Wood-Harper, 1996:238). The second action research phase is action planning. This chapter discusses the action planning phase of this study.

In action planning the researcher identifies specific actions to relieve the identified problems (Baskerville & Wood-Harper, 1996:238). The action planning phase is guided by a conceptual framework of ideas (F); the framework of ideas also guide the choice of methodology/(ies) (M) that are applied to the (diagnosed) area of concern (A) (Mathiassen *et al.*, 2012:349).

This chapter starts by restating the structure of this study in Section 6.2. It then discusses the planned actions to improve the area of concern (A) in Section 6.3 in terms of the framework of ideas (F) and methodologies (M). Section 6.4 discusses the guidelines to enrich the Kimball lifecycle approach with total systems intervention. Section 6.5 discusses the guidelines to enrich the Kimball lifecycle approach with critical systems heuristics.

6.2 The structure of this study

This study is structured similarly to the critical action research approached followed by Checkland & Holwell (1998:27) – refer to Figure 6-1 below – where an action researcher enters a problem situation, i.e. an area of concern (A); takes part in change process; performs the research based on the establishment of roles as well as a declared-in-advance methodology (M) and intellectual framework of ideas (F); and exits the research situation whilst reflecting on the experience and recording learning in relation to the framework of ideas (F), methodology (M) as well as the area of concern (A). In the action planning phase the researcher expands F and M.

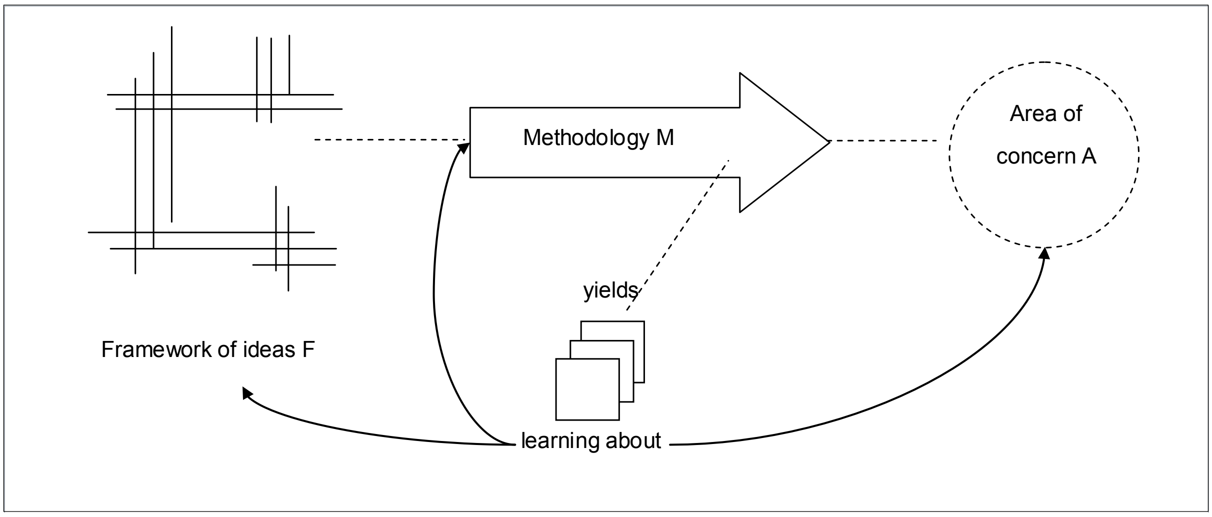

Figure 6-1: Elements of action research (Checkland & Holwell, 1998:27)

6.3 Action planning

The action plan establishes the target for change; it also outlines the approach to change (Baskerville & Wood-Harper, 1996:238). A critical researcher establishes an intellectual framework of ideas (F) for a study by using core concepts from critical social theorists to discover and guide the planned actions of an action research intervention; the framework of ideas then guides the choice of methodology/(ies) (M) to improve the diagnosed area of concern (Myers & Klein, 2011:25; Baskerville & Wood-Harper, 1996:238).

The guiding framework of ideas (F) for this study is discussed in Section 6.3.1. Section 6.3.2 motivates the complementary application of TSI to enrich a traditional BI system development approach; and Section 6.3.3 motivates the complementary application of CSH to enrich a traditional BI system development approach. Section 6.3.4 outlines the action plans to apply the following methodologies (M) in this study: Firstly, the researcher proposes an action plan to enrich a traditional BI system development approach (the Kimball lifecycle approach) with total systems intervention (TSI). Secondly, she proposes to enrich the Kimball lifecycle approach with critical systems heuristics (CSH).

6.3.1 Framework of ideas

Problem solvers in the critical systems thinking (CST) paradigm are committed to emancipation, critical awareness, and complementarism. CST developed as two separate strands: the TSI strand aims to facilitate complementarism through “critical (i.e. theoretically informed and justified) methodology choice”; whilst the CSH strand aims to promote “reflective (i.e. transparent and self-critical) practice” (Ulrich, 2013:316). Refer to Chapter 4 for a detailed discussion on CSH, TSI, and CSH. Traditional BI development approaches, which lack people-orientation and reflective practices when deriving appropriate business requirements (refer to Chapter 3 for a detailed discussion), may therefore benefit from both the CST strands. So, both TSI and CSH can potentially add unique value to a BI system development project. Consequently, during the action planning phase the researcher formulates two action plans; these methodologies are proposed to be applied (separately) to a BI system development project.

To formulate action plans, the researcher applies core concepts from these critical systems thinkers in this study: Flood & Jackson (1991a), i.e. the developers of TSI; and Ulrich (1983), i.e. the developer of CSH. These are applied to overcome the identified shortcomings in BI system development (refer to Chapter 3 and also to the summary in Section 5.3.1 of Chapter 5). TSI and CSH, in turn, guide the empirical work in this study. The researcher motivates that critical systems methodologies can complement a traditional BI development approach: Section 6.3.2 below motivates the application of TSI in BI system development; Section 6.3.3 motivates the application of CSH in BI system development. The Kimball lifecycle approach is a traditional BI system development approach that delivers technically good BI systems; it is applied for the development of the technical components of a BI system. Therefore, the Kimball lifecycle approach is proposed to be enriched with the respective critical systems methodologies; this is discussed in Section 6.3.4.

6.3.2 Motivation: apply TSI in BI system development

Business intelligence system development approaches require methodological pluralism. Current development approaches focus predominantly on the technical features and technical development aspects of the software artefact; these approaches originate from the hard systems thinking paradigm. These development approaches render "technically appropriate" artefacts; unfortunately, these "technically appropriate" artefacts often "fail to meet user needs" because they are "culturally/organizationally infeasible" (Clegg & Shaw, 2008:448). Avison & Fitzgerald (2006:11) blame these failures "squarely on human and organizational factors rather than technical ones". Subsequently, soft systems thinking principles have been embraced – various authors refer for example to Peter Checkland's soft systems methodology as an information system/software development (ISD) approach (Avison & Fitzgerald, 2006:508; Clegg & Shaw, 2008:447; Iivari *et al.*, 2000:191). However, the goals of the software artefact (such as a BI system) in the business remain to fulfil "hard" profit-seeking business objectives and therefore a "soft" development approach that embraces the human, social and organisational aspects must balance these seemingly conflicting dimensions (Córdoba, 2007:910).

Development approaches seem to incorporate the technical dimensions of the software artefact adequately. However, Hirschheim & Klein (1994:83) argue that software development approaches (and by implication also BI system development approaches) must embrace emancipatory principles to become *people-oriented* as well. The development of a BI system entails different phases with different focuses; the business requirements analysis phase entails the discovery user requirements whilst the development phase entails the development of a technical artefact according to the user requirements. An emancipatory approach investigates the assumptions and limitations of the hard systems as well as the soft systems paradigms and embraces pluralism (Mingers & White, 2010:1152). An *emancipatory BI system development approach* must thus embrace pluralism; it must allow for the complementary application of different (theoretically informed and justified) methodologies at different stages of the development process to balance these conflicting dimensions. The TSI strand of CST embraces pluralism to emancipate the oppressed (for the purpose of this study the oppressed are business users with failed BI systems); TSI allows problem solvers to address different phases of an intervention with appropriate problem solving methodologies from the hard and/or soft paradigm (Mingers & White, 2010:1152). This is illustrated in Figure 6-2 below.

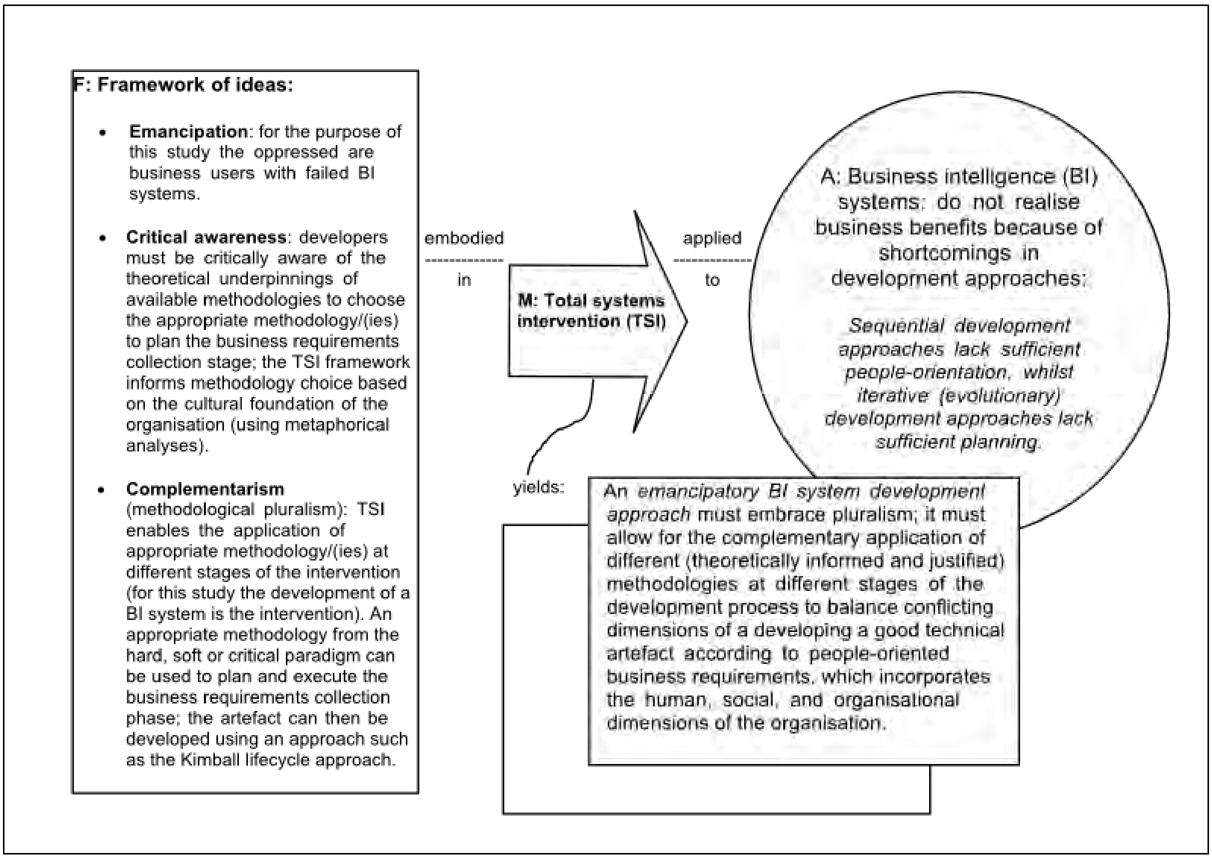

Figure 6-2: FMA illustration for TSI in BI system development

6.3.3 Motivation: apply CSH in BI system development

Business intelligence system development approaches also require emancipatory and reflective practices to enable users to become aware of their actual business requirements to be incorporated in the BI artefact. Current development approaches are quite similar and the process activities are generically comparable. However, evolutionary approaches deliver more successful artefacts since they allow developers to respond to changing/evolving requirements. It is unclear whether requirements really change/evolve in the relative short time that an artefact is being developed; or whether evolutionary development approaches merely allow users to ‘discover’ their real requirements by revealing portions of functionality. Evolutionary approaches thus allow users to adjust their expectations concurrently when they start to experience what is possible, rather than only what they were aware of or were able to imagine earlier. Unfortunately, evolutionary approaches are also less successful when developing large and complex artefacts. The strength of sequential development approaches, including approaches that focus on the development of BI systems, is that they deliver robust technical artefacts (such as the DW component of BI). However, these approaches fail to incorporate appropriate user requirements. The main strength of evolutionary development approaches is that they enable users to discover their requirements and adjust their expectations as part of the development process; hence, they deliver artefacts with higher acceptance rates. However, these approaches struggle to deliver large and complex artefacts that are technically robust and maintainable.

So, if a robust (sequential) development approach can enable emancipation of users to ‘discover’ their real requirements during the requirements analysis and planning phases of sequential development approaches, and also emancipate users to align their expectations to their real requirements during the analysis and planning phases of the development project, it should increase the success and adoption rate and ultimately the development of BI systems. Ulrich (1983:19) asserts that reflective practice necessitates the inclusion of practices (i.e. *heuristic procedures)* to identify and explore relevant assumptions/questions about the problem context; this is necessary to determine the extent of the problem to be resolved, as well as the kind of change required to constitute improvement. So, in this regard, an emancipatory approach such as the CSH strand of CST can emancipate users by promoting reflective practice to determine *what* needs to be done, *who* should be involved in determining it, and *how* to handle conflicts. This is illustrated in Figure 6-3 below.

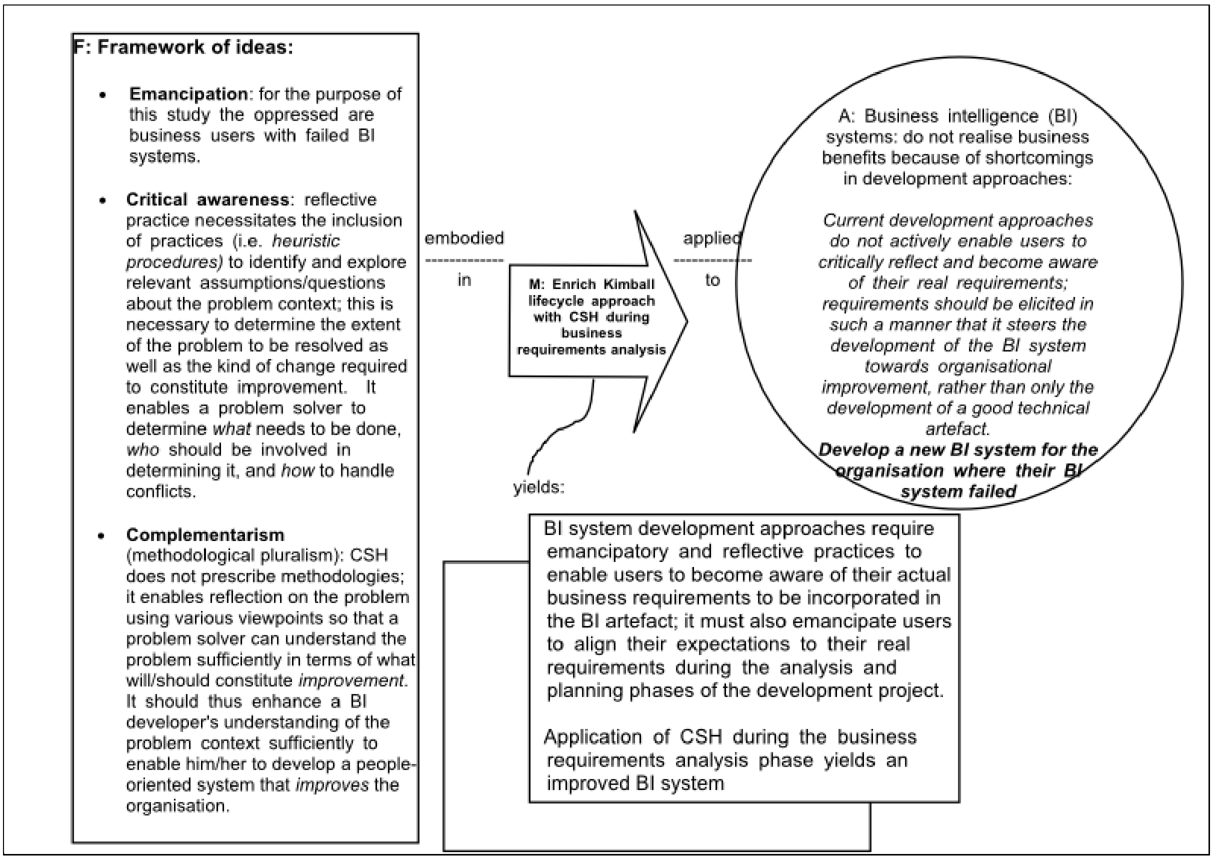

Figure 6-3: FMA illustration for CSH in BI system development

6.3.4 Methodologies to be applied to improve the area of concern

The Kimball lifecycle approach – refer to Chapter 3 for a discussion – is a robust development approach to develop appropriate DW infrastructure. However, appropriate business requirements analysis is crucial to ensure that the developed BI system realises business benefits also. So, it is crucial to ensure that associated business users reflect on their real requirements within their respective organisational contexts, and that business processes are suitably defined to enable creation of the applicable intelligible information. The researcher therefore suggests that the following methodologies (M) be applied in this study: enrich the Kimball lifecycle approach with critical systems methodologies during the business requirements analysis phase as is illustrated in Figure 6-4 below. The next sections discuss the proposed application of the Kimball lifecycle approach in this study.

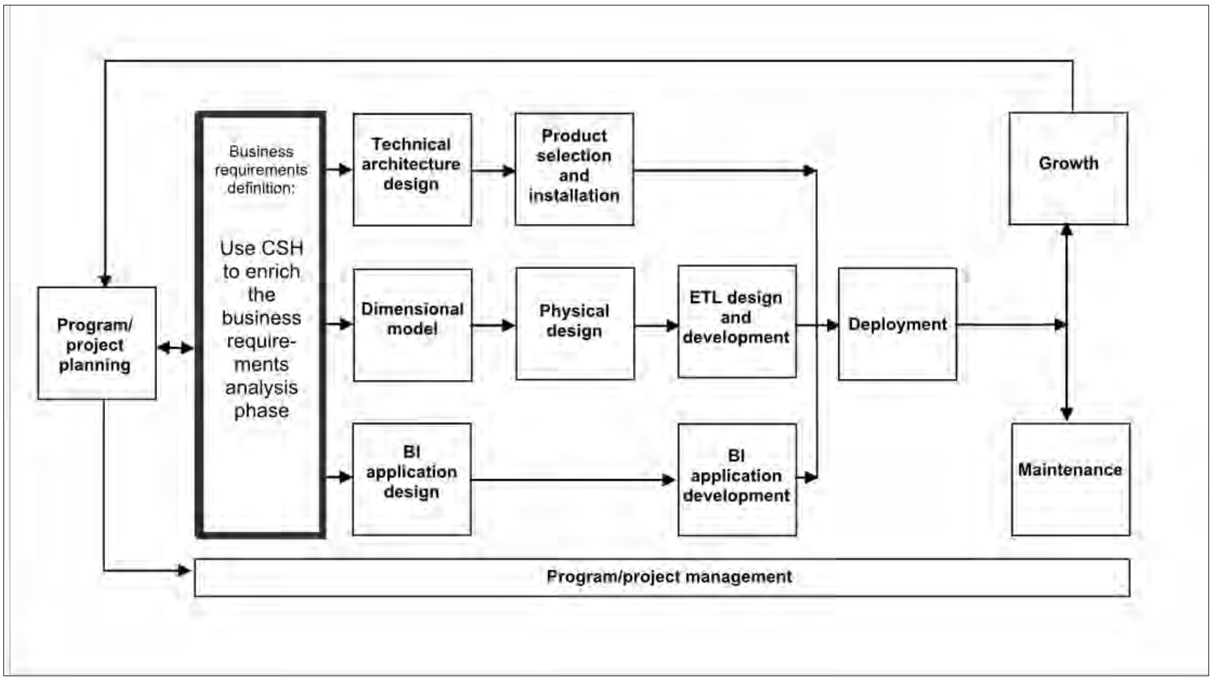

Figure 6-4: Enrich the Kimball lifecycle approach with critical systems methodologies

6.3.4.1 Program/project planning

The program/project planning phase of the Kimball lifecycle approach focuses on launching the project and includes for example scoping and justification of the project, as well staffing the project (Kimball & Ross, 2010:98). Kimball (2008:16) emphasise the importance of "[s]trong support and sponsorship from senior business management" as a critical factor in assessing BI readiness. Refer to Kimball (2008:32) for a detailed discussion on project staffing. However, in addition to a strong business sponsor, the project team should (amongst others) also include a business analyst that can appropriately elicit business requirements. When applying a critical systems methodology such as TSI or CSH, the business analyst should have a thorough understanding of systems concepts as applied by critical systems scholars. The business analyst should assume the role of the facilitator in the critical systems methodologies. The business sponsor should also be supportive of the application of critical systems ideas in the BI project.

6.3.4.2 Business requirements definition

Both strands of CST can enrich the business requirements definition portion of the Kimball lifecycle approach – refer to Sections 6.3.2 and 6.3.3 above. The business analyst should facilitate the elicitation of business requirements as per the chosen critical systems methodology. The business analyst should introduce the principles of the chosen methodology to the team members. Business requirements can then be gathered in dedicated focus group sessions guided by the critical systems methodology process. Team members should be able to clarify their understanding of the applied critical systems methodology; the business analyst should therefore facilitate these work sessions. Gathered business requirements should be verified in terms of the application of the chosen systems methodology, as well as technical and functional feasibility. The business analyst should ensure that business requirements are representative of the needs of all the stakeholders of the BI system. Details of the requirements gathering process guided by TSI is provided in Section 6.4; details of requirements gathering guided by CSH is provided in Section 6.5.

6.3.4.3 Design a system: technology, data, and business intelligence track

Business requirements impact on all aspects a BI project (Kimball, 2008:64). The Kimball lifecycle approach differentiates between three tracks that are developed simultaneously, i.e. the technology track; the data track; and the business intelligence (BI) track. Kimball & Ross (2010:98) explain the tracks as follows: The technology track involves the integration of technologies, data stores, and metadata; it involves the system architecture design, as well as the selection of installation of required products. The data track entails the design of data elements according to business requirements, such as the dimensional data model, the DW bus matrix, and the extract, transform, and load (ETL) system. The business analyst should verify these models prior to implementation. The BI track is concerned with identifying and constructing BI applications such as dashboards and scorecards.

6.3.4.4 Deployment, maintenance and growth

The three tracks of the Kimball lifecycle approach converge at deployment. After deployment the BI system is being maintained. It may grow into a bigger BI system; the Kimball lifecycle then re-iterates (Kimball & Ross, 2010:99). The business analyst, together with the business sponsor, should verify that the completed system adheres to the requirements as was gathered during the business requirements analysis phase. From a critical systems approach, users should be appropriately educated to use the new system. Users should also be given a platform so that they can provide feedback on the system – this is to ensure proper use as well continuous improvement of the system. This is similar to the strategy proposed by Kimball (2008:560).

6.4 Guidelines for the use of TSI in BI system development

TSI embraces pluralism to emancipate the oppressed and allows problem solvers to address different phases of an intervention with appropriate problem solving methodologies from the hard and/or soft paradigm (Mingers & White, 2010:1152). The application of TSI can thus guide the business requirements analysis phase by suggesting appropriate methodologies to apply to identify appropriate methodologies to analyse the business requirements within the relevant organisational context. Once business requirements are understood, the development work can continue as prescribed by the Kimball lifecycle approach. Here, the researcher therefore suggests the following methodologies (M) be applied: enrich the Kimball lifecycle approach with TSI. This is illustrated in Figure 6-5 below and discussed in Section 6.4.

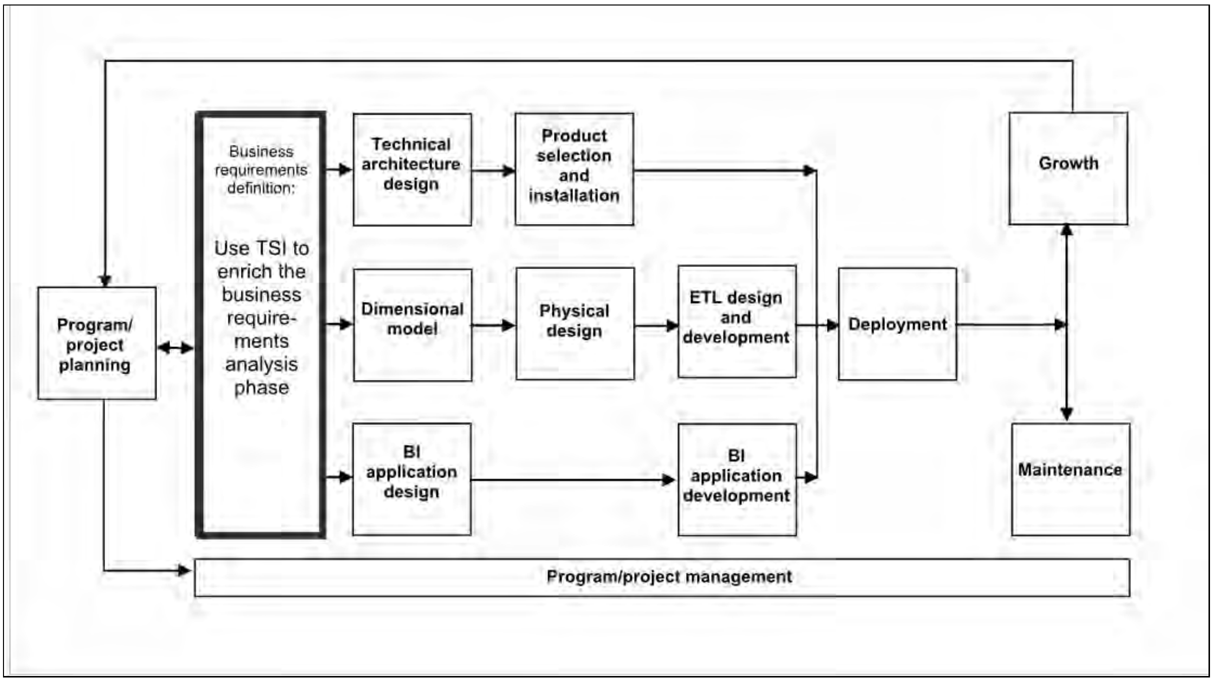

Figure 6-5: Enrich the Kimball lifecycle approach with TSI

The TSI meta-methodology, which encapsulates CST, supports methodological pluralism (Jackson, 2001:236). TSI informs appropriate use of hard systems approaches for technically-oriented problem contexts; softer methodologies to support practical interests; and critical methodologies to serve emancipatory interests (Flood & Jackson, 1991b:200). The researcher proposes that the different phases of BI system development require different problem solving methodologies. To achieve pluralism, the organisational context (of the organisation where the BI system is to be implemented) should be explored appropriately to reveal the cultural foundation of the organisation, e.g. whether it is a bureaucratically oriented organisation, or an organisation driven by organisational conflict and power.

The TSI metaphorical analysis during the business requirements analysis phase should guide the business requirements analysis process of the BI system development project. Business requirements can then be gathered in such a manner that it also captures the relevant human, social and organisational dimensions; the technical artefact can then also be developed using the appropriate (technically-oriented) approach. The researcher therefore proposes that the TSI meta-methodology be applied during the business requirements analysis phase to determine applicable problem solving methodology to analyse and understand the organisational context of the artefact to be developed, in order to appropriately collect suitable business requirements from users.

For example, an organisation that fits the simple-unitary or complex-unitary quadrant in the system of systems methodology (SOSM) framework (refer to Figure 6-6 below) requires a different approach to effectively analyse business requirements, than environments in the pluralist/coercive quadrants (Flood & Jackson, 1991a:35). Refer to Chapter 4 for a detailed discussion on the SOSM.

	Unitary	**Pluralist**	**Coercive**
Simple	simple-unitary	simple-pluralist	simple-coercive
Complex	complex-unitary	complex-pluralist	complex-coercive

Figure 6-6: Grouping types of the SOSM (Flood & Jackson, 1991a:35)

An environment with less complex social relationships can be appropriately addressed with problem solving methodologies from the hard systems thinking paradigm; however an environment with more complex social dimensions require more exploratory/emancipatory approaches. The allocation of methodologies by Flood & Jackson (1991a:42) is illustrated in Table 6-1 below.

Table 6-1: "System of Systems Methodology" (Flood & Jackson, 1991a:42)

	Unitary relationship	Pluralist relationship	Coercive relationship
Simple system	Operational research Systems analysis System engineering System dynamics	Social systems design Strategic assumptions surfacing and testing	Critical systems heuristics
Complex system	Viable system diagnosis General systems theory Socio-technical systems thinking Contingency theory	Interactive planning Soft systems methodology	?

Once users' business requirements are clearly understood, the developer can continue with development work according to an applicable development approach – for this research project the Kimball lifecycle is to be applied. The sections below propose guidelines for the use of TSI to understand the organisational context so that the development of BI systems can be improved.

6.4.1 Analyse the organisational context using metaphors

Firstly, analyse the organisational context where the BI system is to be implemented using the reconstituted account of TSI as written up by Flood (1995b; 1995a) and the list of questions suggested by Torlak (2001:459) to simplify the use of metaphors – this is discussed in detail in Chapter 4 of this study. The business analyst should provide team members with worksheets that detail the metaphors and request them to (individually) comment on the relevance of the different metaphors. Their feedback can then be used to identify the most pertinent metaphor(s). So, metaphorically analyse the organisational context by relating it to the metaphors as portrayed in Table 6-2 below. The outcome of the metaphorical analysis determines whether the organisational context reflects mostly technical issues (relating to the machine, organic or neuro-cybernetic metaphor) or social issues (relating to the socio-cultural or socio-political metaphor). The relevant organisational context also reflects where the specific organisation needs to improve.

Table 6-2: The TSI metaphors

Metaphor	**Characteristics (Flood, 1995a:181)**	**Questions (Torlak, 2001:459):**
Machine	Standardised parts; routine and repetitive operations; predetermined activities, goals, and objectives; efficiency; rational approach; internal control; and a closed system view.	Is this a well-designed machine, i.e. founded in bureaucracy, design of the total organisation, design of individual jobs and management by objectives?
Organic	Some needs to be satisfied; survival; open system; adaptation; organisation; feedback; self-regulation; open system view; and passive control.	Is this a well-designed organism, i.e. founded in organisational needs, organisation-environment relations, species of organisations, population-ecology view of organisation and organisational ecology?
Neuro-cybernetic	Similar to organic but also includes learning and control; information prime; law of requisite variety; viable system; learning to learn; and getting the whole into the parts.	Is this a well-designed brain i.e. founded in information-processing capability, learning, organisational holographic character and a "whole in parts" principle?
Socio-cultural	Collaboration; shared characteristics in terms of language, history, dress etc.; shared reality in terms of values, beliefs, norms; social practices; and a culture (emphases norms, values) or team (unitary political system).	Does this give appropriate attention to cultural issues i.e. founded in culture as an environmental variable, corporate culture and subcultures and organisational reality?

Metaphor	Characteristics (Flood, 1995a:181)	Questions (Torlak, 2001:459):
Socio-political	Coercive conflict; domination; whose interest are served; power central issue; people politically motivated; power a consequence of structure; disintegration; a coalition (pluralist political) or prison (coercive political).	Does the organisation give consideration to the political system i.e. founded in organisational interests, organisational conflict and power?

6.4.2 Relate the identified metaphors to problem solving methodologies

Secondly, relate the identified metaphor(s) to the appropriate problem solving methodology/(ies) as proposed by (Flood & Jackson, 1991a:53) and described in Table 6-3 below. The outcome of this action is a chosen problem solving methodology to include in the development process, prior to the commencement of the actual development work, to emancipate users to explore their real business requirements.

Table 6-3: Methodologies and metaphors (Flood, 1995a:53)

Problem solving methodology	Metaphor(s)
System dynamics	Machine
Viable system diagnosis	Organic and neuro-cybernetic
Strategic assumption surfacing and testing	Machine and socio-cultural
Interactive planning	Neuro-cybernetic and socio-cultural
Soft systems methodology	Organic and socio-cultural
Critical systems heuristics	Machine, organic and socio-political

6.4.3 Apply complementary methodologies in BI system development

Thirdly, apply the identified methodology/(ies) to understand and define the BI system's user and business requirements, i.e. *what* must be implemented in the organisation to *improve* the organisation. For example, when following the Kimball lifecycle approach (Kimball & Ross, 2010:97), use the metaphorical analyses during the business requirements analysis phase and apply the identified methodology/(ies) during the business requirements definition phase (according to Table 6-3 above) to understand and define the BI system's business requirements in this manner.

The TSI meta-methodology aims to provide a framework whereby problem solvers can choose appropriate methodologies. For example: TSI makes provision for the acknowledgement of different viewpoints when an organisation consists of complex systems and portrays pluralist relationship characteristics; it then prescribes the use of methodologies from the soft systems thinking paradigm, i.e. Peter Checkland's soft systems methodology (SSM) or Russel Ackoff's interactive planning (IP) (Flood & Jackson, 1991a:42). TSI also prescribes the use of reflective discursive practice (i.e. CSH) when an organisation consists of complex systems and portrays coercive relationship characteristics, i.e. when it is founded in organisational conflict and power (Flood & Jackson, 1991a:42). The researcher thus proposes the use of TSI to improve the planning as well as the people-orientation dimension of the development of BI systems; i.e., TSI may resolve the shortcoming regarding the lack of sufficient people-orientation when following a sequential development approach.

The researcher proposes that TSI be applied during the business requirements analysis phase of the BI system development project to determine which methodology/(ies) should be applied to understand the organisational context and cultural environment where the BI system will be implemented. She then suggests that the metaphorical analysis of an organisational context guides the choice of methodology/(ies) to analyse and understand the approach required to plan for the collection of a BI system's business requirements as follows: The researcher proposes that an organisation that relates to a machine metaphor can be analysed with *system dynamics*. The organic and neuro-cybernetic organisation can be analysed with viable system diagnosis. The organisation that relates to machine and socio-cultural metaphors can be analysed using *strategic assumption surfacing and testing*. An organisational context that relates to neuro-cybernetic and socio-cultural metaphors can be analysed using *interactive planning.* Where the organisational culture relate to the organic and socio-cultural metaphors it can be analysed using *soft systems methodology*. The machine, organic and socio-political oriented organisation can be analysed using *critical systems heuristics*. Gathered business requirements should be verified for technical as well as functional validity and feasibility. The process followed to gather business requirements should also be reflected upon to understand the contribution of using TSI as a critical systems methodology. Once business requirements are understood, the developer can continue with technical development work using an appropriate (technical) development approach (in this case the Kimball lifecycle approach).

6.5 Guidelines for the use of CSH in BI system development

Critical systems heuristics is a reflective practice that assists identification and exploration of relevant assumptions/questions about the problem context; it can aid to determine the extent of the problem to be resolved, i.e. the kind of change required by the BI system that should constitute improvement in the organisational context. Once the required improvement and change effort is understood, it can be used to guide the development of appropriate business requirements. Thereafter, the development work can continue as prescribed by the Kimball lifecycle approach. Here, the researcher therefore suggests the following methodologies (M) be applied: enrich the Kimball lifecycle approach with CSH. This is illustrated in Figure 6-7 below and discussed in Section 6.5.

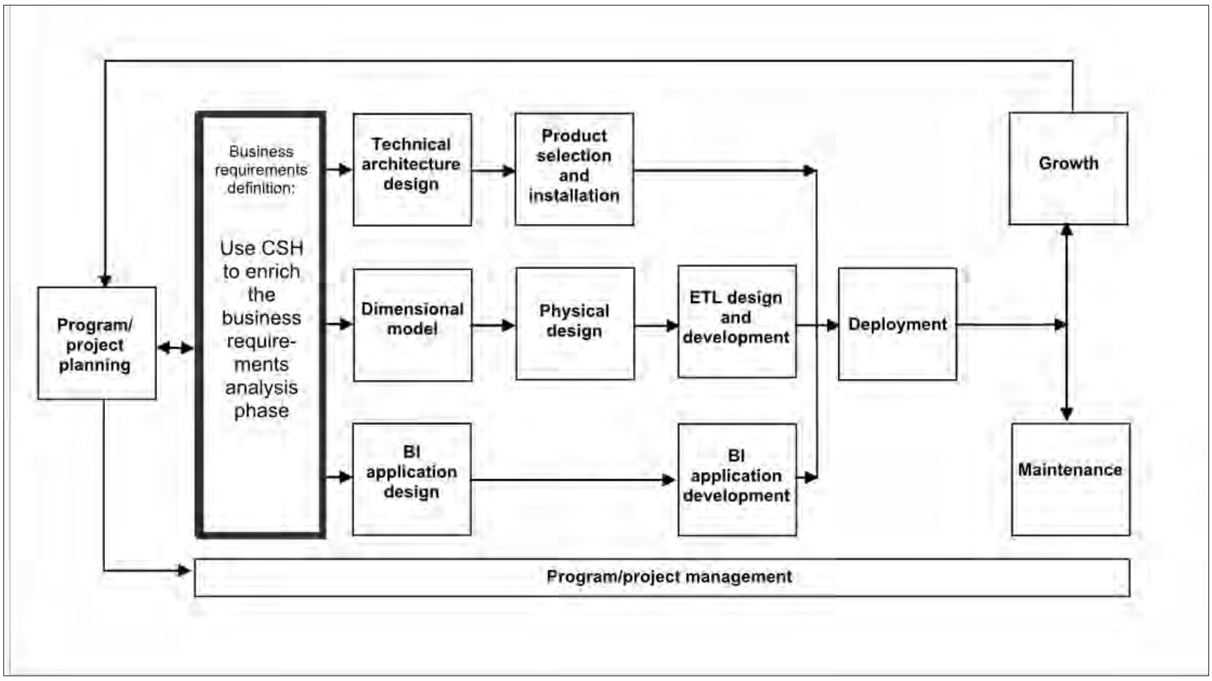

Figure 6-7: Enrich the Kimball lifecycle approach with CSH

Critical systems heuristics is contained in TSI as a problem solving methodology. However, Ulrich (2003:327) argues that CSH is a conceptual framework for reflective practice and critical awareness. Ulrich (2003:327) says that the application of CSH should *always* precede methodology choice. He asserts that *CSH should not only be applied in coercive contexts; unitary and pluralist environments also require critical handling of boundary judgements* (Ulrich, 1983:258). His argument in this regard is rather ambiguous since he argues that CSH enables a problem solver to critically determine *what* is relevant, *who* should assist to determine it, and *how* to handle *conflicting* views amongst relevant stakeholders (Ulrich, 1983:258). However, environments that contain *unitary* relationships share common interests; participate in decision making; agree on objectives; and share values (Flood & Jackson, 1991a:33). Also, environments that contain *pluralist* relationships share interests; participate in decision making; agree on objectives; they have divergent values; yet, they compromise and are not coerced to accept decisions (Flood & Jackson, 1991a:33). Thus, it seems unnecessary to determine what is relevant, who should assist to determine it, and how to handle conflicting views amongst relevant stakeholders if the involved and affected stakeholders in a pluralistic environment.

Still, the methodological core principle of CSH is boundary critique; it provides a systematic effort to critically deal with *boundary judgements* (Ulrich, 1983:258). CSH is discussed in detail in Chapter 4 of this study. The researcher identified that current BI development approaches do not actively enable users to critically reflect and become aware of their requirements in terms of required *improvement*. The fact that the users of a BI system are potentially unaware of their *real* requirements, i.e. the requirements that will constitute *improvement* in the organisation, is thus a contradiction in itself that justifies being explored. In this study the researcher thus also presents the application of CSH as an emancipatory, reflective practice to enable users to reflect upon their *real* requirements to ultimately enable the development of BI systems *that leads to improved organisations*. CSH is to be applied during the business requirements analysis phase of a traditional development approach (in this case the Kimball lifecycle approach).

Since current BI development approaches do not necessarily actively enable users to critically reflect and become aware of their requirements in terms of required *improvement*, and users of a BI system are thus potentially unaware of their *real* requirements, the researcher proposes that the application of CSH during the business requirements analysis phase of a BI system development project can add value; it should enable users to surface requirements that constitute improvement.

6.5.1 Reflect on the required improvement for the organisation

The researcher suggest in this instance that the business analyst do the following: Apply the twelve CSH boundary questions (Ulrich, 1983:342) to reflect on the required *improvement* that should be established by the BI system to be developed – the questions are summarised in Section 6.5.2 below. The business analyst should work with project team members (in focus groups) to apply the twelve boundary questions. These questions should be asked in the "is" mode to determine the actual situation in the organisation (prior to improvement); they should also be asked in the "ought to" mode to determine the ideal situation in the organisation (how it should look once improved by the BI system). These questions are obtained from Ulrich (2005); the researcher added the reference to a BI system to the questions.

The gap between the “is” and the “ought to” situation constitutes the *improvement* required in the organisation.

6.5.2 Define the BI system’s boundary judgements

Firstly, ask the following questions in the “is” and “ought to” mode to determine the sources of motivation:

1. Who is (ought to be) the client/beneficiary of the BI system?
2. What is (ought to be) the purpose of the BI system?
3. What is (ought to be) the measure of improvement/success?

Secondly, ask the following questions in the “is” and “ought to” mode to determine the sources of power:

4. Who is (ought to be) the decision maker regarding the measure of improvement/success of the BI system?
5. What resources and conditions of success is (ought to be) controlled by the decision maker?
6. What success conditions are (ought to be) part of the decision maker and not under the control of the decision maker?

Thirdly, ask the following questions in the “is” and “ought to” mode to determine the sources of knowledge:

7. Who is (ought to be) considered a professional/expert regarding the BI system?
8. What kind of expertise is (ought to be) consulted regarding the BI system?
9. What/who is (ought to be) guarantor of success of the BI system?

Lastly, ask the following questions in the “is” and “ought to” mode to determine the sources of legitimation:

10. Who is (ought to be) witness to the interests of those affected yet not involved?
11. What secures (ought to secure) emancipation of those affected from the promises of those involved?
12. What worldview is (ought to be) determining?

The outcome of this intervention defines the boundary judgements of the problem (the real business requirements of the BI system to be developed) in terms of: the relevant aspects; stakeholders that should be involved in determining relevant aspects; and how to handle conflicting views amongst stakeholders by determining where relevant motivation, power, knowledge, and legitimacy lies. During this process additional stakeholders may be identified and interviewed; this may result in additional business requirements from affected stakeholders. The new requirements should then be communicated to the project team; this may result in an updated business requirements specification. Once business requirements are understood, the developer can continue with technical development work using an appropriate (technical) development approach. For this study the researcher suggests that the Kimball lifecycle approach by applied.

6.6 Summary

This chapter proposes guidelines for the use of critical systems methodologies to improve the development of BI systems. To plan the actions for this study, the researcher applies philosophical concepts from the CST paradigm. She argues that current development approaches must embrace emancipatory principles such as methodological pluralism and critical awareness. Therefore, an *emancipatory BI development approach* must embrace methodological pluralism; it must enable a developer to use different methodologies at different stages of the development project. Methodological complementarism is proposed to be guided by the TSI strand of CST. The researcher also argues that an *emancipatory BI development approach* must enable critical awareness and reflective practice. It must emancipate a user to discover his/her BI requirements in such a manner that it constitutes *improvement.* Critical awareness is proposed to be guided by CSH. To achieve this, the following action plans are proposed: apply TSI during the business requirements analysis phase of the Kimball lifecycle approach; and apply CSH during the business requirements analysis phase.

Applications of these guidelines are discussed in the next chapters.

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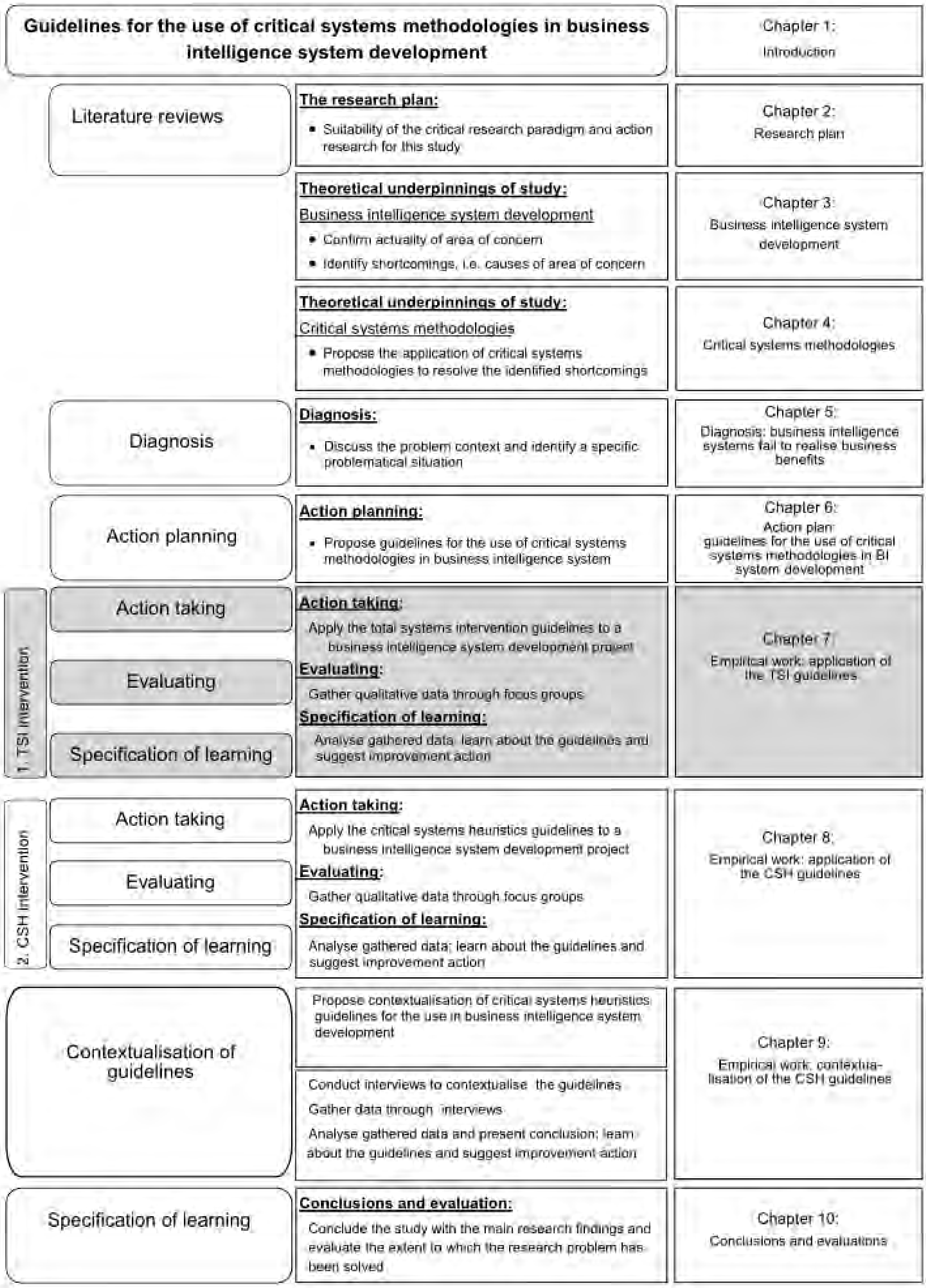
Guidelines for the use of critical systems methodologies in business intelligence system development
Chapter 1: Introduction
Literature reviews
The research plan:
Suitability of the critical research paradigm and action research for this study
Chapter 2: Research plan
Theoretical underpinnings of study:
Business intelligence system development
Confirm actuality of area of concern
Identify shortcomings, i.e. causes of area of concern
Chapter 3: Business intelligence system development
Theoretical underpinnings of study:
Critical systems methodologies
Propose the application of critical systems methodologies to resolve the identified shortcomings
Chapter 4: Critical systems methodologies
Diagnosis
Diagnosis:
Discuss the problem context and identify a specific problematical situation
Chapter 5: Diagnosis: business intelligence systems fail to realise business benefits
Action planning
Action planning:
Propose guidelines for the use of critical systems methodologies in business intelligence system
Chapter 6: Action plan: guidelines for the use of critical systems methodologies in BI system development
1. TSI intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the total systems intervention guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data: learn about the guidelines and suggest improvement action
Chapter 7: Empirical work: application of the TSI guidelines
2. CSH intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the critical systems heuristics guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data; learn about the guidelines and suggest improvement action
Chapter 8: Empirical work: application of the CSH guidelines
Contextualisation of guidelines
Propose contextualisation of critical systems heuristics guidelines for the use in business intelligence system development
Conduct interviews to contextualise the guidelines
Gather data through interviews
Analyse gathered data and present conclusion; learn about the guidelines and suggest improvement action
Chapter 9: Empirical work: contextualisation of the CSH guidelines
Specification of learning
Conclusions and evaluation:
Conclude the study with the main research findings and evaluate the extent to which the research problem has been solved
Chapter 10: Conclusions and evaluations

Chapter 7 : Results from empirical work: application of the total systems intervention guidelines to a business intelligence development project

7.1 Introduction

The objective of this study is to develop guidelines for the use of critical systems methodologies to improve the development of business intelligence systems. In the action planning phase of this study the researcher proposed guidelines for the use two critical systems methodologies in business intelligence system development, i.e. total systems intervention and critical systems heuristics – refer to Chapter 6 for the detail. This chapter discusses the action taking, evaluation, and specification of learning phases of the TSI intervention, i.e. the application of the total systems intervention guidelines. Due to an organisation-wide restructuring process (that was unrelated to the study, yet impacted on the participants that were employees in the organisation) at the time of the research these guidelines could unfortunately not be applied successfully.

This chapter is structured as follows: The action taking phase is structured according to the Kimball lifecycle approach. Participants are discussed in the program/project planning phase – refer to Section 7.2. Data are collected, presented, and analysed during the business requirements definition phase – refer to Section 7.3. This intervention did not result in a system being developed – refer to Section 7.4; therefore, the technical design activities are not discussed in detail in this chapter. The success of the intervention is evaluated in Section 7.5. Section 7.6 discusses the specification of learning in terms of the practical area of concern. Section 7.7 discusses the specification of learning in terms of the methodology. Section 7.8 discusses the learning in terms of the framework of ideas.

7.2 Program/project planning

During program/project planning of the Kimball lifecycle approach a project is launched; this includes activities such as scoping, justification, and staffing (Kimball

& Ross, 2010:98). A project team was already appointed by the organisation to work on this project. The researcher entered the problem context as an employee of the organisation where the research was conducted; she was a business analyst for this intervention. Roles for this intervention were already established as the project team was appointed by senior management. The researcher negotiated with the business sponsor of the project to apply TSI during the business requirements analysis phase. She obtained permission from the organisation to do the research in the organisation (refer to Appendix A of this report) and apply the action plan; the action plan is discussed in Chapter 6 of this report. The project team members therefore became the participants in this research. The participants are discussed in the next section.

7.2.1 Participants

Four employees were appointed to this project; a small focus group was formed to gather data for this study. The focus group included the researcher of this study (as the business analyst), two senior managers from the project management office (PMO) group, and a user of the historical system. The researcher, as the business analyst, facilitated the process of data collection. Data were thus collected from three participants, i.e. the two senior managers and the user.

The PMO group was the custodian and governor of the business process and decision support software; they were tasked to improve the process and/or software and assured the investment managers that their decisions were appropriately informed. Identified senior managers from the PMO thus participated in the study in the following roles: participant P1: Executive Manager PMO; and participant P2: Senior Manager PMO Process & Application. A user of the historical software system also participated in the study in the following role: participant P3: user of the system. Participant P2 was also the executive sponsor of this project whilst participant P1 was the executive manager accountable to ensure that investment managers receive relevant decision support information. P1 and P2 extensively applied information received from the problematic BI system (refer to Chapter 5 for a detailed discussion on the old system) to inform their decisions; they participated in making investment decisions on behalf of the organisation. They respectively had 20 years (P1) and 16 years (P2) working experience in the organisation. P3 used the system to capture process data, and had 9 years of relevant experience in the organisation. All three participants are MBA (Masters in Business Administration) graduates.

7.3 Business requirements definition

In the business requirements analysis phase the participants were requested to analyse the organisational context of the system using metaphors (as was proposed in the total systems intervention (TSI) guidelines in Chapter 6). The collection, presentation, and analysis of data are discussed in the next sections.

7.3.1 Analyse the organisational context using metaphors: data collection

Data were gathered by asking the participants to reflect on the TSI metaphors – refer also to Chapter 6. All the participants were assured that their inputs would be treated as confidential – refer to Appendix A for the confidentiality agreement where the researcher undertook that participants will remain confidential and that participants may choose not to participate in the study.

The organisation where the research was conducted was in an extreme state of flux at the time; the organisation underwent a major workforce transformation (the biggest in its 63 years' history) and as a result employees were frustrated and even anxious with low morale. Therefore, the business sponsor (participant P2) was of the opinion that it would be counter-productive to directly confront employees with the metaphorical analysis and a questionnaire as was proposed by Torlak (2001:459) in his analysis of the characteristics of the metaphors that Flood (1995a:181) suggested can be useful to analyse organisational contexts – refer to Table 4-6 of Chapter 4 for more detail. P2 felt that the impact of the workforce transformation on the employees and the uncertainties that surrounded it might skew the results obtained from such an exercise and that employees may become even more anxious. Still, the value of using metaphors to gain insight into the problem context was appreciated by P2 and therefore the participants agreed to form a small focus group and work with the researcher to gain a better understanding of the organisational context using systems metaphors. Consequently, a three-hour long workshop was conducted; the researcher explained the use of the TSI guidelines (as proposed in Chapter 6) to the participants.

A similar approach to that of Flood & Jackson (1991a:56) was followed where they discuss a case study in their book “Creative Problem Solving: Total Systems Intervention”; they say that they followed “a direct yet *invisible* way” where “the ideas underpinning the metaphors rather than the metaphors themselves” were applied. Hence, rather than directly questioning a large number of employees regarding which metaphors they considered to define the organisation, certain features of the organisation were identified. The ideas that Flood & Jackson (1991a:56) suggest of “likeness” as well as “a dialectical approach: asking when particular metaphors break down in practice and comparing and contrasting the different visions provided by alternative metaphors” were thus applied.

Participants P1, P2, and P3 were thus presented with the TSI metaphors – refer to Figure 7-1 below for an example of the worksheet given to the participants; the researcher (in the role of business analyst) facilitated the process.

Metaphor	Characteristics	Questions	Comments
Machine	Standardised parts; routine and repetitive operations; predetermined activities, goals, and objectives; efficiency; rational approach; internal control; and a closed system view.	Is this a well-designed machine, i.e. founded in bureaucracy, design of the total organisation, design of individual jobs and management by objectives?	
Organic	Some needs to be satisfied; survival; open system; adaptation; organisation; feedback; self-regulation; open system view; and passive control.	Is this a well-designed organism, i.e. founded in organisational needs, organisation-environment relations, species of organisations, population-ecology view of organisation and organisational ecology?	
Neuro-cybernetic	Similar to organic but also includes learning and control; information prime; law of requisite variety; viable system; learning to learn; and getting the whole into the parts.	Is this a well-designed brain i.e. founded in information-processing capability, learning, organisational holographic character and a "whole in parts" principle?	
Socio-cultural	Collaboration; shared characteristics in terms of language, history, dress etc.; shared reality in terms of values, beliefs, norms; social practices; and a culture (emphases norms, values) or team (unitary political system).	Does this give appropriate attention to cultural issues i.e. founded in culture as an environmental variable, corporate culture and subcultures and organisational reality?	
Socio-political	Coercive conflict; domination; whose interest are served; power central issue; people are politically motivated; power as a consequence of structure; disintegration; and a coalition (pluralist political) or prison (coercive political).	Does the organisation give consideration to the political system i.e. founded in organisational interests, organisational conflict and power?	

Figure 7-1: Worksheet given to participants

7.3.1.1 Analyse the organisational context using metaphors: data presentation

The participants were requested to write their comments on the applicability of the metaphors in the worksheet in relation to the organisation. The participants were (as MBA graduates) familiar with metaphorical analogies in business; they were thus able to continue with the analysis as requested. They completed the worksheets individually and without discussing their answers with each other. Their written feedbacks are captured in on a separate compact disc (CD); Table 7-1 below summarises the feedback from the participants.

Table 7-1: Participant's views on the metaphors

Metaphor	Participant 1 (P1)	Participant 2 (P2)	Participant 3 (P3)
Machine	"Organisation founded in bureaucracy."	"Individual business units are unintegrated. They work in silos."	"I believe it's not well designed – a lot of disassociated parts exists that serves isolated objectives – believe it's a symptom of visionary leadership lack."
Organic	"No."	"Current focus on individual survival rather than company survival. Not self-regulating."	"No it's not – it's not self-regulating and correcting. It seems to constantly repeat the same mistakes and still believe it is unique."
Neuro-cybernetic	"No."	"Not applicable to this organisation."	"As said under organic – we do not seem to learn as we go along. Also not synchronised to serve the corporate objective."
Socio-	"Organisation is moving	"WFT[1] move towards	"It addresses socio and

cultural	towards this. End-goal of WFT[1] is shared reality."	collaboration, teamwork, organisational integration. Embedding a one-bottom-line."	cultural issue on the surface forcefully. Underneath it still pursues its own objectives."
Socio-political	"Workforce transformation causes uncertainty and result in demonstration of these. Employees are in a "survival mode" at present."	"Present in the org: Coercive conflict; Domination; Power struggles; Power issues; Employees are uncertain. Probably because of WFT[1]?"	" es it does but only because its external frame of reference forces it to. Not convinced that it does so fairly and transparently."

7.3.1.2 Analyse the organisational context using metaphors: insight gained from the data

The organisation was found to have elements of a machine, i.e. participant P1 said that it was "founded in bureaucracy"; participant P2 referred to the: "Individual business units [that] are unintegrated" and "work in silos"; and participant P3 said that the organisation is "not well designed – a lot of disassociated parts exists that serves isolated objectives".

The participants agreed that the organisation does reflect the characteristics of an organism (i.e. organic metaphor); they also agreed that the neuro-cybernetic metaphor does not define the organisation.

The participants saw characteristics of the socio-political metaphor in the organisation: for example, participant P1 asserted that: "Employees are in a "survival mode" at present"; and participant P2 said that the following are present in the organisation: "Coercive conflict; Domination; Power struggles". However, they stated the possibility that these may be a result of the workforce transformation project and

[1] WFT: Workforce transformation project

extreme uncertainties in the organisation; for example participant P1 said that the "Workforce transformation causes uncertainty and results in demonstration of these"; and participant P2 asserted that the coercive characteristics are: "Probably because of WFT[1]?". Thus, since the organisation was in a state of moving from an "as-is" to a "to-be" state via the workforce transformation project, which inevitably affected the organisational culture in the interim and will continue to affect it for the near future, the researcher found it necessary to reflect on both the "as-is" and the "to-be" situation in order to accurately capture the organisational context. It was recognised that both scenarios would inevitably impact on the design of the improved BI system; however, it became clear to the participants that the BI system ought to be designed for the "to-be" state rather than the "as-is" state.

The participants agreed that the organisation was moving towards a socio-cultural environment. According to participant P1 the "Organisation is moving towards this" whilst participant P2 said that the: "WFT[1] move towards collaboration, teamwork, organisational integration" and that it is: "Embedding a one-bottom-line". Participant P3 asserted that the organisation "addresses socio and cultural issues"; however, he stated that it occurred: "forcefully" and only "on the surface".

7.3.1.3 Relate the identified metaphors to problem solving methodologies

An analysis of the organisational context using the grouping system proposed by Flood & Jackson (1991a:31) was difficult considering that the analysis process described by them focuses mostly on the "as-is" scenario in the organisation. The researcher attempted to adjust the process and requested the participants to consider and incorporate the "to-be" scenario; however, this proved to be difficult since the "to-be" scenario is not yet well-defined. The participants then applied the methodologies and metaphors schema proposed by Flood & Jackson (1991a:53) in the later reconstitution of TSI – refer also to Table 7-2 below.

Table 7-2: Methodologies and metaphors

Problem solving methodology	Metaphor(s)
System dynamics	Machine
Viable system diagnosis	Organic and neuro-cybernetic
Strategic assumption surfacing and testing	Machine and socio-cultural
Interactive planning	Neuro-cybernetic and socio-cultural
Soft systems methodology	Organic and socio-cultural
Critical systems heuristics	Machine, organic and socio-political

The to-be organisational context related mostly to the socio-culture metaphor; hence strategic assumption and surfacing testing (SAST), interactive planning (IP) and soft systems methodology (SSM) were positioned by TSI to be relevant problem solving methodologies. The possible applications of these methodologies are discussed next.

7.3.1.4 Apply complementary methodologies in BI system development

Strategic assumption and surfacing testing (SAST) is a methodology that "focuses managers' attention on the relationship between the participants involved in a problem context" rather than "on the supposed characteristics of the "system" that constitutes the problem context" (Flood and Jackson, 1991:119). This is not the purpose of a BI system and hence the application of SAST was not further explored in this study.

According to Flood & Jackson (1991a:153) IP is useful for planning since it is concerned with who is responsible for "what, when, where and how". Russel Ackoff (1979:189) says that he designed IP to enable people to plan and design in order to solve problems; IP aim to assist organisational teams to remove self-imposed and/or imaginary constraints that prevent them to achieve the desired future (Ackoff, 1981:25). The IP process and outcome is discussed in Chapter 4. The organisation was, at the time of the research, busy with an organisation-wide restructuring project. The restructuring process was independent from the BI system development project discussed in this study. Since Ackoff (2001a:15) argue that IP focuses mostly on moving from and "as-is" to a "to-be" organisational state (such as the restructuring project of the organisation) and facilitates a qualitative change in an organisation, which is not the purpose of a BI system (and hence the BI system development project of this research study), the application of IP was not further explored in this study.

Flood & Jackson (1991a:177) argue that SSM is concerned with the introduction of ordered systems thinking in messy, real-world problems. According to Peter Checkland (1985:575) SSM orchestrates the operation of appreciative systems in situations that are perceived to be problematical by exploring the perceived realities of participants and stakeholders. SSM is also presented by Avison & Fitzgerald (2006:507) as a requirements collection approach whilst Checkland & Holwell (1998:173-213) also applied it in the information systems field. The use of SSM during business requirements collection is discussed in Section 3.9.6 of Chapter 3 whilst the SSM process and outcome is discussed in Chapter 4. The SSM process was therefore presented to the management team to be utilised to understand the organisational context of the BI system; however they asserted that the processes seemed lengthy and complex. Hence, the participants were reluctant to commit themselves as well as the involved and affected employees to formal workshops where, in the words of participant P1, "employees are subjected to yet another new and unknown methodology". The application of SSM was therefore not explored further.

7.4 Design a system: technology, data and business intelligence track

This intervention did not result in the design and development of a BI system, as business requirements were still not appropriately defined after the application of the TSI guidelines. Consequently, the deployment-related step in the Kimball lifecycle approach could also not be applied, i.e. a system was not deployed. However, the organisation still required a new BI system to be developed. The researcher then discussed the second proposal for an action plan, i.e. to apply CSH in the business requirements analysis phase, with the sponsor (P2). The application of the CSH guidelines is discussed in Chapter 8 of this study.

7.5 Evaluation: reflection on the success of the intervention

As a result of the momentous transformation that the organisation was undergoing at the time that this research was conducted, TSI could unfortunately not be applied successfully. The application of the SOSM grouping in TSI also proved to be difficult as the participants were unsure of how the organisation will be after the restructuring process; they were therefore unsure which quadrant was most suitable. The organisational context was analysed using the metaphors. The participants were familiar with metaphorical analyses in organisational contexts – due to their MBA backgrounds. The identified metaphor could be related to problem solving methodologies (as per the later reconstitution of TSI where Flood & Jackson (1991a:53) proposed a methodologies and metaphors schema – refer also to Table 7-2). SSM was found to be a suitable methodology; however, the executive manager (P1) chose not to allow the application of SSM. P1 asserted that the SSM methodology seemed too complex and he wanted to avoid that “employees are subjected to yet another new and unknown methodology”.

7.6 Specification of learning: practical area of concern

The area of concern could not be successfully resolved through the application of this critical systems methodology. The extreme flux in the organisation (that resulted from the organisation-wide restructuring that the organisation underwent at the time of the research) hindered the metaphorical analysis of the organisational context according to the SOSM framework. The organisational context was not well enough defined in its ‘to-be’ state so that participants could fully appreciate how it will affect the BI system to be developed. The later constitution of TSI (Flood & Jackson, 1991a:53) proved valuable; however, the executive manager chose not approve the application of the identified methodology – refer also to the discussion in Section 7.5.

7.7 Specification of learning: reflect on the research cycle: methodology

Whilst reflecting upon the TSI methodology applied, the researcher learned that TSI's metaphorical analysis was negatively impacted by the extreme state of flux in the organisation; metaphorical analyses are thus not useful for organisations that are undergoing *extreme* changes. Also, the fact that the organisation was entering a new era where its entire operating model was being updated made it difficult to analyse the organisational context using the TSI grouping system; the "as-is" scenario was not relevant anymore whilst the "to-be" scenario was not yet fully defined and/or operational.

7.8 Specification of learning: reflect on the research cycle: framework of ideas

With regard to the philosophical foundation of TSI, Flood & Jackson (1991a:191) argue that TSI aim to facilitate social improvement through informed methodological choice and Jackson (2001:236) assert that TSI supports and informs methodological pluralism. However, the complementarist framework can only be fully appreciated when the TSI process can be followed and the metaphorical analysis can be completed. TSI, which is philosophically founded in intervention, complementarism and emancipation, can thus not successfully achieve its purpose in extremely unstable organisational contexts.

7.9 Summary

The researcher proposed the use of TSI to improve the development of BI systems. She suggests that the metaphorical analysis of an organisational context guides the choice of methodology/(ies) to analyse and understand a BI system's business requirements. However, the total systems intervention guidelines could not be applied successfully.

The next chapter discusses the application of the guidelines for the use of an alternative strand of CST, i.e. critical systems heuristics, to improve the development of BI systems.

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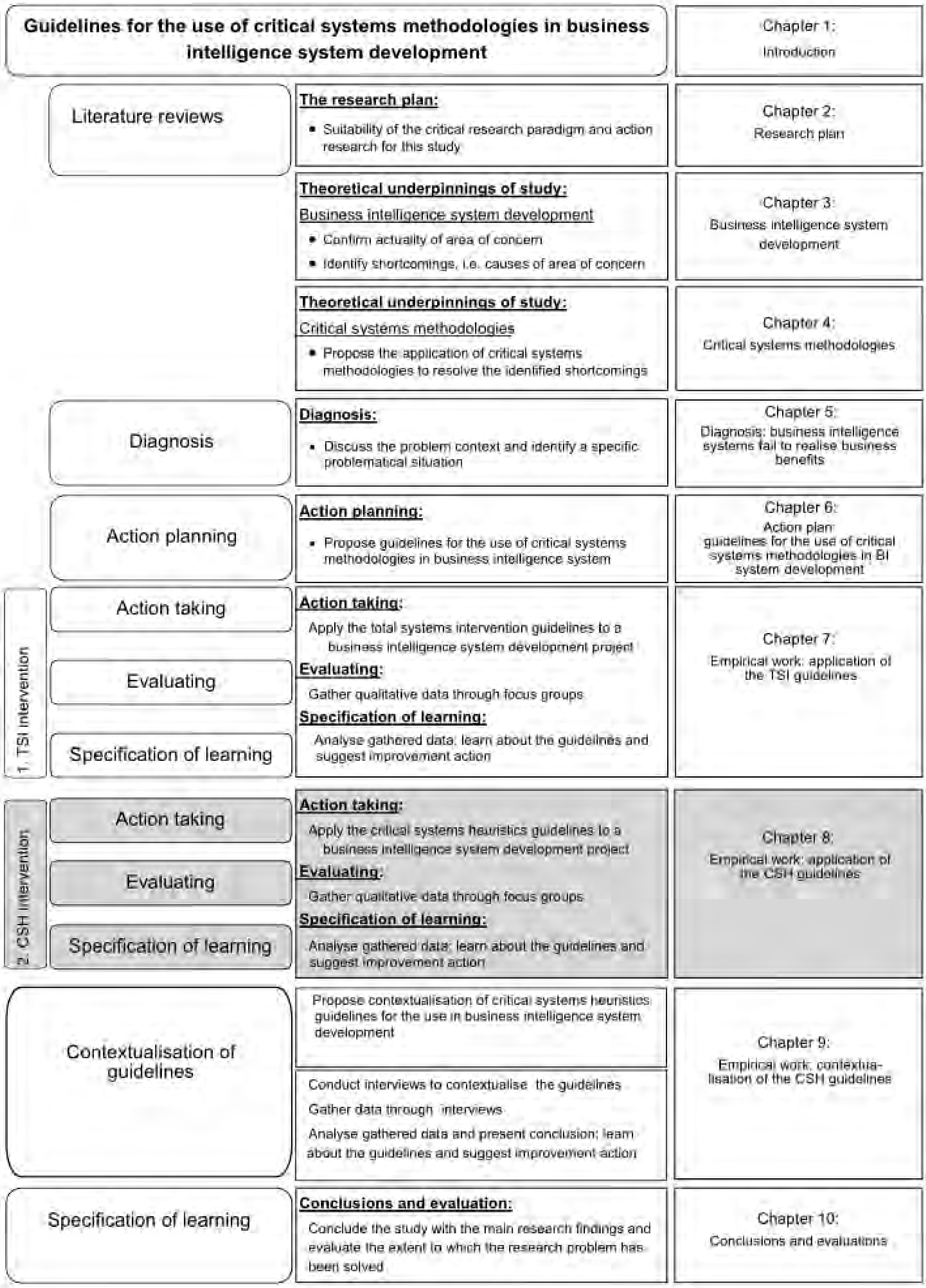

Guidelines for the use of critical systems methodologies in business intelligence system development
Chapter 1:
Introduction
Literature reviews
The research plan:
• Suitability of the critical research paradigm and action research for this study
Chapter 2:
Research plan
Theoretical underpinnings of study:
Business intelligence system development
• Confirm actuality of area of concern
• Identify shortcomings, i.e. causes of area of concern
Chapter 3:
Business intelligence system development
Theoretical underpinnings of study:
Critical systems methodologies
• Propose the application of critical systems methodologies to resolve the identified shortcomings
Chapter 4:
Critical systems methodologies
Diagnosis
Diagnosis:
• Discuss the problem context and identify a specific problematical situation
Chapter 5:
Diagnosis: business intelligence systems fail to realise business benefits
Action planning
Action planning:
• Propose guidelines for the use of critical systems methodologies in business intelligence system
Chapter 6:
Action plan:
guidelines for the use of critical systems methodologies in BI system development
1. TSI intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the total systems intervention guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data: learn about the guidelines and suggest improvement action
Chapter 7:
Empirical work: application of the TSI guidelines
2. CSH intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the critical systems heuristics guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data: learn about the guidelines and suggest improvement action
Chapter 8:
Empirical work: application of the CSH guidelines
Contextualisation of guidelines
Propose contextualisation of critical systems heuristics guidelines for the use in business intelligence system development
Conduct interviews to contextualise the guidelines
Gather data through interviews
Analyse gathered data and present conclusion: learn about the guidelines and suggest improvement action
Chapter 9:
Empirical work: contextualisation of the CSH guidelines
Specification of learning
Conclusions and evaluation:
Conclude the study with the main research findings and evaluate the extent to which the research problem has been solved
Chapter 10:
Conclusions and evaluations

Chapter 8 : Results from empirical work: application of the critical systems heuristics guidelines in a business intelligence development project

8.1 Introduction

The objective of this study is to develop guidelines for the use of critical systems methodologies to improve the development of business intelligence systems. In the action planning phase of this study the researcher proposed guidelines for the use of two critical systems methodologies in business intelligence system development, i.e. total systems intervention and critical systems heuristics – refer to Chapter 6. This chapter discusses the action taking, evaluation, and specification of learning phases of the CSH intervention in this action research study, i.e. the application of the critical systems heuristics guidelines to improve the development of a business intelligence system; the critical systems heuristics boundary questions are applied to derive the business requirements for a business intelligence system.

This chapter is structured as follows: Participants are discussed in the program/project planning phase – refer to Section 8.2. Data are collected, presented, and analysed during the business requirements definition phase; this is discussed in Section 8.3. The derived business requirements are summarised in Section 8.4. Section 8.5 gives an overview of some of the design elements of the new system. Section 8.6 discusses the deployment of the new system. Section 8.8 and Section 8.8 discusses the success of the intervention. Section 8.9 discusses the specification of learning in terms of the area of concern; Section 8.10 discusses the specification of learning in terms of the applied methodologies; and Section 8.11 discusses the specification of learning in terms of the framework of ideas.

8.2 Program/project planning

During program/project planning of the Kimball lifecycle approach a project is launched; this includes activities such as scoping, justification, and staffing (Kimball & Ross, 2010:98). As was stated in Chapter 7 also, a project team was already appointed by the organisation to work on this project. The team members that were involved in the TSI intervention (refer to Chapter 7) also participated in this intervention; to provide additional capacity for the project, one additional team member was allocated to the project team.

As previously (refer also to Chapter 7), the researcher entered the problem context as an employee of the organisation where the research was conducted; she was a business analyst for this intervention. The roles for this intervention were already established as the project team was appointed by senior management. The researcher re-negotiated with the sponsor of the project to apply CSH during the business requirements analysis phase. She obtained permission to apply the proposed action plan; the action plan is discussed in Chapter 6. The participants are discussed in the next section.

8.2.1 Participants

Similar to the TSI intervention (refer to Chapter 7), a small focus group (that also included the participants of the previous intervention plus one additional team member) was used to gather data. In this intervention (similar to the TSI intervention) the researcher, as the business analyst, facilitated the process of data collection. Data were collected from four participants, i.e. the two senior managers and two users of the historical system.

The PMO group was the custodian and governor of the business process and decision support software; they were tasked to improve the process and/or software and assured the investment managers that their decisions were appropriately informed. Identified senior managers from the PMO thus participated in the study in the following roles: Two senior managers from the project management office (PMO) group in the following roles: participant 1 (P1): Executive Manager PMO; and participant 2 (P2): Senior Manager PMO Process & Application; two users of the system, i.e. participant 3 (P3) and participant 4 (P4). Participant 2 (P2) was the executive sponsor of this project, whilst participant 1 (P1) was the executive manager accountable to ensure that investment managers receive relevant decision support information. P1 and P2 extensively applied information received from the problematic BI system (refer to Chapter 5 for a detailed discussion on the old system) to inform their decisions; they participated in making investment decisions on behalf of the organisation. As stated in Chapter 6, they respectively had 20 years (P1) and 16 years (P2) working experience in the organisation. P3 and P4 used the system to capture process data; they had 9 years (P3) and 4 years (P4) of relevant experience in the organisation. P1, P2, and P3 were part of the previous intervention. P4 was a new addition to the team. Participants P1, P2, and P3 are MBA graduates; participant P4 has a B.Sc. IT degree. The responses from the participants gave rise to specific questions about the original BI system; the researcher therefore identified an employee that was part of its design and interviewed him also as an additional participant (P5). Participant P5 is an industrial engineer with a B.Sc. degree.

Participants P1 and P2 represented the decision makers (management that use the information that stem from the BI system to inform strategic decisions); they were thus reliant on the information stemming from the BI system. Participants P3 and P4 represented the operational employees; they executed the business process associated with the BI system and were thus accountable for the integrity of the input data. Participant P5 was involved as an end-user during the development of the historical (failed) system.

8.3 Business requirements definition

In the business requirements analysis phase, the participants were requested to reflect on the CSH boundary questions (as was proposed in the critical systems heuristics (CSH) guidelines in Chapter 6). The collection, presentation, and analysis of data are discussed in the next sections.

8.3.1 Reflect on the required improvement for the organisation: data collection

A half-day workshop was conducted with each of the participants individually; during this workshop the participants were requested to reflect on the CSH boundary questions – refer also to Chapter 6 for a discussion on the action plan. The researcher explained the questions to the participants and requested them to provide their feedback in written format. The researcher explained the questions one-by-one, and then requested the participants to reflect on each question in the "is" and "ought to" mode, before moving to the next question. The participants were allowed to clarify their understanding of the boundary questions. They chose to not discuss their feedbacks in a group setting. All the participants were assured that their inputs would be treated as confidential – refer to Appendix A for the confidentiality agreement where the researcher undertook that participants will remain confidential and that participants may choose not to participate in the study. All the participants' original feedback is captured separately on a compact disc (CD).

Data were thus gathered by asking the participants to reflect on the CSH boundary questions. In the "is" mode the recipients were asked to reflect on the original (historical) BI system that failed the organisation. Since the front-end (for the population of input data) and the back-end (data warehouse that provides strategic decision support information) of a BI system is intricately linked, the participants were requested to reflect on both aspects. Firstly, they were asked to answer the boundary questions in the "is" mode to identify shortcomings in the historical system that was to be improved upon. Secondly, they were asked to reflect on each question in the "ought to" mode to understand the required improvement to be instilled by the new system.

8.3.2 Reflect on the required improvement for the organisation: data presentation and analysis

The data gathered from participants gave insight into their real requirements for the new system. The insight gained from participants' perspectives surfaced business requirements for the new BI system that was developed. It is discussed in the next sections.

8.3.3 Who is (ought to be) the client?

The aim of this question is to determine whose interests are (should be) served through the design or improvement of the system (Ulrich, 2005). The client motivates the design (and hence the existence) of the system; it reveals the social role(s) of the sources of motivation for the system to be designed (Ulrich, 1983:258). When asked in the "is" mode it gives insight to the actual client map; when asked in the "ought to" map it gives insight to the ideal client map.

8.3.3.1 Actual client map

The participants' views on the client of the system in the "is" mode:

- P1: "Project management teams; they have to use the tool to provide management with reporting information."
- P2: "Project management teams. They provide input so that we can make decisions."
- P3: "Project managers. Their projects are measured by this. It is yet another bureaucratic tool."
- P4: "Project management groups are being assessed. They're being checked – bureaucracy!!"

8.3.3.2 Insight gained from the data

When considering the clients of the front-end application in the "is" mode, it became clear that participants viewed the project management teams as the clients of the BI system: both participants P1 and P2 referred to the clients in the "is" mode as: "Project management teams"; P3 said that the clients were: "Project managers"; and P4 also referred to the clients as the: "Project management groups". Participants P1 and P2 wanted these project management teams to populate the BI system with data so that they (as representatives of the management teams) could receive decision making information (thus indirectly referring to themselves as clients of the system as well).

However, the project management teams (of which participants P3 and P4 were representatives) regarded their data capturing roles as bureaucratic governance – P3 said it was "yet another bureaucratic tool", whilst P4 referred to it as "bureaucracy!!". Participants P3 and P4 did not view the front-end application as an enabler for decision making to enable senior management to appropriately allocate resources to projects; they viewed it merely as a compulsory application that they *had* to use: both P3 and P4 alluded that was something that "measured", "checked" and "assessed" their work. The data capturers were thus negative regarding their role of capturing data in the system. This may negatively impact on the quality of the captured data.

8.3.3.3 Ideal client map

The participants' views on the client of the system in the "ought to" mode:

- P1: "Senior management must receive decision support information that can be trusted: strategic, forward looking information to improve project execution performance."
- P2: "We need information to make the right investment decisions. For money and resource allocations. And to do trend analyses – what are consistently bad."
- P3: "Is it necessary? We edit the reports in any case."
- P4: "Probably the investment decision makers?"

8.3.3.4 Insight gained from the data

P3 asserted that they "edit the reports [output information] in any case". As was mentioned earlier, the benchmarking company said that the information stemming from the system could not be trusted. This "editing" of the output information could be a root cause of the information that was, as per the benchmarking company, erroneous. So, to ensure integrity of source data and output information, the BI system must embed metrics used to generate output information; transformation of input data into output information ought to be automated as much as possible to ensure integrity, consistency and transparency.

In the “ought to” mode, the new BI system must enable the users to realise the value addition thereof in terms of the overall organisational business process of which they form a part; their negative perception in terms of bureaucracy must be addressed to ensure the integrity of the source data. Participant P1 said that they (senior management) wanted “decision support information that can be trusted”; he wanted to “improve project execution performance”, i.e. the business process supported by this BI system. P2 also alluded to improvement of “what are consistently bad”. Therefore, output information must be generated automatically and project management teams should not be able to manipulate the source data once it has been entered into the system. This is to assure the senior managers to use (and trust) the output information to inform their decisions, i.e. they required assurance that the information that they receive has been uncompromised and are fact-based.

Guided by this insight, the researcher (as the business analyst) took a closer look at how the output information was generated. It became clear that in most instances the output information was *not* automatically generated by the system; it was exported to a spreadsheet where it was edited off-line by the project management teams. Only selected pieces of the information was copied and formatted into a document; this (edited) report was then presented to senior management. Thus, the decision makers based their decisions (to allocate monetary and human resources for further project development work) on output information that indirectly stems from the decision support application; however, information (including those that were entered by some of the other business processes in this value chain) was in some cases manually edited. Transformation of source data into decision support information was not a consistent and transparent process; hence, integrity of information could have easily been compromised. Refer also to Chapter 5 for a discussion on the (failed) historical BI system.

8.3.3.5 Resultant business requirements

The resultant business requirements are the following:

1. Embed the capturing of the input data in the business process so that data-capturers are not burdened with additional work.

2. Ensure integrity, consistency and transparency of output-information via built-in automated (non-editable) reporting functionality to decision makers.

8.3.4 What is (ought to be) the purpose of the system?

The aim of this question is to determine what are (should be) the goals and/or consequences of implementing the system (Ulrich, 2005). This question must reveal *what* motivates the design (and existence) of the system; the purpose(s) define the specific concerns that the client(s) aim to resolve by designing the system (Ulrich, 1983:258). When asked in the “is” mode it gives insight to the actual purpose map; when asked in the “ought to” map it gives insight to the ideal purpose map.

8.3.4.1 Actual purpose map

The participants’ views on the purpose of the system in the “is” mode:

- P1: “Confirm benchmarking information.”
- P2: “Show where project teams must improve / focus more when they plan.”
- P3: “Assess project readiness and get resources.”
- P4: “To get money and people allocated to my projects for further work.”

8.3.4.2 Insight gained from the data

In the “is” mode the project management teams indicated that they capture the data to: “[a]ssess project readiness and get resources (P1) and: “[t]o get money and people allocated to [their] projects for further work” (P2). They have to capture the data so that they can continue to the subsequent phases in their projects; this is so that they can request resources to develop and execute their projects further. However, as was indicated in the actual client map, project management teams viewed it as bureaucracy. According to the project management teams there were no major deficiencies in their project work.

This perception was reinforced by output graphs generated in the historical system. These graphs rarely indicated any deficiencies at the assessment points. For example, Table 8-1 below illustrates the level of development that was indicated for a sample of 60% randomly chosen projects that were assessed over a period of three years; only two out of a total of twenty projects were indicated by the historical system to be underdeveloped, i.e. only two projects were identified to have had major deficiencies with regard to completeness and quality of the work done.

Table 8-1: Random sample of projects reported on

Project	Acceptable level of development	Immature level of development
Project 1	X	
Project 2	X	
Project 3	X	
Project 4	X	
Project 5	X	
Project 6	X	
Project 7	X	
Project 8	X	
Project 9	X	
Project 10		X
Project 11	X	
Project 12		X
Project 13	X	
Project 14	X	
Project 15	X	
Project 16	X	
Project 17	X	
Project 18	X	
Project 19	X	
Project 20	X	
Total	**85%**	**15%**

However, the findings of a benchmarking company clearly contradicted these results. According to the benchmarking company the organisation's project performance compared negatively to its peers as well as to prescribed industry best practices.

According to the benchmarking company the organisation wasted substantial amounts of resources; they found that most of its projects were significantly more expensive and also took significantly longer to complete than similar projects in similar organisations (an estimated loss of 6.3% internal rate of return (IRR) and, on average, schedule overruns of 23% across its portfolio of projects) – refer to Chapter 5 for more detail. Participant P1 wanted the BI system to reflect the view of the benchmarking company, whilst participant P1 alluded to a piece of strategic decision support information the he requires from the system.

8.3.4.3 Ideal purpose map

The participants' views on the purpose of the system in the "ought to" mode:

- P1: "We need 'independent' information that we can trust – in line with that from benchmarks."
- P2: "Factual information – are projects really ready to continue? Complete information!!!"
- P3: "It is unnecessary – we get good scores on all our projects in any case."
- P4: "We don't need a software tool to tell us we did our job; we do it well. Look at the scores."

8.3.4.4 Insight gained from the data

The question about what "ought to" be the purpose of the new BI system highlighted that senior management – since they were not involved in the daily operational work of the projects, yet they remained responsible to appropriately allocate organisational resources to projects – required non-manipulated (unbiased) and truthful decision support information. P1 needed "independent information that [they] can trust – in line with that from benchmarks"; P2 required: "[f]actual information" and: "[c]omplete information" to support his decisions. They required information that could factually inform them whether the work done by project management teams were complete enough and of an appropriate level of quality to justify further resource allocation.

The operational personnel (represented by P3 and P4) did not agree that the system was purposeful: P3 referred to it as "unnecessary" whilst P4 said that they "don't need a software tool" – this perception was reinforced by the information that stemmed from the system – refer also to Table 8-1 on the previous page.

8.3.4.5 Resultant business requirements

The resultant business requirements are the following:

- Support decision makers to make informed decisions by identifying the decisions to be supported and the supporting information required for those decisions.
- Identify data to be captured to enable the required decisions to be made effectively and efficiently.
- Ensure that the front-end application captures data effectively and efficiently to inform the required decisions.

8.3.5 What is (ought to be) the measure of success/improvement?

This question aims to determine how can (should) one determine the consequences that constitutes an improvement (Ulrich, 2005). This question reveals the crux of the system, i.e. it motivates why the client(s) require the system to be designed (Ulrich, 1983:258). When asked in the "is" mode it gives insight to the actual success map; when asked in the "ought to" map it gives insight to the ideal success map.

8.3.5.1 Actual success map

The participants' views on the measure of success of the system in the "is" mode:

- P1: "I don't think what we currently have works well enough."
- P2: "Our current system is not successful."
- P3: "When we pass the 'test'; get a good score from the software."
- P4: "When we can continue – get good score rating."

8.3.5.2 Insight gained from the data

This question asked in the "is" mode revealed that participants P1 and P2 did not regard their original system as successful. P1 said that he does not think "what we currently have works well enough"; P2 said that their "current system is not successful". This echoes the case of change and the need for this intervention.

Participants P3 and P4 just wanted to receive positive outcome (i.e. a "good score") to continue with their operational work, thus re-emphasising their need to have a system that is embedded efficiently in their work processes.

8.3.5.3 Ideal success map

The participants' views on the system's measure of success in the "ought to" mode:

- P1: "Recommend only projects that developed sufficiently. So that we don't waste any more resources."
- P2: "Un-manipulated information for decision making!"
- P3: "We get good scores so it should stay the same."
- P4: "When we can continue to the next phase."

8.3.5.4 Insight gained from the data

This question asked in the "ought to" mode alluded to the type of strategic decision support information required: The BI system ought to be considered successful if it legitimately recommended projects that are sufficiently developed to warrant further resources to be allocated. It should also legitimately reject projects that are not to be allocated further resources in order to minimise wastage of organisational resources. Participant P1 wanted information to ensure that they "don't waste any more resources", i.e. make the right investment decision; P2 also wanted "[u]nmanipulated information for decision making".

Again, the operational personnel (P3 and P4) were mostly concerned with getting "good scores" and to "continue to the next phase"; they did not see the purpose of the system in the same light as the decision makers (investment managers).

8.3.5.5 Resultant business requirement

The resultant business requirement is the following:

- Improve the new BI systems so that it enables seamless execution of the associated business process, i.e. enable decision makers to allocate resources effectively and efficiently to appropriately developed projects only.

8.3.6 Who is (ought to be) the decision maker?

The purpose of this question is to determine who is (should be) able to change the measure of improvement (Ulrich, 2005). The actual decision makers of a system are the people that are formally designated to control the system as well as those that have "the power of vested interests to influence the formally designated decision maker" (Ulrich, 1983:405). The ideal decision maker concerns the internal structure that would make the decision maker a purposeful and effective controller of the system, as well as the external factors that determine the system's performance that ought to be under the decision maker's control (Ulrich, 1983:401). When asked in the "is" mode it gives insight to the actual decision map; when asked in the "ought to" map it gives insight to the ideal decision map.

8.3.6.1 Actual decision map

The participants' views on the decision maker of the system in the "is" mode:

- P1: "Governance group."
- P2: "Governance group."
- P3: "We give inputs to governance group to update measures."
- P4: "We occasionally update measures when governance team asks us to."

To understand the role of this governance group better, the researcher interviewed an additional participant (P5) also: Firstly, she asked him "Who was involved in the design of the initial system?" P5 responded as follows: "It was designed by a group of people consisting of engineers (for example from chemical, mechanical, civil and electrical disciplines)."

Secondly, she asked him: "Do you know how the key performance indicators (KPIs) and metrics were designed in the original system?" P5 responded as follows: "We were originally assisted by a number of identified (internal to the organisation) subject matter experts from project management teams. We [the governance group] designed and developed the KPIs of the business process. Also the performance metrics that transformed the [source] data into output graphs. The metrics were initially developed with assistance from [a company that specialises in project execution and gate keeping processes] [2]. The metrics unfortunately evolved unrecognisably over a period of sixteen years with minimal documented evidence of how and why they evolved. We periodically adjusted embedded metrics on request from project teams; they are regarded as the experts to what to do and how to do it."

8.3.6.2 Insight gained from the data

In the context of this study the decision makers with regard to the original system in the "is" mode were a project governance group – refer to Chapter 5 for more detail on the related business process. When the researcher interviewed the additionally identified participant (P5), he revealed that this group were assisted by a number of identified (internal to the organisation) subject matter experts from project management teams. This governance group designed and developed the key performance indicators of the business process, including the embedded performance metrics that transformed the source data into output graphs. He said that "the metrics were initially developed with assistance from [a company that specialises in project execution and gate keeping processes]"; however, he asserted that these metrics "evolved unrecognisably over a period of sixteen years with minimal documented evidence of how and why they evolved". It seemed as if the internal employees (the governance group and the project management teams) periodically adjusted the embedded metrics to ensure that output graphs reflected positively to illustrate that their projects adhered to standards with regard to completeness and quality.

[2] Name of the company was removed for confidentiality purposes

8.3.6.3 Ideal decision map

The participants' views on the decision maker of the system in the "ought to" mode:

- P1: "Somebody like the benchmarking companies should ratify measures."
- P2: "Measures should be determined by industry best practice."
- P3: "I think it works so don't change it."
- P4: "The measures are fine as is."

8.3.6.4 Insight gained from the data

The operational employees, P4 and P3, regarded the measures as "fine as is" and "don't [want to] change it"; it reflected positively on them (refer to Table 8-1 in Section 8.3.4 above). However, the system provided inaccurate information – refer to Table 8-1 vs the benchmarking company's verdict of over expenditure and overrunning schedules (refer to Chapter 5 for the detailed discussion of the benchmarking company's findings).

Therefore, in the "ought to" mode decision makers ought to have been an authoritative entity that are appropriately qualified to govern the design of the metrics to ensure that the BI system informs required decisions accurately. Participant P1 said that measures should be ratified by an entity such as a benchmarking company; P2 also referred to "industry best practice" to guide the development of measures. Therefore, an independent group in the organisation, in consultation with *industry best practice experts* (rather than internal employees), ought to design and control the metrics to ensure that the system provides unbiased and legitimate decision support information to senior management.

8.3.6.5 Resultant business requirement

The resultant business requirement is the following:

- Redesign the key performance measures in the BI systems with assistance of industry best practice experts such as the benchmarking company.

8.3.7 What resources are (ought to be) controlled by the decision maker?

This question aims to determine what resources or conditions of success can (should) those that are involved control (Ulrich, 2005). The purpose of the question what resources or conditions are (ought to be) under the decision maker's control determines what conditions of success can (should) those involved control (Ulrich, 1983:248). When asked in the "is" mode it gives insight to the actual resources map; when asked in the "ought to" map it gives insight to the ideal resources map.

8.3.7.1 Actual resources map

The participants' views on the resources of the system in the "is" mode:

- P1: "The information that we get is wrong according to benchmarks; we need you to investigate why."
- P2: "I don't think the software has the right KPIs [key performance indicators] but we need an expert to look at it in detail."
- P3: "The governance group control the elements and their weightings."
- P4: "We give inputs to the governance team."

8.3.7.2 Insight gained from the data

The participants did not clearly understand what was intrinsically wrong with the historical system, i.e. P1 just knew that they received wrong information; P2 said that "we need an expert to look at it in detail". So, to understand the input data and applied metrics and KPIs in the "is" mode it was necessary to analyse the historical system in terms of the operational system's front-end's input screens, as well as the metrics used in the DW to produce output graphs. Participants P3 and P4 also directed the researcher in this instance to the "governance" group/team.

8.3.7.3 Ideal resources map

The participants' views on the resources of the system in the "ought to" mode:

- P1: "If we know what is wrong we can change it. The reports are very lengthy and sometimes don't say much."

- P2: “Let industry experts ratify the KPIs. And give us information that is easy to interpret.”
- P3: “It is very complicated to understand so I don’t know how they determine the weightings. It can maybe be made easier?”
- P4: “The governance team asks us but I don’t know how they interpret the weightings and work out the scores.”

8.3.7.4 Insight gained from the data

Participants P1 and P2 were unsure about this question; they knew something was wrong but were unsure as to exactly what that ‘something’ was. Participants P3 alluded that the system was “very complicated”; P4 asserted that they did not know how measures were embedded in the system. This question’s responses regarding embedded resources resonated with the previous responses regarding the decision maker. It also revealed that the input mechanism is too complicated.

8.3.7.5 Resultant business requirement

The resultant business requirement is the following:

- Redesign the input mechanisms so that they are easy to use and understand.
- Redesign the output mechanisms to ensure that output information is easy to interpret.

8.3.8 What success conditions are (ought to be) part of the environment?

This question aims to determine what conditions can (should) the decision maker not be able to control (Ulrich, 2005). The question regarding what resources or conditions are (ought to be) part of the environment aims to determine what conditions can (should) the decision-maker not control (e.g. from the viewpoint of those not involved) (Ulrich, 1983:248). Ulrich (1983:408) states that the decision environment includes “everything that coproduces the system’s performance but is not controlled by the system’s decision maker”; the decision maker should service the ideal client’s purposes and include the affected stakeholders’ concerns. When asked in the "is" mode it gives insight to the actual environment map; when asked in the "ought to" map it gives insight to the ideal environment map.

8.3.8.1 Actual environment map

The participants' views on the environment of the system in the "is" mode:

- P1: "We don't get the information that we need."
- P2: "We apparently get wrong information. So no success??"
- P3: "The interface that we work with is difficult. The whole system is just bureaucratic."
- P4: "It is very difficult and just another bureaucracy! It does not really inform decisions!"

8.3.8.2 Insight gained from the data

To reinforce the case for change and the need for this intervention, the actual map indicated "no success" (P2). Participants P3 and P4 were more concerned with the front-end of the BI system; this was understandable as this was their main contact point with the system. They (again) alluded to it being "bureaucratic" (P3) and "bureaucracy" (P4). Participants P1 and P2 said that they "don't get the information that [they] need" and that the information that they receive is "apparently…wrong".

8.3.8.3 Ideal environment map

The participants' views on the environment of the system in the "ought to" mode:

- P1: "If we get good unbiased information that is usable it will be great!"
- P2: "Information must be accurate and supplied when we need it."
- P3: "If we have to use the system please make it easier."
- P4: "Make it less complex please?"

8.3.8.4 Insight gained from the data

In the "ought to" mode success of the BI system was to be indicated by the willingness of senior management to use the information stemming from the BI system in their decision making processes. P1 said that: "[i]f we get good unbiased information that is usable it will be great!"; P2 said that he wanted information that is "accurate and supplied when we need it". The BI system's metrics embedded in the BI system must therefore be designed such that it supplies accurate and timeous information – refer also to the ideal purpose map in Section 8.3.4.3.

The operational system that supports the BI system must also have an easy-to-use user interface so that project management teams can easily populate the input data – refer also to the ideal resources map earlier in this chapter. Participant P3 wanted the system to be "easier"; P4 wanted the system to be "less complex".

8.3.8.5 Resultant business requirement

This question did not surface a new requirement; rather, it highlighted the importance of requirements identified in the previous sections (e.g. data must be easy to capture; and output information must be accurate).

8.3.9 Who is (ought to be) considered a professional or further expert?

The purpose of this question is to determine who is (should be) included in the design team (Ulrich, 2005). A BI system has social as well as technical dimensions; the design team should reflect both dimensions. When asked in the "is" mode it gives insight to the actual expert map; when asked in the "ought to" map it gives insight to the ideal expert map.

8.3.9.1 Actual expert map

The participants' views on the expert of the system in the "is" mode:

- P1: "I don't know who designed the original system."
- P2: "It was designed 16 years ago by engineers from civil, chemical, electrical and mechanical."
- P3: "Probably the governance group? Project teams know better what works for them."
- P4: "I think the project managers know what should be included in measures."

8.3.9.2 Insight gained from the data

The original system was developed approximately 16 years ago. According to P2 the original system "was designed 16 years ago by engineers from civil, chemical, electrical and mechanical". This was confirmed by the additional participant (P5) that said that it was designed "by a group of people consisting of engineers (for example from chemical, mechanical, civil and electrical disciplines)".

8.3.9.3 Ideal expert map

The participants' views on the expert of the system in the "ought to" mode:

- P1: "The software must be developed by IT[3] people. Get BI people involved as well. Get business people to design the KPIs."
- P2: "IT must develop the system but business and BI people must be involved for the KPIs."
- P3: "Industry experts?"
- P4: "Probably industry benchmarking expertise."

8.3.9.4 Insight gained from the data

Participants P1 and P2 asserted that a diverse group must be involved to design the various components. Therefore, in the "ought to" mode the BI system should be designed and developed by appropriately skilled software designers and developers; the team should also include a BI expert to design the technological architecture such as the front-end software, hardware and data warehouse components. The content should be provided by business experts that are competent to design metrics with regard to the assessment of project performance.

[3] Information technology department

8.3.9.5 Resultant business requirement

This question did not surface a business new requirement; however, it highlighted the importance of an appropriately skilled design and development team that needs to be involved in this project

8.3.10 What kind of expertise is (ought to be) consulted?

The aim of this question is to determine what counts (should count) as relevant knowledge and sources of expertise in designing and implementing the system (Ulrich, 2005). When asked in the "is" mode it gives insight to the actual expertise map; when asked in the "ought to" map it gives insight to the ideal expertise map.

8.3.10.1 Actual expertise map

The participants' views on the expertise of the system in the "is" mode:

- P1: "We receive inaccurate information – refer to benchmark reports."
- P2: "The benchmarks show that we don't get the right information."
- P3: "There is nothing wrong with the scoring – we do well."
- P4: "We don't get bad scoring so it should be all good."

8.3.10.2 Insight gained from the data

These responses were similar to the responses regarding the actual decision map – refer to Section 8.3.6.

8.3.10.3 Ideal expert map

The participants' views on the expertise of the system in the "ought to" mode:

- P1: "Refer to the question regarding the experts."
- P2: The right people from the right groups must give input."
- P3: "Nothing wrong…"
- P4: "It is good."

8.3.10.4 Insight gained from the data

The responses from participant P3 and P4 were in this instance also similar to the responses regarding the actual decision map – refer to Section 8.3.6. Participants P1 referred back to the ideal expert map; participant P2 also re-iterated his response from the ideal expert map.

8.3.10.5 Resultant business requirement

This question did not surface a new requirement.

8.3.11 What/who is (ought to be) the guarantor of success?

The purpose of this question is to determine where do (should) those involved seek some guarantee that improvement will be achieved (Ulrich, 2005). For example, it may include consensus among experts, the involvement of stakeholders, the experience and intuition of those involved or political support (Ulrich, 1983:248). However, according to Ulrich (1983:441) the "appropriate ideal might be to free ourselves from the need for a guarantor"; it may thus be better to accept the lack of a guarantor rather than attempt to find a guarantor as the ideal guarantor may only be found when the need for a guarantor disappeared. Therefore, the researcher did not attempt to answer this question.

However, the question regarding the witness to those affected but not involved – refer to Section 8.3.12.1 below – revealed that the historical system failed according to participant 2 (P2) because "[w]e did not have a business analyst before when the original system was designed. IT was not involved in building it"; thus, alluding to the fact that the historical system did not succeed as a result of lack of involvement of all relevant stakeholders.

8.3.12 Who is (ought to be) witness to those affected but not involved?

This question aims to determine who is (should be) treated as a legitimate stakeholder, and who argues (should argue) the case of the stakeholders who are affected but not involved and hence cannot speak for themselves, including future generations and non-humans (Ulrich, 2005). The witnesses should incorporate the requirements of those that are *affected* by the system (Ulrich, 1983:258). When asked in the “is” mode it gives insight to the actual witness map; when asked in the “ought to” map it gives insight to the ideal witness map.

8.3.12.1 Actual witness map

The participants’ views on the expertise of the system in the “is” mode:

- P1: “No comment.”
- P2: “We did not have a business analyst before when the original system was designed. IT was not involved in building it.”
- P3: “I am not sure.”
- P4: “I don’t really know?”

8.3.12.2 Insight gained from the data

The participants were unsure about this question. P2 alluded to the fact that “[they] did not have a business analyst before when the original system was designed. IT was not involved in building it”. Thus, the historical system may have failed based on the lack of involvement of all relevant stakeholders that resulted in an incomplete/incorrect scope when it was developed. The researcher determined that the historical system’s KPIs were designed by a single affected group (i.e. the capturers of source data) – refer also to the responses of participant P5 in the actual decision map in Section 8.3.6.1 above. However, the group mostly affected by a BI system is the decision makers that base their strategic decisions on information stemming from the system was not involved in designing the embedded KPIs.

8.3.12.3 Ideal witness map

The participants’ views on the expertise of the system in the “ought to” mode:

- P1: “No comment.”
- P2: “Get the right people involved for the different aspects of the system!”
- P3: “I am not sure.”
- P4: “I don’t know.”

8.3.12.4 Insight gained from the data

The participants were unsure about this question. According to participant P2 the development of the new BI system should involve "the right people…for the different aspects of the system". Contextualisation of the CSH questions to ensure that the questions are clear to the users of BI systems is discussed in the next chapter of this study.

8.3.12.5 Resultant business requirement

This question did not highlight a new requirement; it reiterated that the right people had to be involved to design and develop the new BI system.

8.3.13 What secures (ought to secure) the emancipation of the affected?

The purpose of this question is to determine where does (should) legitimacy lie in terms of those affected by the premises/promises of those involved (Ulrich, 2005). This question should firstly determine *what* constitutes emancipation to determine how to measure success (Ulrich, 1983:258). When asked in the "is" mode it gives insight to the actual emancipation map; when asked in the "ought to" map it gives insight to the ideal emancipation map.

8.3.13.1 Actual emancipation map

The participants' views on the expertise of the system in the "is" mode:

- P1: "Users are not emancipated."
- P2: "No emancipation in current system!"
- P3: "This is not applicable."
- P4: "Nothing."

8.3.13.2 Insight gained from the data

The historical system did not emancipate its users. P1 said that "[u]sers [were] not emancipated"; P2 agreed. Participants P3 and P4 did not have additional comments about this question in the "is" mode. The team therefore decided to focus on the ideal emancipation map rather than the actual emancipation map.

8.3.13.3 Ideal emancipation map

The participants' views on the expertise of the system in the "ought to" mode:

- P1: "Do proper stakeholder analysis and requirements analysis. Give us a system that we can trust in terms of information."
- P2: "Analyse requirements from all stakeholders appropriately. Built integrity into the system."
- P3: "Nothing to comment."
- P4: "Nothing."

8.3.13.4 Insight gained from the data

The BI system should emancipate the involved and affected communities. This can be achieved by doing "proper stakeholder analysis and requirements analysis" (P1). P2 said to "[a]nalyse requirements from all stakeholders appropriately." Both P1 and P2 wanted a trustworthy system. They merely re-stated what they alluded to in earlier responses.

8.3.13.5 Resultant business requirement

This question did not surface a new business requirement. However, it re-iterated the need for a trustworthy system that serves its stakeholders appropriately. The decision makers would thus feel emancipated if the BI system provided them with trustworthy information.

8.3.14 What is (ought to be) the determining worldview

This question aims to determine what different visions of 'improvement' are (should be) considered and how are they (should they be) reconciled (Ulrich, 2005). These questions were not asked to the participants. Rather, it was derived from their perspectives. There was a clear distinction between the management representative participants and the operational representative participants. P1 and P2 (from the management perspective) were interested in getting accurate and unbiased information. Participants P3 and P4 (operational employees) were interested in an easy to use system that enabled them to do their operational work. Since they populated the system's data, they wanted a system that did not add to their workload, but made their work easier.

8.4 Define the BI system's boundary judgements: summary of derived business requirements that constitute improvement

Reflection on the CSH boundary questions gave insight into the desired business requirements for the BI system. This project initially started off as a pure automation project – as is often the case according to authors such as Gardner (1998:55) as well as Newman & Lamming (1995:150); however, business requirements should be surfaced that improve the organisation (Newman & Lamming, 1995:150; Inmon, 2005:55) – refer also to Section 3.7 of Chapter 3. The team was initially requested to improve upon the BI system by automating it so that decision makers can automatically receive trustworthy information that was not edited off-line by operational employees – refer also to Chapter 5 for a detailed discussion on the failed system that was done during the diagnosis phase. However, the analysis of the requirements using the CSH boundary questions highlighted nine *new* requirements from the involved stakeholders. For example, the CSH boundary questions highlighted that the front-end application captured the wrong data and hence the output information was inaccurate also. The application of CSH resulted in this project being extended from a pure automation project, to a business improvement project. The business analyst ensured that business requirements were representative of the needs of all the stakeholders of the BI system: She communicated the final set of requirements to the team members; and the team members (and ultimately the business sponsor (P2)) formally signed off on the requirements. The derived business requirements extended beyond the scope of mere business requirements and resulted in additional improvements (such as the associated business process) as listed below[4]:

[4] All of these were implemented during the development of the system

1. Embed the capturing of the input data in the business process so that data-capturers are not burdened with additional work – refer to Section 8.5.1 below for a discussion on the improvement in the business process.
2. Ensure integrity, consistency and transparency of output-information via built-in automated (non-editable) reporting functionality to decision makers – refer to Section 8.5.4 below.
3. Support decision makers to make informed decisions by identifying the decisions to be supported and the supporting information required for those decisions – this is captured in the improved business process – refer to Section 8.5.1 below.
4. Identify data to be captured to enable the required decisions to be made effectively and efficiently – refer to Section 8.5.3 below.
5. Ensure that the front-end application captures data effectively and efficiently to inform the required decisions – refer to Section 8.5.3 below.
6. Improve the new BI systems so that it enables seamless execution of the associated business process, i.e. enable decision makers to allocate resources effectively and efficiently to appropriately developed projects only – this is captured in the improved business process – refer to Section 8.5.1 below.
7. Redesign the key performance measures in the BI systems with assistance of industry best practice experts such as the benchmarking company – refer to Section 8.5.3 below.
8. Redesign the input mechanisms so that they are easy to use and understand – refer to Section 8.5.3 below.
9. Redesign the output mechanisms to ensure that output information is easy to interpret – refer to Section 8.5.4 below.

8.5 Design and implement a BI system

The derived business requirements were incorporated into the design of the new BI system. The associated business process was improved upon – refer to Section

8.5.1 below. Thereafter, a business requirements definition document was handed over to a supplier to develop and implement the new BI system according to the Kimball approach. Extracts of design specificities that were improved upon and included the final system are discussed in Sections 8.5.2 to 8.5.4.

8.5.1 Improvement in the existing business process

The application of the CSH boundary questions highlighted the different perspectives of the different stakeholder groups. For example, managerial representatives had different requirements than the operational employees; these had to be reconciled and the business process simplified. Hence, before any design/development work commenced, the team mapped a simplified business process; it is illustrated in Figure 8-1 and Figure 8-2 below. Improvement of the business process was an unexpected outcome, as it was not included in the initial request for the development of the new system – refer also to Section 5.3 of Chapter 5.

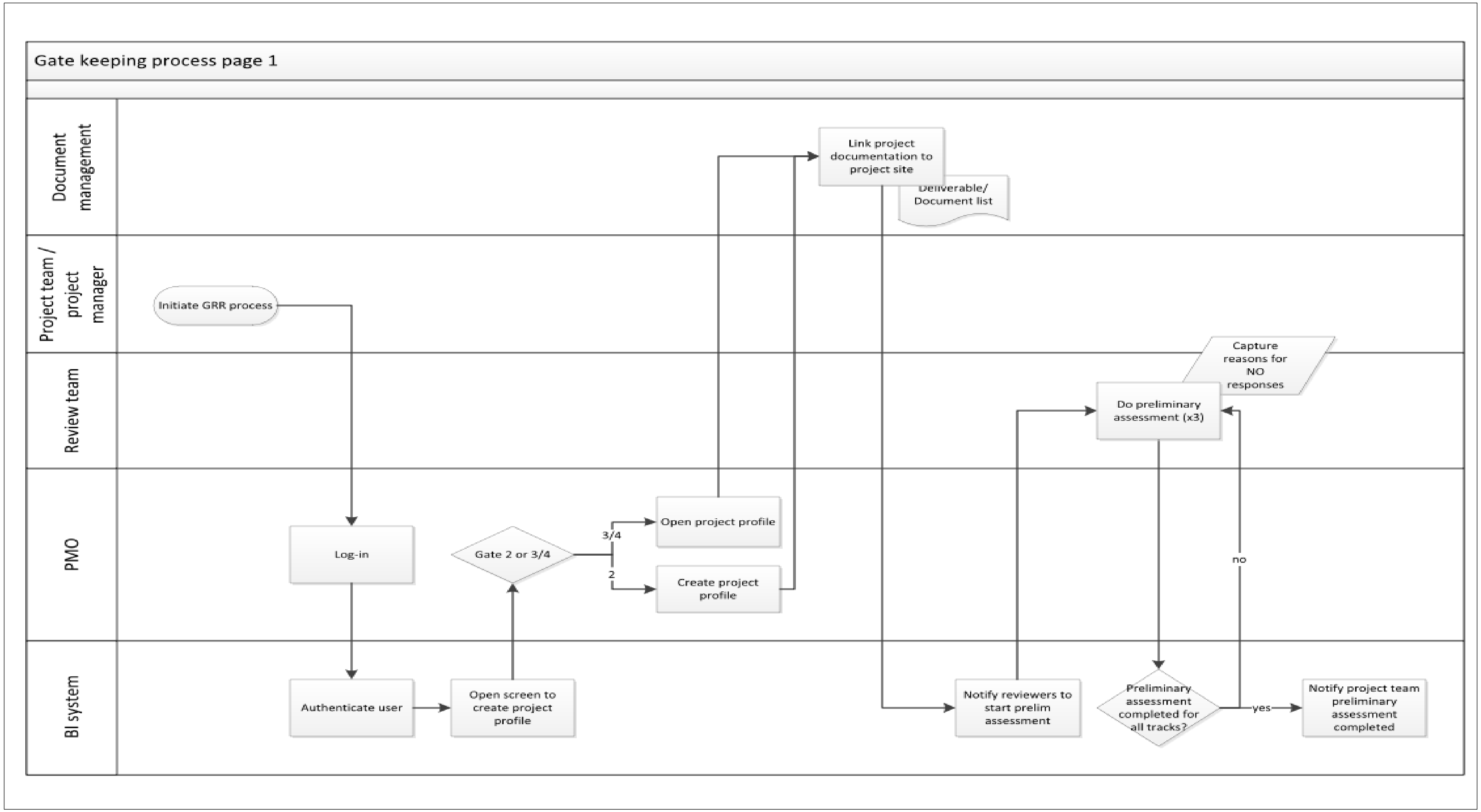


Figure 8-1: Simplified business process

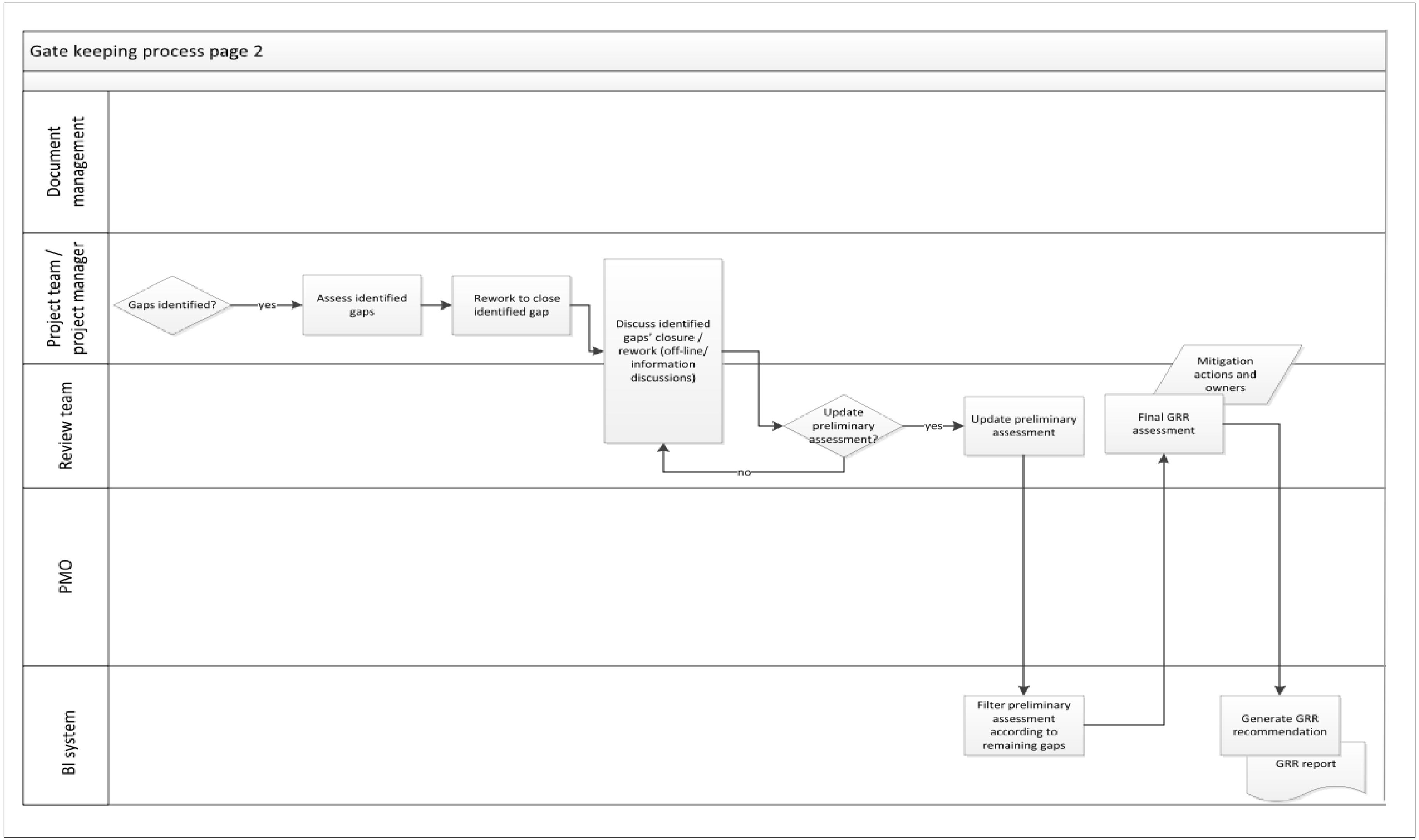


Figure 8-2: Simplified business process continued

8.5.2 Improvement in the data warehouse

The applicable data warehouse portion (i.e. the data mart which assimilated the data generated by the business process in Figure 8-1 and Figure 8-2 and its associated front-end application) was redesigned and dimensionally modelled around the business process. It was then re-integrated with a number of other business processes (data marts) to enable the display of integrated decision support information – some of the reports are illustrated later in this chapter in Section 8.5.4. A simplified bus matrix of the new system is shown Figure 8-3 below.

	Date dim	Project profile dim	Sponsor profile dim	Project team profile dim	Engineering team profile dim	Business team profile dim	Review team profile dim	Facts
Create project profile	X	X						One project per portfolio per cluster per tier
Sponsor evaluation	X		X				X	One outstanding action per project per sponsor track
Project evaluation	X		X	X			X	One outstanding action per project per project track
Engineering evaluation	X		X		X		X	One outstanding action per project per engineering track
Business evaluation	X		X			X	X	One outstanding action per project per business track
Gate readiness review and assessment process	X	X	X	X	X	X	X	One score per project per track per gate One outstanding action per track per project Scorecard snapshot Scorecard accumulation
Document management	X	X	X	X	X	X	X	One review per project per gate per tier

Figure 8-3: The (new) data warehouse bus matrix

8.5.3 Improvement in the data capturing mechanisms

In order to identify data to be captured to enable the required decisions to be made effectively and efficiently, the project team analysed the historical BI system's input data in terms of the data captured as well as the way the data were captured. In the historical system, the input screens captured responses via a screen that presented the data-capturer with possible responses for a particular element; a response was indicated by selecting the radio button next to the response that described best the level of development for the particular element. This is illustrated in Figure 8-4 (this figure is also illustrated in Figure 5-5 where the failed historical system is discussed – refer to Chapter 5 for more detail.

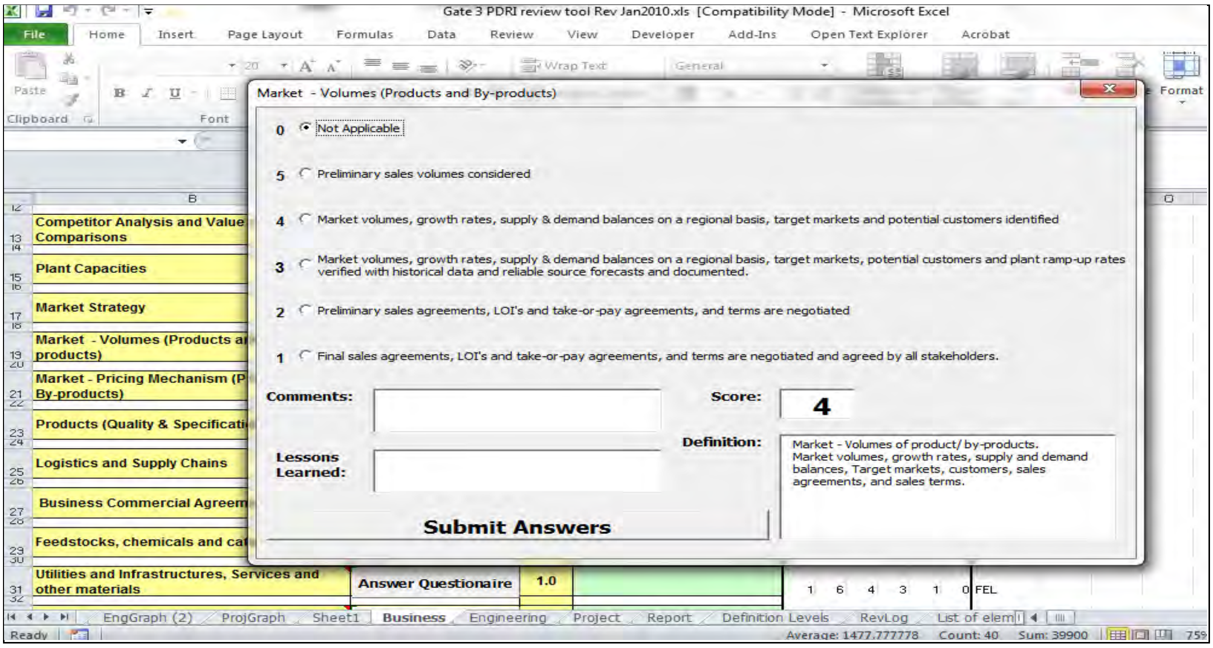


Figure 8-4: Possible response levels in the historical front-end application

The improvements that were made in terms of the data captured, as well as the input mechanisms in the front-end application, are discussed in the next sections.

8.5.3.1 The data captured

The project team analysed all the input screens at all three the assessment points (refer to Chapter 5 for more detail on the business process); this analysis highlighted deficiencies in expected levels of development at the assessment points. For example, the following elements: project accounting requirements; equipment utility requirements; as well as business and commercial agreements had ideal levels of development that were similar at the second and the third assessment point. An extract of the elements levels of definition in the "is" mode is illustrated in Table 8-2 below.

Table 8-2: Extract of historical system's elements' levels of definition: "is" mode

Element	**Ideal level of development at first assessment point**	**Ideal level of development at second assessment point**	**Ideal level of development at third assessment point**
Business strategy	Strategic alignment of opportunity tested with strategy and business unit charters; agreed with all stakeholders.	Detailed business strategy written up and approved by all stakeholders.	Detailed business strategy written up and approved by all stakeholders.
Project accounting requirements	Project control philosophies were defined in view of possible partner capabilities.	All requirements have been compiled but were not yet agreed.	All requirements have been compiled but were not yet agreed.
Project sponsor	The project executive/sponsor accepted his/her leadership role, but no documentation exists to show acceptance.	The project executive/sponsor accepted his/her leadership role, but no documentation exists to show acceptance.	The project executive/sponsor accepted his/her leadership role, but no documentation exists to show acceptance.
Equipment utility requirements	No considerations given to requirements or very rough estimates exist.	Requirements were reviewed and agreed.	Requirements were reviewed and agreed.
Commissioning philosophies	Commissioning philosophies developed but not yet shared with stakeholders.	Documented commissioning philosophies available and agreed.	Documented commissioning strategy developed and agreed by all stakeholders.
Social and/or community issues	Not applicable.	Interested and affected parties consulted; verbal agreement reached on social issues.	Interested and affected parties consulted; written agreement reached on social issues.
Business and commercial agreements	Not applicable.	All other commercial agreements compiled but not reviewed and agreed.	All other commercial agreements compiled but not reviewed and agreed.

Table 8-2 above is an extract for illustrative purposes only; the team identified a total of 306 elements across the three assessment points that required improvement. Detailing all the deficiencies that were highlighted during this analysis is beyond the scope of this study. However, all these levels of definition were then improved (in consultation with an industry best practice organisation). Consequently, a separate project was launched whereby the team worked with the benchmarking company that highlighted the lack of credible information to the organisation; this 'clean-up' of the embedded performance metrics was completed before the new BI system was further developed. An extract of the as-is ("is" mode) versus the suggested improved ("ought to" mode) levels of definition are illustrated in Table 8-3 below (again, the full extent of these discussions are beyond the scope of this study and hence only a summarised sample is inserted here).

Table 8-3: Extract of ideal levels of definition for elements in the "ought to" mode

Element	**Ideal level of development at first assessment point**	**Ideal level of development at second assessment point**	**Ideal level of development at third assessment point**
Business strategy (is-mode)	Strategic alignment of opportunity tested with group strategy, technology strategy and business unit charters; agreed with all stakeholders.	Detailed business strategy written up and approved by all stakeholders.	Detailed business strategy written up and approved by all stakeholders.
Business strategy (ought to mode)	*A preliminary business strategy was assessed based on compatibilities, synergies, risks and potential conflicts of interests with other business units.*	*Detailed business strategy written up and approved by all stakeholders.*	*Detailed business strategy written up and approved by all stakeholders.*
Project accounting requirements (is mode)	Project control philosophies were defined in view of possible partner capabilities.	All requirements have been compiled but were not yet agreed.	All requirements have been compiled but were not yet agreed.
Project accounting requirements (ought to mode)	*Project control philosophies were defined in view of possible partner capabilities.*	*All project accounting requirements were compiled.*	*All project accounting systems and processes were implemented.*

Element	**Ideal level of development at first assessment point**	**Ideal level of development at second assessment point**	**Ideal level of development at third assessment point**
Project sponsor (is mode)	The project executive/sponsor accepted his/her leadership role, but no documentation exists to show acceptance.	The project executive/sponsor accepted his/her leadership role, but no documentation exists to show acceptance.	The project executive/sponsor accepted his/her leadership role, but no documentation exists to show acceptance.
Project sponsor (ought to mode)	*The project executive/sponsor accepted his/her leadership role.*	*The project executive/sponsor accepted his/her leadership role.*	*The project executive/sponsor accepted his/her leadership role.*
Equipment utility requirements (is mode)	No considerations given to requirements or very rough estimates exist.	Requirements were reviewed and agreed.	Requirements were reviewed and agreed.
Equipment utility requirements (ought to mode)	*Utility requirements were considered, availability on site was assessed and utility requirements were provided for in the project scope.*	*A list of all utilities was developed with interfaces, battery limits and preliminary tie-in positions; quality and quantity requirements agreed; all actual battery limit conditions were verified on site and discussed with the supplying authority.*	*All utility related interface documents were signed off; project scope and design is fully consistent with requirements.*
Commissioning philosophies (is mode)	Commissioning philosophies developed but not yet shared with stakeholders.	Documented commissioning philosophies available and agreed.	Documented commissioning strategy developed and agreed by all stakeholders.
Commissioning philosophies (ought to mode)	*Not applicable.*	*Commissioning philosophy documented and agreed with stakeholders.*	*Commissioning strategy documented and agreed with stakeholders.*
Social and/or community issues (is mode)	Not applicable.	Interested and affected parties consulted and verbal agreement reached on social issues.	Interested and affected parties consulted and written agreement reached on social issues.
Social and/or community issues (ought to mode)	*A preliminary summary of potential SHE/EIA issues for technical alternatives was completed.*	*EIA includes business specific environmental impacts that were pro-actively identified and incorporated into the design; EIA is ready to be submitted to the authorities.*	*Final authorisation from relevant authorities was obtained; all aspects that influence the design were identified and included in the design; the environmental management plan is available for execution.*

The importance of this piece of project work, whereby the team ensured that the front-end application (even though not normally part of a DW project) captured appropriate data, highlights that a successful BI system is more than a good DW. Successful BI requires, as Inmon (2005:60) rightly states, more than only appropriate architecture and infrastructure, but also supporting and enabling processes. It also emphasises that: BI professionals must focus firstly on the business needs and user requirements, rather than to primarily focus on the technology and technical aspects (Popovič *et al.*, 2012:738; Yeoh & Koronios, 2010:31). In this instance, the application of CSH resulted therein that the business analyst (the researcher) analysed the embedded performance measures of the system and it was improved upon, rather than merely automated.

8.5.3.2 The input mechanism in the front-end application

The input criteria and associated response levels ought to be uncomplicated and transparent. The user interface ought to be simpler, easier to use and easier to understand. Table 8-4 below illustrates how the user interface can be simplified by coupling the status questions with a specific deliverable and posing it in the form of a direct question with three possible responses, i.e. yes, no, or not applicable (n/a). This way incomplete deliverables could be easily identified by simply filtering the questions with ‘no’ responses.

Table 8-4: Extraction of a simplified user interface

	Gate deliverable (element)	Required status at assessment point 3:	Status	Comments
1	Alternative evaluation	There is a clear understanding and agreement across the organization what **value measures and trade-offs** will be used for decision making.	TRUE	
2	Alternative evaluation	A method such as a peer review was used to test for and eliminate **bias in the data** whilst **value of** gathering additional **information** has been formally evaluated together with stakeholders and/or functional/line managers.	FALSE	

	Gate deliverable (element)	Required status at assessment point 3:	Status	Comments
3	Alternative evaluation	A wide range of **business options** were **considered** e.g. non-capital options, project delay, buy service over the fence, JV, rent service etc.	TRUE	
4	Alternative evaluation	**Business alternatives** were creatively generated by seeking external input, i.e. outside of the company and industry rather than inside the work team and the SBU.	N/A	
5	Alternative evaluation	Reasoning behind the selection of the specific business alternative is understood by team and decision makers; it is documented.	TRUE	
6	Business plan	Preliminary assessments of **competitors' value chain** and cash costs were made and compared to this proposal.	TRUE	
7	Business plan	**Plant capacities** design rate, on-stream factors, product yields (saleable products per year) were based on documented assumptions.	TRUE	

The required status at the assessment points (as reflected in Table 8-4 above) is derived from the improved ideal levels of definitions of the elements (as described earlier in this chapter) where the project team worked with the industry best practice experts to derive appropriate levels of definitions for the elements – this is discussed in Section 8.5.3.1 above.

8.5.4 Improvement in the decision support (output) information

Figure 8-5, Figure 8-6, and Figure 8-7 below are examples of new decision support reports that could be extracted from the improved BI system. By simplifying the embedded metrics the information could be extracted and modelled in various views.

Figure 8-5 is an example of a report that uses the data from the DW (where the data from the front-end application is integrated with data from other business processes to be represented as integrated decision support information) that indicates for example that this project's business plan is only 87% complete (and hence still required 13% of work to be viewed as complete enough for the project to receive funding for further development work). Another significant deficiency that this report indicates is for example that the project's schedule is only 75% complete (and hence still required 25% of work to be viewed as complete enough for the project to receive funding for further development.

The same argument is applicable to all the other elements on the graph that indicates development gaps; the discussions of all of these are beyond the scope of this study but it is important to note that this graph shows various deficiencies in the project's performance contradicting the information that stemmed from the historical system (refer to Table 8-1 in Section 8.3.4.2 above).

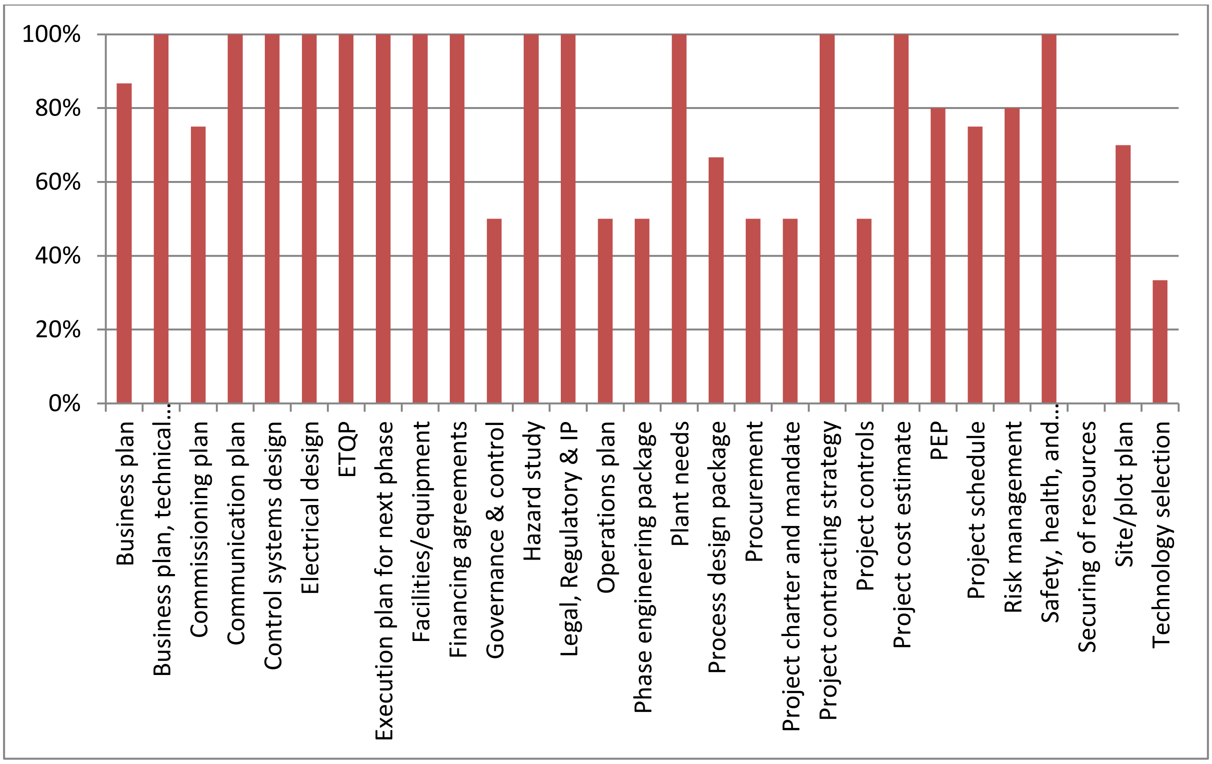


Figure 8-5: Decision support information that indicates development gaps

Figure 8-6 below shows a report generated by the new system. It gives an overview of a business unit's projects per location, project driver, end of job cost etc.; it shows integrated data from a number of different business processes, e.g. contracting, project tiering, costing, contractor management, and project planning.

Business unit	<BU>
Project location	<Location>
Project driver	<Cost / Schedule / Other>
End of job cost	<EOJ cost>
Internally managed project	<Yes / No>
Contracting strategy for this phase	<Strategy>
Main contractor for this phase	<Contractor>
Contractor rating from supplier management	<Rating>
Contractor rating from project team	<Rating>
Reasons for rating: <supporting comments>	
Project Tier rating	<Tier>
Special Tier rating factors: <supporting comments>	

Figure 8-6: Management report generated from information in the data warehouse

Figure 8-7 also displays integrated data from four different business processes to indicate four integrated factors pertaining to a project's performance, i.e. positive working relations within the project team (refer to the first block called "Team"); the gate readiness process (the business process relating to this study is depicted in the second block called "Process"; the number of scope changes that this project was subjected to already (refer to the third block called "Scope"); and the overall estimated competitiveness of this project relative to other projects in the portfolio (refer to the fourth block called "Competitiveness").

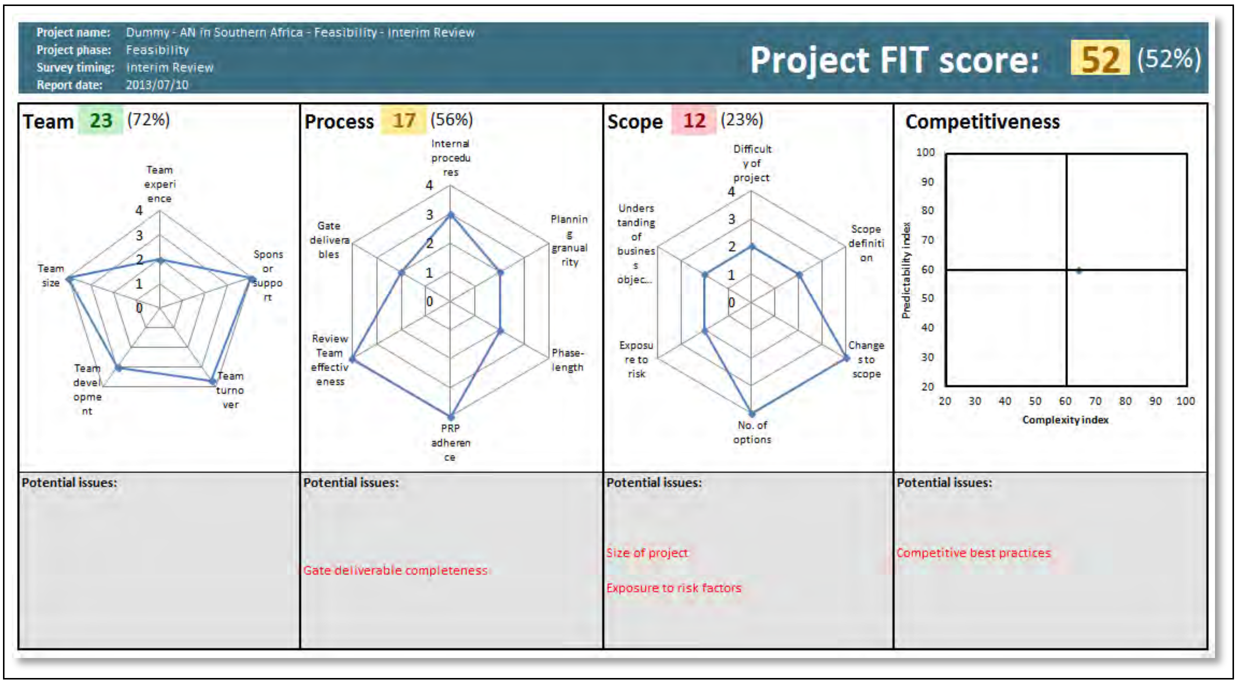


Figure 8-7: Management report generated from information in the data warehouse

8.6 Deployment, maintenance and growth

Upon completion of the new BI system, it was populated with historical data from the old system; the historical data was then compared with results received from the benchmarking company for specific projects in the portfolio. The new BI system informed decisions appropriately, as it confirmed the results of the benchmarking company. The figures below illustrate one example where a decision was better informed: Figure 8-8 shows benchmarking information for a project in the organisation's portfolio; they indicated development gaps for this project. Figure 8-9 and Figure 8-10 shows how the historical system failed to show any development gaps. Lastly, Figure 8-11 shows how the new system confirmed the development gaps as was indicated by the benchmarking company in Figure 8-8.

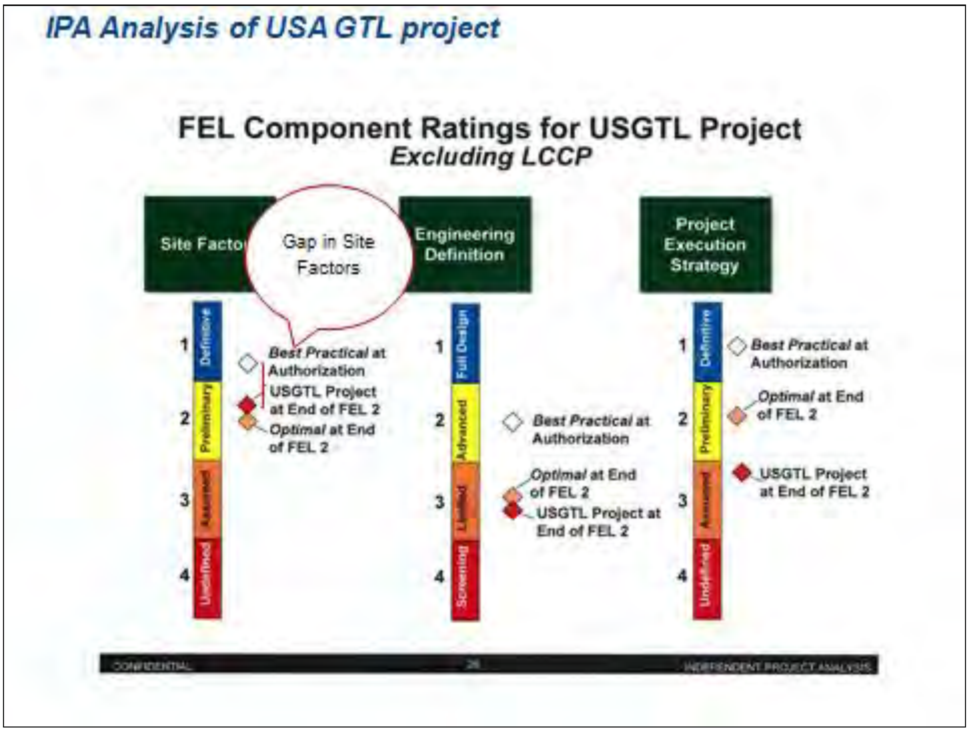


Figure 8-8: Information from benchmarking company indicating development gaps

Original PDRI: USA GTL

Front End Loading: USA GTL project

Track	Score	Index	Comment
Total	396	99	Acceptable
Business	84	112	Acceptable
Engineering	232	97	Acceptable
Project	80	94	Acceptable

Figure 8-9: Historical system contradicting benchmarking company's information

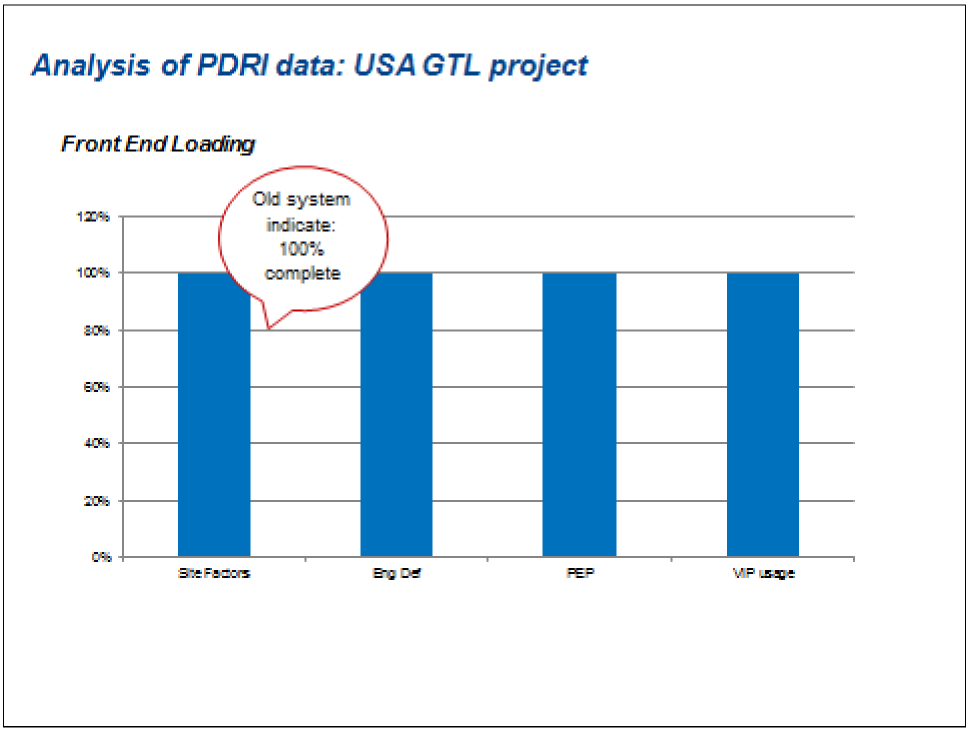


Figure 8-10: Old BI system contradicting the benchmarking company's information

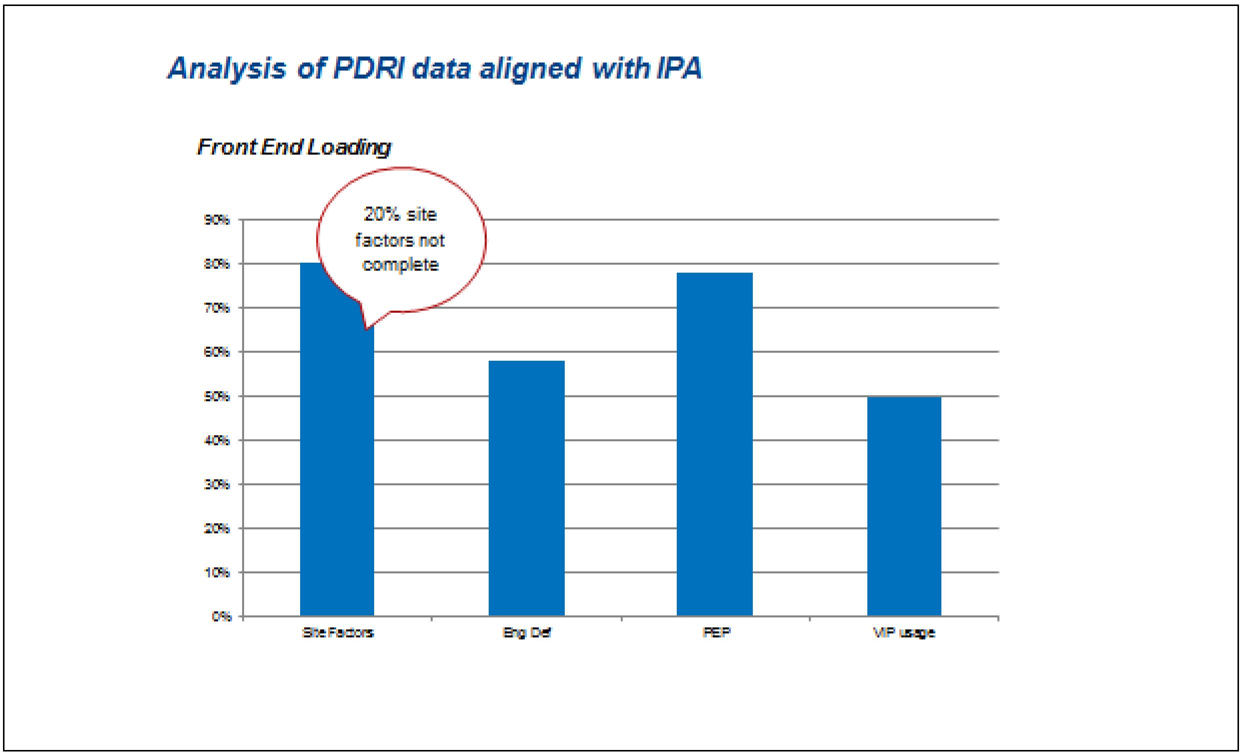


Figure 8-11: New BI system confirming the benchmarking company's information

After completion the system was evaluated to ensure that it appropriately supported the business process, and appropriately informed the required decisions (and approved to be functionally and technically suitable). The business analyst took responsibility to ensure the functional and technical suitability of the system. The system was then rolled out to the users.

Continuous maintenance and growth of this system is beyond the scope of this study.

8.7 Evaluation: the new system

As was indicated in Chapter 5, where the background of the failed historical BI system was discussed, a benchmarking company indicated that this organisation's projects were not planned effectively and efficiently. This was regardless of the fact that the information that stemmed from the organisation's historical BI system indicated only minimal deficiencies on a very small number of projects – refer also to Table 8-1 in Chapter 8 of this report. The historical system – refer to Chapter 5 for the detailed discussion – therefore inappropriately informed strategic decisions as this system portrayed that projects that were actually deficient, were at an acceptable level of development. Insight gained from the participant's responses, when they reflected on the CSH boundary questions, compelled the researcher (as the business analyst) to 'dig deeper' into the associated business process that was supported by the BI system. Consequently, the business process and its embedded metrics and data capturing mechanisms, were scrutinised and improved before development of the new system commenced. The new system informed decision appropriately – refer to the previous section. The next section discusses the system in terms of user acceptance.

8.8 Evaluation: user acceptance of the new system

To evaluate the success of the problem solving cycle the researcher invited a number of users to participate in an informal survey. The organisation was undergoing a major restructuring in terms of personnel reductions at the time of the research. For this reason, the researcher was unable to get permission to conduct a formal surveyed assessment amongst all the users of the new BI system. However, she invited 7 users to participate in an informal survey (out of a total of approximately 20 users); the survey was distributed via the electronic mail system. Of the 7 invitees, 4 users responded to the survey. These participants were not part of the project team as was discussed in Section 8.2.1 of this chapter. The detailed responses are captured on a separate compact disc (CD); their responses are summarised and analysed in the next section.

8.8.1 User acceptance of the new system

The business process and historical system's front-end application was perceived as bureaucratic and hence the users had a negative perception of the system (refer also to Section 8.3.3.1 and Section 8.3.8.1 earlier in this chapter). As a result, the system was populated with inaccurate data that resulted ultimately in inaccurate decision support information. Since these facilitators also presented the decision support information to the relevant decision makers, they were also cognisant of decision makers' perception of the new system.

The survey aimed to determine whether the new BI system provided relevant decision support information, i.e. inform relevant management decisions as was intended when it was designed. Then, it aimed to determine whether the perceived bureaucracy of the historical system was removed by the new BI system (i.e. is it easy to use). The survey also aimed to determine whether the associated new (simplified) business process and front-end application that supports the DW were incorporated seamlessly (i.e. transparently and without adding to users' work load). Lastly, users were given the opportunity to note any additional benefits and give general comments. The following questions were thus included in the survey:

1. Does the new system (data warehouse component) inform the relevant management decisions as per its intended purpose?
2. Is the system easy to use?
3. Is the performance metrics embedded in the system's front end transparent enough?
4. Does the system support the gate keeping process without adding unnecessarily to the work load of its users?
5. What additional benefits (if any) did you gain from using the new system's front end?
6. Respondents were also invited to give general comments.

The identified stakeholders responded positively to the new BI system. The users that responded to the e-mailed survey work closely together; they discussed the survey questions and responses amongst each other. Their responses are summarised in Section 8.8.1.1 below; the researcher reflects on the data in Section 8.8.1.2.

8.8.1.1 Data gathered in the survey

Question 1: Does the new system (data warehouse component) inform the relevant management decisions as per its intended purpose?

- Respondent 1: “ es, as it identifies the deliverables where a project did not meet the requirements.”
- Respondent 2: “ es, it also brings focus and clear indication of where “burning platforms” exists by means of the associated criticality assessment.”
- Respondent 3: “ es, it indicates if the deliverables were met, at a certain gate.”
- Respondent 4: “yes”

Question 2: Is the system easy to use?

- Respondent 1: “ es for reviewers accustomed to the GRR process, although the functionality of the tool can be further improved”
- Respondent 2: “Certainly easy to use although it has been commented in sessions that some of the questions could maybe be broken down into two or more questions to allow more focus on sub elements of the question. Some participants also suggested that questions should be grouped per track and not be spread throughout. Personally I feel the way it is allows for review interestedness as opposed to a per track focus.”
- Respondent 3: “ es, it is easy to use.”
- Respondent 4: “yes”

Question 3: Is the performance metrics embedded in the system’s front end transparent enough?

- Respondent 1: “ es, although there will always be issues that people want to debate. There is also always scope to improve on the detail.”
- Respondent 2: “I agree with [name removed for confidentiality purposes]’s comment.” – This is referring to the response of respondent 1.
- Respondent 3: “ es, and it can also be used for small projects.”
- Respondent 4: “Not sure”

Question 4: Does the system support the gate keeping process without adding unnecessarily to the work load of its users?

- Respondent 1: “ es”

- Respondent 2: “ es”
- Respondent 3: “ es, it decreases the time spent, to execute a gate keeping session.”
- Respondent 4: “If applied correctly, yes”

Question 5: What additional benefits (if any) did you gain from using the new system’s front end?

- Respondent 1: “The focus now shifts more towards a debate on the criticality of the identified gaps. Although experienced reviewers always emphasised that the old PDRI tool was more about the process than the score obtained, unfortunately project teams tended to focus heavily on the score”
- Respondent 2: “Removing the scoring and weighting was a major improvement as it provided a false sense of compliance and it shadowed focus on potentially critical shortfalls.”
- Respondent 3: “It is easy to use. The new front end enables the users to decrease the time spent to execute this process.”
- Respondent 4: “Great management info – informs sponsors”

General comments by respondents:

- Respondent 1: “The front end generally retained the positive issues present in the old PDRI tool and makes the integrated review session less complicated allowing time to debate the real issues”
- Respondent 2: “A positive Gate review is dependent on having the right people (team and reviewers) present; following the principles of the review process and all supported by the most efficient tools. The tool (user interface) is definitely of value in this regard. The tool will become even more valuable if we can manage to get the preceding deliverable quality assurance sorted out – no gate review tool should be expected to cater for that too. To repeat [full name removed for confidentiality purposes - referring to a comment made by Respondent 1]’s comment to an extent – the tool does not determine the quality of the review outcome – this is obviously determined by the quality of review participants and their preparation.”

- Respondent 3: “It increases productivity. The facilitator must encourage the use of this to enhance a positive participation from the project teams (end user).”
- Respondent 4: “Keep up the good work!”

8.8.1.2 Insight gained from the data

The informal survey indicated that they agreed that the data warehouse component of the system achieved its purpose to: “inform the relevant management decisions as per its intended purpose” (question 1). Respondent 1 said that “it identifies the deliverables where a project did not meet requirements”. Respondent 2 also said that it “brings focus and a clear indication of where “burning platforms” exist by means of the associated criticality assessment”. Respondent 3 also agreed that “it indicates if the deliverables were met”. Thus, the BI system informed relevant decisions required by this business process in terms project performance – refer to Chapter 5 for more detail on the business process.

Users also asserted that it was “easy to use” (question 2) and thus improved the way that they worked, for example respondent 2 said that “[r]emoving the scoring and weighting was a major improvement as it provided a false sense of compliance and it shadowed focus on potentially critical shortfalls” and respondent 4 asserted that the system provides “[g]reat management info[rmation]”. Users felt emancipated by the system’s new front-end; they stated that it “makes the integrated review session less complicated allowing time to debate the real issues” (respondent 1); it also “increases productivity” and “enhance a positive participation from the project teams” (respondent 3). Hence, barriers regarding perceived bureaucracy were reduced (refer for example to Section 8.3.3 and Section 8.3.7 earlier in this chapter).

8.9 Specification of learning: practical area of concern

In terms of the problem solving cycle (discussed in Chapter 5) the identified problematical situation was improved. The new BI system realised business benefits as it informed decisions appropriately (refer to Section 8.6 above). Users responded positively to the new system (refer to Section 8.8 above).

8.10 Specification of learning: methodology

The CSH guidelines were effectively applied as part of the Kimball lifecycle. The BI system was still developed according to the intended technical approach. However, the application of the CSH boundary questions during the requirements definition phase highlighted a number of crucial requirements that would've not been surfaced if this project team simply continued with their original task of only automating the old BI system and improving its technological platform. Refer to Figure 8-12 below for the positioning of the CSH boundary questions in the Kimball lifecycle.

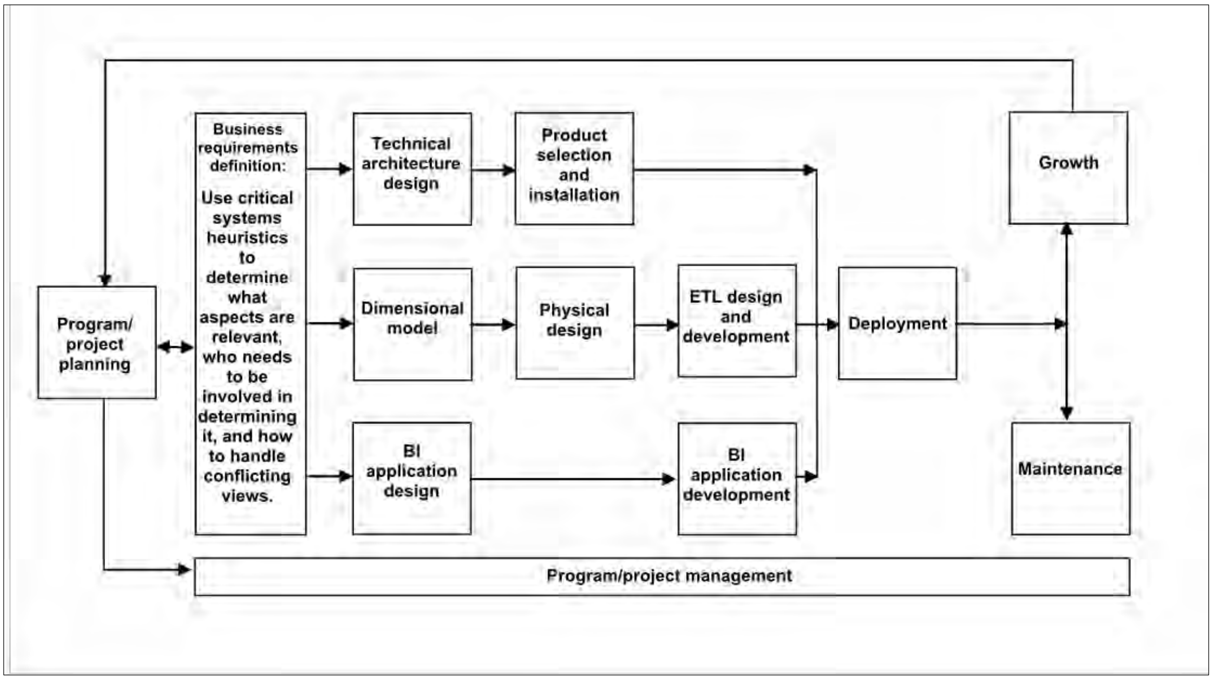


Figure 8-12: Positioning of the CSH guidelines in the Kimball lifecycle diagram

In terms of the research cycle (refer to Chapter 5) the researcher concludes that the broader problem context was improved. On a philosophical level, the normative content of the new BI system was determined, according to the work done by Ulrich (1983:258), to describe the BI system's bases of: motivation, power, knowledge and legitimacy. These are discussed in Sections 8.10.1 to 8.10.4 below.

8.10.1 CSH: the basis of motivation of a business intelligence system

The question regarding the client/beneficiary of the system highlighted conflicting views between the end-users of the system (those that populate the source data as represented by participants P3 and P4) and the senior managers in the organisation (the recipients of the output, i.e. the decision support information as represented by participants P1 and P2); these conflicts had to be resolved to ensure that the system is accepted by both stakeholder groups.

The questions about the purpose and measures of success/improvement of the system revealed some root causes of the bias and lack of integrity in the organisation's source data and decision support information; it also exposed a gap between the input data and output information where decision support information were manually edited to fill the gap and decisions were thus indirectly manipulated. The business process was thus flawed; this had to be revised first.

8.10.2 CSH: the basis of power of a business intelligence system

The decision maps highlighted inadequacies in the KPIs applied to transform source data into decision support information. The resources and conditions maps provided a platform whereby to analyse the inherent flaws of the old system in terms of its front-end as well as embedded KPIs in the data warehouse. For example, it showed that the front-end was difficult and cumbersome to use; it revealed some root causes of the perceived bureaucracy of this system and the process supported by it. Knowing what did *not* work and *why* it did not work in the previous system gave the design team a starting point to design towards *improvement* rather than mere automation.

8.10.3 CSH: the basis of knowledge of a business intelligence system

The questions about the experts and expertise to be consulted and included during the design process highlighted shortcomings in the design team of the historical system; it also indicated who to involve in the design of the new BI system. It made explicit the required expertise for the new BI system from the business perspective.

These analyses clearly highlighted the need for both business and technical experts to be included in the design team. It also showed deficiencies in the actual development process of the historical decision support system, to be provided for during the development of the new BI system so that the team does not 'repeat mistakes'. These concerns could be addressed in the design of the new system; the designers of the new BI system recognised that they had to design the system in such a manner that it prevents possible reappearance of these organisational issues.

8.10.4 CSH: the basis of legitimation of a business intelligence system

The participants were unsure about the actual and ideal witnesses, as well as the emancipation maps. They knew that the original system did not emancipate them; in the "ought to" scenario, they also intuitively knew that stakeholder and requirements analysis need to be done appropriately for the new BI system. The researcher did not ask the participants to answer the question regarding the worldview. However, the two stakeholder groups that were involved as participants revealed this through their answers. Accurate decision support information was the driving force for the managerial employees; an easy executable business process was the driving force for the operational employees.

8.11 Specification of learning: reflect on the research cycle: framework of ideas

In this intervention the researcher, as the business analyst, applied the classic CSH guidelines to a BI system development project. Users of the BI system were emancipated by the application of the guidelines (the BI system was successful and empowered them in their improved decision making capabilities); in addition, the capturers of the front-end data were also emancipated as the system enabled them to capture data effectively without adding to their work load.

The development team derived a complete set of business requirements that enabled the development of an efficacious BI system and the application of CSH enhanced the development of this BI system. However, when reflecting on the CSH guidelines applied, the researcher realised that: even though the intervention was successful, she spent a significant amount of time explaining the *intent* of the boundary questions during her interactions with the rest of the team.

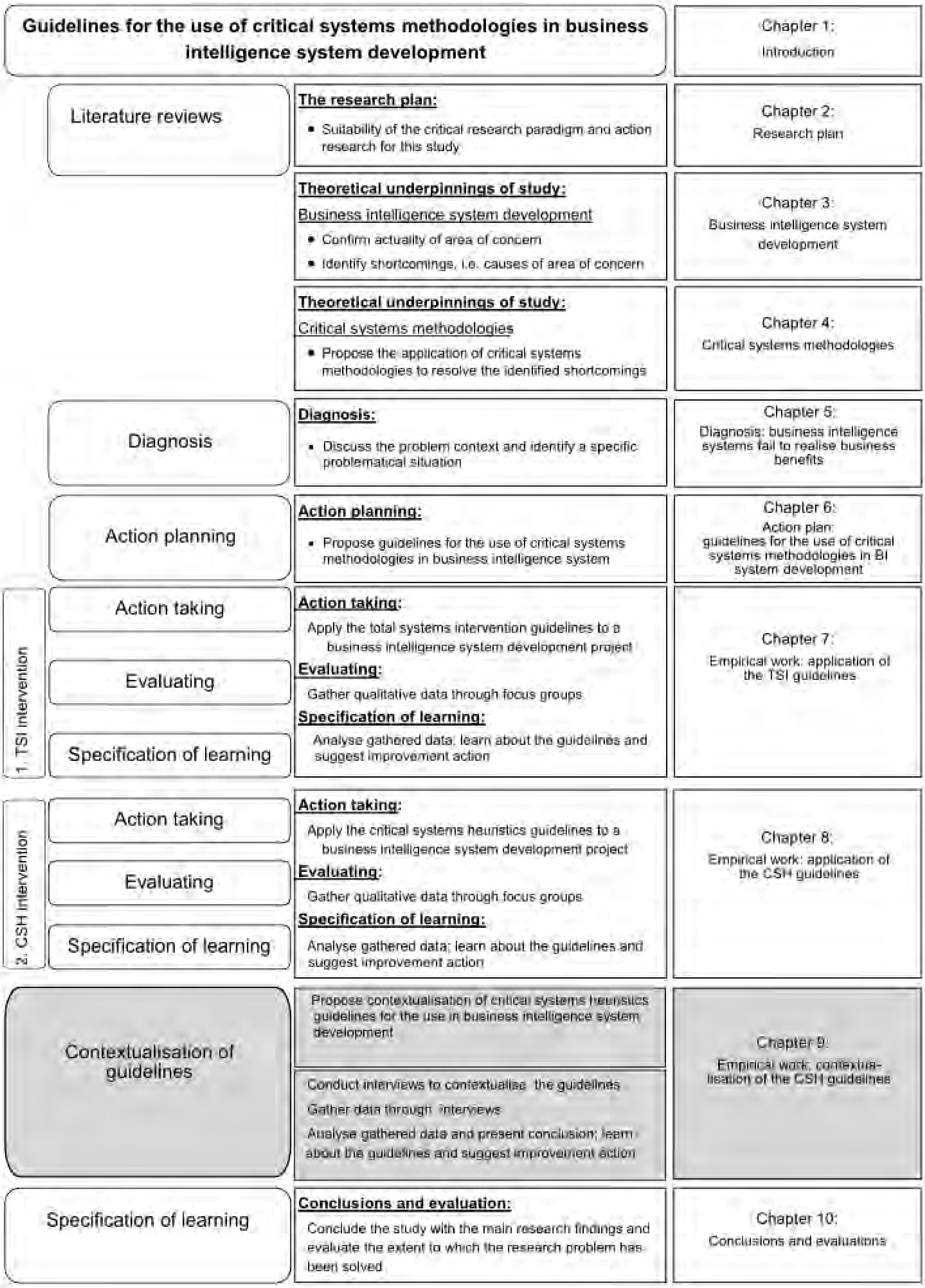
Consequently, to contextualise the boundary questions, a third action research cycle commenced where the researcher attempted to contextualise the boundary questions for a BI context. These questions may then be applied to improve the completeness and quality of the derived set of business requirements. This is discussed in detail in the next chapter of this study.

8.12 Summary

This chapter discusses the action taking and evaluation phases of this action research study; the researcher, as the business analyst, applied the CSH guidelines (as was proposed in Chapter 6) to a BI system development project. This project was originally intended to merely automate the business process and improve the technological platform so that managers could have assurance that they receive non-edited (automated) reporting. However, the application of the CSH boundary questions surfaced new requirements; it highlighted deficiencies in the associated business process and embedded key performance measurements. Improvement of these resulted in a successful BI system that realised business benefits.

In reflecting upon the methodology, the researcher realised that she spent a significant amount of time to contextualise the boundary questions for the participants. She therefore contends that the CSH guidelines could be contextualised for a BI perspective, by contextualising the boundary questions specifically for a BI context. This is discussed in the next chapter.

The next chapter discusses the process whereby the CSH boundary questions are contextualised for a BI context.


Guidelines for the use of critical systems methodologies in business intelligence system development
Chapter 1: Introduction
Literature reviews
The research plan:
Suitability of the critical research paradigm and action research for this study
Chapter 2: Research plan
Theoretical underpinnings of study:
Business intelligence system development
Confirm actuality of area of concern
Identify shortcomings, i.e. causes of area of concern
Chapter 3: Business intelligence system development
Theoretical underpinnings of study:
Critical systems methodologies
Propose the application of critical systems methodologies to resolve the identified shortcomings
Chapter 4: Critical systems methodologies
Diagnosis
Diagnosis:
Discuss the problem context and identify a specific problematical situation
Chapter 5: Diagnosis: business intelligence systems fail to realise business benefits
Action planning
Action planning:
Propose guidelines for the use of critical systems methodologies in business intelligence system
Chapter 6: Action plan: guidelines for the use of critical systems methodologies in BI system development
1. TSI intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the total systems intervention guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data; learn about the guidelines and suggest improvement action
Chapter 7: Empirical work: application of the TSI guidelines
2. CSH intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the critical systems heuristics guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data; learn about the guidelines and suggest improvement action
Chapter 8: Empirical work: application of the CSH guidelines
Contextualisation of guidelines
Propose contextualisation of critical systems heuristics guidelines for the use in business intelligence system development
Conduct interviews to contextualise the guidelines
Gather data through interviews
Analyse gathered data and present conclusion; learn about the guidelines and suggest improvement action
Chapter 9: Empirical work: contextualisation of the CSH guidelines
Specification of learning
Conclusions and evaluation:
Conclude the study with the main research findings and evaluate the extent to which the research problem has been solved
Chapter 10: Conclusions and evaluations

Chapter 9 : Results from empirical work: contextualisation of the critical systems heuristics guidelines for business intelligence system development

9.1 Introduction

The objective of this study is to develop guidelines for the use of critical systems methodologies to improve the development of business intelligence systems. The researcher identified an area of concern within a research theme (refer to Chapter 5), proposed guidelines within the critical systems thinking paradigm (refer to Chapter 6) and then applied the proposed guidelines in a business intelligence system development project (refer to Chapter 7 and Chapter 8). The total systems intervention guidelines could not be applied successfully (the TSI intervention is discussed in Chapter 7). The CSH intervention, where the critical systems heuristics guidelines were applied as part of a business intelligence system development project, was successful; this is discussed in Chapter 8. Upon reflection on the CSH intervention, the researcher realised that it may be beneficial for business intelligence practitioners if the boundary questions are contextualised specifically for a business intelligence context. This chapter discusses the contextualisation of the critical systems heuristics boundary questions for a business intelligence system development context.

This chapter is structured as follows: Section 9.2 discusses the motivation to contextualisate the boundary questions. Section 9.3 discusses the participants. Data collection is discussed in Section 9.4. Data are presented and analysed in Section 9.5. Section 9.6 summarises the boundary questions for a business intelligence context. The contextualised boundary questions are evaluated in Section 9.7. Section 9.8, Section 9.9, and Section 9.10 discusses the specification of learning in terms of the FMA framework.

9.2 Motivation to contextualise the boundary questions

Action researchers are confronted with a dual goal: they must develop a solution to a practical (specific) problem that is valuable to the recipients of their solution (such as organisational employees) during the *research cycle* of action research; simultaneously, they must also develop theoretical knowledge that is valuable to a research community that is interested in the broader problem context during the *problem solving cycle*, as is applicable to action research (Mathiassen *et al.*, 2012:348). Following an action research approach "involves the researcher immersing himself or herself in a human problem situation and following it along whatever path it takes as it unfolds through time" (Checkland & Holwell, 1998:22); this (still) happens within a declared-in-advance epistemological framework of ideas (F) that may, through this process, be modified or even (in extreme cases) abandoned (Checkland & Holwell, 1998:22).

Chapter 8 of this study describes how the researcher applied CSH guidelines to improve the development of a BI system. The practical solution (i.e. the BI system) that was developed was valuable to the recipients of the system (refer to Chapter 8). In terms of the research cycle (refer to Chapter 5) the broader problem context was also improved; the researcher learnt that the boundary questions enabled her to determine the normative content of the new BI system, according to the work done by Ulrich (1983:258), to describe the BI system's bases of: motivation, power, knowledge and legitimacy – refer to Chapter 8 for the detailed discussion. However, potential for further research was identified, i.e. to contextualise the classic CSH boundary questions to be applicable specifically to BI system development context; this can enable BI practitioners that do not necessarily have knowledge of CST and systems ideas, to apply the boundary questions. This is discussed in the next sections in terms of the problem solving cycle and research cycle of action research.

9.2.1 The problem solving cycle

Upon reflection on the previous intervention, the researcher realised that she spent a significant amount of time explaining the *intent* of the (classic) CSH boundary questions during her interactions with the rest of the team that was involved with the development of the BI system. The relevant *problem solving cycle* is thus that developers of BI systems do not necessarily have sufficient theoretical knowledge of a critical systems methodology such as CSH; they are therefore unable to apply it within the limited time frame available to derive business requirements for such a system. The classic CSH guidelines may therefore be contextualised to enable developers to apply them intuitively as part of the development approach when developing a BI system.

9.2.2 The research cycle

In contextualising the boundary questions for a BI context, one must remain mindful of the original intent of the original questions. The intentions of the original questions must remain intact. However, the specific words that Ulrich (1983) used when he phrased the classic CSH questions may have different (limiting) meanings when applied in a BI context. As was eluded to in Chapter 8, the team members were only able to provide valuable inputs when they reflected upon the boundary questions once they understood the intent of the classic CSH questions and interpreted them (with the help of the researcher) for a BI scenario. Therefore, the researcher elected to apply theoretical knowledge regarding CSH to refine the classic CSH boundary questions in such a manner that they are specifically applicable (and to a large extent self-explanatory) when applied during the business requirements phase of a BI system development project. In contextualising the boundary questions, the researcher aims to gain practical insights by discovering new theoretical knowledge (in the form of contextualised BI specific boundary questions) that can be applied to inform future research. The intended practical outcome is boundary questions that are applicable specifically to a BI system development context.

The action researcher aims to establish the target for change and outlines the approach to change (Baskerville & Wood-Harper, 1996:238). Core concepts from critical social theorists guide action research interventions (Myers & Klein, 2011:25). Thus, an action researcher must develop theoretical assumptions about the problem context (that the classic CSH boundary questions are difficult to understand when one does not have theoretical knowledge about CSH) to guide the intervention. To improve upon this shortcoming, the researcher applies theoretical concepts from Peter Checkland; he applied the soft systems methodology (SSM) to refine SMM through an action research process (Checkland, 1981). For this purpose he said that, in considering the FMA-illustration (refer to Figure 9-1 below): "F is the set of system ideas informing the methodology, M is the classic representation of SSM as a learning system…; and that representation, together with all of its internal techniques, provides an epistemology in terms of which the research findings can be expressed; this yields the required recoverability with respect to a specific piece of research and also allows for the development of the approach over time through changes to F and M" (Checkland, 2011:500).

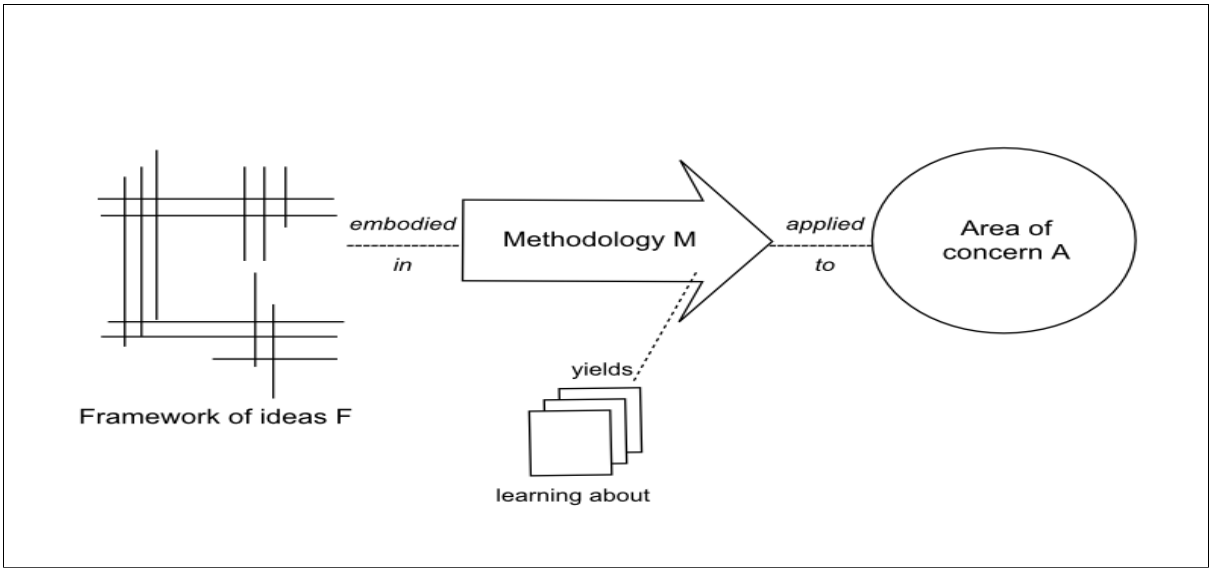


Figure 9-1: FMA illustration (Checkland & Holwell, 1998:23)

9.3 Participants

In this intervention the researcher elected to identify participants that are involved with different aspects of BI to interview; she interviewed them (individually during a one-hour interview) using the classic set of boundary questions as the interview questions. The researcher interviewed a total of ten participants to gather data. The business unit of the organisation where the research was conducted had a small team of people (sixteen in total) that worked in the field of BI; ten of these employees agreed to participate in this research. The participants were part of the organisation where the research, as written up in the previous chapters, was conducted. However, they were not part of these previous research interventions – refer to Chapter 7 and Chapter 8 of this study.

The participants included stakeholders from the following user communities: two data capturers (participants P1 and P6); three business intelligence practitioners (P2, P3 and P7); two business analysts (P4 and P9); and three senior managers that apply decision support information from business intelligence systems to enable strategic decisions (P5, P8 and P10). The participants are numbered in the order that they were interviewed. The experiences and highest qualifications of the participants in the organisation (as obtained from the organisation's Human Resources register of the organisation) are listed below:

- P1: 12 years as a data capturer in the project-portfolio investment group; B.Tech. (IT);
- P6: 9 years as a data capturer and reporting analyst in the project-portfolio investment group; Technical diploma: data analysis and reporting;
- P2: 12 years as a BI practitioner that were responsible for the overall BI architecture in this business unit; B.Sc. (IT);
- P3: 19 years as a BI practitioner involved with the BI architecture in this business unit; B.Sc. (IT);
- P7: 13 years as a BI practitioner involved with the BI architecture in this business unit; MBA;
- P4: 6 years as a business analyst deriving business requirements and translating that to business requirements specifications for software development projects; MBA;
- P9: 7 years as a business analyst deriving business requirements and translating that to business requirements specifications for software development projects; B.Com (IS);
- P5: 24 years as a capital investment decision maker; B.Sc. (Industrial Engineering);
- P8: 12 years as a strategic governance (risk-related) decision maker; MBA; and

- P10: 19 years as an operational resourcing decision maker; MBA.

Refer to Section 9.4 for a discussion on the data collected from these participants; data are presented and analysed in Section 9.5. Section 9.6 summarises the contextualised boundary questions.

The contextualised questions were then evaluated by interviewing an additional participant (a BI expert) that was not involved in the process of formulating these questions with the contextualised set of questions. As a BI practitioner, this participant was not familiar with CSH; she does not have knowledge of systems ideas in the CST paradigm. She was also not an employee of the organisation where the research was conducted. The aim of this interview was to determine whether the BI practitioner understands the questions clearly (i.e. the questions and the terminology contained in them are unambiguously clear to the BI practitioner), and whether she views the questions as logical and useful to apply when deriving requirements. This is discussed in Section 9.7.

9.4 Data collection

During one-hour (individual) interviews, the researcher explained the intent of each question to the participants; and then asked the participants to reflect on these questions to determine possible answer(s) to the questions in relation to a BI environment. By interviewing various possible stakeholder groups that are involved in and affected by BI systems, the researcher formulated new (contextualised) questions. After each interview the researcher documented the relevant participant's responses and e-mailed it back to him/her; the participant was then requested to confirm (by responding to the e-mail) that his/her responses were captured accurately - refer also to the separate compact disc (CD) that accompanies this document for detailed records of these.

Data were gathered by asking the participants to reflect on the critical systems heuristics (CSH) boundary questions for a business intelligence (BI) system development context. The researcher explained the purpose of the boundary questions to the participants in order to remove the perceived ambiguity of the classic CSH terminology when applied in a BI context. Then, she asked them to answer each of the boundary questions by reflecting on a BI system, and to reflect on the following aspects for each of the CSH categories (i.e. motivation, power, expertise, and legitimation) as per the work of Ulrich (1983:258): firstly, the social roles affected by a BI system; secondly, the role-specific concerns of the specific category with regard to a BI system; and thirdly, the crux of the BI system. These categories allow a problem solver to determine the relevant: clients/beneficiaries; decision makers; planners; and witnesses to be affected and/or involved in developing a purposeful BI system for a specific organisational context.

The reader is reminded that the classic CSH framework was originally designed for a social-political context; for example, where a planner refers to the role of specifically an engineering/architectural planner such as a town planner (Ulrich, 1983:251). The researcher derived a contextualised boundary question using the insight gained from the participants' perspectives. Through the explanation of the questions the researcher intended to: invoke a broader understanding of the terms; and identify a broader stakeholder community whom should be associated with the role categories.

All the participants were assured that their inputs would be treated as confidential – refer to Appendix A for the confidentiality agreement where the researcher undertook that participants will remain confidential and that participants may choose not to participate in the study. All the participants' original feedback is captured separately on a compact disc (CD). Their feedback is discussed in the next sections.

9.5 Data presentation and analysis

Checkland & Holwell (1998:22) describe action research and argue that, in researching social contexts, "[a]n alternative view is that social reality – what counts as 'fact' about the social world – is continually being constructed and re-constructed in dialogue and discourse among human beings, and in action which they take". They therefore argue that, in researching social reality, it "becomes an organized discovery of how human agents *make sense of* their perceived worlds, and how those perceptions change over time and differ from one person or group to another" where "[t]hat kind of researcher does not expect to discover unchanging 'social laws' to set alongside the laws of physics", but rather abide by the nature of interpretive research methods to position our (intersubjective) knowledge of reality as a social construction of human actors, of which the researcher is also part. The insight gained from participants' perspectives on the classic boundary questions enabled the researcher to formulate BI-specific contextualised boundary questions. It is discussed in the next sections.

9.5.1 Who is (ought to be) the client?

The aim of this question is to determine whose interests are (should be) served through the design or improvement of the system (Ulrich, 2005). The client motivates the design (and hence the existence) of the system; it reveals the social role(s) of the sources of motivation for the system to be designed (Ulrich, 1983:258). This question aimed to determine who the interviewees viewed as the primary clients and/or beneficiaries of BI systems.

9.5.1.1 Client map of a business intelligence system

The following responses were received from the interviewees regarding the question: who is or ought to be the client or beneficiary; the participants' views on the client of a BI system were as follows:

- P1: "The decision makers of the business; they may be at any level in the organisation."
- P6: "Decision makers on all levels in an organisation."
- P2: "Executive management must take ownership of BI; it is driven by the decision support reports by management. End-users supply (populate) the data by doing their normal daily jobs and by performing their operational (transaction) tasks. This should not be an additional effort for end-users; the population of data should be entrenched in their daily activities. Base systems consist of the data populated through the above mentioned activities; there is a "disconnect" when management are not aware of the content hereof

and hence require information that cannot be derived from the data in these base systems. Base systems are then populated with unnecessary data that adds to the workload of end-users. E.g. the project-portfolio database contains approximately 60% of unrequired fields that were created as a result of this."

- P3: "This is dependent upon the reason for the system being developed. So, the client should be the person that is the end-user of the system; the client, can, however, become a different or another client as time goes on. For example, looking at the data that I asked from you (Carin) the other day regarding the [name of the system removed to ensure confidentiality] – it was not developed for me but I ended up as the user of the system."
- P7: "The group of people that makes investment decisions, i.e. the clients are the recipients of the information. The group of people that must populate the system with information are also clients."
- P4: "All layers of the business use BI systems; the business impact of BI filters down to all organisational levels. The lowest level (data-capturer) must also get value from the system otherwise he/she will not effectively capture data. The management levels receive decision support information from BI."
- P9: "The organisation benefits when appropriate decisions can be taken based on accurate decision support information. The recipients of the decision support information apply the information to make the right decisions."
- P5: "The shareholders should ultimately benefit; however, the client is the user of the system, i.e. the people generating information to inform decision makers."
- P8: "The business owner, i.e. the person and/or business, which will benefit in terms of monetary/productivity/decision support benefits."
- P10: "The recipients of decision support information, the data capturers and also the executive management/business owners/shareholding entities."

9.5.1.2 Insight gained from the data

The word “client” or “beneficiary” refers, in the context of the classic CSH, to those that contribute (ought to contribute) to direct the planning purpose, i.e. the stakeholders which purposes are to be served by the system that is being designed (Ulrich, 1983:250). In the case of a BI system it is difficult to think about such stakeholders without considering the exact purpose of the system first. It may thus be worthwhile to consider the purpose of the BI system first (and hence ask this question only after that). Nevertheless, the responses to this question revealed that there are (amongst others) two stakeholder groups in terms of clients and beneficiaries of BI systems: firstly, it is “decision makers” (P1, P6) including “executive management” (P2), i.e. the recipients of decision support information (as referred to by P4, P5, P7, P9, P10), “which will benefit” from the information stemming from the system (P8); and secondly it also includes the source data managers such as (in the context of the organisation where the research was conducted source data managers are referred to as those that capture the data): “data-capturer” (P4, P10) that must “effectively capture data” (P4).

9.5.1.3 Contextualised boundary question

Who are (ought to be) the clients of a BI system in terms of diverse stakeholder groups, amongst others: decision makers (such as executive management) that are the recipients of the decision support (output) information; and the managers of the source (input) data?

9.5.2 What is (ought to be) the purpose of the system?

The aim of this question is to determine what are (should be) the goals and/or consequences of implementing the system (Ulrich, 2005). This question must reveal *what* motivates the design (and existence) of the system; the purpose(s) define the specific concerns that the client(s) aim to resolve through the design of the system (Ulrich, 1983:258).

9.5.2.1 Purpose map for a business intelligence system

The following responses were received from the interviewees regarding the question: what is or ought to be the purpose of BI systems, i.e. how should BI systems serve their clients and beneficiaries; the participants' views on the purpose of a BI system were as follows:

- P1: "To provide information to business to make decisions."
- P6: "Translate data into information; this information should enable decision makers to make better-informed decisions."
- P2: "Business intelligence is a tool to be applied to build dashboards. It must also have added functionality to identify problems to enable management to take actions for overall improving the business. BI must enable accurate forecasts once historical data have been gathered and normalised. BI must enable accurate forecasts once historical data have been gathered and normalised, to aid future planning."
- P3: "It should be to facilitate business decision making within a minimum time frame. Also, to facilitate BI that can lead to decision making."
- P7: "Firstly, demonstrate and confirm good governance with regard to investment information. Also, to provide assurance and traceability for auditory purposes, i.e. that a formal process was applied during decision making processes such as the investment decision. To minimise undue exposure to risk."
- P4: "It must enable strategic decision making across the value chain of the organisation and it must enable the business to grow."
- P9: "It enables decisions."
- P5: "To inform decisions; however, information presented should be simplistic and visual. Complex data should thus be assimilated in such a manner that it can be presented simplistically and visually. For example, information should enable decision makers to identify potential problematical areas to be rectified in order to improve quality of decision; information should enable management to make the *right/appropriate* decisions."

- P8: “The system must increase the profit margin as well as the decision support capabilities of the business owner through optimisation, rationalisation and simplification.”
- P10: “To improve the way that organisations do business by supporting (improving) its decision making requirements.”

9.5.2.2 Insight gained from the data

Inmon (2006:8) defines a data warehouse (DW) as a *“su j c r , gr , v v r ”* data source to be used for *“ g ’s c s r c ss s”.* Similarly, Kimball & Ross (2010:104) refer to a DW as *“ h f r f r all forms of business intelligence*”. A BI system is thus a system that must timeously and consistently provide specific, integrated decision support information. This is echoed by the participants’ responses that indicated that the main purpose of a BI system is to “provide information” (P1), “enable decisions” (P9), “increase…the decision support capabilities” (P8) and “inform decisions” (P5) based on “decision making requirements” (P10) of the organisation. A BI system must use “historical data” to enable “accurate forecasts” for “future planning” (P2); “business decision making” must be facilitated “within a minimum time frame” (P3). A BI system must also “[t]ranslate data into information” for “better-informed decisions” (P6). Ultimately, a BI must “improve the way that organisations do business” (P10) and “increase the profit margin” (P8).

The generic purpose of a BI system is thus clearly defined already; however, the specific decisions to be informed by the BI system are not generically definable. Strategic decisions must improve an organisation; the specific decisions to be informed by the BI system (and the time considerations thereof) that is being developed must therefore be considered carefully in the design of a specific BI system. These decisions dictate the quality of the output information as well as the specific data sources to be included in the DW.

9.5.2.3 Contextualised boundary question

What is (ought to be) the purpose of a BI system, i.e. which proactive decisions are (ought to be) enabled by the BI system, so that these decisions improve the organisation's planning abilities timeously (for each identified recipient of decision support information); and what are the base (raw) data from source systems to be incorporated to enable it?

9.5.3 What is (ought to be) the measure of success/improvement?

This question aims to determine how can (should) one determine the consequences that constitutes an improvement (Ulrich, 2005). This question reveals the crux of the system, i.e. it motivates why the client(s) require the system to be designed (Ulrich, 1983:258). This question aimed to determine how a designer can know that an implemented BI system has been successful and that it improved the organisation.

9.5.3.1 Success map of a business intelligence system

The following responses were received from the interviewees regarding the question: what is or ought to be the measure of success or improvement when considering BI systems; the participants' views on the measure of success of a BI system were as follows:

- P1: "When the information supplied is on-time and it is not stale. When we enable business to make the right decisions, i.e. the information that they use must influence business going *forward*. BI must support proactive decision making; it must not merely report on historical data."
- P6: "There ought to be a cost implication in terms of: risks avoided; best alternatives chosen; and increased productivity (day-to-day users of the system). Also, decisions should be taken faster."
- P2: "A data warehouse that contains all the relevant base data and a data model that is flexible enough to derive more than 90% of business reports, including ad-hoc and new requests for reports as new business requirements arise."

- P3: "If the system meets objectives that led to its creation/development. If the person that initiated the development of the system is satisfied then it is successful. However, a new user that starts to use the system at a later stage might have "new" needs and hence adjustments will need to be made; this does not represent failure, but may result in additional functionalities to be requested (evolution)."
- P7: "If it can be demonstrated that information stemming from the system is in fact applied in informing investment decisions. And also to demonstrate good governance."
- P4: "Business intelligence systems' benefits ought to be measured in terms of increased profitability; for example, decisions can be made faster and business decisions are improved."
- P9: "A system that is being used on a continuous basis can be deemed successful."
- P5: "A successful system yields business results to the organisational shareholders, i.e. it preserves/adds value to the shareholders."
- P8: "The system should achieve the predetermined definition of victory. Firstly, the definition of victory should be well-defined and measure (refer to the SMART principles: Simple; Measurable; Attainable; Repeatable; and Timeous). Secondly, the predefined measurement criteria must *remain* the measurement criteria post implementation."
- P10: "The definition of victory and business benefits must be agreed by the owners and/or users of the system, i.e. the recipients of the information. This should be measurable and preferably quantifiable to ensure that realised benefits can be proved to stakeholders."

9.5.3.2 Insight gained from the data

The crux of a BI system is closely related to its purpose. The responses to this question is thus also closely related to the purpose of a BI system: A successful BI system "is being used on a continuous basis" (P9) and provides "on-time" information (P1); the information "enable[s] business to make the right decisions…influence business going *forward*…support proactive decision making"

(P1). A successful BI system has a "data warehouse that contains all the relevant base data and a data model that is flexible enough" (P2). It "inform[s]…decisions" (P7), enables "decisions…taken faster" (P6) and "decisions [that] can be made faster and business decisions [that] are improved" (P4) so that it "preserves/adds value to the shareholders" (P5).

The responses to this question were quite diverse in terms of measurement dimensions; respondents all worked within a specific frame of reference and organisational context, and therefore replied with specific measures that made sense for them at the time of the interview. The measurements noted by the respondents are thus all applicable to various types of BI systems, but are not necessarily all encompassing with regard to measuring BI success/improvement. The goal of the contextualised BI-specific questions should be to invoke answers that relate to the measure of success/improvement of the specific BI system being developed; however, the question should not limit practitioners to specific types of measurments. It is therefore necessary to return to the basic purpose of a BI system, and ensure that this basic purpose is being measured to determine its success/improvement. The answers to the previous questions emphasised that the measure of success for a BI system should ultimately be whether it enables decisions that timeously improves an organisation's planning abilities. This measure of success is therefore essentially already incorporated in the previous contextualised question, i.e. "…so that these decisions improve the organisation's planning abilities timeously (for each identified recipient of decision support information)…".

The purpose of a BI system and its measure of success is so intricately linked that it makes sense to discuss these two elements together. The purpose of a BI system is to enable appropriate and timeous decisions for specifically identified decision makers, whilst is measure of success/improvement would to determine whether the BI system enabled such decisions for these decision makers. Participant P8 stated that measurement criteria for a BI system must be "predetermined". Measures "must be agreed by the owners and/or users of the system, i.e. the recipients of the information" (P10); and "[a] successful system yields business results to the organisational shareholders" (P5). However, these measures cannot be determined 'after the fact', but should be an integral part of the discussion that entails the purpose of the system that it should reach on behalf of its identified clients.

The question regarding the purpose can be extended to explore specific measures to achieve the system's purpose, i.e. they can be explored in terms of "SMART principles: Simple; Measurable; Attainable; Repeatable; and Timeous" (P8).

9.5.3.3 Contextualised boundary question

What is (ought to be) the purpose of a BI system, i.e. which proactive decisions are (ought to be) enabled by the BI system, so that these decisions improve the organisation's planning abilities timeously (for each identified recipient of decision support information); and what are the base (raw) data from source systems to be incorporated to enable it? – this is the previous question; it can be extended as follows to enable exploration of specific measures: Ensure to explore measures of success/improvement that are (ought to be) incorporated in terms of SMART principles: Simple; Measurable; Attainable; Repeatable; and Timeous. Figure 9-1 below illustrates how these questions are to be discussed together.

Summary: categorical social role of the client

Table 9-1 below summarises the categorical social role of the client. It visually displays how the questions that explore this social role fit together, and should as such be discussed as a unit.

Table 9-1: Client, purpose, and measure of success

<table>
<tr><td colspan="2">The client of the BI system:
Who are (ought to be) the clients of a BI system in terms of diverse stakeholder groups, amongst others: decision makers (such as executive management) that are the recipients of the decision support (output) information; and the managers of the source (input) data?</td></tr>
<tr><td>The purpose of the BI system:
What is (ought to be) the purpose of a BI system, i.e. which proactive decisions are (ought to be) enabled by the BI system, so that these decisions improve the organisation’s planning abilities timeously (for each identified recipient of decision support information); and what are the base (raw) data from source systems to be incorporated to enable it?</td><td>The measure of success/improvement:
Ensure to explore measures of success/improvement that are (ought to be) incorporated in terms of SMART principles: Simple; Measurable; Attainable; Repeatable; and Timeous.</td></tr>
</table>

9.5.4 Who is (ought to be) the decision maker?

The purpose of this question is to determine who is (should be) able to change the measure of improvement (Ulrich, 2005). The actual decision makers of a system are the people that are formally designated to control the system as well as those that have “the power of vested interests to influence the formally designated decision maker” (Ulrich, 1983:405). The ideal decision maker concerns the internal structure that would make the decision maker a purposeful and effective controller of the system, as well as the external factors that determine the system’s performance that ought to be under the decision maker’s control (Ulrich, 1983:401). The question regarding the measure of success and improvement revealed that management requirements may change/evolve rapidly. Therefore, this question aimed to determine who should have the power to change the measure whereby the BI system’s success is measured, i.e. who should ensure that the system *remains* relevant in a rapidly changing/evolving environment.

Who is (ought to be) the decision maker regarding the business dimensions of the BI system such as sources of input data, decomposed reports and the supported business process; and who is (ought to be) the decision maker regarding the technical dimensions of the BI system such as technology and infrastructure?

9.5.4.1 Decision map for a business intelligence system

The following responses were received from the interviewees regarding the question: who is or ought to be the decision maker with regard to the system's measure of success or improvement when considering BI systems; the participants' views on the decision maker of a BI system were as follows:

- P1: "The people that create the views on behalf of the decision makers, i.e. those that collate the information to provide the appropriate views for decision makers. Measures of success/improvement should be defined from the top-down (decompose reports) and from the bottom-up (starting point is then the data)."
- P6: "The manager of the group of people that uses the system must measure its success; however, the measure of success must be translated to ensure that the day-to-day users (those that populate the data) of the system are informed of the value that the system ought to add."
- P2: "The (competent) BI manager. He/she is the link between executive management and the end-user."
- P3: "The end-user decides upon the measure of success. However, the actual end-user may change as time goes on and hence the measure of success may change."
- P7: "In the case of investment decision support it will be chairman of the investment committee; he/she must confirm whether he/she receives benefits from applying the received information. Also, a benefit should be gained by the people that populate the system as it drives their behaviour in a formal and structured manner; it enforces the business process."
- P4: "A governance committee must be created for this purpose as it can't be one person's responsibility only since the various dimensions/aspects of BI

must be looked at. There must be a balance between the costs and the benefits."

- P9: "The designer of the system; however, he/she must involve the users of the system and incorporate their inputs regarding the required measure(s) of success and improvement."
- P5: "The person(s) that is accountable for the realisation of the benefits to the shareholders. E.g., it may be to save/preserve/grow their investment."
- P8: "The process of designing must be facilitated by an independent entity, which do not benefit from the system and/or the outcome of the system."
- P10: "Performance metrics and sources of input data should be kept up-to-date by the business; however, technical people should ensure that the BI system is built using the best and most appropriate technology and infrastructure."

9.5.4.2 Insight gained from the data

The term "decision maker" is ambiguous in a BI context where the "decision maker" refers to the recipient of the decision support information, i.e. the client of the BI system. However, Ulrich (1983:258) defines the decision maker as the source of power/control of the system in terms of its performance measures.

The responses indicate that, in a BI context, a single person or entity in an organisation cannot take accountability (i.e. custodianship) for this in its entirety. Both the business and technical dimensions have to be taken into account. For example, participant P4 says that "it can't be one person's responsibility since the various dimensions/aspects of BI must be looked at". Success measures have different perspectives and hence "[m]easures of success/improvement should be defined from the top-down (decompose reports) and from the bottom-up (starting point is then the data)" (P1). "The (competent) BI manager…is the link between executive management and the end-user" (P2). The "designer of the system…must involve the users" (P9) and it is important "that the day-to-day users (those that populate the data) of the system are informed of the value that the system ought to add" (P6); it "drives their behaviour in a formal and structured manner…enforces the business process" (P7). Success measures are also dynamic and must be reassessed as the business/users evolve (P3) and "kept up-to-date by the business (P10) whilst "technical people should ensure that the BI system is built using the best and most appropriate technology and infrastructure" (P10).

9.5.4.3 Contextualised boundary question

Who is (ought to be) the custodian[5] (decision maker) regarding the business dimensions of the BI system such as sources of input data, decomposed reports and the supported business process; and who is (ought to be) the custodian (decision maker) regarding the technical dimensions of the BI system such as technology and infrastructure?

9.5.5 What resources are (ought to be) controlled by the decision maker?

This question aims to determine what resources or conditions of success can (should) those that are involved control (Ulrich, 2005). The purpose of the question what resources or conditions are (ought to be) under the decision maker's control determines what conditions of success can (should) those involved control (Ulrich, 1983:248). This question aimed to determine what aspects of the BI system ought to be designed and controlled by whom.

9.5.5.1 Resources map for a business intelligence system

The following responses were received from the interviewees regarding the question: what resources of the system are or ought to be controlled by the decision maker of BI systems; the participants' views on the resources of a BI system were as follows:

- P1: "Decision executives do not care how reports are generated, as long as they receive the required information. The gap between the decision reports

[5] The term "custodian" refers to the ultimate owner (manager) of the BI process; the term decision maker is confusing in a BI context as it usually refers to a decision maker that applies information stemming from a BI system in support of his/her decisions and not to the decision maker that makes decision regarding the BI process. Therefore, for the remainder of this document the term custodian will be used in this context to refer to the BI process owner and manager.

and the source data should be bridged by those people that create the views on behalf of decision makers, i.e. those that collate the information to provide the appropriate views for decision makers."

- P6: "The manager of the group of people that uses the system must be in control of the output (e.g. reports' content and format) of the system."
- P2: "The BI manager must implement key performance metrics (KPIs) and/or formulae as he/she receives them; he/she may not change these. The BI manager only reports output information."
- P3: "The system developer must decide on and determine the infrastructure required (e.g. servers, warehousing, interfacing) and skills required to develop the system."
- P7: "The receiver of the decision support information should control the content representation (content) to ensure appropriate transformation of data into information. He/she must have a say in the tailoring of the information for effective application (optimal use) thereof."
- P4: "Hardware and software must be controlled by information technology and information management functions. Business processes must be controlled by the respective businesses."
- P9: "The designer must design the technical components of the system."
- P5: "The format of the output information must be controlled by the person(s) that are accountable for the realisation of the benefits for the shareholders; output information must be easy to interpret and understand."
- P8: "The main function of the decision maker is to elicit and appropriate definition of victory."
- P10: "The team members' roles should be clearly defined so that technical experts design technical components whilst business experts design business dimensions such as performance metrics to be incorporated in the system."

9.5.5.2 Insight gained from the data

This question relates closely to the previous question, which revealed that the various stakeholder groups must take responsibility for the various dimensions of the BI system. For example, "[t]he system developer must decide on and determine the infrastructure required…and skills required to develop the [technical] system" (P3); "[t]he designer must design the technical components of the system" (P9); "technical experts [must] design technical components whilst business experts [must] design business dimensions such as performance metrics to be incorporated in the system" (P10); and "[h]ardware and software must be controlled by information technology and information management functions…[b]usiness processes must be controlled by the respective businesses" (P4). The format and transformation metrics contained in the output information must be controlled by "[t]he receiver of the decision support information" (P7), i.e. the users of the system (P6).

Also, the question that pertains to the resources under control of the identified custodians (as decision takers in the BI process) cannot be discussed in isolation; it must be discussed in the context of the custodian(s) identified in the previous question. It is therefore recommended that this question is explored in conjuction with the previous question to determine the resources to are (ought to be) controlled by the custodians identified in the previous question.

So: Firstly, the previous question should be extended to also include the embedded transformation (performance) metrics, i.e. "Who is (ought to be) the regarding the business dimensions of the BI system such as sources of input data, decomposed reports, *embedded performance metrics that transform input data into output information*, and the supported business process; and who is (ought to be) the decision maker regarding the technical dimensions of the BI system such as technology and infrastructure?". Secondly, additional resources that are (ought to be) controlled by identified custodians should be explored.

9.5.5.3 Contextualised boundary question

What resources are (ought to be) controlled by the custodians identified in the previous question? – refer to Section 9.5.4.3.

9.5.6 What success conditions are (ought to be) part of the environment?

This question aims to determine what conditions can (should) the decision maker not be able to control (Ulrich, 2005). The question regarding what resources or conditions are (ought to be) part of the environment aims to determine what conditions can (should) the decision-maker not control (e.g. from the viewpoint of those not involved) (Ulrich, 1983:248). Ulrich (1983:408) states that the decision environment includes “everything that coproduces the system’s performance but is not controlled by the system’s decision maker”; the decision maker should service the ideal client’s purposes and include the affected stakeholders’ concerns.

9.5.6.1 Environment map of a business intelligence system

The following responses were received from the interviewees regarding the question: what success conditions are or ought to be part of the systems environment, i.e. not controlled by the decision maker, of BI systems; the participants’ views on the environment of a BI system were as follows:

- P1: “Data must be collected from source systems where data ownerships lie (i.e. captured for the first time). Data collectors must capture data into systems, which is the data that must be used source data where possible. However, there is often a gap between sources systems’ data and information required for reporting; capability should then be created to capture and fill this gap.”
- P6: “The manager of the group of people that uses the system should not be able to change the input (source) data; to ensure data and information integrity the data should not be manipulated.”
- P2: “The BI manager may not be able to change transactional components, i.e. input transactions. He/she should only *read* data and ensure the integrity of the technological components of the system (i.e. data warehouse, OLTP, OLAP). Calculations for output information must be controlled and signed off by a client (business user). The BI manager must only report on data; he/she should not care if data is *correct.*”
- P3: “None of the technical components should be controlled by the end-user; the decision maker (end-user) cannot tell a developer how to create a system.

He/she can only tell the developer what the system must do. E.g., a user cannot tell you [the technical developer] which programming language to use; he/she can only tell you [the technical developer] the functionalities that the system must have."

- P7: "None applicable."
- P4: "The governance committee created to oversee the measure of success and improvement of the BI system should not control core functionalities that are not business-driven e.g. outsourced infrastructure."
- P9: "The designer must embed performance metrics from the business as-is to ensure that transformed information reflects accurately and appropriately.
- P5: "The person(s) that are accountable for the realisation of the benefits to shareholders should not control the input data; this is to ensure adherence to for example auditory laws."
- P8: "The independent entity, which do not benefit from the system and/or the outcome of the system and design the system, should not direct the quantification of monetary benefits on behalf of the business owner, as well as the technical specification on behalf of the technology developer."
- So, the designer should not have control, i.e. be able to change, the performance metrics to be included in the system."
- P10: "The various team members should have definite roles and responsibilities; they should be allowed to make decisions appropriate to their roles. For example, only the technical experts should make decisions regarding architecture and technology whilst only the business experts should make decisions regarding business performance metrics and sources of input data."

9.5.6.2 Insight gained from the data

This question is the exact opposite of the previous question. To determine the boundaries of a system, one should also determine what is (ought to be) outside of the control of the identified decision makers. This question confirmed the importance of segregation of duties to ensure integrity of data and information, as well as the system itself. Segregation of duties is also important for legislative purposes such as auditability and traceability of information. However, it did not highlight a new requirement regarding the development of a BI system; rather, it confirmed the outcome of the previous two questions. For example, "[c]alculations of output information must be controlled and signed off by a client (business user)" and "[t]he BI manager may not be able to change transactional components, i.e. input transactions" (P2); "[n]one of the technical components should be controlled by the end-user; the decision maker (end-user) cannot tell a developer how to create a system" (P3). "The designer must embed performance metrics from the system as-is…should not…be able to change…performance metrics (P9)"; and "only the technical experts should make decisions regarding architecture and technology whilst only the business experts should make decisions regarding business performance metrics and sources of input data" (P10).

When reflecting on these questions to determine the boundary judgements of a BI system, it makes sense to discuss the elements that are in the control of the custodians and the elements that outside of the control of the custodians together; elements identified in this reflection impacts on (and may even help to clarify) the respective roles and responsibilities of the identified custodians. Elements that that are out of the control sphere of all identified custodians, yet impact on the system, must be appropriately catered for in the design and development process. The term 'environment' is limiting in this regard; rather, this question refers to success conditions of the BI system – it is reflected as such in Table 9-2 below.

9.5.6.3 Contextualised boundary question

What resources are (ought to be) controlled by the identified custodians[6]? – this is the previous question. However, it is suggested that this reflection should be extended to also include: And what aspects of the BI system design is (ought to be)

[6] The term "decision maker" refers in this regard to the person(s) making decision about the components, as phrased in the question.

outside the control of the BI custodians? How will these be handled during the design and development process?

Summary: categorical social role of the BI custodian

Table 9-2 below summarises the categorical social role of the BI custodian (Ulrich refers in this original questions to the decision maker – refer to Section 9.5.4.3 for a discussion on the term decision maker versus custodian in this BI context). Table 9-2 visually displays how the questions that explore this social role fit together, and should as such be discussed as a unit.

Table 9-2: BI custodian, resources under his/her control, and success conditions

<table>
<tr><td colspan="2">The custodian of the BI system:
Who is (ought to be) the custodian (decision maker) regarding the business dimensions of the BI system such as sources of input data, decomposed reports and the supported business process; and who is (ought to be) the custodian (decision maker) regarding the technical dimensions of the BI system such as technology and infrastructure?</td></tr>
<tr><td>The resouces of the BI system:
What resources are (ought to be) controlled by the identified custodians?</td><td>Success conditions of the BI system:
And what aspects of the BI system design is (ought to be) outside the control of the BI custodians? How will these be handled during the design and development process?</td></tr>
</table>

9.5.7 Who is (ought to be) considered a professional or further expert?

The purpose of this question is to determine who is (should be) included in the design team (Ulrich, 2005). A BI system has social as well as technical dimensions; the design team should reflect both dimensions. This question aimed to determine who should design the various dimensions of the BI system.

9.5.7.1 Expert map of a business intelligence system

The following responses were received from the interviewees regarding the question: who is or ought to be involved as the designer of a BI system; the participants' views on the expert of a BI system were as follows:

- P1: "The technical (i.e. data warehousing) team and enterprise architects (such as the organisational employees) with a view of the current architecture already implemented in the organisation as well as the capabilities /functionalities of the existing architecture."
- P6: "The technical system developer; the system's end-users (those that populate the data as well as those that receive decision making information in terms of reports."
- P2: "The BI manager; executive management; and the (transactional) end-user."
- P3: "The system developer has to design the back-end as well as the front-end of the system. The end-user must be involved in the design of the format of the end-result and front-end (e.g. the user-interface)."
- P7: "The decision maker; the technical architectural team; the group that populates the information; and users with ad-hoc information requests and/or requirements."
- P4: "The technical development team including technology experts; subject matter experts from the business (for content); decision makers from the business (such as sponsors that invest their money); and end-users (those that populate the input data). End-users must be involved in the design of the user-interface."
- P9: "The business dimension should be designed with inputs from: the subject matter experts from the business (those accountable for performance metrics); and the end-users (those that facilitate the population of data as well as those that provide the input data)."
- P5: "Everybody that is influenced and affected, i.e. the decision makers, clients, end-users and subject matter experts should be involved to design the content; and the involved parties, i.e. technical system designers should design the system so that it transforms data into decision making information."

- P8: “Technical experts should design the technical architecture; business owners should ensure that the purpose (intent/relevance) is achieved; and the end-user. Technical experts should ensure ease-of-use, maintainability, flexibility and cater for potential future evolution.”
- P10: “The designer cannot be one person only; it must be a team of people with all the applicable expertise required. This includes relevant business and technical expertise.”

9.5.7.2 Insight gained from the data

Different experts were identified, i.e. “it must be a team of people with all the applicable expertise required…includes relevant business and technical expertise” (P10). For example, “[t]he technical (i.e. data warehousing) team (P1), “technology experts” (P4), and “[t]he system developer” (P3) on the technical side; as well as “decision makers from the business…and end-users (those that populate the input data)” (P4), “end-users (those that facilitate the population of data as well as those that provide the input data)” (P9), “the system’s end-users (those that populate the data as well as those that receive decision making information in terms of reports” (P6), “subject matter experts from the business (those accountable for performance metrics)” (P9) and “executive management and the (transactional) end-user” on the business side (P2).

9.5.7.3 Contextualised boundary question

Who is (ought to be) considered as a professional or further expert, i.e. who design (ought to design) the business dimensions of the BI system; and who design (ought to design) the technical dimensions of the BI system?

9.5.8 What kind of expertise is (ought to be) consulted?

The aim of this question is to determine what counts (should count) as relevant knowledge and sources of expertise in designing and implementing the system (Ulrich, 2005). This question aimed to determine the types of expertise required to design the various dimensions of a BI system.

9.5.8.1 Expertise map of a business intelligence system

The following responses were received from the interviewees regarding the question: what kind of expertise is (ought to be) incorporated when designing BI systems; the participants' views on the expertise of a BI system were as follows:

- P1: "Data analysts: people that understand data analytics; business analysts: people that understand business as well as systems and therefore can elicit business requirements and translate it into functional specifications; and systems analysts: people with BI and DW expertise."
- P6: "Subject matter experts, such as people that have experience with regard to similar projects in the organisation and can reflect on lessons learnt from that. The technical skills and abilities of the end-users that will operate the system must be taken into account, including their current system-use requirements. Details on the input data (e.g. location of source, update frequency, quality and/or integrity of data, duplication of data, naming conventions of fields etc.). Typical examples of the outputs required by decision makers (e.g. reports). An overview of the environment where the system will be implemented, including those that affected by the system and those that the system will affect. Assumptions on the operating philosophies in the environment."
- P2: "Designing BI is a team effort. The BI architect must provide expertise for the technological component whilst the integrated business team (consisting of executive management as well as end-users, i.e. those that populate the data) must bring the business process component to the table."
- P3: "Various types of expertise are required, i.e. technical expertise in information management and information technology; and business expertise regarding functionality and business processes (e.g. key performance metrics of the applicable business processes and the function/department where the system will be used)."
- P7: "This is dependent upon the type of decision to be supported by the system. E.g. the following is required: discipline specific expertise from a technical system support and architectural design perspective; and business specific expertise in terms of the business process being supported, such as

what is required to ensure that the business remain operational, sustain itself, as well as grow and create new business."

- P4: "Solutions architecture expertise is required to evaluate potential solutions; subject matter expertise (business representatives) is required for business specific content; and business analysts must align business requirements with technology solutions."
- P9: "Subject matter experts (to ensure appropriate performance metrics are embedded); and end-users (to ensure an appropriate user-interface)."
- P5: "The decision makers, clients, end-users and subject matter experts (for business components). The technical system designers (for technical components).
- P8: "Business related expertise for the front-end; technical expertise for the back-end; and innovative/creative expertise to ensure that the system *improves* the business and adds value, i.e. "not just more of the same"."
- P10: "The design and development of a BI system requires technical expertise for the technological platforms and architecture. It also requires business-related expertise to ensure that it provides the required outputs."

9.5.8.2 Insight gained from the data

The responses to this question are related to the previous question's answers. It highlighted, yet again, that the different dimensions of the BI system require different types of expertise. "Designing BI is a team effort" (P2) that requires "technical expertise in information management and information technology…and business expertise regarding functionality and business processes (e.g. key performance metrics of the applicable business processes and the function/department where the system will be used) (P3); the development team must include expertise such as "[d]ata analysts…business analysts…system analysts" (P1). A BI system requires "[b]usiness related expertise for the front-end; technical expertise for the back-end; and innovative/creative expertise to ensure that the system *improves* the business and adds value" (P8); it requires "technical expertise for the technological platforms and architecture…business-related expertise to ensure that it provides the required outputs" (P10).

The expert and his/her expertise cannot be subdivided and treated as separate elements. However, the important aspect to reflect upon here is: what qualifies an identified expert to be qualified to act as an expert in the role that he/she has in this context, i.e. what expertise *should* he/she have (i.e. what *ought to qualify* him/her). This question should be discussion in conjuction with the previous question, i.e. “who is (ought to be) considered as a professional or further expert, i.e. who design (ought to design) the business dimensions of the BI system; and who design (ought to design) the technical dimensions of the BI system?” This reflection should be extended to also include the required expertise that the experts should have in order to identify skills that may be lacking.

9.5.8.3 Contextualised boundary question

Who is (ought to be) considered as a professional or further expert, i.e. who design (ought to design) the business dimensions of the BI system; and who design (ought to design) the technical dimensions of the BI system? What qualifies (ought to qualify) a designer (such as a business analyst) to design the business dimensions of the BI system regarding the embedded performance metrics relating to the business process and front-end data capturing mechanisms; and what qualifies (ought to qualify) a designer (such as a BI developer) to design the technical dimensions of the BI system regarding the technological platforms and architecture such as the data warehouse?

9.5.9 Who/what is (ought to be) the guarantor of success?

The purpose of this question is to determine where do (should) those involved seek some guarantee that improvement will be achieved (Ulrich, 2005). For example, it may include consensus among experts, the involvement of stakeholders, the experience and intuition of those involved or political support (Ulrich, 1983:248).

9.5.9.1 Guarantor map of a business intelligence system

The following responses were received from the interviewees regarding the question: who is or ought to guarantee success; the participants' views on the guarantor of a BI system were as follows:

- P1: "Change management employees, which are part of the organisation, must ensure that the changes are embedded. The business analyst must also play a role to instil functionalities/capabilities of the system. User acceptance testing must be done appropriately so that users understand the functionalities/capabilities of the implemented system and hence are able to use it to its full extent."
- P6: "The user of the decision making output (e.g. reports) should enforce proper application of the system."
- P2: "Executive (business) management."
- P3: "The business manager or the head of the business must ensure that the newly implemented system is used on a continuous basis, and that users do not revert back to their old systems."
- P7: "The decision maker, i.e. the chairman of the investment committee (receiver of the decision making information) must ensure that his/her objectives have been met and that the system continuously improves."
- P4: "An internal change management/transformation expert should become part of the decision making committee (which ensures that benefits are realised). He/she must have a vested interest to make the system work; he/she must therefore be a part of the governing body that ensures continuous improvement."
- P9: "Management must ensure continuous use of the system; they should encourage the use thereof."
- P5: "The person(s) accountable for the realisation of the business benefits."
- P8: "The business owner must ensure continued use. The end-user will continue to use the system if it is not a burden for him/her."
- P10: "A system is successful if it is used continuously, and for the purpose that it was created for. Senior management benefit the most from decision support systems and must therefore ensure that it is used appropriately."

9.5.9.2 Insight gained from the data

The responses to this question were too diverse to surface a single guarantor of success; however, it highlighted that the participants see the guarantor of the system as the person/entity that ensures continued use of the system. P10 said that the "system is successful if it is used continuously". The guarantor must thus "ensure that the changes are embedded…instil functionalities/capabilities of the system" (P1) and "ensure that the newly implemented system is used on a continuous basis, and that users do not revert back to their old systems" (P3). "The business owner must ensure continued use" (P8) and "[m]anagement must ensure continuous use of the system" (P9).

9.5.9.3 Contextualised boundary question

Who/what is (ought to be) the guarantor of success, i.e. who/what is (ought to) ensure continued use of the BI system after implementation? Also consider the specific actions to be taken by the guarantor of success ensure that success is guaranteed.

Summary: categorical social role of the BI expert

Table 9-7 below summarises the categorical social role of the BI expert. It visually displays how the questions that explore this social role fit together, and should as such be discussed as a unit.

Table 9-3: Expert, expertise, and guarantor

<table>
<tr><td colspan="2">The expert of the BI system:
Who is (ought to be) considered as a professional or further expert, i.e. who design (ought to design) the business dimensions of the BI system; and who design (ought to design) the technical dimensions of the BI system?</td></tr>
<tr><td>The expertise of the BI system:
What qualifies (ought to qualify) a designer (such as a business analyst) to design (ought to design) the business dimensions of the BI system regarding the embedded performance metrics relating to the business process and front-end data capturing mechanisms; and what qualifies (ought to qualify) a designer (such as a BI developer) to design (ought to design) the technical dimensions of the BI system regarding the technological platforms and architecture such as the DW?</td><td>The guarantor of the BI system:
Who/what is (ought to be) the guarantor of success, i.e. who/what is (ought to) ensure continued use of the BI system after implementation? Also consider the specific actions to be taken by the guarantor of success ensure that success is guaranteed.</td></tr>
</table>

9.5.10 Who is (ought to be) witness to those affected but not involved?

This question aims to determine who is (should be) treated as a legitimate stakeholder, and who argues (should argue) the case of the stakeholders who are affected but not involved and hence cannot speak for themselves, including future generations and non-humans (Ulrich, 2005). The witnesses should incorporate the requirements of those that are *affected* by the system (Ulrich, 1983:258). This question aimed to identify affected (but not involved) communities; it also aimed to identify who should represent such affected communities.

9.5.10.1 Witness map for a business intelligence system

The following responses were received from the interviewees regarding the question: who is or ought to be witness to the interest or concerns of those affected by the BI systems; the participants' views on the expertise of a BI system were as follows:

- P1: "Change agents or a change management group, i.e. people that can ensure alignment between the affected community as well as the decision makers and designers."
- P6: "End-users should be allowed to voice their concerns and provide constructive builds; they must receive "political immunity" so as to protect them from victimisation by powerful organisational pressures."
- P2: "The BI specialist can analyse and identify trends in data, which can benefit the business user that don't have expertise to analyse data. E.g. statistical experts can build models etc. and hence can make suggestions to improve the business."
- P3: "Not applicable."
- P7: "Change agents or a change management group."
- P4: "This is dependent upon the organisational culture. For example, a change management expert may be useful in case of a hierarchical (status driven) organisation. 'Super users' may be employed to guide end-users to use the system effectively."
- P9: "Management must ensure that all the affected parties are identified and included. Also, the designer must ensure that he/she then involves all those affected parties."
- P5: "The sponsor of the project should be held accountable to ensure that the affected community are involved during the design."
- P8: "End-users are affected; they populate the system with data but are often not included during design phases. The decision maker (which should be an independent facilitator that will not benefit from the system or its outcome) must ensure that the end-users are emancipated by involving them during the design phases."
- P10: "Business units differ in how much they allow their different levels of employees to say and to whom; hierarchical organisations do not allow lower

level employees to 'talk too much'. However, these employees are often the capturers of data; if they are unsatisfied with the system then they will capture data ineffectively. It is thus important to allow them to speak as well."

9.5.10.2 Insight gained from the data

Participants had diverse opinions regarding definite affected stakeholder groups that are not allowed opportunities to voice their concerns when a BI system is being designed and developed. The bulk of the interviewees referred to the need for independent change experts or agents to be a part of the design and development team such as: "a change management group, i.e. people that can ensure alignment between the affected community as well as the decision makers and designers" (P1); "a change management expert may be useful"; and "[c]hange agents or a change management group" (P7). These change agents should then ensure that any affected party be identified and drawn in to the process; they should also "protect them from victimisation by powerful organisational pressures" (P6). However, since organisational cultures differ these answers may have looked different in a different (less hierarchically structured) organisation that rely less on external change management consultants to embed organisational change.

9.5.10.3 Contextualised boundary question

This question was kept as the original question from Ulrich; however, this question may be contextualised still if this research can be repeated in another organisation. So: Who is (ought to be) the witness to the interests of those that are affected but not involved in the process?

9.5.11 What secures (ought to secure) the emancipation of the affected?

The purpose of this question is to determine where does (should) legitimacy lie in terms of those affected by the premises/promises of those involved (Ulrich, 2005). This question should firstly determine *what* constitutes emancipation to determine how to measure success (Ulrich, 1983:258).

9.5.11.1 Emancipation map of a business intelligence system

The following responses were received from the interviewees regarding the question: what secures or ought to secure the emancipation of those affected from the premise or promises of those involved with BI systems; the participants' views on the emancipation of a business intelligence system were as follows:

- P1: "Business analysts must determine the area of impact and define it. The business analyst must liaise with 'need creators', i.e. the business representatives."
- P6: "This is a joint accountability of the manager signing off on the design document as well as the design of the system."
- P2: "Systems must work for people; people must not work for systems. There is a gap between management expectations and transactional day-to-day operation that must be closed by the system."
- P3: "Business intelligence systems save time and improve accuracy. If the objectives of these systems are not met then emancipation cannot be achieved. The system must ensure accuracy and correctness (referring to system and data integrity)."
- P7: "Change agents or a change management group".
- P4: "The governance committee, accountable for business benefits realisation and continuous improvement, must ensure that business benefits realise; business benefits realise only later hence expectations must be managed to not expect results too soon."
- P9: "Management must ensure that promised business benefits realise; they must empower designers so that they are able to realise promised business benefits."
- P5: "The sponsor of the project should be held accountable for promises made during the design; he/she should be held accountable for this post implementation also."
- P8: "The designer of the system must ensure that all relevant stakeholders are identified and that the system developed includes inputs from all these relevant stakeholders."

- P10: “Emancipation is linked to the pre-defined business objectives of the system; when the right business objectives are realised then all its users should be empowered. Empowerment should be defined for management, as well as for the capturers of data.”

9.5.11.2 Insight gained from the data

Emancipation in a BI context occurs when the business benefits are realised for all stakeholders: “Empowerment should be defined for management, as well as for the capturers of data” (P10). The implemented “[s]ystems must work for people; people must not work for systems” (P2). “Emancipation is linked to the pre-defined business objectives of the system; when the right business objectives are realised then all its users should be empowered” (P10). Expected (and realistic) business benefits must therefore be agreed upfront and during the design phases, i.e. “determine the area of impact and define it” (P1) to ensure that “[b]usiness intelligence systems save time and improve accuracy (P3).

9.5.11.3 Contextualised boundary question

What secures (ought to secure) the emancipation of the affected and involved, and ensure that the BI system realises its intended business benefits?

9.5.12 What is (ought to be) the determining worldview?

This question aims to determine what different visions of ‘improvement’ are (should be) considered and how are they (should they be) reconciled (Ulrich, 2005). This question aimed to determine whether interviewees regarded the use of software artefacts such as BI systems as merely technical artefacts, or whether they regarded BI systems as artefacts that impacts socially on its users also.

9.5.12.1 Worldview map of a business intelligence system

The following responses were received from the interviewees regarding the question: what worldview is (ought to be) determining; the participants’ views on the worldview regarding a business intelligence system were as follows:

- P1: “A BI system is technical artefact to be used as tool that should enhance the well-being of its users, i.e. the employees should have a better work-experience. It should make their lives easier; it should also be a mechanism for them to perform better.”
- P6: “A system is only as effective as the person using the system; the requirements of the users should drive the design, i.e. the design should be people-centric.”
- P2: “Business intelligence has a social impact on its users; integrated and systems (proper BI) can improve business, i.e. make it healthier. Productivity can increase if information that stems from BI is managed and used correctly; however, immature management may also use information as a ‘stick’ because there is nowhere to hide anymore…when information becomes visible to all.”
- P3: “Business intelligence systems should not be viewed as technical tools only; it also affects the social dimensions of the organisation. The social dimensions should therefore also be captured in the design. These twelve questions can help to focus the attention of the end-users and developers to incorporate these social dimensions.”
- P7: “Information systems have a definite social dimension, i.e. people that are forced to use a system where improvement-related promises do not realise are negatively affected (e.g. they may become disengaged). Systems must be user-friendly and have an enhancing effect that increases efficiency; it must *improve* and not be a step backwards.”
- P4: “Business intelligence has a social impact on its users. E.g., BI users reliant on timeous decision support information; hence, if BI can’t produce reports timeously the social well-being of its users is negatively influenced. Technology is becoming more and more integrated in our daily lives.”
- P9: “Technical systems influence its users. For example, a system that does not work affects its users negatively in terms of productivity. Also, a poorly designed system, or a technically inferior system (such as a user interface that is unsuitable), discourages the use thereof even when the system informs decision accurately and appropriately.”

- P5: “Business intelligence systems are social systems; they should be designed to improve the lives of its users. The tail should not wag the dog, i.e. we are not servants of systems, but systems should serve us.”
- P8: “The success of a system is determined largely by the world view of the implementer; he/she should not regard these systems as merely technical artefacts. If he/she regards it as technical artefact then the guaranteed continuation of the system is compromised; it can easily be replaced by yet another technical artefact.”
- P10: “Power balances may shift when information becomes ‘too’ available, i.e. when information is misused by ‘power-hungry’ executives. BI’s definition of victory must be defined very clearly and carefully to ensure that it improves business. It can be a powerful tool in the hands of management – they must be mature enough to also use it appropriately.”

9.5.12.2 Insight gained from the data

The predominant worldview is that BI systems are social systems, in addition to being technical artefacts. A BI system “should enhance the well-being of its users” (P1). It “has a social impact on its users; integrated and systems (proper BI) can improve business, i.e. make it healthier” (P2). “Technology is becoming more and more integrated in our daily lives” (P4); however, we are not servants of systems, but systems should serve us” (P5). BI systems impacts on the social well-being of users; this impact can be positive (such as improved productivity and easier ways of work) or it can be negative (for example, when the power brought on by having access to information are “misused by ‘power hungry’ executives” (P10)). BI systems must therefore be designed whilst being cognisant of the potential *perceived* effect that it may have on its users. However: “The success of a system is determined largely by the world view of the implementer; he/she should not regard these systems as merely technical artefacts. If he/she regards it as technical artefact then the guaranteed continuation of the system is compromised; it can easily be replaced by yet another technical artefact” (P8).

9.5.12.3 Contextualised boundary question

What worldview is (ought to be) determining? In a BI context it may, for example, be relevant to determine whether the involved and affected stakeholders perceive the use of software artefacts such as BI systems as merely technical artefacts, or do they perceive it is artefacts that impacts socially on its users also?

Summary: categorical social role of the affected

Table 9-8 below summarises the categorical social role of the witness to the affected but not involved. It visually displays how the questions that explore this social role fit together, and should as such be discussed as a unit.

Table 9-4: Witness to and emancipation of affected, and the determining worldview

<table>
<tr><td colspan="2">The witness of the BI system:
Who is (ought to be) the witness to the interests of those that are affected but not involved in the process?</td></tr>
<tr><td>Emancipation of the affected:
What secures (ought to secure) the emancipation of the affected and involved, and ensure that the BI system realises its intended business benefits?</td><td>The determining worldview:
What worldview is (ought to be) determining (so what?)? In a BI context it may, for example, be relevant to determine whether the involved and affected stakeholders perceive the use of software artefacts such as BI systems as merely technical artefacts, or do they perceive it is artefacts that impacts socially on its users also?</td></tr>
</table>

9.6 Summary: contextualised boundary questions

The researcher contextualised the CSH methodology for a BI context during this intervention. She learned about the dimensions of a BI system that needs to be considered when designing and developing such a system; considering these dimensions enable definition of the normative content of a BI system in terms of its bases of: motivation, power, knowledge, and legitimacy. Ulrich (1983:308) initially argued that a truly rational and democratic planning process must “start with a practical discourse among the involved and the affected” where “the affected must not be required to submit to the rationality standards of the involved but must be entitled to argue polemically”, i.e. he/she is not required to have theoretical knowledge or competence in support of his/her argument. However, he later pointed out that there may inevitably be an ever increasing gap between the democratic civil rights of the affected, and their *actual* capability to participate; consequently “the necessary rights of participation and democratic control is not enough to ensure effective participatory chances to them; if the issues are beyond their understanding, how can they argue their concerns in a competent manner?” (Ulrich, 1998:3). It may therefore be valuable to contextualise the boundary questions in such a manner that they are easy to interpret by the novice as well as seasoned BI practitioner, especially since BI practitioners are not generally experts in subjects such as critical systems thinking and critical systems methodologies.

The next pages contain a visual summary of the questions; the researcher suggests that the questions be presented to BI practitioners in this format. Each categorical social role can then be discussed in its totality, before moving on the next categorical social role to be discussed.

Table 9-5: Client, purpose, and measure of success

<table>
<tr><td colspan="2">The client of the BI system:
Who are (ought to be) the clients of a BI system in terms of diverse stakeholder groups, amongst others: decision makers (such as executive management) that are the recipients of the decision support (output) information; and the managers of the source (input) data?</td></tr>
<tr><td>The purpose of the BI system:
What is (ought to be) the purpose of a BI system, i.e. which proactive decisions are (ought to be) enabled by the BI system, so that these decisions improve the organisation's planning abilities timeously (for each identified recipient of decision support information); and what are the base (raw) data from source systems to be incorporated to enable it?</td><td>The measure of success/improvement:
Ensure to explore measures of success/improvement that are (ought to be) incorporated in terms of SMART principles: Simple; Measurable; Attainable; Repeatable; and Timeous.</td></tr>
</table>

Table 9-6: Custodian, resources under his/her control, and success conditions

<table>
<tr><td colspan="2">The custodian of the BI system:
Who is (ought to be) the custodian (decision maker) regarding the business dimensions of the BI system such as sources of input data, decomposed reports and the supported business process; and who is (ought to be) the custodian (decision maker) regarding the technical dimensions of the BI system such as technology and infrastructure?</td></tr>
<tr><td>The resouces of the BI system:
What resources are (ought to be) controlled by the identified custodians?</td><td>Success conditions of the BI system:
And what aspects of the BI system design is (ought to be) outside the control of the BI custodians? How will these be handled during the design and development process?</td></tr>
</table>

Table 9-7: Experts, expertise, and guarantor

The expert of the BI system: Who is (ought to be) considered as a professional or further expert, i.e. who design (ought to design) the business dimensions of the BI system; and who design (ought to design) the technical dimensions of the BI system?	
The expertise of the BI system: What qualifies (ought to qualify) a designer (such as a business analyst) to design (ought to design) the business dimensions of the BI system regarding the embedded performance metrics relating to the business process and front-end data capturing mechanisms; and what qualifies (ought to qualify) a designer (such as a BI developer) to design (ought to design) the technical dimensions of the BI system regarding the technological platforms and architecture such as the DW?	**The guarantor of the BI system:** Who/what is (ought to be) the guarantor of success, i.e. who/what is (ought to) ensure continued use of the BI system after implementation? Also consider the specific actions to be taken by the guarantor of success ensure that success is guaranteed.

Table 9-8: Witness to and emancipation of affected, and the determining worldview

The witness of the BI system: Who is (ought to be) the witness to the interests of those that are affected but not involved in the process?	
Emancipation of the affected: What secures (ought to secure) the emancipation of the affected and involved, and ensure that the BI system realises its intended business benefits?	**The determining worldview:** What worldview is (ought to be) determining (so what?)? In a BI context it may, for example, be relevant to determine whether the involved and affected stakeholders perceive the use of software artefacts such as BI systems as merely technical artefacts, or do they perceive it is artefacts that impacts socially on its users also?

9.7 Evaluation of the guidelines

To evaluate the success of the problem solving cycle outside of the organisational context of the organisation where the research was conducted, the researcher interviewed an external BI consultant. It was important that this participant is not an expert in systems ideas from the CST paradigm, as the aim of this interview was to determine whether these questions were sufficiently contextualised so that they could be intuitively understood and applied by a BI practitioner *without* knowledge of CST and methodologies such as CSH. So, the interview aimed to determine whether the respondent understood the questions clearly (i.e. the questions and the terminology contained in them are unambiguously clear to a BI practitioner), and whether the questions were perceived to be logical. The following questions were asked to this participant:

1. How would you describe your role in a BI environment?
2. How long have you been working in a BI environment?
3. Kindly reflect on the boundary questions in a BI context by thinking about a specific BI project that you were involved in. Are you thinking of a specific BI project?
4. Which project are you thinking about?
5. For the boundary questions:
    a. What do you think is the meaning of the question?
    b. Do you think this is a logical question to ask when deriving business requirements for a BI system?

The responses are summarised in Section 9.7.1; the researcher reflects on the data in Section 9.7.2.

9.7.1 Data gathered in the interview

Interview responses from participant P11 are transcribed below:

Interviewer: “How would you describe your role in a BI environment?”

P11: “I am involved with the full spectrum of BI development from planning the project to implementing the BI system.”

Interviewer: “How long have you been working in a BI environment?”

P11: “25 years”

Interviewer: “Kindly reflect on the boundary questions in a BI context by thinking about a specific BI project that you were involved in. Are you thinking of a specific BI project?”

P11: “ es”

Interviewer: “Which project are you thinking about?”

P11: “A BI project at an organisation that consists of seven smaller companies; they did not have any BI to start with. I was involved with the development of a BI system for their buy-and-sell business process for each of the seven smaller companies.”

Interviewer: “For the boundary questions[7], please reflect on them as follows: What do you think is the meaning of the question; and do you think this is a logical question to ask when deriving business requirements for a BI system?”

P11: “Ok.”

Interviewer: “Who are (ought to be) the clients of a BI system in terms of diverse stakeholder groups, amongst others: decision makers (such as executive

[7] The boundary questions with the corresponding responses are below; questions were logically clustered – refer also to Tables 9-5 to 9-8 in Section 9.6 above – for the interview.

management) that are the recipients of the decision support (output) information; and the managers of the source (input) data?"

P11: "This question is about the end user of the system; it determines who will be the receiver of the information as well as who will be the provider of source data. The stakeholder group missing from this question is managers of the sub systems that provide source data; they are not necessarily the same stakeholder group as the ones that provide the actual input data. It is a logical question; however, this question should also reflect on the client of this BI system rather than generically about a BI system."

Interviewer: "What is (ought to be) the purpose of a BI system, i.e. which proactive decisions are (ought to be) enabled by the BI system, so that these decisions improve the organisation's planning abilities timeously (for each identified recipient of decision support information); and what are the base (raw) data from source systems to be incorporated to enable it? Ensure to explore measures of success/improvement that are (ought to be) incorporated in terms of SMART principles: Simple; Measurable; Attainable; Repeatable; and Timeous."

P11: "This question is about the aim and expected results of a BI project. By not asking this question too wide (i.e. referring to specific relevant elements for example specific decisions for specific recipients) the developer bound the scope and expectations regarding the results of the project early on in the project, and thereby limits the amount of scope creep later on in the project. It is a logical question; however, if the goal is to define the purpose of a specific BI project, the question should reflect on the purpose of *this* BI system rather than generically about *a* BI system (thus changing the question to "…the purpose of *this* BI system…". It is important to first determine the purpose(s) and then only can one determine the client(s) of the system."

Interviewer: "Who is (ought to be) the custodian regarding the business dimensions of the BI system such as sources of input data, decomposed reports and the supported business process; and who is (ought to be) the custodian (decision maker) regarding the technical dimensions of the BI system such as technology and infrastructure? What resources are (ought to be) controlled by the identified custodians? And what aspects of the BI system design is (ought to be) outside the control of the BI custodians? How will these be handled during the design and development process?"

P11: "To add to the questions: custodianship within business is made up of two or more diverse stakeholder groups such as those accountable for the business dimensions (i.e. the business process and embedded performance metrics) and those accountable for the source systems and data. These are logical questions."

Interviewer: "Who is (ought to be) considered as a professional or further expert, i.e. who design (ought to design) the business dimensions of the BI system; and who design (ought to design) the technical dimensions of the BI system? What qualifies (ought to qualify) a designer (such as a business analyst) to design (ought to design) the business dimensions of the BI system regarding the embedded performance metrics relating to the business process and front-end data capturing mechanisms; and what qualifies (ought to qualify) a designer (such as a BI developer) to design (ought to design) the technical dimensions of the BI system regarding the technological platforms and architecture such as the DW?"

P11: "These questions can be helpful to choose the right team members for the project. The word "architect" may describe the designer role of the BI technical developers better as it is the term used more often in this environment. These are logical question."

Interviewer: "Who/what is (ought to be) the guarantor of success, i.e. who/what is (ought to) ensure continued use of the BI system after implementation? Also consider the specific actions to be taken by the guarantor of success ensure that success is guaranteed."

P11: “A person can’t force or ensure the continued use of a system. However, if a system adds value it will be used continually. This question should also reflect on what this person must do to demonstrate the value of the system so that people will want to use it. This question is logical but should also reflect how of value the system must be demonstrated so that the system will be used continually and as per its intended purpose.”

Interviewer: “Who is (ought to be) the witness to the interests of those that are affected but not involved in the process?”

P11: “The meaning of this question is not clear.”

At this point in the interview the researcher explained to the participant that this question is to reflect on stakeholders that do not directly gain from changes brought on by the system, but are still affected due to changes in for example business processes.

P11: “It is logical now after an explanation of the intent of the question. The intent of this question should be explained in more detail in the question.”

Interviewer: “What secures (ought to secure) the emancipation of the affected and involved, and ensure that the BI system realises its intended business benefits?”

P11: “This question reflects on and re-affirms the goal of the system. It is a logical question.”

Interviewer: “What worldview is (ought to be) determining (so what?)? In a BI context it may, for example, be relevant to determine whether the involved and affected stakeholders perceive the use of software artefacts such as BI systems as merely technical artefacts, or do they perceive it is artefacts that impacts socially on its users also?”

P11: “The meaning of this question is not clear. This question can only have a yes or no answer but is unclear as to what to do with that answer.”

At this point the researcher explained that the aim of this question is to reflect on the change management strategy that will be required to embed the new BI system in the organisation. Users that view these types of artefacts as social artefacts that socially impacts on them and improve their lives requires a different change management approach, than those that view them as merely technical artefacts.

P11: “After the explanation this question is logical and will help to plan the change management effort and the required intensity thereof; the question will be clearer when the explanation is also included in it.”

9.7.2 Insight gained from the data

The interview data indicated that the boundary questions are logical questions to ask when deriving business requirements for a BI system. The questions can be contextualised further by incorporating the responses received from this participant. For example, the questions should reflect on a specific BI system (“…this BI system…” rather than generically on “…a BI system…”). Some of the questions can also be described in more detail to ensure that the questions – refer to the questions where the participant requested more detail on the questions before she could reflect on them. These contextualisations will be included in the final set of guidelines – this is discussed in Chapter 10 of this study.

9.8 Specification of learning: practical area of concern

This contextualisation aimed to derive a set of boundary questions that applies specifically to a BI context. The purpose of these boundary questions is to enable a developer to reflect on relevant stakeholders that should be considered when developing a BI system; they can then be included in the development process and all these stakeholders’ requirements can be reflected upon – refer to Chapter 10 for a discussion on the final set of guidelines.

9.9 Specification of learning: reflect on the research cycle: methodology

The boundary questions were contextualised and ambiguous terminology that was not necessarily applicable to in a BI environment, was replaced with BI specific terminology. The terminology, which was in the classic CSH framework design for a social-political context (Ulrich, 1983:251), was contextualised. The questions were also visually presented to indicate the relevant categorical social roles and the questions that pertain to these roles; these should be discussed as units. The questions were reflected upon by an external BI consultant (participant P11) to determine whether these questions are self-explanatory; participant P11 also commented on whether these questions are logical questions to ask in order to derive business requirements for a BI system. It is discussed in the next sections:

9.9.1 CSH: the basis of motivation of a business intelligence system

In terms of the basis of motivation the researcher suggests that the relevant stakeholder groups of a BI system (such as the recipients of the decision support information and the managers of source data as well as sub systems) are dependent upon the specific purpose of the BI system, i.e. the specific decisions to be informed. Therefore, she concurred that the orders of these questions also reflect this – P11 eluded to the fact that the purpose(s) should be determined before one can explore the client(s) of a BI system.

9.9.2 CSH: the basis of power of a business intelligence system

The word “decision maker” is rather ambiguous in this context; therefore, it was replaced with the word “custodian” to indicate that this person takes control of all the components and the environment that relates to the domain under his/her control. The custodian and the components as well as environmental success conditions in (and outside of) his/her domain are intricately linked; this is also reflected by the similar responses to the three questions that relate to this category.

9.9.3 CSH: the basis of knowledge of a business intelligence system

The relevant experts involved in the development of a BI system, and the expertise required by these experts are closely related. It enables a developer to choose appropriate team members for the development project, and also identify lacking skills. The guarantor of a BI system was defined as the stakeholder that can determine actions to facilitate continuity of the system, i.e. continued use thereof.

9.9.4 CSH: the basis of legitimation of a business intelligence system

Emancipation in the context of a BI system is defined as a system that realises its business benefits. The business benefits are closely related to the purpose(s) required by the respective client(s). This question serves as an additional "mind jogger" to reflect on business benefits that may have been excluded earlier in the process. The question regarding the worldviews of users enable developers to reflect on the change management action required to embed the use of the BI system in the organisation.

9.10 Specification of learning: reflect on the research cycle: framework of ideas

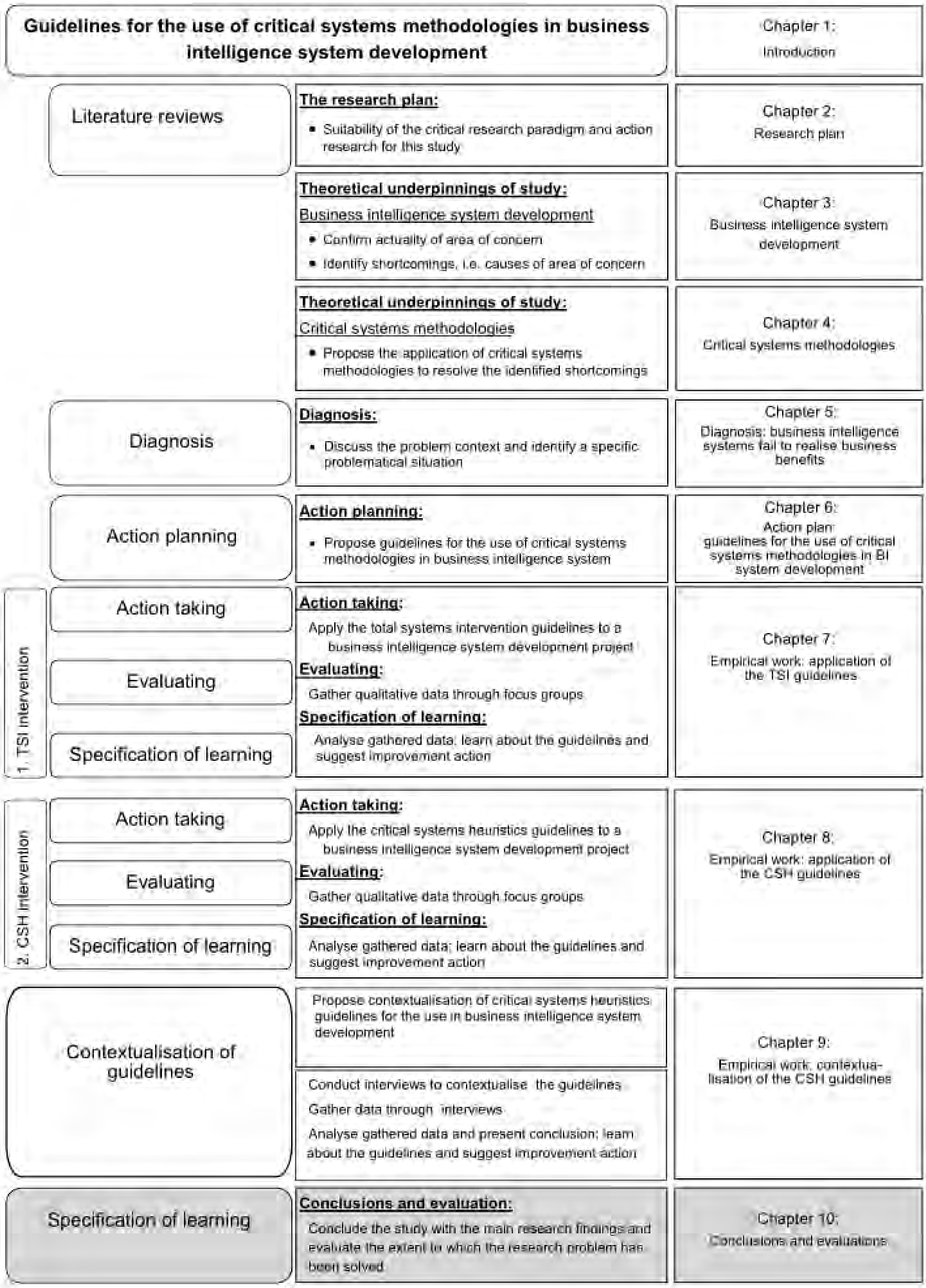
The detail of the responses from the participants that answered the twelve classic boundary questions (refer to Chapter 8) diminished from question 9 onwards where responses such as "not applicable" and "no comment" were frequently used. Miller (1994:351) argues that people can receive, process, and remember limited amounts of information at a time. For example, given too much information to process at a given point in time, people may lose interest. Thus, the researcher suggests that the questions be visually clustered together and discussed as units that refer to the relevant categorical social roles – refer to Section 9.6 above.

Logical breaks can therefore be instituted by the business analyst (as the facilitator of the process) between discussing these units (where each unit enables discussion of one categorical social role). Upon completion, the group can then move on to discussing the next categorical social role as a unit.

9.11 Summary

This chapter discusses the contextualisation of the guidelines; the researcher contextualised the classic CSH guidelines and derived a set of boundary questions specifically for a BI context. The guidelines were evaluated by a BI expert to determine whether these can be intuitively applied by a BI practitioner that does not have knowledge of systems ideas as reflected in the CST paradigm.

The next chapter concludes with the main research findings. It presents the final set of guidelines for the application of CSH in BI system development.


Guidelines for the use of critical systems methodologies in business intelligence system development
Chapter 1: Introduction
Literature reviews
The research plan:
• Suitability of the critical research paradigm and action research for this study
Chapter 2: Research plan
Theoretical underpinnings of study:
Business intelligence system development
• Confirm actuality of area of concern
• Identify shortcomings, i.e. causes of area of concern
Chapter 3: Business intelligence system development
Theoretical underpinnings of study:
Critical systems methodologies
• Propose the application of critical systems methodologies to resolve the identified shortcomings
Chapter 4: Critical systems methodologies
Diagnosis
Diagnosis:
• Discuss the problem context and identify a specific problematical situation
Chapter 5: Diagnosis: business intelligence systems fail to realise business benefits
Action planning
Action planning:
• Propose guidelines for the use of critical systems methodologies in business intelligence system
Chapter 6: Action plan: guidelines for the use of critical systems methodologies in BI system development
1. TSI intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the total systems intervention guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data; learn about the guidelines and suggest improvement action
Chapter 7: Empirical work: application of the TSI guidelines
2. CSH intervention
Action taking
Evaluating
Specification of learning
Action taking:
Apply the critical systems heuristics guidelines to a business intelligence system development project
Evaluating:
Gather qualitative data through focus groups
Specification of learning:
Analyse gathered data; learn about the guidelines and suggest improvement action
Chapter 8: Empirical work: application of the CSH guidelines
Contextualisation of guidelines
Propose contextualisation of critical systems heuristics guidelines for the use in business intelligence system development
Conduct interviews to contextualise the guidelines
Gather data through interviews
Analyse gathered data and present conclusion; learn about the guidelines and suggest improvement action
Chapter 9: Empirical work: contextualisation of the CSH guidelines
Specification of learning
Conclusions and evaluation:
Conclude the study with the main research findings and evaluate the extent to which the research problem has been solved
Chapter 10: Conclusions and evaluations

Chapter 10 : Specification of learning: conclusions and summary

10.1 Introduction

The objective of this study was to develop guidelines for the use of critical systems methodologies to improve the development of business intelligence systems. This study explored the application of critical systems methodologies to enable inclusion of the relevant human, social and organisational factors in the development process.

The application of critical systems heuristics facilitated systemic critical reflection and practical discourse amongst relevant stakeholders of a business intelligence system. Stakeholders were empowered to surface appropriate business requirements for a business intelligence system that was developed; the application of the classic critical systems heuristics guidelines enabled realisation of business benefits, in addition to the development of a business intelligence system that adhered to high technological standards. The first successful outcome of this study was thus an improved development approach, which resulted in a successful business intelligence system.

The researcher then contextualised the classic guidelines and developed a set of specific boundary questions for the use of critical systems heuristics to improve business intelligence system development; this was the second outcome of this study. The researcher reflects on the study, specifies the learning, and concludes with the main research findings in this chapter; she reflects on the area of concern, the applied methodology and its embedded framework of ideas.

This chapter is structured as follows: The researcher reflects on the research objectives of this study in Section 10.2. In Section 10.3 the researcher specifies learning in terms of the area of concern; she presents the final guidelines for the use of the critical systems methodology, i.e. critical systems heuristics, in the development of business intelligence systems. The researcher specifies the learning in terms of the methodology applied in Section 10.4; and specifies the learning in terms of the framework of ideas in Section 10.5. The researcher reflects on the extent to which the research problem was solved in Section 10.6. In Section 10.7 the researcher reflects on the study in terms of the principles for action research. In Section 10.9 the researcher states possible areas for further research.

10.2 Reflection: research objectives of this study

The following sections highlight the key findings in this study. In Section 10.2.1 below the researcher reflects on the theoretical objectives. In Section 10.2.2 below the researcher reflects on the primary objective of this study.

10.2.1 Reflection on the theoretical objectives

In order to achieve the primary objective, theoretical objectives were formulated for the study, i.e. to gain an understanding of key concepts in this study it included literature reviews for: the critical research paradigm; BI system development; as well as the CST paradigm and critical systems methodologies.

10.2.1.1 The critical social theory research paradigm

The researcher discussed the ontological and epistemological assumptions of the research paradigms that are prevalent in information systems (IS) research; she also reflected on the suitability of the research paradigms for this study in Chapter 2. Critical research aims to intervene in and improve social situations where social artefacts (i.e. BI systems) are used; she therefore concluded that a critical research approach was most suitable. Action research (AR) is applied in this study as a critical research approach; it is used in IS research to reflect on the social issues related to the development, use and impact of the artefact being developed. It was thus adopted in this study. In this study the researcher continuously reflected on: improvement in the area of concern (A); the applied methodology (M); and the applied methodology's embedded framework of ideas (F). The structure of this study based on the FMA illustration was discussed in Chapter 2. The first theoretical objective was addressed in Chapter 2 of this study.

10.2.1.2 Business intelligence system development

The existing literature on BI system development was reviewed and the suitability of existing (traditional) software development approaches, including approaches that specifically focus on the development of BI systems, were evaluated – this was discussed in Chapter 3. Shortcomings in traditional approaches were identified; the researcher proposed that the identified shortcomings may be resolved by complementing these technically-oriented software development approaches with critical (people-oriented) systems methodologies to also incorporate relevant human, organisational and social aspects. The second theoretical objective was thus addressed in Chapter 3 of this study.

10.2.1.3 Critical systems thinking and critical systems methodologies

The paradigm shifts that occurred in systems thinking, and the subsequent development of the CST paradigm, were discussed in Chapter 4; it also included a discussion on the critical systems methodologies positioned in the CST paradigm. The researcher reflected on the development of software within these paradigms. CST was discussed in terms of the two strands in the literature, i.e. total systems intervention (TSI) and critical systems heuristics (CSH). The third theoretical objective was thus addressed in Chapter 4 of this study.

10.2.2 Reflection on the primary objective: development of the guidelines

The primary objective of this study was to develop guidelines for the use of critical systems methodologies to improve the development of BI systems. A critical research approach was followed to achieve the primary objective. The study was done using action research (AR); it was structured in terms of the FMA illustration of Checkland & Holwell (1998:27): The researcher aimed to improve an area of concern by applying methodologies; these methodologies embed philosophical frameworks of ideas. In terms of the methodology (M), she applied critical systems methodologies TSI and CSH; in terms of the embedded frameworks of ideas (F), both methodologies embed the philosophical notions of CST and ideas of scholars such as Flood and Jackson as well as Ulrich.

The researcher aimed to improve the identified area of concern (A), i.e. to improve the realisation of business benefits of BI systems. The researcher identified a practical problem context that was a representative instance of the broader area of concern (research theme) in this study; this was discussed in Chapter 5. She proposed the application of TSI as well as CSH to improve the development of BI systems; this was discussed in Chapter 6. The AR process includes five iterative phases, i.e. diagnosis; action planning; action taking; evaluation; and specification of learning (Baskerville, 1999:14).

10.2.2.1 The diagnosis phase of the interventions

The diagnosis phase of the intervention was discussed in Chapter 5 of this study. The research theme related to the identified area of concern (A) for this study was that BI systems fail to realise business benefits. Therefore, the researcher identified a specific representation of the area of concern, i.e. a failed BI system in an organisation; a new BI system had to be developed for this organisation. The background to this failed (historical) BI system, and the organisation where the research was conducted, was discussed in Chapter 5.

10.2.2.2 The action planning phase of the interventions

The action plan for the intervention was discussed in Chapter 6; it also included a discussion to motivate the development of the critical systems methodologies BI system development. The researcher suggested that critical systems methodologies enrich the business requirements definition phase of the Kimball lifecycle approach. The researcher proposed two sets of guidelines for the application of the two critical systems methodologies. Firstly, the researcher suggested guidelines for the application of TSI in BI system development in the first AR intervention (i.e. the TSI intervention); in this intervention she suggested that TSI be applied during the business requirements definition phase of the Kimball lifecycle approach. Secondly, the researcher suggested guidelines for the application of CSH in BI system development in the second AR intervention (i.e. the CSH intervention); in this intervention she suggested that CSH be applied during the business requirements definition phase of the Kimball lifecycle approach.

10.2.2.3 TSI: action taking, evaluating, and specification of learning phases

In the action taking phase of the application of the TSI guidelines; the researcher evaluated this research intervention and specified learning in terms of the FMA illustration. The TSI guidelines (M) could not be applied successfully. In terms of the philosophical foundation (F) of TSI, it aims to facilitate methodological pluralism through a metaphorical analysis of the organisational and problem context. However, the metaphorical analysis of the organisation was skewed by the extreme flux in the organisation at the time of the research; as a result the complementarist framework could not be fully appreciated. Therefore, the TSI guidelines (M) could not be successfully applied, and the area of concern (A) was not improved. The philosophical notions (F) of the TSI methodology, i.e. emancipation, critical awareness, and methodological pluralism could not be realised. Learning for this AR intervention was specified in terms of FMA. This was discussed in Chapter 7.

10.2.2.4 CSH: action taking, evaluating, and specification of learning phases

The researcher then applied a classic set of CSH guidelines in the intervention. Again, this intervention was evaluated and learning was specified in terms of the FMA illustration. The classic set of CSH guidelines (M) were applied successfully. The area of concern (A) was improved by a successful BI system. The philosophical notions (F) of CSH, i.e. emancipation, critical awareness, and methodological pluralism, were realised. Learning for this AR intervention was specified in terms of FMA. This was discussed in Chapter 8. When the researcher reflected on the embedded framework of ideas (F), she realised that the classic guidelines could be improved by contextualising them for a specific BI context. Therefore, a contextualisation commenced – refer to Section 10.2.2.5 below.

10.2.2.5 Contextualisation of the guidelines

An AR approach has a cyclical an iterative nature. The researcher continuously evaluates the effects of the implemented actions and specifies the accumulative learnings; thereby he/she revises his/her understanding of the world (Sterman, 1994:331). This may lead to further research within the AR process. In this study the researcher realised that, even though the application of the CSH guidelines was successful, reflection upon these guidelines highlighted that the classic CSH guidelines could be contextualised for a BI context.

In the CSH intervention the researcher identified that the classic CSH questions are difficult to interpret if one does not have theoretical knowledge about CSH. On a methodological (M) level she proposed the application of CSH to derive BI-specific boundary questions. Therefore, the CSH boundary questions were used to interview participants in order to derive BI specific contextualised CSH boundary questions; the framework of ideas (F) that applied to the contextualisation was thus still the philosophical notions that embedded in the CSH framework. The contextualised questions were then evaluated by a BI practitioner (that does not have knowledge of CSH) and learning specified in terms of FMA. This was discussed in Chapter 9. The outcome of this intervention was a final set of CSH guidelines that can be applied in BI system development.

10.3 Specification of learning: area of concern

The final set of guidelines for the use of critical systems methodologies in BI system development is presented in Section 10.3.1 below.

10.3.1 The guidelines for the application of CSH in BI system development

The researcher applied the classic representation of the CSH boundary questions in a BI system development project (refer to Chapter 8). Thereafter, she contextualised the classic CSH boundary questions; the boundary questions were contextualised specifically for a BI context (refer to Chapter 9).

The outcome of the contextualisation of guidelines and boundary questions are discussed in the next sections: The contextualisation of questions to determine the sources of motivation of the BI system being developed is discussed in Section 10.3.1.1 below; Section 10.3.1.2 discusses the sources of power of the BI system being developed; Section 10.3.1.3 discusses the sources of knowledge that are applicable to the BI system being developed; and Section 10.3.1.4 discusses the sources of legitimation of the BI system that is being developed. The final set of BI specific boundary questions is summarised in Section 10.3.2.

10.3.1.1 Sources of motivation of the BI system

To determine the sources of motivation the classic CSH guidelines included three questions in the "is" and "ought to" mode:

1. Who is (ought to be) the client/beneficiary of the BI system?
2. What is (ought to be) the purpose of the BI system?
3. What is (ought to be) the measure of improvement/success?

In the evaluation phase (refer to Chapter 9), the BI expert suggested that the purpose of the BI be discussed first, and then the client of the BI system. She also suggested two refinements to the contextualised questions. The question regarding the purpose was in the first instance of enhancement contextualised as follows: *What is (ought to be) the purpose of a BI system, i.e. which proactive decisions are (ought to be) enabled by the BI system, so that these decisions improve the rg s 's g s us y (f r ch ified recipient of decision support information); and what are the base (raw) data from source systems to be incorporated to enable it?* In the evaluation phase of the contextualisation of the questions, this question was contextualised further to refer to the specific BI system being developed, i.e. "…*this* BI system…", rather than generically to "…a BI system…". The question to determine the purpose of the BI system that was included in the final guidelines was thus the following: *What is (ought to be) the purpose of* ***this*** *BI system, i.e. which proactive decisions are (ought to be) enabled y h BI sys , s h h s c s s r v h rg s 's g abilities timeously (for each identified recipient of decision support information); and what are the base (raw) data from source systems to be incorporated to enable it?*

The question regarding the client/beneficiaries was in the first instance of enhancement contextualised as follows: *Who are (ought to be) the clients of a BI system in terms of diverse stakeholder groups, amongst others: decision makers* *(such as executive management) that are the recipients of the decision support (output) information; and the managers of the source (input) data?* Similar to the previous question, this question was contextualised further in the evaluation phase to refer to the specific BI system being developed, i.e. "…*this* BI system…", rather than generically to "…a BI system…". The question to determine the client of the BI system that was included in the final guidelines was the following: *Who are (ought to be) the clients of **this** BI system in terms of diverse stakeholder groups, amongst others: decision makers (such as executive management) that are the recipients of the decision support (output) information; and the managers of the source (input) data?*

The question regarding the measure of success/improvement was not contextualised further. The final set of contextualised boundary questions to determine the sources of motivation of the BI system is illustrated in Table 10-1 below.

Table 10-1: Sources of motivation of the BI system

<table>
<tr><td colspan="2">The purpose of the BI system:
What is (ought to be) the purpose of this BI system, i.e. which proactive decisions are (ought to be) enabled by the BI system, so that these decisions improve the organisation's planning abilities timeously (for each identified recipient of decision support information); and what are the base (raw) data from source systems to be incorporated to enable it?</td></tr>
<tr><td>The client of the BI system:
Who are (ought to be) the clients of this BI system in terms of diverse stakeholder groups, amongst others: decision makers (such as executive management) that are the recipients of the decision support (output) information; and the managers of the source (input) data?</td><td>The measure of success/improvement:
Ensure to explore measures of success/improvement that are (ought to be) incorporated in terms of SMART principles: Simple; Measurable; Attainable; Repeatable; and Timeous.</td></tr>
</table>

10.3.1.2 Sources of power of the BI system

To determine the sources of power the classic CSH guidelines include three questions in the "is" and "ought to" mode:

1. Who is (ought to be) the decision maker regarding the measure of improvement/success of the BI system?
2. What resources and conditions of success is (ought to be) controlled by the decision maker?
3. What success conditions are (ought to be) part of the decision maker and not under the control of the decision maker?

The BI expert did not suggest refinements to the contextualised questions. So, these questions were not contextualised further in the evaluation phase – refer to Chapter 9. The final set of contextualised boundary questions to determine the sources of power of the BI system is illustrated in Table 10-2 below.

Table 10-2: Sources of power of the BI system

<table>
<tr><td colspan="2">The custodian of the BI system:
Who is (ought to be) the custodian (decision maker) regarding the business dimensions of the BI system such as sources of input data, decomposed reports and the supported business process; and who is (ought to be) the custodian (decision maker) regarding the technical dimensions of the BI system such as technology and infrastructure?</td></tr>
<tr><td>The resouces of the BI system:
What resources are (ought to be) controlled by the identified custodians?</td><td>Success conditions of the BI system:
And what aspects of the BI system design is (ought to be) outside the control of the BI custodians? How will these be handled during the design and development process?</td></tr>
</table>

10.3.1.3 Sources of knowledge of the BI system

The classic CSH guidelines include three questions in the "is" and "ought to" mode to determine the sources of knowledge:

1. Who is (ought to be) considered a professional/expert regarding the BI system?
2. What kind of expertise is (ought to be) consulted regarding the BI system?
3. What/who is (ought to be) guarantor of success of the BI system?

In the evaluation phase (refer to Chapter 9), the BI expert suggested one refinement to this set of questions; she suggested that the term "architect" be used to refer to the BI designer/developer since this is an acceptable term used an BI environment. The question regarding the required expertise of a BI system being developed was formulated as follows in the first instance of enhancement: *What qualifies (ought to qualify) a designer (such as a business analyst) to design (ought to design) the business dimensions of the BI system regarding the embedded performance metrics relating to the business process and front-end data capturing mechanisms; and what qualifies (ought to qualify) a designer (such as a BI developer) to design (ought to design) the technical dimensions of the BI system regarding the technological platforms and architecture such as the DW?* So, in the evaluation phase this question it was contextualised further to include the term "architect" to refer to the technical designer i.e. it the contextualised boundary questions were as follows: *What qualifies (ought to qualify) a designer (such as a business analyst) to design (ought to design) the business dimensions of the BI system regarding the embedded performance metrics relating to the business process and front-end data capturing mechanisms; and what qualifies (ought to qualify) a designer/**architect** (such as a BI developer) to design (ought to design) the technical dimensions of the BI system regarding the technological platforms and architecture such as the DW?*

The questions regarding the expert and the guarantor were not contextualised further. The final set of contextualised boundary questions to determine the sources of knowledge of the BI system is illustrated in Table 10-3 below.

Table 10-3: Sources of knowledge of the BI system

<table>
<tr><td colspan="2">The expert of the BI system:
Who is (ought to be) considered as a professional or further expert, i.e. who design (ought to design) the business dimensions of the BI system; and who design (ought to design) the technical dimensions of the BI system?</td></tr>
<tr><td>The expertise of the BI system:
What qualifies (ought to qualify) a designer (such as a business analyst) to design (ought to design) the business dimensions of the BI system regarding the embedded performance metrics relating to the business process and front-end data capturing mechanisms; and what qualifies (ought to qualify) a designer/architect (such as a BI developer) to design (ought to design) the technical dimensions of the BI system regarding the technological platforms and architecture such as the DW?</td><td>The guarantor of the BI system:
Who/what is (ought to be) the guarantor of success, i.e. who/what is (ought to) ensure continued use of the BI system after implementation? Also consider the specific actions to be taken by the guarantor of success ensure that success is guaranteed.</td></tr>
</table>

10.3.1.4 Sources of legitimation of the BI system

To determine sources of legitimation the classic CSH guidelines ask the following questions in the “is” and “ought to” mode:

1. Who is (ought to be) witness to the interests of those affected yet not involved?
2. What secures (ought to secure) emancipation of those affected from the promises of those involved?
3. What worldview is (ought to be) determining?

In the evaluation phase (refer to Chapter 9), the BI expert suggested two refinements. The question regarding the required expertise of a BI system being developed was formulated as follows in the first instance of enhancement: *Who is (ought to be) the witness to the interests of those that are affected but not involved in the process?* However, in the evaluation phase, this question was further contextualised to also include stakeholders that do not directly gain from changes brought on by the system, but are still affected due to changes in for example business processes. The question regarding the witness was thus further contextualised to the following: *Who is (ought to be) the witness to the interests of the affected yet not involved; for example, who do not gain directly from the changes brought on by the system, but are still affected by it?*

The question regarding the worldview was contextualised as follows: *What worldview is (ought to be) determining, i.e. do the involved and affected stakeholders perceive the use of software artefacts such as BI systems as merely technical artefacts, or do they perceive it is artefacts that impacts socially on its users also?* However, in the evaluation phase, this question was further contextualised to explain the intent and purpose of the question better, i.e. to reflect on the change management strategy that will be required to embed the new BI system in the organisation: *To reflect on the type and intensity of the change management strategy that will be required to embed this new BI system in the organisation: reflect on what worldview is (ought to be) determining, i.e. do the involved and affected stakeholders perceive the use of software artefacts such as BI systems as merely technical artefacts, or do they perceive it is artefacts that impacts socially on its users also?*

The question regarding the emancipation of the affected was not contextualised further. The final set of contextualised boundary questions to determine the sources of legitimation of the BI system is illustrated in Table 10-4 below.

Table 10-4: Sources of legitimation

<table>
<tr><td colspan="2">The witness of the BI system:
Who is (ought to be) the witness to the interests of the affected yet not involved; for example, who do not gain directly from the changes brought on by the system, but are still affected by it?</td></tr>
<tr><td>Emancipation of the affected:
What secures (ought to secure) the emancipation of the affected and involved, and ensure that the BI system realises its intended business benefits?</td><td>The determining worldview:
To reflect on the type and intensity of the change management strategy that will be required to embed this new BI system in the organisation: reflect on what worldview is (ought to be) determining, i.e. do the involved and affected stakeholders perceive the use of software artefacts such as BI systems as merely technical artefacts, or do they perceive it is artefacts that impacts socially on its users also?</td></tr>
</table>

10.3.2 Summary: guidelines for use of CSH in BI system development

The final outcome of this research was a set of guidelines for the use CSH in BI system development. Appropriate business requirements are crucial to the success of a developed artefact – refer to Chapter 3 for a discussion on appropriate requirements collection and verification of requirements. The guidelines are to be applied during the business requirements definition phase of the development project – refer to Figure 10-1 below.

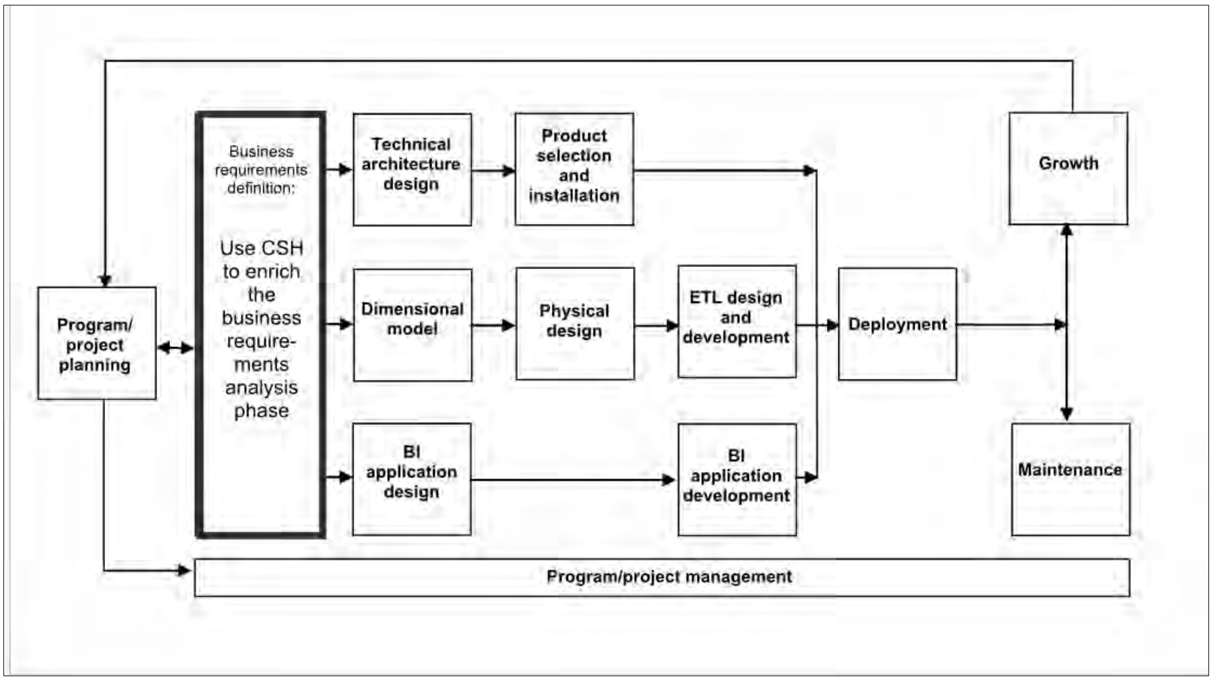


Figure 10-1: Enrich the Kimball lifecycle approach with CSH

In following the Kimball lifecycle approach, it is important to apply the principles as proposed by Kimball during the program/project planning phase, the design and implementation phase of the technology, data, and business intelligence tracks, as well as the deployment, maintenance, and growth phases as prescribed by the developers of the Kimball lifecycle approach (Kimball, 2008; Kimball & Ross, 2010). Refer to Chapter 6 for a discussion on the Kimball phases; these are summarised in the next sections. Refer to Chapters 7 and 8 for applications of these.

Plan the program/project

The program/project planning phase of the Kimball lifecycle approach focuses on launching the project; it includes scoping, justifying, and staffing the project (Kimball & Ross, 2010:98). Kimball (2008:16) emphasises the importance of having a strong business sponsor as a critical factor in assessing BI readiness; he also gives guidelines on staffing (Kimball, 2008:32). In addition to a strong business sponsor, the project team should (amongst others) also include a business analyst that can appropriately elicit business requirements. The business analyst should assume the role of the facilitator in applying the contextualised boundary questions; the business sponsor should also be supportive of this.

Define the business requirements

Apply the CSH boundary questions to guide the business requirements definition:

Table 10-5: Sources of motivation of the BI system

The purpose of the BI system: What is (ought to be) the purpose of this BI system, i.e. which proactive decisions are (ought to be) enabled by the BI system, so that these decisions improve the organisation's planning abilities timeously (for each identified recipient of decision support information); and what are the base (raw) data from source systems to be incorporated to enable it?	
The client of the BI system: Who are (ought to be) the clients of this BI system in terms of diverse stakeholder groups, amongst others: decision makers (such as executive management) that are the recipients of the decision support (output) information; and the managers of the source (input) data?	**The measure of success/improvement:** Ensure to explore measures of success/improvement that are (ought to be) incorporated in terms of SMART principles: Simple; Measurable; Attainable; Repeatable; and Timeous.

Table 10-6: Sources of power of the BI system

The custodian of the BI system: Who is (ought to be) the custodian (decision maker) regarding the business dimensions of the BI system such as sources of input data, decomposed reports and the supported business process; and who is (ought to be) the custodian (decision maker) regarding the technical dimensions of the BI system such as technology and infrastructure?	
The resouces of the BI system: What resources are (ought to be) controlled by the identified custodians?	**Success conditions of the BI system:** And what aspects of the BI system design is (ought to be) outside the control of the BI custodians? How will these be handled during the design and development process?

Table 10-7: Sources of knowledge of the BI system

<table>
<tr><td colspan="2">The expert of the BI system:
Who is (ought to be) considered as a professional or further expert, i.e. who design (ought to design) the business dimensions of the BI system; and who design (ought to design) the technical dimensions of the BI system?</td></tr>
<tr><td>The expertise of the BI system:
What qualifies (ought to qualify) a designer (such as a business analyst) to design (ought to design) the business dimensions of the BI system regarding the embedded performance metrics relating to the business process and front-end data capturing mechanisms; and what qualifies (ought to qualify) a designer/architect (such as a BI developer) to design (ought to design) the technical dimensions of the BI system regarding the technological platforms and architecture such as the DW?</td><td>The guarantor of the BI system:
Who/what is (ought to be) the guarantor of success, i.e. who/what is (ought to) ensure continued use of the BI system after implementation? Also consider the specific actions to be taken by the guarantor of success ensure that success is guaranteed.</td></tr>
</table>

Table 10-8: Sources of legitimation

<table>
<tr><td colspan="2">The witness of the BI system:
Who is (ought to be) the witness to the interests of the affected yet not involved; for example, who do not gain directly from the changes brought on by the system, but are still affected by it?</td></tr>
<tr><td>Emancipation of the affected:
What secures (ought to secure) the emancipation of the affected and involved, and ensure that the BI system realises its intended business benefits?</td><td>The determining worldview:
To reflect on the type and intensity of the change management strategy that will be required to embed this new BI system in the organisation: reflect on what worldview is (ought to be) determining, i.e. do the involved and affected stakeholders perceive the use of software artefacts such as BI systems as merely technical artefacts, or do they perceive it is artefacts that impacts socially on its users also?</td></tr>
</table>

Design the system: data, technology, and business intelligence tracks

Business requirements impact on all aspects a BI project (Kimball, 2008:64). The Kimball lifecycle approach differentiates between three tracks that are developed simultaneously, i.e. the technology track; the data track; and the BI track. Kimball & Ross (2010:98) explain the tracks as follows: The technology track involves the integration of technologies, data stores, and metadata; it involves the system architecture design, as well as the selection of installation of required products. The data track entails the design of data elements according to business requirements, such as the dimensional data model, the DW bus matrix, and the extract, transform, and load (ETL) system. The business analyst should verify these models prior to implementation. The BI track is concerned with identifying and constructing BI applications such as dashboards and scorecards – these should serve the identified purpose(s) for the identified client(s).

Deploy, maintain, and grow the BI system

The three tracks of the Kimball lifecycle approach converge at deployment. After deployment the BI system is being maintained. It may grow into a bigger BI system; the Kimball lifecycle then re-iterates (Kimball & Ross, 2010:99). The business analyst, together with the business sponsor, should verify that the completed system adheres to the requirements as was gathered during the business requirements analysis phase. The system, as a whole, should serve the identified (measurable) purpose(s) for its client(s). From a critical systems approach, users should be appropriately educated to use the new system. Users should also be given a platform so that they can provide feedback on the system – this is to ensure proper use as well continuous improvement of the system. This is similar to the strategy proposed by Kimball (2008:560).

10.4 Specification of learning: methodology

The application of the classic CSH boundary questions during the business requirements definition phase of the BI system development project enabled the researcher to determine the normative content of the BI system that was being developed; it revealed the bases of motivation, power, knowledge, and legitimation for the BI system in terms of: who had to be involved; what possible conflicts had to be resolved; what was wrong (the as-is situation of the historical system); and what ought to have been improved upon (the to-be scenario that formed the basis of the requirements for the new BI system that was developed) – refer also to Chapter 8.

The outcome of the intervention was an improvement in the area of concern; however, the researcher felt that the (classic) methodology could be contextualised further for a BI context. Therefore, a contextualisation cycle commenced, i.e. the researcher contextualised the classic questions specifically for a BI context. The purpose of this was thus to contextualise the classic boundary questions so that they were specifically applicable to a BI context, and to make the guidelines self-explanatory to such an extent that BI practitioners could apply the questions even if they are not knowledgeable on the subject of critical systems thinking and the theoretical underpinnings of the classic boundary questions. So, the process that involved the contextualisation of the CSH boundary questions for a BI context resulted in specific boundary questions that can be applied to enable a BI development team to include representatives from relevant social categories as role players (i.e. stakeholders); these stakeholders should be purposefully involved during the BI system development process to facilitate elicitation of appropriate business requirements for a specific BI system.

Ulrich (1983:245) asserts that boundary judgements, that are constitutive of social maps and designs, can be determined by giving a systematic list of social actors (i.e. social roles) to be referred to by the planner; in referring to such a systematic list, it then enables the planner to understand the normative content of his/her maps and designs in terms of relevant social roles (*who?*). The planner must then also consider, for each relevant social role, two auxiliary constituents: their essential concerns regarding the social system under investigation (*what?)*; and the *crux* regarding the boundary judgements (*so what?*) (Ulrich, 1983:258). The contextualised boundary questions still encapsulate the relevant social roles, as well as the two auxiliary constituents of these roles.

The categorical social roles contained within CSH, as described by Ulrich (1983:258), serve to bound a social system through critical reflection and practical discourse. The classic CSH questions were used as interview questions to ask participants to reflect on possible answer(s) to the questions in relation to a BI environment. The social system refers in the context of this study to a specific BI system that is being developed; the social roles refer to BI stakeholders and include both involved and affected parties. Ulrich's four categorical social roles, i.e. the client, decision maker, planner, and witness, were in this study translated to be relevant for BI; the questions were broadened to stimulate practical discourse regarding the system's boundary judgements. The guidelines can then guide the business requirements analysis phase to elicit requirements and to facilitate the development of a BI system that improve the organisational context of those that are involved with *(who)*, as well as also those that are affected by, the BI system in terms of *what* is to be improved upon, as well as defining the crux (*so what?*) of the required improvement. These are discussed in the next sections.

10.4.1 The social role of the client

The *client* of the BI system is, as is typically the case with a social system, not a single entity or a homogeneous group of people; they also don't typically share a common purpose but seem to have several conflicting purposes. Affected role players, such as data capturers that are responsible to capture data effectively and efficiently, were also included in this social category. The purpose(s) of these client(s) give direction as to who to involve as the relevant clients. Therefore, on a methodological level, these two questions were switched around: the question regarding the purpose was asked first in the contextualised boundary questions, whilst the question regarding the client was asked second. Once the client(s) and purpose(s) were determined, required measures of improvement can be explored.

10.4.2 The social role of the decision maker

The role of a *decision maker* in a BI context have a different connotation to it than what was intended by Ulrich (1983:255) for this social category; he defines the decision makers "as the complex of persons who can produce and control changes in [the system's] measure of improvement", i.e. the sources of power and control. To reflect on Ulrich's intended definition for this role the term "custodian(s)" was introduced here; in a BI context the term "custodian(s)" is more relevant to refer to a person (or group of people) that control the measures of improvement and/or the (technical as well as business) environments of the BI system. In a BI environment (as is the case in social systems as defined by Ulrich), this role is also not represented by a single entity or a homogeneous group of people.

On a methodological level, the sources of power for a BI system must reflect representation of both the technical (e.g. BI platform and technological infrastructure) and business (e.g. supported business process) dimensions of the system. These two groups of stakeholders have a role in the BI system as a result of their role-specific concerns (components) and the respective environments that they control (and don't control); this was also reflected in the data gathered from the participants when they were asked to reflect on these questions – refer also to Chapter 9.

10.4.3 The social role of the planner

The social category of the *planner* refers to "whoever has some relevant knowledge, experience or skill to contribute to the planning process" (Ulrich, 1983:255). Ulrich differentiates between a *planner* and *expertise*; the *planner* refers to the person that brings all the people whose expertise are required together; whilst the *expertise* refers to the actual expertise necessary to bring about improvement. The nature of a BI development project is such that the experts (developers) that develop the BI system should also be responsible to source the appropriate (human) resources with the required skills to effectively develop the BI system; it is never a single person that develops such a system, but rather a group of people with different technical and business related skills – refer for example to the Kimball lifecycle model (Figure 8-8 in Chapter 8) where the different tracks require specific expertise to ensure that the project is executed successfully as a whole.

Ulrich also brings in the *guarantor* role to ensure that the system designer remains cognisant that the presence of all the relevant experts and expertise in the team will not necessarily result in the desired/expected improvement; for this study the guarantor role was associated with continued use of the system, i.e. what should be done by whom to ensure continued use thereof.

10.4.4 The social role of the witness

According to Ulrich (1983:256) the witnesses “do not contribute resources or expertise, nor do their purposes motivate the planning effort…they remind the latter of their moral responsibility for all the practical consequences of their planning effort”; “it extends to the costs and risks imposed on all those who do not belong to the client”. The planner should therefore act on behalf of these affected parties and aim to ensure that he/she emancipates them also; they potentially have conflicting worldviews that affect how they define emancipation, and how they can therefore be emancipated by the planner. Emancipation in the context of a BI system and for this study is defined as a system that realises its business benefits; these closely relate to the purpose(s) required by the respective client(s). Therefore, the contextualised set of boundary questions finally include questions from this category to enable the developer to retrospectively reflect on business benefits that may have been excluded previously during the design process; as well the respective worldviews of users to guide change management actions required to facilitate continued use of the BI system.

10.5 Specification of learning: framework of ideas

Ulrich (1983:19) aims to provide a conceptual framework whereby one can trace at least some of the delusions that he believes are present when a social planner attempts to plan *rationally.* His CSH framework therefore aims to be *critical*, employ the *systems idea*, and explore *heuristically* rather than theoretically. Firstly, Ulrich (1983:20) argues that being critical implies self-reflection; he roots his views on that of Kant, and therefore aspires to enable one to become aware of the presuppositions of one’s own judgements. Secondly, Ulrich (1983:22) also incorporates the Kantian viewpoint of a system; he regards systems as normative intellectual concepts of critical reason to be used to make transparent that we don’t (and can never really have) a completely comprehensive understanding of the social “system” that we are exploring, planning, designing and developing; it can, however, epistemologically guide exploration of the (whole) social system. Thirdly, Ulrich (1983:23) also has a Kantian understanding of the term “heuristic”, i.e. as representing a hypothetical *a priori* judgement of reason; judgements are thus based solely on reason.

In the classic CSH of Ulrich (1983:244) the boundary questions represent synthetic and relative *a priori* judgements as these judgements cannot be justified logically or empirically. Each basic categorical social role that Ulrich includes in CSH (i.e. the client, decision maker, planner, and witness) is explored in terms of two dimensions: first, the relevant role-specific concerns (*what* is to be achieved through this system); and secondly the crux of the social system that relates to the third basic question that Kant formulated to motivate man’s search knowledge (i.e. *what may I hope?*) in terms of what can be wished for regarding improvement through the (whole) social system being explored. This whole system does not imply that the system can be known it its *totality*; rather, it implies that the planner must remain cognisant that he/she is dealing with a *projected* (planned) unity that is very much dependent upon his/her own realities, and perceptions of what the system *should* entail but must also include realities and perceptions of those involved and affected by this system.

By asking the CSH boundary questions in the “is-mode” and then in the “ought-to” mode, Ulrich therefore attempts to: enable dialoguers to firstly surface what they know; and secondly attempt to surface what they can only hope to know by reflecting on the system from the perspective of making transparent presupposed norms and values that inevitably influence perceptions about the system, as well as desired improvement to be brought about by this system. Ulrich wants the designers of social systems to identify social participants, and then enable them to enter into a dialogue of the objective and real situation, versus the normative and ideal situation; and of that which can be (have been) experienced versus that which can only be thought and discoursed about regarding the social system that is being explored.

The application of the classic set of boundary questions in the CSH intervention (refer to Chapter 8) enabled the researcher to guide participants to surface synthetic and relative *a priori* requirements (that they were previously unaware of and also have not yet "seen" or "experienced" at that point in time). For example, in addition to a successful BI system that was developed in applying CSH during the business requirements analysis phase, the associated business process and data capturing mechanisms were also contextualised and improved – refer to Chapter 8. The participants realised through the CSH boundary-reflections that these were flawed and had to be improved upon to enable development of a successful enablement (BI) system.

The boundary questions enabled participants to reflect in a structured manner on the failed (historical) BI system – refer to Chapter 5 for a description of the historical system. Through structured reflection on the failed BI system (in the "is-mode"), participants became aware of what they did *not* want to have in the new BI system. They also started to reflect on what they could have instead (again, without logical and/or empirical knowledge thereof at that point in time), thus leading them to surface new requirements in a manner that resonates well with Kant's third basic question to motivate man's search for knowledge, i.e. *what may I hope for?*; it enabled participants to *hope* for an improved organisational context of which the BI system was merely one component of the bigger whole. This *hope* may realise through the role of the guarantor, which attempts to embed change by doing what he/she *thinks* should be done in order to achieve that which is hoped for.

At the end of this intervention the researcher can still not presuppose that she now knows "the whole system" that was the subject of this study; however, by undertaking a critical effort to reflect on the *a priori* whole system judgements, she was able to surface *a priori* requirements. These requirements extended to supposedly external components (such as the business process and data capturing mechanisms) that ultimately improved the design and development of this BI system. The researcher feels that she, in addition to improving the development approached, also successfully facilitated improvement in the organisational context of users through the improvement of elements (i.e. the business process and front-end data capturing mechanisms) that would not have been included in this process if a critical approach was been followed. Surfacing and inclusion of these did not extend the scope of the development project significantly; however, it ultimately improved the development approach and the success of the BI system that was developed.

10.6 Reflection: did this study solve the research problem?

The researcher identified an area of concern, i.e. BI systems do not realise business benefits. She also identified a specific problematical situation that represented the area of concern, i.e. an instance of a failed BI system. The researcher then followed and action research approach to develop and apply a set of guidelines for a critical systems methodology (CSH); the guidelines were applied in the development of a new BI system to replace the failed system. This was done successfully and the new BI system was successfully adopted by its users – this was discussed in Chapter 8. The researcher then contextualised the classic CSH boundary questions and developed guidelines (based on CSH) to improve BI system development – this was discussed in Chapter 9. The research problem was thus solved.

10.7 Reflection: principles of action research

Action research is evaluated according to two sets of principles, i.e. the principles of Myers & Klein (2011) for critical research; and the principles for rigour and evaluation of the method according to Heikkinen *et al.* (2012) – refer to the next sections for a discussion on these.

10.7.1 Reflection on the principles for critical social theory research

Firstly, Myers & Klein (2011:23) is concerned with *insight* in the research situation. The researcher gained insight in the research situation by setting and achieving theoretical objectives – refer to 10.2.1 above.

Secondly, Myers & Klein (2011:23) suggest that the researcher *critiques* the research situation. Critiquing the research situation necessitates application of the following three principles: use core concepts from critical social theorists; take a value position; as well as reveal and challenge prevailing beliefs and social practices (Myers & Klein, 2011:25). Refer to Chapter 2 for a discussion.

Thirdly, Myers & Klein (2011:24) argue that *transformative redefinition* implies that the organisational context must be improved through the development of "critical, managerially relevant knowledge and practical understandings"; transformative redefinition refers to individual emancipation, improvements in society as well as improvements in social theories, i.e. transformative redefinition is the result of the research activity. Transformative redefinition therefore necessitates application of the following three principles: individual emancipation; improvements in society; and improvements in social theories (Myers & Klein, 2011:25). The outcome of the first TSI intervention was learning about the applied methodology – it could not be applied successfully in the organisation undergoing extreme changes; the researcher specified learning in terms of FMA – refer to Chapter 7. The outcome of the CSH intervention was emancipated BI users; the BI system that was developed was successful – refer to Chapter 8. The researcher also learnt about the methodology applied and its embedded framework of ideas; she specified learning in terms of FMA – refer to Chapter 8. The insight gained in the CSH intervention resulted in the commencement of a contextualisation cycle; the outcome was a contextualised methodology; the researcher also learnt about all the elements of research and specified learning in terms of FMA – refer to Chapter 9.

10.7.2 Reflection on rigour and evaluation of the method

The principles proposed by Heikkinen *et al.* (2012:8) to ensure that the research method is rigorously applied were adopted for this study; these are discussed below:

The principle of historical continuity analyses: the history of action, i.e. how has the action evolved historically; and emplotment, i.e. how logically and coherently does the narrative proceed.

The researcher discussed the research in terms of the AR phases; the study described how these phases were completed consecutively. In terms of the AR process followed, the researcher explained the action plan for the interventions in

Chapter 6; the action plan for the contextualisation of the guidelines was discussed in Chapter 9. The researcher evaluated the success of the AR interventions; she then specified what she learned in terms of the elements of the FMA framework. She also explained the data presentation and analysis in the chapters that describe the empirical work – refer to Chapters 7, 8 and 9.

Checkland & Holwell (1998:26) argue that the cyclical process of AR, where the researcher continuously learns about F, M, and A during the research process, "may well cause a re-thinking of earlier stages". In this study, the learning of the CSH intervention was used to devise the contextualisation cycle where the classic guidelines were contextualised. Refer to Section 10.3.1 above for a summary of how the guidelines were developed; the detailed discussion is included in Chapter 8 and Chapter 9 of this study.

The principle of reflexivity determines: subjective adequacy, i.e. what is the nature of the researcher's relationship with the research object; ontological and epistemological presumptions, i e what are the researcher's presumptions of knowledge and reality; and transparency, i.e. how does the researcher describe material and methods used.

The researcher explained her role in the organisation where the research was conducted in Chapter 2. She was part of the organisation where the research was conducted; she was also part of the team that developed the BI system where the guidelines were applied. When Checkland & Holwell (1998:25) explain the action research process, they say that "it is important, and certainly prudent, to negotiate carefully the respective roles of the researcher(s) and people in the problem situation…because there is always some ambiguity in the complex dual role of the researcher: both involved in the action as participant and consciously reflecting upon it to extract useful lessons"; the action researcher is thus "involved in the action in the situation…the aim being to help bring about changes felt to be 'improvements'".

Checkland & Holwell (1998:26) therefore assert that the action researcher can improve a problematical situation; the action researcher achieves this when he/she “tries to make sense of the accumulating experience, doing so using the declared F and M”. Accordingly, the researcher proposed a structure for this study in terms of the FMA illustration – refer to Chapter 6. She reflected on these elements throughout the study – refer also to Chapters 7, 8, and 9 as well as Sections 10.2.2.3, 10.2.2.4, 10.2.2.5, and 10.3 above. The researcher also critiqued the research situation and took a value position; this was done as per the guidelines presented by Myers & Klein (2011:25) – refer to Chapter 2.

The principle of dialectics evaluates: dialogue, i e how has the researcher’s insight developed in dialogue with others; polyphony, i.e. how does the research report present different voices and interpretations; and authenticity, i.e. how authentic and genuine are the protagonists of the narrative.

The researcher interviewed a number of participants during the course of this study. The participants and their respective roles were discussed in the chapters that describe the empirical work; these chapter also summarised their responses – refer to Chapters 7, 8, and 9. The original feedback received from the participants was captured on a separate compact disc (CD). The researcher applied the following process to gather, verify, and interpret data gathered in this study: firstly, she interviewed the participants individually; secondly, she confirmed the interview responses by sending an e-mail to each participant asking him/her to confirm that his/her responses were captured correctly; thirdly, the researcher presented and analysed the participants’ verbatim responses; and lastly, she reflected on the insight gained from the data – refer to Chapters 7, 8, and 9.

The principle of workability and ethics evaluates: pragmatic quality, i.e. how well does the research succeed in creating workable practices; criticalness, i.e. what kind of discussion does the researcher provoke; ethics, i.e. how are ethical problems dealt with; and empowerment, i.e. does the research make people believe in their own capabilities and possibilities to act and thereby encourage new practices and actions.

The outcome of this research was a set of contextualised boundary questions to be applied during the development process of a BI system. The classic guidelines that were applied in the CSH intervention were contextualised. The contextualised set of guidelines was evaluated by asking an external BI consultant to reflect on the contextualised set of questions and therefore to ensure workability of the guidelines. All identified stakeholders affected and involved in a BI context participated in the contextualisation cycle to ensure that the questions evoke the right answers when applied in a BI environment. This was discussed in Chapter 9. The outcome was a final set of guidelines for the use of CSH in BI system development.

Lastly, the principle of evocativeness determines how well the research narrative evokes mental images, memories or emotions related to the theme.

The research was structured according to the FMA framework. The researcher continuously evaluated the research in terms of this framework throughout the research report. The report also included an illustration of the study that was presented at the beginning of every chapter.

The questions was visually presented to logically cluster questions that should be discussed together; this was done to ensure that the use of the guidelines remain effective – the researcher referred to the argument of Miller (1994:351) that people can receive, process, and remember limited amounts of information at a time.

10.8 Exiting the problem context

In this research intervention the researcher developed guidelines for the use of a critical systems methodology, i.e. critical systems heuristics, in business intelligence system development. In terms of entering the problem context, the researcher was an employee of the organisation where the research was conducted; also, the project team that assisted with the design and development of the BI system that was aided in this research intervention was appointed by the organisation – refer also to Chapter 7 and Chapter 8. She obtained permission from the organisation to do the research in the organisation – refer to Appendix A of this report. Exiting a research situation "may be an arbitrary act since the situation itself will continue to evolve through time" (Checkland & Holwell, 1998:26). For this research intervention, exiting the problem context was not a formal action as it mainly consisted of the disbanding of the project team, as is the case after completion and user evaluation of a developed software artefact. In contextualising the guidelines (refer to Chapter 9) the researcher interviewed employees of the organisation and, upon completion of the contextualised guidelines, communicated the results of the study to the participants.

10.9 Further research

This study successfully developed guidelines for the use of a critical systems methodology, i.e. CSH, in system development. The researcher applied the CSH boundary questions as guidelines to guide the development of a BI system; these guidelines were successfully applied in an organisation. The classic CSH set of questions was then contextualised; she contextualised the boundary questions for a BI context. The contextualised guidelines were evaluated. These guidelines can now be applied in other organisations as well.

The TSI guidelines that were proposed in Chapter 5 could not be successfully applied in the organisation where the research was conducted. This was mainly due to a major transformation project in the organisation; refer to Chapter 7 for the discussion. However, the TSI guidelines can be applied (tested) in another organisation that is not undergoing such major transformations.

10.10 Summary

The aim of this study was to develop guidelines for the application of critical systems methodologies to improve the development of BI systems. This was completed by reviewing the existing literature to identify shortcomings in development approaches that could be improved by applying methodologies from the critical systems thinking paradigm. A specific instance of the broader research context, i.e. that BI systems fail to realise business benefits, was identified. In the diagnosis phase of this study, the researcher identified a failed BI system in an organisation.

In the action planning phase, the researcher proposed two sets of guidelines: the application of TSI in BI system development; and the application of CSH in BI system development. In the action taking phases the researcher applied both sets of guidelines.

In the action taking phase of the TSI intervention, she applied the TSI guidelines as part of the development approach to develop a BI system to replace the identified failed BI system. Evaluation of this intervention showed that the TSI guidelines could not be applied successfully. However, the researcher still specified the learning of terms of the FMA framework.

In the action taking phase of the CSH intervention, the researcher applied the CSH guidelines; the CSH guidelines were applied as part of a traditional development approach (i.e. the Kimball lifecycle approach) to derive business requirements for the new BI system that was developed. Evaluation of this intervention showed that the CSH guidelines were applied successfully as part of the BI system development project. The newly developed BI system realised business benefits as it was regarded as successful by its users. When the researcher specified the learning of in terms of the FMA framework, she realised that the classic CSH guidelines could be contextualised further. Therefore, a contextualisation cycle commenced.

In the contextualisation cycle the researcher identified a shortcoming in the initially proposed CSH guidelines: CSH is difficult to understand when one does not have theoretical knowledge about CSH. The researcher then proposed that the classic CSH framework be applied to contextualise the questions for a BI context. The classic boundary questions were contextualised for a BI context, i.e. the classic boundary questions were contextualised to be self-explanatory for a BI practitioner; the guidelines were also visually represented as logical units – refer to Tables 10-5 to 10-8 in Section 10.3.2 for the final set of guidelines that was presented after evaluation thereof. Lastly, she specified the learning in terms of the FMA framework.

The final outcome of this study is thus a set of contextualised CSH boundary questions that can be applied to improve the development of BI systems. The researcher successfully completed this study and developed develop guidelines for the application of a critical systems methodology, i.e. CSH, to improve the development of BI systems.

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Appendix A: Consent form

The consent that the researcher obtained from the organisation to conduct the research in the organisation:

School of Information Technology in the Faculty of Economic Sciences and Information Technology
Permission to conduct research in the organisation
Research Project in Business Intelligence

Research conducted by:

Carin Venter

Dear Sir

The purpose of this letter is to inform you of the aim of the study and to obtain permission to do the research in your organisation. The study will be conducted by Carin Venter, a doctorate (Ph.D.) student from the Faculty of Economic Sciences and Information Technology at the North-West University (Vaal Triangle Campus).

The study has been approved and is funded in full by the study aid programme.

The Primary objective of the study is: To develop guidelines for the use of critical systems methodologies in business intelligence system development. It thus aims to improve decision making to meet strategic business objectives.

Please note the following:

- This study will involve anonymous interviews and focus groups. Names of individuals and the name of the company will not appear in the findings; answers and findings will be treated as strictly confidential. Participants will not be identified in person based on the answers they provided.
- Participants may choose not to participate and may also stop participating at any time without any negative consequences.
- The results of the study will be used for academic purposes only and may be published in an academic journal. We will provide the company with a summary of the findings on request.
- You may contact me or my study supervisor, Prof R Goede, Roelien.Goede@nwu.ac.za if you have any questions or comments regarding the study.

Please sign the form to indicate that you give permission for the study to be done in your organisation, subject to the confidentiality agreement stipulated above.

reserves the right to review the final manu-script before submission in order to ensure compliance to the measures undertaken above.

13/08/2013.

Metaphorical analysis workshop

The notes taken at the workshop where the metaphorical analysis was done where MN was participant 1 (P1); DS was participant 2 (P2); JS was participant 3 (P3); CV was the researcher.

Minutes of meeting

Subject:	**FEL DSS business requirements analysis – workshop 1**
Date of meeting:	**16 July 2014**
Time of meeting:	**11:00 - 12:00**
Venue:	**Christopher Columbus conference room**

Attendees
MN – Executive Manager PMO DS – Senior Manager PMO Process & Application JS – End-user CV – Business Analyst
Apologies: None
Purpose of meeting: Metaphorically analyse the organisational context of the organisation where the Front End Loading Decision Support System (FEL DSS) will be implemented. Based on the metaphorical analysis, a methodology will be chosen whereby business requirements will be gathered for the FEL DSS.

1 Welcome – CV welcomed all to the meeting and explained the purpose of the meeting.

2 Safety minute – CV presented to the group a video clip that emphasises the importance of road safety.

3 Background and context – CV presented the total systems intervention process and explained the role of metaphorical analyses in this methodology. All attendees agreed to participate in the workshop and follow the suggested process. CV presented all the attendees with a list of the suggested metaphors coupled with their descriptive characteristics and questions. She requested the attendees to write their comment on the metaphors and how they see the metaphors relating to the organisation. Comments were captured on individual sheets.

4 Closing remarks – CV thanked all the attendees for their participation.

Data gathered from participants: metaphorical analysis

View of participant P1 on the metaphorical analysis:

Metaphor	Characteristics	Questions	Comments
Machine	Standardised parts; routine and repetitive operations; predetermined activities, goals, and objectives; efficiency; rational approach; internal control; and a closed system view.	Is this a well-designed machine, i.e. founded in bureaucracy, design of the total organisation, design of individual jobs and management by objectives?	Organisation founded in bureaucracy
Organic	Some needs to be satisfied; survival; open system; adaptation; organisation; feedback; self-regulation; open system view; and passive control.	Is this a well-designed organism, i.e. founded in organisational needs, organisation-environment relations, species of organisations, population-ecology view of organisation and organisational ecology?	No.
Neuro-cybernetic	Similar to organic but also includes learning and control; information prime; law of requisite variety; viable system; learning to learn; and getting the whole into the parts.	Is this a well-designed brain i.e. founded in information-processing capability, learning, organisational holographic character and a "whole in parts" principle?	No.
Socio-cultural	Collaboration; shared characteristics in terms of language, history, dress etc.; shared reality in terms of values, beliefs, norms; social practices; and a culture (emphases norms, values) or team (unitary political system).	Does this give appropriate attention to cultural issues i.e. founded in culture as an environmental variable, corporate culture and subcultures and organisational reality?	Organisation is moving towards this. End-goal of WFT is shared reality.
Socio-political	Coercive conflict; domination; whose interest are served; power central issue; people are politically motivated; power as a consequence of structure; disintegration; and a coalition (pluralist political) or prison (coercive political).	Does the organisation give consideration to the political system i.e. founded in organisational interests, organisational conflict and power?	Workforce transformation caused uncertainty and results in demonstration of these. Employees are in a "survival mode" at present

P1.

View of participant P2 on the metaphorical analysis:

Metaphor	Characteristics	Questions	Comments
Machine	Standardised parts; routine and repetitive operations; predetermined activities, goals, and objectives; efficiency; rational approach; internal control; and a closed system view.	Is this a well-designed machine, i.e. founded in bureaucracy, design of the total organisation, design of individual jobs and management by objectives?	Individual business units are un-integrated. They work in silos
Organic	Some needs to be satisfied; survival; open system; adaptation; organisation; feedback; self-regulation; open system view; and passive control.	Is this a well-designed organism, i.e. founded in organisational needs, organisation-environment relations, species of organisations, population-ecology view of organisation and organisational ecology?	Current focus on individual survival rather than company survival. Not self regulating.
Neuro-cybernetic	Similar to organic but also includes learning and control; information prime; law of requisite variety; viable system; learning to learn; and getting the whole into the parts.	Is this a well-designed brain i.e. founded in information-processing capability, learning, organisational holographic character and a "whole in parts" principle?	Not applicable to this organisation
Socio-cultural	Collaboration; shared characteristics in terms of language, history, dress etc.; shared reality in terms of values, beliefs, norms; social practices; and a culture (emphases norms, values) or team (unitary political system).	Does this give appropriate attention to cultural issues i.e. founded in culture as an environmental variable, corporate culture and subcultures and organisational reality?	WFT move towards collaboration, teamwork, organisational integration. Embedding a one-bottom-line.
Socio-political	Coercive conflict; domination; whose interest are served; power central issue; people are politically motivated; power as a consequence of structure; disintegration; and a coalition (pluralist political) or prison (coercive political).	Does the organisation give consideration to the political system i.e. founded in organisational interests, organisational conflict and power?	Present in the org: Coercive conflict; Domination; Power struggles; Power issues; Employees are uncertain. Probably because of WFT?

View of participant P3 on the metaphorical analysis:

Metaphor	Characteristics	Questions	Comments
Machine	Standardised parts; routine and repetitive operations; predetermined activities, goals, and objectives; efficiency; rational approach; internal control; and a closed system view.	Is this a well-designed machine, i.e. founded in bureaucracy, design of the total organisation, design of individual jobs and management by objectives?	I believe its not well designed - a lot of disassociated parts exists that serves isolated objectives - believe its a symptom of visionary leadership lack.
Organic	Some needs to be satisfied; survival; open system; adaptation; organisation; feedback; self-regulation; open system view; and passive control.	Is this a well-designed organism, i.e. founded in organisational needs, organisation-environment relations, species of organisations, population-ecology view of organisation and organisational ecology?	No its not - its not self regulating and correcting. It seems to constantly repeat the same mistakes and still believe it is unique.
Neuro-cybernetic	Similar to organic but also includes learning and control; information prime; law of requisite variety; viable system; learning to learn; and getting the whole into the parts.	Is this a well-designed brain i.e. founded in information-processing capability, learning, organisational holographic character and a "whole in parts" principle?	As said under organic - we do not seem to learn as we go along. Also not syncronised to serve the corporate objective.
Socio-cultural	Collaboration; shared characteristics in terms of language, history, dress etc.; shared reality in terms of values, beliefs, norms; social practices; and a culture (emphases norms, values) or team (unitary political system).	Does this give appropriate attention to cultural issues i.e. founded in culture as an environmental variable, corporate culture and subcultures and organisational reality?	It addresses socio and cultural issue on the surface ~~to~~ forcefully. Underneath it still pursues its own objectives.
Socio-political	Coercive conflict; domination; whose interest are served; power central issue; people are politically motivated; power as a consequence of structure; disintegration; and a coalition (pluralist political) or prison (coercive political).	Does the organisation give consideration to the political system i.e. founded in organisational interests, organisational conflict and power?	Yes it does but only because its external frame of reference forces it to. Not convinced that it does so fairly and transparently.

Data gathered from participants: boundary questions

Data gathered from participant P1:

Question	Response
Who is the client?	Project management team; they have to use the tool to provide management with reporting information
Who ought to be the client?	Snr mgt* are must receive decision support information that can be trusted: strategic, forward looking information to improve project execution performance.
What is the purpose?	Confirm benchmarking information
What ought to be the purpose?	We need 'independent' information that we can trust - in line with that from benchmarks.
What is the measure of improvement or success?	I don't think what we currently have works well enough.
What ought to be the measure of improvement or success?	Recommend any project that developed sufficiently so we don't waste any more resources
Who is the decision maker?	Governance Group
Who ought to be the decision maker?	Somebody like the benchmarking companies should ratify measures
What resources are controlled by the decision maker?	The information that we get is wrong according to benchmarks; we need to investigate why.

* Snr mgt = Senior Management

Question	Response
What resources ought to be controlled by the decision maker?	If we know what is wrong we can change it. The reports are very lengthy and sometimes don't say much.
What conditions of success is part of the decision environment?	We don't get the information that we need.
What conditions of success ought to be part of the decision environment?	If we get good unbiased information that is usable it will be great!
Who is considered an expert?	I don't know who designed the original systems.
Who ought to be considered an expert?	The software must be developed by IT people. Get BI people involved as well. Get business people to design the KPIs
What kind of expertise is consulted?	We receive inaccurate information - refer to benchmark reports.
What kind of expertise ought to be consulted?	Refer to question regarding the experts.
What/who is (ought to be) the guarantor of success?	You don't have to answer this question.
Who is witness to the affected?	No comment

Question	Response
Who ought to be witness to the affected?	No. Comment.
What secures emancipation of those affected?	Users are not emancipated.
What ought to secure emancipation of the affected?	Do proper stake-holder analysis & requirements analysis. Give us a system that we can trust in terms of information

Thank you!

Data gathered from participant P2:

Question	Response
Who is the client?	Project management teams They provide input so that we can make decisions
Who ought to be the client?	We need information to make the right investment decisions for money and resource allocations. And to do trend analyses - what are consistently bad?
What is the purpose?	Show where project teams must improve/ focus more when they plan
What ought to be the purpose?	Factual information - are projects really ready to continue? Complete information!!!
What is the measure of improvement or success?	Our current system is not successful
What ought to be the measure of improvement or success?	Un-manipulated information for decision making!
Who is the decision maker?	Governance group
Who ought to be the decision maker?	Measures should be determined by industry best practice
What resources are controlled by the decision maker?	I don't think the software has the right KPI's but we need an expert to look at the detail.

Question	Response
What resources ought to be controlled by the decision maker?	Let industry experts ratify the KPIs And give us information that is easy to interpret
What conditions of success is part of the decision environment?	We apparently get wrong information. So, no success??
What conditions of success ought to be part of the decision environment?	Information must be accurate and supplied when we need it.
Who is considered an expert?	It was designed 16 years ago by engineers from civil, chemical, electrical and mechanical.
Who ought to be considered an expert?	IT must develop the system but business and BI people must be involved for the KPIs
What kind of expertise is consulted?	The benchmarks show that we don't get the right information.
What kind of expertise ought to be consulted?	The right people from the right groups must give inputs.
What/who is (ought to be) the guarantor of success?	You don't have to answer this question.
Who is witness to the affected?	We did not have a business analyst before when the original system was designed. IT was not involved in building it.

Question	Response
Who ought to be witness to the affected?	Get the right people involved for the different aspects of the system!
What secures emancipation of those affected?	No emancipation in current system!!
What ought to secure emancipation of the affected?	Analyse requirements from all stakeholders appropriately Built integrity into the systems.

Data gathered from participant P3:

Question	Response
Who is the client?	Project managers. Their projects are measured by this. It is yet another bureaucratic tool.
Who ought to be the client?	Is it necessary? We edit reports in any case.
What is the purpose?	Assess project readiness and get resources
What ought to be the purpose?	It is unnecessary - we get good scores on all our projects in any case.
What is the measure of improvement or success?	When we pass the "test"; get a good score from the software
What ought to be the measure of improvement or success?	We get good scores so it should stay the same.
Who is the decision maker?	We give inputs to governance group to update measures.
Who ought to be the decision maker?	I ~~dont~~ think it works so don't change it.
What resources are controlled by the decision maker?	The governance group control the elements and their weightings

Question	Response
What resources ought to be controlled by the decision maker?	It is very complicated to understand so I dont know how they determine the weightings. It can maybe be made easier?
What conditions of success is part of the decision environment?	The interface the we work with is difficult The whole system is just bureaucratic.
What conditions of success ought to be part of the decision environment?	If we have to use the system please make it easier
Who is considered an expert?	Probably the governance group? Project teams know what works best for them.
Who ought to be considered an expert?	Industry experts?
What kind of expertise is consulted?	There is nothing wrong with the scoring We do well.
What kind of expertise ought to be consulted?	Nothing wrong...
What/who is (ought to be) the guarantor of success?	You don't have to answer this question.
Who is witness to the affected?	I am not sure

Question	Response
Who ought to be witness to the affected?	I am not sure
What secures emancipation of those affected?	This is not applicable.
What ought to secure emancipation of the affected?	Nothing to comment

Data gathered from participant P4:

Question	Response
Who is the client?	Project management groups are being assessed. They're being checked – bureaucracy!!
Who ought to be the client?	Probably the investment decision makers?
What is the purpose?	To get money and people ~~to~~ allocated to my projects for further work.
What ought to be the purpose?	We don't need a software tool to tell us ~~what~~ we did our job, we do well. Look at the scores.
What is the measure of improvement or success?	When we can continue – get good score rating
What ought to be the measure of improvement or success?	When we can continue to the next phase
Who is the decision maker?	We occasionally update measures when governance team asks us to
Who ought to be the decision maker?	The measures are fine as is
What resources are controlled by the decision maker?	We give inputs to the governance team

Question	Response
What resources ought to be controlled by the decision maker?	The governance team asks us but I dont know how they interpret the weightings and work out the scores
What conditions of success is part of the decision environment?	It is very difficult and just another bureaucracy! It does not really informs decisions!
What conditions of success ought to be part of the decision environment?	make it less complex please?
Who is considered an expert?	I think project managers know what should be included in measures
Who ought to be considered an expert?	Probably industry benchmarking expertise
What kind of expertise is consulted?	We don't get bad scoring so it should all be all good
What kind of expertise ought to be consulted?	It is good.
What/who is (ought to be) the guarantor of success?	You don't have to answer this question.
Who is witness to the affected?	I dont really know?

Question	Response
Who ought to be witness to the affected?	I dont know
What secures emancipation of those affected?	Nothing
What ought to secure emancipation of the affected?	Nothing

Data gathered from participant P5:

From: [participant's full name removed for confidentiality purposes]
Sent: 09 September 2014 10:23 AM
To: Venter, Carin (C)
Subject: RE: Confirmation of interview responses

Hi Carin,

Glad I could help. Yes it is true.

Regards,

[participant's full name removed for confidentiality purposes]

From: Venter, Carin (C)
Sent: 08 September 2014 02:57 PM
To: [participant's full name removed for confidentiality purposes]
Subject: Confirmation of interview responses

[participant's full name removed for confidentiality purposes],

Thank you for spending the time with me to discuss the system that you currently use to keep track of gate review data.

I've captured your responses herewith below; kindly confirm that this is a true reflection?

1. Who was involved in the design of the initial system?

It was designed by a group of people consisting of engineers (for example from chemical, mechanical, civil and electrical disciplines).

2. Do you know how the key performance indicators (KPIs) and metrics were designed in the original system?

We were originally assisted by a number of identified (internal to the organisation) subject matter experts from project management teams. We [the governance group] designed and developed the KPIs of the business process. Also the performance metrics that transformed the [source] data into output graphs. The metrics were initially developed with assistance from [a company that specialises in project execution and gate keeping processes][1]. The metrics unfortunately evolved unrecognisably over a period of sixteen years with minimal documented evidence of how and why they evolved. We do periodically adjusted embedded metrics on request from project teams; they are regarded as the experts to what to do and how to do it.

[1] Name of the company was removed

Survey to test user acceptance

Data gathered from respondent 1:

From: [full name removed for confidentiality purposes]
Sent: 22 September 2014 03:05 PM
To: Venter, Carin (C)
Subject: RE: For your action: feedback regarding the new BI system

Hi Carin

See my response below

[full name removed for confidentiality purposes]

From: Venter, Carin (C)
Sent: 18 September 2014 12:12 PM
To: [full names removed for confidentiality purposes]
Subject: For your action: feedback regarding the new BI system

Dear All,

As facilitators of and/or stakeholders in the gate keeping process where the new BI (decision support front end and data warehouse) has been applied to inform decisions, kindly provide me with some feedback regarding the use of this versus the old .

Kindly answer the questions below. You may also add any additional comments that you may have received from teams that have used the system.

1. Does the new system (data warehouse component) inform the relevant management decisions as per its intended purpose?
    a. Yes as it identifies the deliverables where a project did not meet the requirements 2. Is the system easy to use?
    a. Yes for reviewers accustomed to the GRR process, although the functionality of the tool can be further improved
3. Is the performance metrics embedded in the system's front end transparent enough?
    a. Yes, although there are always be issues that people want to debate. There is also always scope to improve on the detail
4. Does the system support the gate keeping process without adding unnecessarily to the work load of its users?
    a. Yes
5. What additional benefits (if any) did you gain from using the new system's front end?
    a. The focus now shifts more towards a debate on the criticality of the identified gaps. Although experienced reviewers always emphasised that the old PDRI tool was more about the process than the score obtained, unfortunately project teams tended to focus heavily on the score
6. General comments:
    a. The front end generally retained the positive issues present in the old PDRI tool and makes the integrated review session less complicated allowing time to debate the real issues
    b. A positive Gate review is dependent on having the right people (team and reviewers) present; following the principles of the review process and all supported by the most efficient tools. The tool (user interface) is definitely of value in this regard

Data gathered from respondent 2:

From: [full name removed for confidentiality purposes]
Sent: 22 September 2014 05:11 PM
To: Venter, Carin (C)
Subject: RE: For your action: feedback regarding the new BI system

Hi Carin, I have added comments.

Kind regards

[full name removed for confidentiality purposes]

From: [full name removed for confidentiality purposes]
Sent: 22 September 2014 03:05 PM
To: Venter, Carin (C)
Subject: RE: For your action: feedback regarding the new BI system

From: Venter, Carin (C)
Sent: 18 September 2014 12:12 PM
To: [full names removed for confidentiality purposes]
Subject: For your action: feedback regarding the new BI system

Dear All,

As facilitators of and/or stakeholders in the gate keeping process where the new BI (decision support front end and data warehouse) has been applied to inform decisions, kindly provide me with some feedback regarding the use of this versus the old .

Kindly answer the questions below. You may also add any additional comments that you may have received from teams that have used the system.

1. Does the new system (data warehouse component) inform the relevant management decisions as per its intended purpose?

   Yes, it also brings focus and clear indication of where "burning platforms" exists by means of the associated criticality assessment

2. Is the system easy to use?

   Certainly easy to use although it has been commented in sessions that some of the questions could maybe be broken down into two or more questions to allow more focus on sub elements of the question. Some participants also suggested that questions should be grouped per track and not be spread throughout. Personally I feel that the way it is allows for review interestedness as opposed to a per track focus.

3. Is the performance metrics embedded in the system's front end transparent enough?
   a. "Yes, although there are always be issues that people want to debate. There is also always scope to improve on the detail"

   I agree with [name of respondent removed for confidentiality purposes]'s comment

4. Does the system support the gate keeping process without adding unnecessarily to the work load of its users?

   Yes

5. What additional benefits (if any) did you gain from using the new system's front end?

   Removing the scoring and weighting was a major improvement as it provided a false sense of compliance and it shadowed focus on potentially critical shortfalls.

6. General comments:

   The tool will become even more valuable if we can manage to get the preceding deliverable quality assurance issues sorted - no gate review tool should be expected to cater for that too.

   To repeat Herman's comment to an extent - the tool does not determine the quality of the review outcome – that is obviously determined by the quality of review participants and their preparation.

Data gathered from respondent 3:

From: [full name removed for confidentiality purposes]
Sent: 23 September 2014 10:36 AM
To: Venter, Carin (C)
Subject: RE: For your action: feedback regarding the new BI system

Hi Carin, here are my responses.
Greetings,
[full name removed for confidentiality purposes]

From: [full name removed for confidentiality purposes]
Sent: 22 September 2014 05:11 PM
To: Venter, Carin (C)
Subject: RE: For your action: feedback regarding the new BI system

From: Venter, Carin (C)
Sent: 18 September 2014 12:12 PM
To: [full names removed for confidentiality purposes]
Subject: For your action: feedback regarding the new BI system

Dear All,

As facilitators of and/or stakeholders in the gate keeping process where the new BI (decision support front end and data warehouse) has been applied to inform decisions, kindly provide me with some feedback regarding the use of this versus the old .

Kindly answer the questions below. You may also add any additional comments that you may have received from teams that have used the system.

1. Does the new system (data warehouse component) inform the relevant management decisions as per its intended purpose?
   Yes, it indicates if the deliverables were met, at a certain gate. 2.
   Is the system easy to use?
   Yes, it is easy to use.
3. Is the performance metrics embedded in the system's front end transparent enough?
   Yes, and it can also be used for small projects.
4. Does the system support the gate keeping process without adding unnecessarily to the work load of its users?
   Yes, it decreases the time spend, to execute a gate keeping session.
5. What additional benefits (if any) did you gain from using the new system's front end?
   It is easy to use. The new front end enables the user to decreased the time spend to execute this process.
6. General comments:
   It increases productivity. The facilitator must encourage the use of this to enhance a positive participation from the project teams (end user).

Data gathered from respondent 4:

From: [full name removed for confidentiality]
Sent: 18 September 2014 12:15 PM
To: Venter, Carin (C)
Subject: RE: For your action: feedback regarding the new BI system

My responses below,

[full name removed for confidentiality]

From: Venter, Carin (C)
Sent: Thursday, September 18, 2014 12:12 PM
To: [full name removed for confidentiality]
Subject: For your action: feedback regarding the new BI system

Dear All,

As facilitators of and/or stakeholders in the gate keeping process where the new BI (decision support front end and data warehouse) has been applied to inform decisions, kindly provide me with some feedback regarding the use of this system versus the old system.

Kindly answer the questions below. You may also add any additional comments that you may have received from teams that have used the system.

1. Does the new system (data warehouse component) inform the relevant management decisions as per its intended purpose?
   a. yes
2. Is the system easy to use?
   a. yes
3. Is the performance metrics embedded in the system's front end transparent enough?
   a. Not sure
4. Does the system support the gate keeping process without adding unnecessarily to the work load of its users?
   a. If applied correctly, yes
5. What additional benefits (if any) did you gain from using the new system's front end?
   a. Great management info – informs sponsors
6. General comments:
   a. Keep up the good work!

Evaluation of guidelines: data gathered from independent BI practitioner

From: [name removed for confidentiality purposes]
To: carinventer@outlook.com
Subject: RE: Interview responses - for confirmation please
Date: Mon, 4 October 2015 12:03:23 +0200

Hi Carin,

Sorry for the delay in my response.

I hereby confirm that this is the answers I supplied and suggestions that we discussed.

Kind Regards,

[name removed for confidentiality purposes]

From: Carin Venter [mailto:carinventer@outlook.com]
Sent: 24 September 2015 08:47 AM
To: [name removed for confidentiality purposes]
Subject: Interview responses - for confirmation please

Dear participant,

Thank you for allowing me to interview you. Please be assured that all responses will remain confidential.

Herewith your responses as I've captured them.

Kindly confirm that your responses have been captured correctly:

Interviewer: “How would you describe your role in a BI environment?”

P11: “I am involved with the full spectrum of BI development from planning the project to implementing the BI system.”

Interviewer: “How long have you been working in a BI environment?”

P11: “25 years”

Interviewer: “Kindly reflect on the boundary questions in a BI context by thinking about a specific BI project that you were involved in. Are you thinking of a specific BI project?”

P11: “Yes”

Interviewer: “Which project are you thinking about?”

P11: “A BI project at an organisation that consists of seven smaller companies; they did not have any BI to start with. I was involved with the development of a BI system for their buy-and-sell business process for each of the seven smaller companies.”

Interviewer: “For the boundary questions[1], please reflect on them as follows: What do you think is the meaning of the question; and do you think this is a logical question to ask when deriving business requirements for a BI system?”

[1] The boundary questions with the corresponding responses are below; questions were logically clustered – refer also to Tables 9-5 to 9-8 in Section 9.6 above – for the interview.

P11: “Ok.”

Interviewer: “Who are (ought to be) the clients of a BI system in terms of diverse stakeholder groups, amongst others: decision makers (such as executive management) that are the recipients of the decision support (output) information; and the managers of the source (input) data?”

P11: “This question is about the end user of the system; it determines who will be the receiver of the information as well as who will be the provider of source data. The stakeholder group missing from this question is managers of the sub systems that provide source data; they are not necessarily the same stakeholder group as the ones that provide the actual input data. It is a logical question; however, this question should also reflect on the client of this BI system rather than generically about a BI system.”

Interviewer: “What is (ought to be) the purpose of a BI system, i.e. which proactive decisions are (ought to be) enabled by the BI system, so that these decisions improve the organisation’s planning abilities timeously (for each identified recipient of decision support information); and what are the base (raw) data from source systems to be incorporated to enable it? Ensure to explore measures of success/improvement that are (ought to be) incorporated in terms of SMART principles: Simple; Measurable; Attainable; Repeatable; and Timeous.”

P11: “This question is about the aim and expected results of a BI project. By not asking this question too wide (i.e. referring to specific relevant elements for example specific decisions for specific recipients) the developer bound the scope and expectations regarding the results of the project early on in the project, and thereby limits the amount of scope creep later on in the project. It is a logical question; however, if the goal is to define the purpose of a specific BI project, the question should reflect on the purpose of *this* BI system rather than generically about *a* BI system (thus changing the question to “…the purpose of *this* BI system…”. It is important to first determine the purpose(s) and then only can one determine the client(s) of the system."

Interviewer: "Who is (ought to be) the custodian regarding the business dimensions of the BI system such as sources of input data, decomposed reports and the supported business process; and who is (ought to be) the custodian (decision maker) regarding the technical dimensions of the BI system such as technology and infrastructure? What resources are (ought to be) controlled by the identified custodians? And what aspects of the BI system design is (ought to be) outside the control of the BI custodians? How will these be handled during the design and development process?"

P11: "To add to the questions: custodianship within business is made up of two or more diverse stakeholder groups such as those accountable for the business dimensions (i.e. the business process and embedded performance metrics) and those accountable for the source systems and data. These are logical questions."

Interviewer: "Who is (ought to be) considered as a professional or further expert, i.e. who design (ought to design) the business dimensions of the BI system; and who design (ought to design) the technical dimensions of the BI system? What qualifies (ought to qualify) a designer (such as a business analyst) to design (ought to design) the business dimensions of the BI system regarding the embedded performance metrics relating to the business process and front-end data capturing mechanisms; and what qualifies (ought to qualify) a designer (such as a BI developer) to design (ought to design) the technical dimensions of the BI system regarding the technological platforms and architecture such as the DW?"

P11: "These questions can be helpful to choose the right team members for the project. The word "architect" may describe the designer role of the BI technical developers better as it is the term used more often in this environment. These are logical question."

Interviewer: “Who/what is (ought to be) the guarantor of success, i.e. who/what is (ought to) ensure continued use of the BI system after implementation? Also consider the specific actions to be taken by the guarantor of success ensure that success is guaranteed.”

P11: “A person can’t force or ensure the continued use of a system. However, if a system adds value it will be used continually. This question should also reflect on what this person must do to demonstrate the value of the system so that people will want to use it. This question is logical but should also reflect how of value the system must be demonstrated so that the system will be used continually and as per its intended purpose.”

Interviewer: “Who is (ought to be) the witness to the interests of those that are affected but not involved in the process?”

P11: “The meaning of this question is not clear.”

At this point in the interview the researcher explained to the participant that this question is to reflect on stakeholders that do not directly gain from changes brought on by the system, but are still affected due to changes in for example business processes.

P11: “It is logical now after an explanation of the intent of the question. The intent of this question should be explained in more detail in the question.”

Interviewer: “What secures (ought to secure) the emancipation of the affected and involved, and ensure that the BI system realises its intended business benefits?”

P11: “This question reflects on and re-affirms the goal of the system. It is a logical question.”

Interviewer: “What worldview is (ought to be) determining (so what?)? In a BI context it may, for example, be relevant to determine whether the involved and affected stakeholders perceive the use of software artefacts such as BI systems as merely technical artefacts, or do they perceive it is artefacts that impacts socially on its users also?”

P11: “The meaning of this question is not clear. This question can only have a yes or no answer but is unclear as to what to do with that answer.”

At this point the researcher explained that the aim of this question is to reflect on the change management strategy that will be required to embed the new BI system in the organisation. Users that view these types of artefacts as social artefacts that socially impacts on them and improve their lives requires a different change management approach, than those that view them as merely technical artefacts.

P11: “After the explanation this question is logical and will help to plan the change management effort and the required intensity thereof; the question will be clearer when the explanation is also included in it.”

Kind regards,

Carin Venter