A PRACTICAL APPLICATION OF CRITICAL SYSTEMS THINKING TO IMPROVE A BUSINESS INTELLIGENCE SYSTEM'S BUSINESS REQUIREMENTS

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ABSTRACT

Efficacious decision-making requires relevant, intelligible information. Organisations implement data warehousing/business intelligence systems to provide required information timeously for improved decision-making capabilities. Unfortunately, more than half of these systems fail. Data warehousing/business intelligence systems are multi-faceted and have a technical as well as social dimension. Failure to incorporate these systems' social dimensions lead to low adoption rates and, ultimately, failure of these systems.

The critical systems thinking paradigm is founded on the idea of emancipation through methodological pluralism and critical awareness. The total systems intervention strand of critical systems thinking embraces pluralism, i.e. the idea that different methodologies, from different paradigms, can be applied during different phases of interventions, to enrich the ultimate solution. This study applies an action research approach to incorporate critical systems thinking principles, operationalised by total systems intervention, to critically reflect and choose a suitable methodology whereby to elicit a richer set of business requirements.

This paper starts by introducing and motivating the study. It then discusses the theoretical concepts of the study, i.e. action research, business requirements elicitation and the critical systems thinking strand that is total systems intervention. The remainder of the paper is structured according to the action research phases, i.e. diagnosis, action planning, action taking, evaluation and specification of learning.

INTRODUCTION

Organisations are bombarded with increasingly large volumes of data to support decision-making (Işik et al., 2013). Information quality affects the quality of decisions and, as such, affects organisations' competitive advantage: inferior quality of information yields inferior decisions (Popovič et al., 2012). Organisations implement processes and systems, such as data warehousing/business intelligence (DW/BI), to provide intelligible information, in order to enhance decision-making (Popovič et al., 2012). Unfortunately, DW/BI success remain low: failure rates of 30-41% are consistently reported (Hwang and Hongjiang, 2007, Gartner, 2011, Dresner Advisory Services, 2012).

Appropriate requirements elicitation is a key success factor in information system development (ISD) and, subsequently, in information system (IS) success. Authors such as Kimball and Ross (2010), Inmon (2005) and Leffingwell (1997) acknowledge the importance of suitable business requirements; suitable requirements enable the development of systems that bring about organisational improvement, rather than mere automation of existing business processes.

Traditional requirements elicitation approaches, as described by authors such as Sommerville (2011), Kimball and Ross (2010) as well as Avison and Fitzgerald (2006), are effective to elicit technical requirements. However, IS success is driven predominantly by the degree to which the developer understands the users' *business* requirements (Leffingwell, 1997). Traditional approaches aim to incorporate both business and technical requirements; however, these approaches are functionalistic and, as such, they seem to fail to incorporate the social (human and organisational) dimension and "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 and Fitzgerald, 2006).

A different (socially-oriented) approach is thus necessary to elicit (additional) business requirements that also encompass the system's social dimension. The appropriate methodology for a problem context must be critically chosen with the single purpose: to suit the problem being investigated (Ezell and Crowther, 2007). Problem solvers involved in organisational interventions, such as DW/BI projects, have a plethora of systems methodologies to choose from, ranging from hard (quantitative) to soft (qualitative) methodologies. However, it is difficult to choose appropriate (alternative) methodologies that suit specific problems and the associated environments (Clegg and Shaw, 2008).

The critical systems thinking (CST) paradigm is founded on emancipation through critical awareness and methodological pluralism. CST developed as two separate strands: the total systems intervention (TSI) strand embraces methodological pluralism through critical awareness (Flood and Jackson, 1991); and the critical social heuristics (CSH) strand is aimed at self-reflection to determine boundary judgements for a social system (Ulrich, 1983). TSI 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).

In this study, the researchers' stance is that DW/BI designers/developers should apply critical awareness and methodological pluralism to develop emancipatory systems that adhere to technical quality standards *and* realise business benefits, i.e. result in improvement. So, they applied the TSI strand of CST to identify a methodology to elicit richer business requirements for a DW/BI system. They followed an action research (AR) approach to achieve this.

MOTIVATION FOR THE STUDY

Traditional requirements elicitation approaches assume that requirements can be conceptually discovered from users; it can capture most requirements but does not necessarily incorporate the social (human and organisational) dimension of IS (Avison and Fitzgerald, 2006). When questioned about requirements, business users restrict themselves within the performance limitations of current systems and hence use only current information; they request only automation of current systems and information when questioned regarding potential actions for improvement (Gardner, 1998). However, this does not bring about anticipated (unarticulated) organisational improvement. Hence, users are dissatisfied and user adoption remain low (Gartner, 2011, Dresner Advisory Services, 2012).

In this study, the researchers were involved in a DW/BI system development project; the users also initially requested mere automation of a business process and data warehousing of existing information to improve decision-making capabilities. Being aware of the low adoption rates of developed IS and the associated shortcomings in traditional business requirements elicitation approaches, they proposed that the incorporation of the CST principles of critical awareness

and methodological pluralism (operationalised by TSI) in the business elicitation phase may surface an alternative methodology to be applied; application of such methodology may then result in a richer set of business requirements that extends beyond the initial scope. So, the researchers proposed a critical social research approach, i.e. AR, as defined by Checkland and Holwell (1998) and Baskerville (1999), to apply TSI, as a methodology that embodies CST principles, to identify a suitable methodology whereby to elicit richer business requirements.

THEORETICAL CONCEPTS OF THIS STUDY

The following theoretical concepts of this study are discussed next: action research; business requirements elicitation; and the critical systems thinking strand applied in this study, i.e. total systems intervention.

Action research

Action researchers join a problematical social situation: they enter into discussions with affected stakeholders to define and execute improvement actions; they then critically reflect on the outcome and expressed learnings (Checkland and Holwell, 1998). AR can be applied as a critical social research practice whereby researchers directly experience, interact and intervene in a problem situation being researched, in order to improve the problematical social situation by emancipating affected stakeholders; the researchers may therefore understand the problem situation better and hence suggest more effective emancipatory solutions (Bentley et al., 2013).

Checkland and Holwell (1998) state that AR, when applied as a critical social research practice, entails a suitable methodology (M), which embodies the philosophical notions of a particular framework of ideas (F), that is to be applied to investigate and resolve a problematical social situation, i.e. an area of concern (A), so as to emancipate affected stakeholders – this is referred to as the FMA illustration, as is illustrated in Figure 1 below.

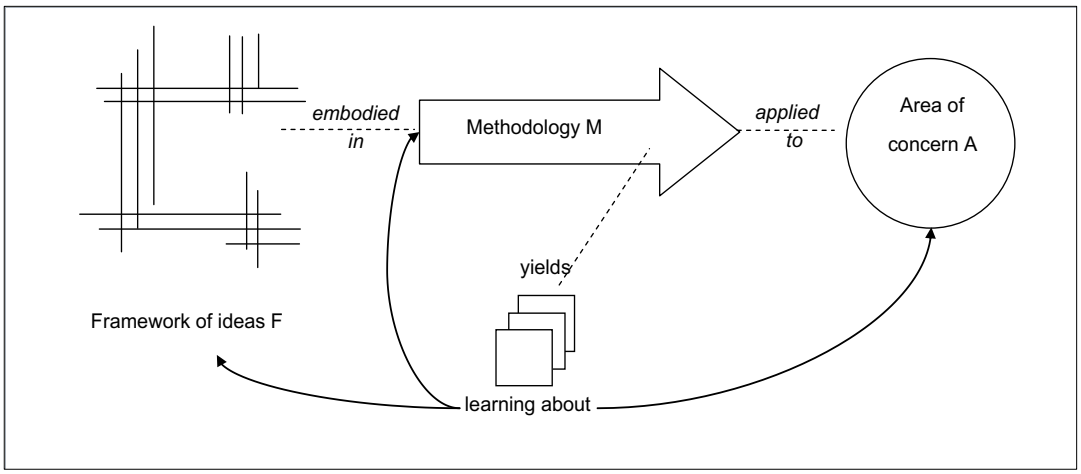

Figure 1. FMA illustration (adapted from Checkland and Holwell (1998))

Combining the work of Baskerville (1999) and Checkland and Holwell (1998), the AR phases are as follows: first, the diagnosis phase involves the identification of the primary reason(s) that necessitates changes, i.e. an identified area of concern (A) represented by a problematical social context that negatively affects relevant stakeholders; second, the action planning phase includes determining the actions to relieve the problem and emancipate affected stakeholders,

i.e. a methodology (M) embedded in a framework of ideas (F); third, the planned actions are implemented (through M) in the action taking phase; fourth, the outcomes of the implemented actions and the extent to which the problem (A) was resolved through (M) are assessed in the evaluation phase; and fifth, the specification of learning phase is concerned with the recognition of new knowledge gained – this is in terms of F, M and A.

The problem with traditional business requirements elicitation

User adoption indicates IS success whilst the degree of understanding that a designer/developer has of relevant business requirements drives IS success (Leffingwell, 1997). Inappropriate specification of requirements, i.e. when requirements do not reflect real customer needs and are inconsistent and/or incomplete, is the principle problem that leads to low adoption rates (Sawyer et al., 1997). So, appropriate business requirements elicitation is the most critical part of the development process (Keating et al., 2008).

Appropriate requirements elicitation is crucial to avoid that "specifications [are] based upon the designers' ignorance before they started the job" (Naur and Randell, 1969). A DW/BI system is no exception; requirements must be elicited appropriately to ensure success (Maté et al., 2014). Successful DW/BI encompasses improvement and new functionalities (Newman and Lamming, 1995). Failure to elicit appropriate business requirements leads to expensive modifications to be applied during development/deployment phases; modifications become exponentially more expensive during later stages (McConnell, 1996) – this is illustrated in Figure 2 below – or, ultimately, IS failure (Sawyer et al., 1997).

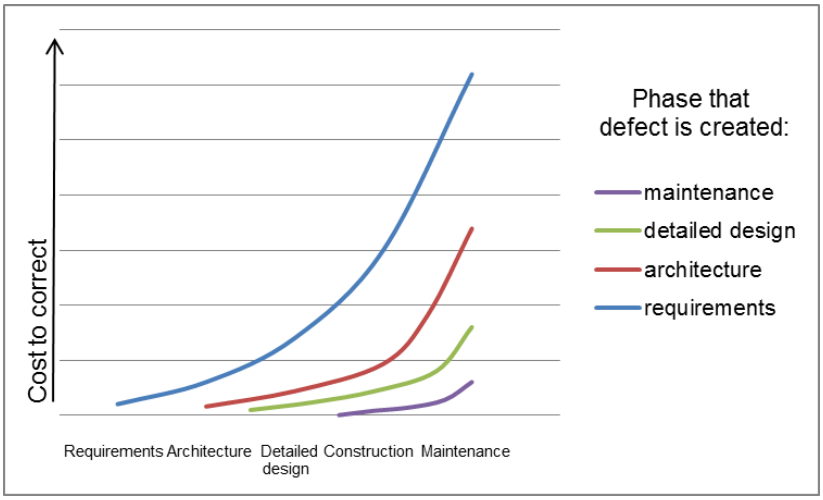

Figure 2. Cost to fix defective requirements (adapted from McConnel, 1996)

Business requirements are traditionally elicited using approaches that are founded in the hard systems thinking paradigm, e.g. systems analysis (Checkland, 1981). Methodologies in this paradigm "have a built-in positivist ontology" (Checkland, 1981); this implies an inherent assumption that the problem solver (e.g. the DW/BI designer/developer) is independent from the problem he/she is attempting to solve (i.e. requirements being elicited) and the problem can be easily defined and solved using reductionist and functionalistic methods.

As an example, systems analysis entails the systematic examination of a problem and is suitable in fields where the focus is on the method (*how*) to resolve a pre-defined problem, rather than

on the definition of the problem itself (*what*) (Hoag, 1956). These methods potentially disregard social *(what)* facets, in favour of technically specific *(how)* elements that are more easily modelled; 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" (Ezell and Crowther, 2007).

Unfortunately, traditional approaches, such as systems analysis, fail to incorporate IS artefacts' social dimension and fail to recognise that it "stirs things up, introduces uncertainties, gets people perceiving their world in a new way" (Checkland and Holwell, 1998). These artefacts are rejected because they are "technically appropriate but culturally/organizationally infeasible or fail to meet user needs" (Clegg and Shaw, 2008); and "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 and Fitzgerald, 2006). DW/BI users "operate in a mode of discovery…cannot tell what the information needs are until they see the possibilities" (Inmon, 2005). Hence, an alternative analysis approach, which also incorporates such systems' cultural/organisational dimension, may bring about an improved outcome.

Critical systems thinking

The CST paradigm developed as two separate strands; both strands aim to operationalise CST: The TSI strand represents methodological pluralism; it is "a meta-methodological framework for facilitating critical (i.e. theoretically informed and justified) methodology choice". The CSH strand represents a "discursive framework for promoting reflective (i.e. transparent and self-critical) practice" (Ulrich, 2013).

Flood (1990) argue that the key observations to recognise pluralism are methodological and theoretical commensurability; these must be achieved in unison. Methodological pluralism implies evaluation of methodologies' practical relevance "in terms of how the theoretical assumptions underlying the methodology relate to the possibilities of bringing about desired change in situational context" to ultimately determine "*which* methodology should be used *when* and *why* and hence *what* the possibilities of outcome are" (Flood, 1990). The TSI framework aims to facilitate methodological pluralism and inform methodology choice (Flood and Jackson, 1991). Hence, the researchers applied the TSI framework in this research to identify an appropriate methodology whereby to elicit business requirements that also embrace a DW/BI system's social dimension. The TSI framework is discussed next.

Total systems intervention

The TSI framework comprises three main phases: a creativity phase; a choice phase; and an implementation phase (Flood, 1995a). The problem solver: analyses and defines the (organisational/social) problem context during the creativity phase; identifies dominant and supporting problem solving methodologies suitable for the problem context during the choice phase; and implements the chosen methodologies during the implementation phase to resolve identified problems (Flood and Jackson, 1991).

The TSI methodology was originally based on a theoretical tool referred to as the "system of systems methodologies" (SOSM), which applies an ideal-type grid of potential problem contexts; systems methodologies are then classified based on their assumptions about problem contexts (Jackson, 2001). Problem contexts are in the SOSM categorised based on the relative complexity of the problem's system dimension (i.e. simple/complex), and the nature of the relationships of involved stakeholders (i.e. unitary/pluralist/coercive) (Flood and Jackson,

1991). So, problem solvers apply the SOSM in the creativity phase to understand the problem context in terms of its (systemic) complexity and involved stakeholders' relationships. Figure 3 below shows the grouping types of the SOSM.

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

Figure 3. Grouping types of the SOSM

Flood and Jackson (1991) say that they initially coupled methodologies with problem contexts, based on the strengths, weaknesses and theoretical underpinnings of the methodologies – this is illustrated in Figure 4 below.

	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 social heuristics
Complex system	Viable system diagnosis General systems theory Socio-technical systems thinking Contingency theory	Interactive planning Soft systems methodology	?

Figure 4. System of systems methodology (SOSM)

The TSI methodology employs metaphors to surface contextual issues and creatively think about organisational challenges; the proposed metaphors (machine, organism, brain, cultural or political metaphor) also relate to methodologies (Flood and Jackson, 1991) - this is showed in Table 1 below.

Table 1. 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 social heuristics	Machine, organic and socio-political

The application of the original constitution of TSI, using the SOSM, proved somewhat difficult/ cumbersome - refer for example to Warren and Adman (1999). Flood (1995b) (one of the founders) also found the TSI process to be somewhat drawn-out; so, he then reconstituted TSI and recommended a simpler complementarist framework to replace the SOSM framework in the choice phase. Systems methodologies now link directly to metaphors based on the main purposes of the methodologies (newly classified as designing, debating or disemprisoning). This is illustrated in Figure 5 below.

	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 social heuristics

Figure 5. TSI complementarist framework

THE ACTION RESEARCH PROCESS

In this study, the researchers applied AR from a critical social research perspective. So, in accordance with the AR structure described by Checkland and Holwell (1998) – refer also to the FMA illustration in Figure 1 earlier in this paper – the methodology (M) applied in this study was TSI, which embodies, on a philosophical level, principles from the CST paradigm as the framework of ideas (F); the TSI framework was thus applied to achieve methodological pluralism, i.e. to identify a suitable methodology whereby to elicit richer business requirements that constitutes organisational improvement (A). Such richer business requirements should, ultimately, enable the development of a successful DW/BI system.

The remainder of the paper is structured according to the AR phases as prescribed by Baskerville (1999), and taking into account the FMA framework of Checkland and Holwell (1998), followed in this study: The diagnosis phase, action planning phase, action taking phase, evaluation phase and specification of learning phase are discussed next.

THE DIAGNOSIS PHASE

This study was done in a South African based organisation that also has an international footprint. The organisation continually sustains, improves and grows its local and international asset base to remain competitive within its industry; sustainability and growth depends upon its ability to plan and execute sustainability/growth projects efficaciously. These projects are resource intensive in terms of capital as well as human resources. The organisation attempted to apply a standardised stage-gated project planning and execution process across the organisation; yet, implementation thereof was disjointed, supporting software was segregated and the process was in some instances paper-based. Consequently, value was destroyed, especially during planning phases: due to lack of properly consolidated and timeous decision-support information, insufficiently developed projects were recommended for continuation at key decision points. This resulted in re-work during execution phases and, consequently, an estimated loss of 6.3% internal rate of investment (IRR) as well as schedules that overran on

average by 23% across the portfolio of projects[1]. To preserve value and plan projects more efficaciously, management requested that the project planning process be automated and embedded in a DW/BI system where all captured (operational) source data be uploaded and stored in a centralised data warehouse; information is then to be made available (via BI reports) to support and enhance project and investment related decision-making. So, even though they requested a DW/BI system that would improve their decision-making capabilities, the request was, still, to simply upload existing operationally captured source data into a central data warehouse, and automate the creation and distribution of the current BI reports.

However, successful DW/BI requires *more* than a good data warehouse platform and automated business process; it entails a range of processes/systems to create intelligible information and enhance decisions (Inmon, 2005). DW/BI must ultimately *improve* an organisation (Inmon, 2005). DW/BI systems often fail because these users "operate in a mode of discovery…cannot tell what the information needs are until they see the possibilities" (Inmon, 2005). Even though business users such as these often initially request mere automation and warehousing of data, they ultimately expect organisational improvement and are inevitably disappointed when tangible organisational improvement does not realise post-implementation of the requested BI/DW. So, taking into account the high failure rates of IS such as DW/BI (Hwang and Hongjiang, 2007, Chakraborty et al., 2010, Gartner, 2011, Dresner Advisory Services, 2012), as well as the notion that these system were potentially rejected because they are "culturally/organizationally infeasible or fail to meet user needs" (Clegg and Shaw, 2008) and "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 and Fitzgerald, 2006), the researchers endeavoured to identify an alternative (more culturally/organisationally aware) methodology whereby to elicit the DW/BI system's socially-aware business requirements.

THE ACTION PLANNING PHASE

The action plan for this study was as follows: Apply CST principles as follows: A TSI metaphorical analysis during the business requirements analysis phase should guide the business requirements elicitation process (to achieve methodological pluralism through critical awareness). Business requirements can then be gathered using the methodology/ies proposed by TSI to elicit a richer set of requirements that also incorporate the system's social (human and organisational) dimension. So, the summarised action plan was as follows:

1. Identify the participants that will take part in this study
2. Request participants to reflect on the metaphors to understand the organisational context where the DW/BI system will be implemented
3. Apply the TSI complementarist framework to choose appropriate methodology/ies for requirements elicitation
4. Evaluate the proposed methodology/ies for suitability to elicit business requirements for a DW/BI system
5. Apply the chosen methodology/ies to elicit business requirements and compare the set of business requirements with the original request from the organisation to determine whether a richer set of requirements, that will constitute organisational improvement, was derived

[1] As per the findings of an independent audit that was done by an internationally accredited benchmarking company

THE ACTION TAKING PHASE

Three employees from the organisation were already allocated to the DW/BI project to elicit business requirements; so, these employees also became the participants in this study. The participants were: two senior managers (responsible to govern the organisation's project planning an execution process and disseminate relevant BI reports for decision making to executive management), and one project manager (responsible for the operational data to be uploaded into the operational source systems and, ultimately, into the new DW/BI system). The researchers played the role of business analysts; they elicited business requirements from the participants. The application of TSI is discussed next.

The application of TSI to guide business requirements elicitation

Participants were provided with worksheets detailing the metaphors, as prescribed by TSI; participants were requested to comment on the relevance of the different metaphors in the organisational context and with reference to the environment of the new DW/BI system. The participants worked individually and did not discuss their answers with each other. Participants were provided with the following information regarding the metaphors – refer to Table 2 below – where the work of Flood (1995a) was enriched with that of Torlak (2001).

Table 2. The metaphors

Metaphor	Characteristics (Flood, 1995a)	Questions (Torlak, 2001):
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 politically motivated; power a consequence of structure; disintegration; a coalition (pluralist political) or prison (coercive political).	Does the organisation consider the political system i.e. founded in organisational interests, organisational conflict and power?

The participants were all familiar with metaphorical analogies in the business environment; they were thus able to continue with the analysis as requested without further explanations required from the researchers.

The participants' responses are presented in Table 3 below.

Table 3. Participants' 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-cultural	"Organisation is moving towards this. End-goal of WFT^2 is shared reality."	"WFT^2 move towards collaboration, teamwork and organisational integration. Embedding a one-bottom-line."	"It addresses socio and 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^2?"	"Yes, it does but only because its external frame of reference forces it to. Not convinced that it does so fairly and transparently."

The TSI application – metaphorical analysis

The participants' responses, as they relate to the metaphors, are discussed next.

Reflection on the machine metaphor

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". It is noteworthy that the organisation was, at the time of study, undergoing an organisation-wide management restructuring – refer also to responses related to the other metaphors where the 'WFT'[2] project was mentioned. So, the issues mentioned by the participants here seemed to be related more to

[2] WFT: Workforce transformation project - referring to a restructuring initiative that was ongoing in the organisation

the way that the organisation was managed, which were being addressed by this restructuring project. The researchers tested this assumption with the participants and, subsequently, when the researchers discussed this assumption with the participants, they agreed that these are not issues to be resolved by the DW/BI system. The machine metaphor should thus not be viewed as representative of the problem context at hand.

Reflection on the organic metaphor and neuro-cybernetic metaphor
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 did not define the organisation.

Reflection on the socio-cultural metaphor
The participants agreed that the organisation was moving towards a socio-cultural environment. Participant P1 said that the: "Organisation is moving towards this" whilst participant P2 said that the: "WFT^2 move towards collaboration, teamwork, and 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". Again, it seemed that the organisational restructuring project influenced the participants' responses – refer also to the reflection on the machine metaphor earlier in this paper.

Reflection on the socio-political metaphor
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 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^2?" Again, the participants' responses seemed to have been influenced by the restructuring process – refer also to reflections at the previous metaphors.

Summary: outcome of the metaphorical analysis
Even through this 'WFT' intervention was focused on restructuring the organisation from a management perspective and, in theory, should not have impacted on the development of a business-process-specific IS, it seemed that it definitely impacted upon this TSI intervention as various comments about it was surfaced in the metaphorical analyses. Still, the researchers argued that, since the planned system would have been implemented in the organisation where these issues were surfaced, and may therefore still impact upon the system, the researchers viewed the metaphorical reflections as representative of the organisational context and, as such, the DW/BI system; so, they continued to implement the action plan as planned.

The most relevant metaphors that were surfaced were: the socio-culture and socio-political metaphors; hence, strategic assumption and surfacing testing (SAST), interactive planning (IP), soft systems methodology (SSM) and critical social heuristics (CSH) were positioned by TSI to be relevant problem solving methodologies – refer also to Figure 5 earlier in this paper where metaphors are directly related to methodologies. The researchers then reflected on the suitability of these methodologies to elicit business requirements for a DW/BI system – this is discussed next.

The suitability of SAST to elicit DW/BI business requirements

The SAST methodology "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). To focus on the relationships between involved participants is not the purpose of a DW/BI system and hence SAST was not further explored to elicit DW/BI business requirements in this study.

The suitability of IP to elicit DW/BI business requirements

According to Flood and Jackson (1991) IP is useful for planning since it is concerned with who is responsible for "what, when, where and how". Russel Ackoff (1979) says that he designed IP to enable people to plan and design in order to solve organisational problems. IP is positioned in the soft system thinking paradigm; it referred to as Ackoff's "softer" approach to operational research (OR) (Ackoff, 2001).

Practitioners in the OR field aim to optimise organisational performance (Schlager, 1956); it is 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, OR "can hardly generate the kind of irrational decision which, in a management situation, often turns out to be a good one" (Checkland, 1981). Therefore, Ackoff (1979) 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"; so, he subsequently developed IP.

The IP methodology aims to assist organisational teams to remove self-imposed and/or imaginary constraints that prevent them to achieve the desired future (Ackoff, 1981). The organisation was, at the time of the research, busy with an organisation-wide restructuring project; this process was, even though it influenced the metaphorical analysis, independent from the DW/BI system development project. Hence, since Ackoff (2001) 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 DW/BI system, the application of IP was not further explored to elicit DW/BI business requirements in this study.

The suitability of SSM to elicit DW/BI business requirements

The SSM methodology is presented by Avison and Fitzgerald (2006) as a requirements collection approach. Iivari et al. (2000) also position it as an ISD approach. Checkland and Holwell (1998) report that they applied it in the ISD field; they suggest that the organisational dimension of IS can be modelled using SSM, and they provide some useful examples of how they applied SSM in the IS field to explore the organisational context. Even though Checkland and Holwell (1998) do not explicitly link their process with requirements design for ISD, Checkland and Scholes (1990) argue that SSM is an interpretive approach driving "purposeful action deriving from intentions...based on knowledge"; it may thus be useful to elicit socially-aware business requirements.

The suitability of CSH to elicit DW/BI business requirements

Some authors have attempted to incorporate CSH in ISD: Petkova and Petkov (2002) present a framework to measure software development productivity using CSH, but do not focus on the development process itself. On a theoretical level, Ulrich (2001) proposes the use of CST

and CSH to identify and scrutinise diverse issues that IS researchers and practitioners may face in an ISD project. Bentley et al. (2013) documented how they applied CST to improve the effectiveness of a university's electronic student-record-system; they asked a number of "is" and "ought-to" mode questions to identified stakeholders but did not explicitly apply the CSH boundary questions, and conclude that the "is" vs. "ought-to" investigation uncovered organisational issues 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). So, CSH may also be useful to elicit socially-aware business requirements.

A difficult choice – SSM or CSH?

On the surface, it seems that both SSM and CSH may be suitable methodologies whereby to elicit socially-aware DW/BI business requirements. So, both these methodologies are presented next in terms of their respective theoretical underpinnings, process and expected outcomes when applied to elicit DW/BI requirements.

Discussion on SSM to elicit socially-aware business requirements

This section discusses the potential of SSM to elicit socially-aware DW/BI business requirements. SSM is discussed in terms of theoretical underpinnings, the SSM process and expected outcome when applied to elicit requirements.

Theoretical underpinnings of SSM

The soft systems concept provides a process of enquiry whereby complex problem situations can be explored (Checkland and Scholes, 1990). From this perspective a system is regarded as a conceptual tool to be applied to explore and describe social contexts (Vickers, 1983). In order to explore problematical social contexts, Checkland (1981) encapsulated the work of C. West Churchman in the SSM methodology: he argues that an enquiring (social) system contains the following minimum characteristics to be explored: it has 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; interconnected components; existence within wider systems/ environments with which it interacts; a boundary separating it from its wider systems/ environments; physical and abstract resources that are at the decision making process' disposal; and lastly, a guarantee of continuity.

According to Checkland (1985) SSM enables exploring perceived realities of participants/ stakeholders. Checkland and Scholes (1990) say that a set of purposefully linked activities, described relatively according to a specific worldview and in terms of the characteristics of enquiring systems, can be explored and modelled as a "human activity system"; accordingly, SSM is useful to enquire about ill-structured problem contexts where participants/stakeholders largely agree on objectives (*what*), but the means to achieve them (*how*) are still to be selected. Also, Flood and Jackson (1991) say that SSM is concerned with the introduction of ordered systems thinking in messy, real-world problems; they position SSM in TSI as an enquiring methodology to be applied in contexts with non-coercive participants/stakeholders that are able/willing to deliberate possible improvement actions. SSM is thus to be applied to explore and acknowledge differences in perceptions, rather than to resolve power struggles and emancipate participants (Flood, 1995b).

The SSM process

The SSM methodology incorporates Churchman's characteristics of enquiring systems – refer to the theoretical underpinnings of SSM in the previous section – and, as such, entails a seven-stage process where the problem solver: enters the problematical social context; expresses the problem situation; formulates root definitions of relevant systems; builds conceptual models; compares the models with the real-world situations; defines changes; and implements changes (Checkland and Scholes, 1990). This (generic) SSM process is illustrated in Figure 6 below.

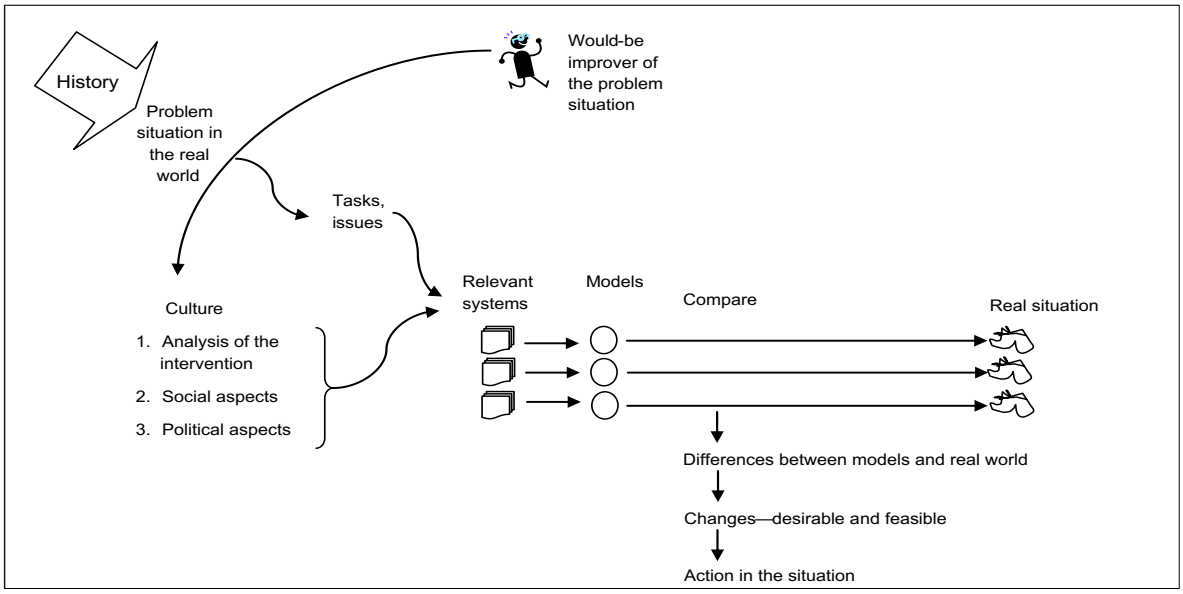

Figure 6. SSM process (Checkland and Scholes, 1990)

The SSM process to be applied specifically to an ISD project, as it is suggested by Checkland and Holwell (1998), includes an analysis of how organisational employees view their worlds (elements 1 and 2) and an analysis of accepted purposes and intentional actions that follow to pursue identified purposes as defined (elements 3 to 5) – this is illustrated in Figure 7 below.

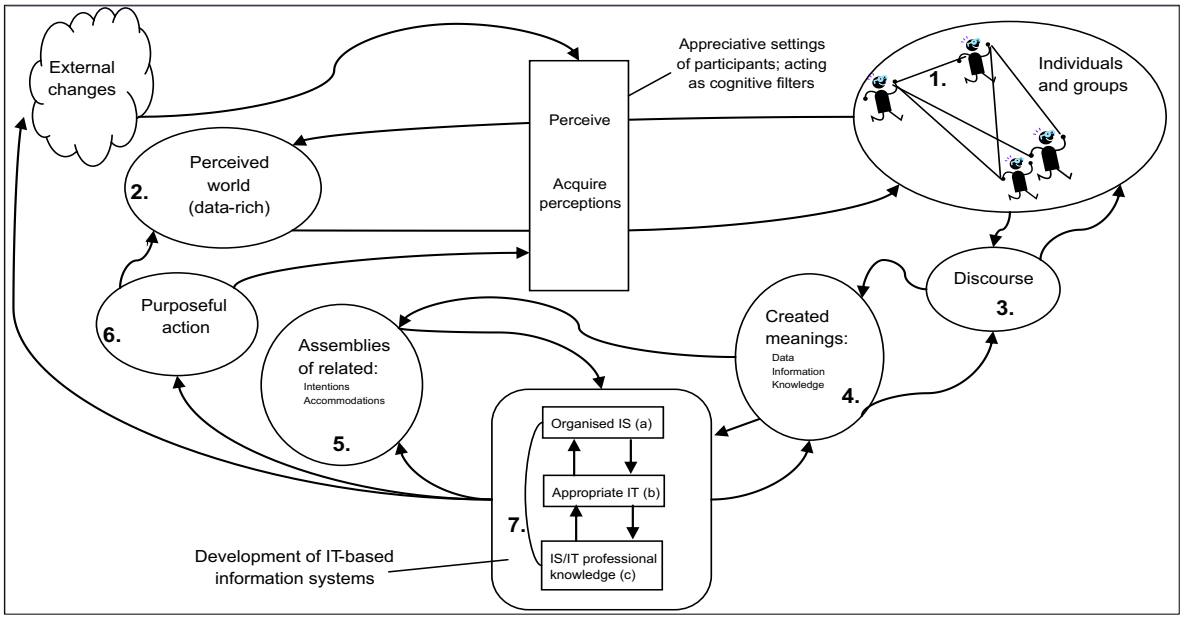

Figure 7. ISD development (Checkland and Holwell, 1998)

Expected outcome of SSM when applied to elicit DW/BI business requirements
As was pointed out in the discussion on traditional business requirements elicitation, authors such as Newman and Lamming (1995) argue that successful DW/BI involves improvement and new functionalities; business users expect newly implemented DW/BI to bring about organisational improvement. However, Gardner (1998) states that these business users restrict themselves with performance limitations of current (known) systems; they are then dissatisfied when anticipated improvement (that they have difficulty recognising and articulating in early design stages) do not realise upon implementation of these systems. Also, Inmon (2005) maintains that DW/BI users "operate in a mode of discovery…cannot tell what the information needs are until they see the possibilities". An alternative methodology, as to be proposed by TSI, should aim to overcome these challenges.

However, it is unclear to the researchers how the SSM process described by Checkland and Scholes (1990) and Checkland and Holwell (1998) can achieve more than a traditional requirements elicitation approach such as systems analysis. Systems analysis entails the systematic examination of a problem and is suitable to determine the method (*how*) to resolve a pre-defined problem, rather than on the definition of the problem itself (*what*) (Hoag, 1956). Similarly, Checkland and Scholes (1990) assert that SSM deals with problem situations where participants agree on objectives (*what*) but the means to achieve them (*how*) are still to be selected. So, SSM, as a probing methodology in a non-coercive context, where those that are involved in the enquiring process are able/willing to deliberate possible improvement actions; it may thus result in an outcome where participants/stakeholders (still) agree on actions (*what*) to take to achieve pre-defined means, but may be less useful to determine the new possibilities (*how*) to be achieved by a new DW/BI system.

Discussion on CSH to elicit socially-aware business requirements

This section discusses the potential of CSH to elicit socially-aware DW/BI business requirements. CSH is discussed in terms of theoretical underpinnings, the CSH process and expected outcome when applied to elicit requirements.

Theoretical underpinnings of CSH
Ulrich (1983) also based CSH on Churchman's conceptualisation of inquiring systems where Churchman lists conditions for purposeful social systems where: 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) then translated these conditions into categorical roles in terms of the *involved* stakeholders that: motivate the system's existence/purpose; have ultimate power/control over the system and its environment as well as resources; and have the relevant knowledge/expertise regarding the system and its design. Further, he added a self-reflective dimension in the categorical role of a witness to those that are *affected* by the planned system to legitimise its planned social improvement (Ulrich, 1983). So, 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 to explore the boundary judgements of a social system in terms of its actual ('is') and ideal ('ought-to') context. This enables problem solvers to critically determine boundary judgements of a social system (problem context), where the social system (S) is to

be bound according to the social actors (the *involved* versus *affected*) that defines the normative content of S as well as versus its environment (Ulrich, 1983).

Ulrich (1983) suggests that, when starting to plan for social improvement, one must attempt to accommodate the involved (participating) as well as affected stakeholders (those that are unable to participate). 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). The basic boundaries of a system (S) is illustrated in Figure 8 below.

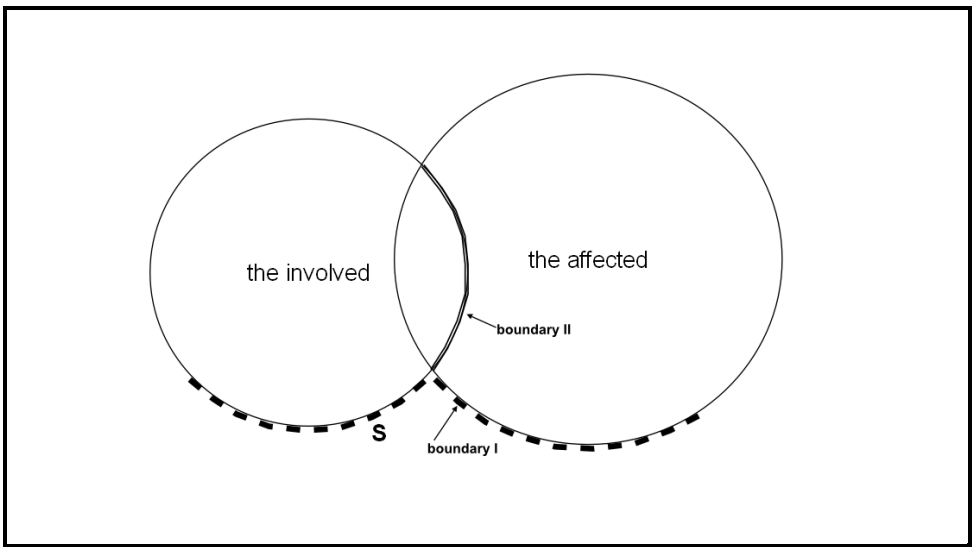

Figure 8. Basic kinds of boundary judgements (Ulrich, 1983)

Ulrich (1983) argues that CSH embodies a conceptual framework to trace delusions in rational planning; it aims to be critical "against present conceptions of "rational" planning". The boundary judgements of a system is, according to CSH, to be explored in the actual ('is-mode') as well as ideal ('ought-to-mode') context thereof, using twelve boundary questions; the boundary questions are derived from the categorical roles where the basis of *motivation* refers to the clients motiving the existence of the system; the basis of *power/control* refers to decision makers controlling the system; the basis of *knowledge/expertise* indicates planners/designers that implement the system; and the basis of *legitimacy* is concerned with those that are affected by the system, but not involved during its design and implementation – refer to the next section for a description of the twelve questions.

The CSH process

The CSH methodology contains a checklist of twelve boundary questions; these questions should be reflected upon in both the 'is' mode (to reflect on the as-is/actual situation) and the 'ought-to' mode (to reflect on the to-be/ideal situation) to determine the following dimensions of a system: *what* are to be considered relevant; *who* should be involved/is affected; and *how* to handle conflicts amongst stakeholders in terms of four basic categories, i.e. the bases of motivation, power/control, knowledge/expertise and legitimacy (Ulrich, 1983).

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).

Expected outcome of CSH when applied to elicit DW/BI business requirements

Referring again to the arguments posed earlier in this paper, e.g. that successful DW/BI involves improvement, new functionalities and that business users expect newly implemented DW/BI to bring about organisational improvement (Newman and Lamming, 1995), that business users restrict themselves with performance limitations of current (known) systems and that they are then dissatisfied when anticipated improvement (that they have difficulty recognising and articulating in early design stages) do not realise upon implementation of these systems (Gardner, 1998), as well as the notion that DW/BI users "operate in a mode of discovery… cannot tell what the information needs are until they see the possibilities" (Inmon, 2005), the researchers attempted to evaluate whether CSH may potentially achieve the goal of eliciting socially-aware business requirements.

Flood and Jackson (1991) say that 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 position CSH as methodology to deal with coercive contexts that require disemprisonment – refer also to Figure 4 and Figure 5 earlier in this paper. Accordingly, the twelve questions, asked in the 'is' (actual) and 'ought-to' (ideal) mode, aim to determine: the sources of actual (and ideal) motivation; the sources of actual (and ideal) power; the sources of actual (and ideal) knowledge; and the sources of actual (and ideal) legitimacy in order to ultimately determine *who* should do *what* and *why* to ultimately achieve systemic improvement (Ulrich, 1983, Ulrich, 2005).

So, 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 envisaged system (Ulrich, 1983). In view of that, CSH is a reflective practice that aim to assist in the identification/exploration of relevant assumptions/questions about a problem context; it can aid to also determine the extent of the problem to be resolved, i.e. the kind of change required by the DW/BI system (*what*) that should constitute improvement in the organisational context and stand in contrast with other methodologies that focus more on *how* to achieve pre-defined improvement.

The methodology applied to elicit business requirements

The researchers evaluated both SSM and CSH for suitability. Based on the requisite to elicit socially-aware business requirements that also embrace the DW/BI system's social dimension, i.e. reflect on the system in its entirety from the perspectives off involved and affected stakeholders, they found CSH to be more suitable for the problem context at hand.

Also, on a practical note, when the SSM process was presented to the management team, they asserted that the processes seemed lengthy and complex. They were reluctant to commit themselves and their employees to formal workshops where, in the words of participant P1, "employees are subjected to yet another new and unknown methodology". The perceived simplicity of reflecting twice on the twelve boundary questions appealed to senior management; they immediately agreed to reflection on the requirements for the DW/BI system by applying the boundary questions.

Applying CSH to elicit business requirements for the DW/BI system was successful; for a detailed account of the CSH implementation refer to Author and Author (2016)[3].

EVALUATION

The study was completed successfully. The application of the CSH methodology, guided by the TSI metaphorical analysis, resulted in a richer set of business requirements for the DW/BI system. Methodological pluralism was achieved. However, the two methodologies that were found to be suitable, are, according to the TSI framework, suitable for very different social contexts; SSM is suitable for a socio-cultural context that requires debating, whilst CSH is suitable for a socio-political context that requires disemprisonment – refer to Figure 4 (SOSM) and the TSI complementarist framework in Figure 5 earlier in this paper; these position methodologies as suitable (or not) for a problem context based on the relative complexity of the problem context that is evaluated according to the nature of relationships between the stakeholders involved in the problem context, as well as its perceived systemic complexity.

SPECIFICATION OF LEARNING

The methodologies that were surfaced by TSI were: SAST, IP, SSM and CSH. Both SAST and IP were found to be unsuitable for the problem at hand. SSM and CSH appeared both, on the surface, to be suitable. Further scrutiny of these two methodologies indicated that CSH, as a

[3] Full reference will be provided post review of this paper

critical systems methodology, was more suitable to elicit socially-aware business requirements. On a practical level, CSH was also preferred by the management team (due to its perceived simplicity) over SSM (due to its perceived complexity). In terms of the methodology that was surfaced by TSI, and subsequently applied to elicit business requirements, it is noteworthy that the methodology that was eventually applied is the 'other' CST strand, i.e. Werner Ulrich's CSH. The eventual application of CSH in this research study may pose the question whether the initial application of TSI, prior to the application of CSH, added significant value, or whether the researchers could have applied CSH from the onset of the research, and still achieve the same output and results.

Ulrich (2013) recognises TSI as "meta-methodological framework for facilitating critical (i.e. theoretically informed and justified) methodology choice". However, he argues that boundary critique must always 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). He 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). However, in this intervention, the application of CSH resulted in a set of business requirements (which was the purpose of the intervention); application of TSI *after* application of CSH would thus not have added any value as the application of the CSH boundary questions *concluded* the intervention.

It must also be noted that the alternative suitable methodology that was also proposed by the TSI complementarist framework, i.e. Peter Checkland's SSM, was found to be unsuitable based on its interpretive rather than critical nature: Checkland (2012) defines 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, Ulrich (2013) refers to SSM as purely interpretive; and Jackson (2001) also refers to SSM as "subjective" and "regulative", which subsequently "constrain the ability of … practitioners to intervene".

SUMMARY

This paper discusses an action research study whereby methodological pluralism was achieved through the application of CST principles; CST is operationalised by the TSI framework (Flood and Jackson, 1991) as well as through CSH (Ulrich, 1983). The researchers applied CST principles according to the TSI framework to guide methodology choice in order to elicit richer business requirements that also embrace the DW/BI system's social (cultural/organisational) dimension. The researchers applied the TSI framework to surface a methodology whereby to elicit business requirements for the DW/BI system: the participants reflected on the organisational context using metaphors; the TSI complementarist framework was then applied to identify suitable methodologies to apply. At first glance two of them, i.e. SSM and CSH, were found to be suitable. However, critical reflection positioned CSH as more suitable.

The application of the CSH boundary questions gave insight into the DW/BI system's social dimension; additional, socially-aware DW/BI business requirements aimed at organisational improvement were surfaced. In conclusion, the initial request (mere automation and data warehousing of existing data) was enriched.

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