CHAPTER 5   CASE STUDY REPORT

5.1   Introduction

The aim of the research project is to develop a framework for the explicit use of specific system thinking methodologies[1&2] for data warehousing. As indicated in chapter 1, the first part of reaching the objective is to understand current practices of data warehouse practitioners from a systems thinking point of view.   After doing literature studies on systems thinking and data warehousing, the researcher now aims to explore the systems thinking nature of current data warehousing practices.

After reviewing research methodology in terms of philosophy, methodology and practice, it was indicated in chapter 2 that while typical positivistic methods were not suited to this cause, interpretive and critical social theory methods also had shortcomings.   It was argued that this research problem leans more to the critical social theory paradigm. The aim of the methodological mapping given in chapter 2 (tables 2.2 and 2.3 in section 2.5.2) was to orientate the problem with regard to typical IS research paradigms. This chapter reports on the actual data collection and data analysis done in the study on the systems thinking influences of data warehouse practitioners. Since section 2.5 (specifically section 2.5.3) described the selection of appropriate methods, this chapter aims to demonstrate how the selected methods were used in the research activity.

The chapter reports on the data warehousing practices in terms of systems thinking methodologies[1&2]. The aim is to understand data warehousing practices according to hard, soft, critical and disclosive systems thinking methodologies[1&2].   This understanding is essential for the development of a framework for the use of specific systems thinking methodologies[1&2] in data warehousing practices presented in chapter 6.   This chapter represents the deconstruction part of the critical social research methodology for this study described in chapter 2, section 2.5.2.

The first part of the chapter defines general guidelines for the mapping of data warehousing practices to systems thinking methodologies[1&2]. Section 5.2 explores the pattern-matching scheme used in terms of a high level mapping that serves as a guideline for the detailed mapping given in table 5.1. This table constitutes the basis

for the analysis of case study data. It includes the different systems thinking methodologies'$_{1\&2}$ typical responses to specific data warehousing questions. The table is organised in different segments coinciding with the data warehousing concepts presented in chapter 4 (section 4.5).

The first part of the chapter was submitted and accepted in research paper format for the systemics track of the annual systemics, cybernetics and informatics (SCI) conference of 2004 held in Orlando, Florida from 18-22 July 2004.

The second part of the chapter reports on the interpretive case study data that was collected at organisations in South Africa. Three case studies were conducted in the banking sector, health sector and at a data warehousing consulting firm respectively. Background information on each of the organisations is given, including the specific circumstances of each case study. The responses of the respondents are then mapped to the table developed in section 5.2.

Each case study's result is presented on a separate copy of the table to identify trends with regard to specific systems thinking methodologies$_{1\&2}$ used at that specific organisation. The responses of people interviewed are identified by individual notations to illustrate that different people in the same organisation have different motivations from a systems thinking point of view. Each case study report is concluded with an overall analysis of the systems thinking methodologies$_{1\&2}$ used in that organisation.

It is assumed that data warehousing professionals are not familiar with systems thinking methodologies$_{1\&2.}$ The case study data proved the assumption to be true. Section 5.3 concludes with a section on problems encountered during data analysis.

Section 5.4 describes the research results and serves as link between the current practices of the data warehousing practitioners and the final framework presented in chapter 6.

5.2   Interpretive pattern matching

It was shown in chapter 2 that the nature of this study differs from typical interpretive research since typical interpretive data abstraction would not link data warehousing

practices to systems thinking methodologies$_{1\&2}$. The discussion on grounded theory given in chapter 2 demonstrated that an interpretive researcher gathers data to be able to arrive at a theory which is grounded in reality. If such an approach was followed in this research design the resulting theory would describe the practices of the data warehousing professionals in general, but not in relation to systems thinking methodologies$_{1\&2}$. Therefore, the aim of the data collection was not to generate a theory by analysing and coding the data, as is typical in interpretive methods such as grounded theory, but rather to be analysed through pattern matching to reveal the underlying systems structures of the data warehousing practices.

Prior to data collection a mapping was done between systems thinking methodologies$_{1\&2}$ and data warehousing practices to guide data collection and to serve as basis for data analysis.

This mapping was done on two levels of detail to guide the researcher. Firstly a high level mapping between each systems thinking methodology$_{1\&2}$ and data warehousing practice was done. The aim of these mappings (presented in section 5.2.1) is to give an overall perspective of a certain systems thinking methodology$_{1\&2}$ on data warehousing. The mappings were compiled by applying the hard, soft, critical, and disclosive systems practices described in section 3.5 on data warehousing practices. Since the methodology$_2$ for practicing disclosive systems thinking is not yet completed the mapping was done from the principles guiding disclosive systems thinking described in section 3.4.

After the high level mapping was completed a detailed level mapping (presented in section 5.2.2) was done in the form of 60 questions grouped in six categories. This mapping is given in Table 5.1.   The motivation for selecting these specific questions is twofold.   Firstly, after studying data warehousing (presented in chapter 4) certain questions were designed to determine the overall data warehousing methods used by the organisation. Examples of such questions are questions A1, B1, C1, E1 and F1 given in Table 5.1. The data warehousing literature study also led to the selection of the specific 6 categories for the questions. Secondly, after studying systems thinking in terms of its underlying philosophy, methodology and practice (presented in chapter 3) certain questions were designed to enquire about the specific systems orientation of the data warehousing team. Specific questions were designed to enquire about specific systems concepts, for example questions A7, A8, C7 and D7 regarding boundary judgement.

During the design of each question three aspects were considered and tabulated in working notes. The purpose of this process was to ensure that no leading questions were asked as well as to document the thought process behind the formulation of specific questions. Each question had three aspects:

- The systems thinking concept that is examined by the question.
- The "real" question to be asked.
- An open ended formulation that is the actual question asked to the respondent.

Consider question A2 of table 5.1 as an example:

- The concept to be tested is the role of overall objectives in the selection of the data warehouse as well as the role of the data warehouse as a subsystem of a greater system in the organisation.
- The "real" question would have been: "Was management involved in the decision to develop a data warehouse?"
- The actual open question asked was: "Who decided the organisation needed a data warehouse?"

For each of the 60 questions a typical answer was formulated for each of the systems thinking methodologies$_{1\&2}$. Since no literature on data warehousing from systems thinking perspectives could be found the researcher of this study needed to formulate these answers very carefully. The philosophical underpinning of each systems methodology$_{1\&2}$ (described in section 3.3) was taken into account when the answers to these questions were formulated to incorporate the correct ontological assumptions in the respective answers. Available literature on systems thinking methodologies$_{1\&2}$ applied to information systems in general (discussed in section 3.6) also guided some of the formulations of the answers.

5.2.1 High level mapping between systems thinking methodologies$_{1\&2}$ and data warehousing practices

Figure 5.1 (described in chapters 1 and 3) depicts the relationship between philosophy, methodology$_1$, practice and information systems, specifically data warehousing. This chapter involves the two bold-printed arrows in figure 5.1. The solid line represents the relationship between practical systems methodologies$_2$, such

as the SSM and data warehousing.   The broken line indicates the relationship between hard, soft, critical and disclosive systems thinking methodologies$_1$ and data warehousing. The broken line indicates that the relationship between systems thinking methodologies$_1$ and data warehousing can be more direct without the use of practical systems methodologies$_2$.   This view is motivated by the fact that methodologies$_2$ for the practising of disclosive thinking are not yet completed, as well as the existence of multiple methodologies$_2$ for the practising of hard, soft and critical systems thinking.

This section aims to give a high level overview of the relationships depicted by bold lines in figure 5.1.

It should be noted that the perspectives presented here are the interpretations of the researcher and are subject to the understanding of systems thinking methodologies$_{1\&2}$ by the researcher. Since the systems thinking methodologies$_{1\&2}$ are rooted in philosophy, the underlying philosophy was used to provide guidelines for the mapping of certain data warehousing practices to specific systems thinking methodologies$_{1\&2}$.
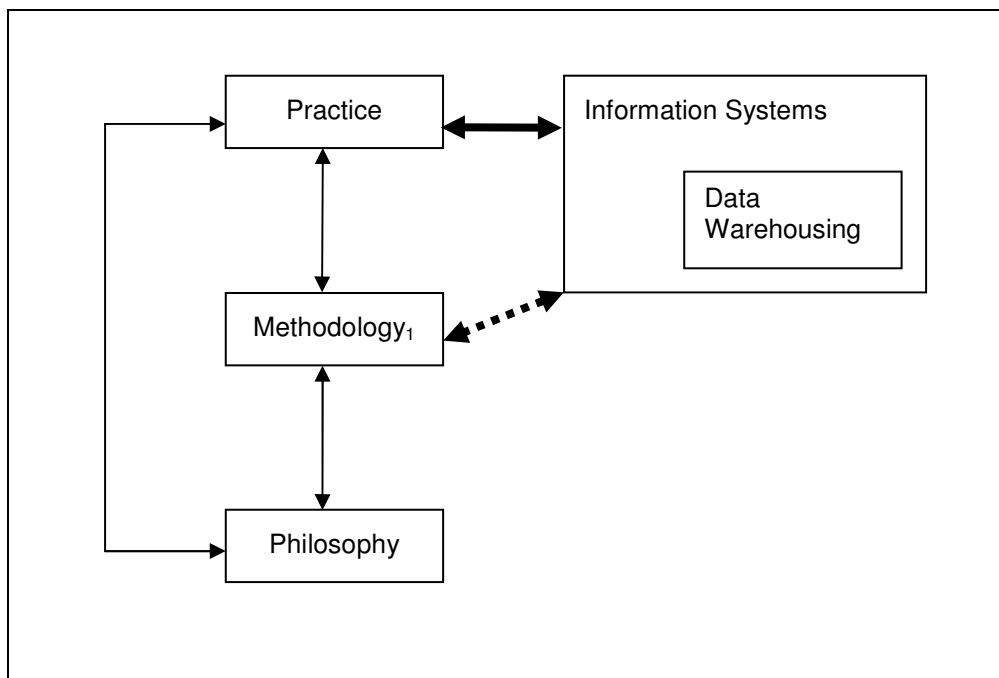

Figure 5.1 The relationship between philosophy, methodology$_1$, and practice

5.2.1.1   Data warehousing from a hard systems thinking perspective

Hard system thinking is common in information systems development. Problems are seen as well defined, and end-user participation is limited to requirements specification. The rigid application of the typical systems development lifecycle (SDLC) is an example of a hard systems approach to data warehousing. Inmon's (1996:24) idea of the reverse SDLC (the CLDS), where requirements emerge from the application of technical rules on data, can also be viewed as a hard systems approach.

Hard systems thinkers are motivated by efficiency of the design in terms of technical performance. Models are seen as a true reflection of reality. Hard systems thinkers would typically use ERDs to model the data warehouse and star schemas to model separate data marts according to Inmon's (1996) methods.

Systems are seen as collections of parts of which the overall functionality is the sum of the functionalities of the individual parts. A data warehouse is then also a system built from parts that achieves its functionality from the functionalities of the parts. It is unlikely that a hard systems thinker would view people as part of the data warehouse.

Any political power conflict in the organisation is ignored. Differences of opinion, for example the accuracy of data and the standard of data quality, are resolved through rational thought.

The main success criteria for the data warehouse are vested in the compliance with end-user specification documentation.

The main disadvantage of a data warehouse built according to hard systems thinking ideas is that a single view of the organisation's objectives is represented in the data warehouse. Problems to be solved by the data warehouse are typically ill-defined and only a one-sided view is represented by the specification given to the data warehousing team by a specific business unit. When different business units give their requirements, the data warehousing team focusses on one business unit at a time, resulting in a group of independent systems that are not compatible.

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5.2.1.2   Data warehousing from a soft systems thinking perspective

The soft systems methodology[2] (SSM) (Checkland (1981) and its modification (Checkland & Scholes, 1999)) provides guidelines for the practising of soft systems thinking. The SSM advocates an iterative process where the users are involved, refining models to represent the real-world problem situation. It is possible to apply the "CATWOE" method to data warehousing. A soft systems approach will define the customers ("C") of the data warehouse as the customers of the organisation, as well as the decision makers using the data warehouse. The actors ("A") involved are the data warehouse team, the business sponsors and the information technology department in the organisation. Transformation ("T") implies the transformation of source data into information presented to the decision makers. Another kind of transformation is the way business decisions are made in the organisation before and after the development of the data warehouse. The *Weltanschauung* ("W"), or world view, represents different views that motivate the development of the data warehouse. Different people in the organisation have different motivations for the development of the data warehouse, such as the improvement in quality of the data, a change in the decision making methods, or just the overall improvement of profitability of the organisation. Ownership ("O") of the data warehouse is a very important aspect of the success of a data warehouse. Ownership of various data warehouse aspects should be defined, such as source system ownership, data staging ownership (including data quality), data warehouse data ownership and end-user application ownership. The environmental ("E") constraints in data warehousing include factors, such as current operating systems platforms, current software usage agreements, resistance to change and budget constraints. Since the SSM views systems as holons or human activity systems, people are seen as part of the systems. This implies that the business user, the data staging manager and others are seen as part of the data warehouse system.

Although the latest version of the SSM advocates sensitivity to the political system in the organisation, soft systems thinking still operates in the order dimension of Burrell and Morgan (1979) and is not focussed on the emancipation of specific groups in the organisation.

The work presented in chapter 2 of Churchman (1968) can also be viewed as a methodology[2] for practising soft systems thinking. The objectives of the data warehouse need to be real objectives that are not contradictory to other objectives of

the organisation. Each of the subsystems of the data warehouse (e.g. data staging and end-user applications) should have measurable objectives supporting the overall objective of the data warehouse. Resources of the data warehouse are defined and should be used optimally to support the overall objective of the data warehouse. Since the boundary of the data warehouse is defined as everybody and everything influenced by the data warehouse, it implies that the business users are also viewed as part of the data warehouse. The environment of the data warehouse is similar to the environment discussed as part of CATWOE, i.e. those factors that cannot be changed by the data warehouse system.

It should be noted than one can follow a soft systems thinking approach to data warehousing without practising the SSM explicitly. Table 5.1 contains soft systems answers to data warehousing questions independent of the SSM.

5.2.1.3 Data warehousing from a critical systems thinking perspective

The literature studies of chapters 2 and 3 indicate three complimenting strategies for the practicing of critical systems thinking in data warehousing. The work of Harvey (1990), Flood and Jackson (1991) and Ulrich (1987) can be applied to data warehousing.

Although Harvey's (1990) work is presented in chapter 2 to guide critical social research, the principles of critical social theory also apply to critical systems thinking. According to Harvey (1990), structure is an important aspect of critical thinking. The critical systems thinker aims to deconstruct the problem situation to expose the underlying oppressive structures. In data warehousing terms this implies that the data warehousing development team needs to study the structure of both the data warehouse and the total structure of the organisation. They have to look beneath the surface to determine the real purpose of the data warehouse in the organisation. Decision taking strategies are often taken for granted but they could be manifestations of the oppressive structures enforced by management. Therefore, the motivations of specific decision strategies should be investigated by the data warehousing team. It is important that the data warehousing team realises the danger of their efforts being a tool in the reinforcing of specific structures in the organisation that might be harmful to individuals or groups inside the organisation or the general public. This critical awareness is achieved among others by studying the

history of decision making as well as the construction of history in order to understand the advantages and disadvantages of current decision making strategies in the organisation.

During data staging, the data warehousing team should similarly try to look beneath the surface of data quality issues. They should determine why certain parties are satisfied with data that is not totally accurate. They should also determine which interests are served by data that has been historically unreliable.   The data warehouse team should strive to take all the role-players' interests into account when deciding on standards for data definitions and quality.

Flood and Jackson (1991) presented total system intervention (TSI) as a method for selecting appropriate methodologies to achieve positive change in a problem situation (discussed in chapter 3). TSI is an iterative process consisting of three phases: creativity, choice and implementation. During the creativity phase the data warehousing team should take a broad view of the problem situation in the organisation. They should investigate the decision making strategies and motivations thereof. TSI proposes the use of metaphors to understand the problem situation. The data warehouse team should ascertain whether the organisation is seen as a machine or organism with a brain, or some other metaphor. During the choice phase of TSI an appropriate methodology will be chosen.   The "system of systems methodologies" is used to select the most appropriate methodology for the particular problem situation.   The chosen methodology is implemented and the results are evaluated.   A critical data warehouse team will be cautious of the inherent weaknesses of different methodologies and the impact thereof. During each iteration the focus of the project is sharpened. A critical data warehousing team would be willing to combine different methodologies to compliment each other while being critically aware of the weaknesses of each methodology.

Data warehousing from Ulrich's (1987) point of view would focus strongly on critical boundary judgements.   The data warehouse team will take the inevitability of argumentation break-offs into account. Critical heuristics (discussed in chapter 3) gives practical guidelines for the involvement of all the affected parties in the solution of argumentation break-offs. A major part of the data warehousing effort will be to determine the boundary of the data warehousing effort in the organisation. Critical heuristics differs from soft methods in that it does not ask "what is part of the data warehouse?" but rather "what ought to be part of the data warehouse?"   These

boundary judgements are only possible if the organisation as a whole is understood. The data warehousing team will be critical rather than objective in determining the boundary of their effort as boundary judgements are often personal value judgments. The data warehousing team would be very aware of the rights of all the affected parties of the data warehouse and would include such "witnesses" (see list of questions in section 3.6.3.2) in the data warehousing process.

These three strategies towards practicing data warehousing from a critical systems point of view are complimentary toward one another and are all considered in the detailed mapping of critical systems thinking and data warehousing presented later in this chapter.

Since critical systems thinkers believe that the world is not fundamentally harmonious, they are aware of power struggles in the organisation. Specific measures are taken to eliminate the negative effects of power struggles in data warehousing projects. These include the project team meetings where everyone is seen as of equal importance in the organisation. All stage outcome documents, for example the requirements specification, are critically examined by all the team members for specific elements that might be harmful to certain groups in the organisation.

Critical systems thinking has a foundation in intervention and emancipation. Therefore, the data warehouse is also viewed as a tool for intervention and emancipation. The aim of the data warehouse is to change inefficient decision making in the organisation and to expose and rectify data quality problems in the operational information systems. The data warehousing team view themselves as emancipators in the organisation.

5.2.1.4   Data warehousing from a disclosive systems thinking perspective

Since the disclosive systems thinker does not regard human freedom to be absolute, the data warehousing team leader does not belief that he controls the problem situation. His role is to facilitate the disclosure of the intrinsic normativity of the situation and to ensure that team member's responsibilities are performed in harmony with such intrinsic normativity. The disclosive systems thinker views his

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facilitation as a response to structural conditions in the situation. Although other systems thinkers might not be aware or even choose to ignore the intrinsic normativity, the disclosive thinker aims to disclose the intrinsic normativity.

The intrinsic normativity is the essence or the meaning of the organisation. One might ask: "What is the main benefit of this organisation?" The intrinsic normativity of a hospital system is ethical in nature and focuses on patient care. A disclosive systems thinker keeps the intrinsic normativity in mind during every phase of the data warehousing project. Strijbos (2000:174) states that: "each entity functions in a diversity of modalities or modes of being, which are aspects of one and the same entity". The qualifying norm of an organisation guides the different aspects of that organisation. A data warehouse also has different aspects such as an analytical, economic, and a juridical aspect according to the list of aspects given in section 3.3.1.3, but the qualifying aspect is found in the intrinsic normativity of the organisation in which the data warehouse functions such as a hospital. The data warehouse should be designed to support the qualifying function of the organisation.

In a hospital, requirements collection will focus on how the daily actions of managers can be improved with the aim of improving patient care. Disclosive systems thinking emphasises the responsibilities of various actors. Various people from different sections in the organisation will be included in the process to ensure that the data warehousing team better understands the circumstances to which the data warehouse forms a response. The requirements team needs a clear understanding of the social-cultural context in which the data warehouse will be used. The data staging phase will focus on how data quality can be improved to improve patient care. Once again other modalities such as the arithmetic and analytic aspects of data staging are guided by the ethical modality of patient care.

The choice of a data modelling method will be influenced by the degree to which each of the possible methods advance patient care. One might argue that data modelling is very far away from patient care in a hospital. However, it is clear that patient caretakers are able to understand a star schema and therefore to test the model. They are able to ensure that all the information required by management to improve patient care, is available.

The intrinsic normativity of every type of organisation is not as easy to determine as that of a hospital. It is the responsibility of the data warehousing team to disclose the

intrinsic normativity, or the internal meaning of the organisation, before starting to develop a data warehouse. It is often found that the intrinsic normativity becomes more clear (is more clearly disclosed) as the development continues. This is only possible when end-users are involved in the development process.

The ideas presented here coincide with Churchman's (1968) systems objective that needs to be central to all the subsystems. The difference however, is that Churchman's central objective is not subject to ethical scrutiny. The disclosive systems thinker accepts the given reality (intrinsic normativity) and also that man cannot change everything. He aims to involve different actors and gives responsibility to people ensuring accountability for actions with regard to the intrinsic normativity. Consensus is used to determine what is best for everybody involved. This is in contrast with the work of Churchman (1968) that uses a central measurable objective, which implies that the main objective should be quantifiable.

5.2.2   Detailed level mapping between systems thinking methodologies$_{1\&2}$ and data warehousing practices

The high level mapping of the previous section is extended to give detail on how specific data warehousing concepts are viewed from each of the discussed systems methodologies$_{1\&2}$. This mapping is given in table 5.1. The table is broken down in segments that coincide with the different data warehouse concepts discussed in chapter 4.

There are five aspects to consider when observing table 5.1.
1. The answers to the questions presented in the table need to be probable answers that can be expected from industry professionals. It also needs to be a true reflection of the specific systems methodology$_{1\&2}$ it represents.
2. In certain instances, similar answers are given for more than one methodology$_{1\&2}$ since the practice level of the methodologies$_1$ are similar. This however does not imply that the ontological motivation for the practices is similar.
3. Systems thinking methodology$_{1\&2}$ literature does not give clear answers to many of these questions; therefore, the foundational philosophy was used to formulate an answer.

4. The questions contained in the different segments of the table were typically directed at different people in the organisation. Some of the questions were repeated to different people, mainly to ascertain the degree to which a holistic approach was followed.

5. The term "essence of the organisation" used in the disclosive systems thinking perspective, refers to the intrinsic normativity or meaning of that organisation which differs from a human assigned objective of the organisation.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
SECTION A: Data warehouse adoption					
1	What is a data warehouse?	A data warehouse is an integrated data source to fulfil the reporting needs of business units. It consists mainly of data, metadata, and technology such as computers.	A data warehouse is a system to improve decision making in the organisation. It consists of people, data and technology.	A data warehouse is a tool to affect positive change in the organisation as a whole. It consists of everything required to succeed in the realisation of the proposed change.	The essence of a data warehouse depends on the organisation. A data warehouse in a bank and a data warehouse in a hospital are fundamentally different because the essence of a bank is fiduciary services and the essence of a hospital is patient care.
2	Who decided the organisation needed a data warehouse?	The IT (IS) department decided that integration of data will aid their reporting to management. The implementation of a data warehouse will decrease their data conversion problems.	Data warehousing is only a tool for solving the business problem of management information accessibility. It was decided to select a data warehouse as a business intelligence tool, not as a data management tool.	It is important to identify the decision taker since it provides clues to the underlying structures and the boundary judgments.	This information will assist the data warehouse team in disclosing the qualifying norm in the organisation.

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	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
3	What is the root problem to be solved by the data warehouse?	Data quality issues.	To aid the organisation's strategic objectives.	To solve a specific problem in the organisation through active intervention or change.	To perform better in the essence of the organisation.
4	If any, what other solutions to the problem were considered?	Mostly technical solutions.	Solutions focussed on a holistic approach, with strong user participation.	Solutions aimed at identifying structures and boundary judgments	Solutions that accept that man does not control everything but has to respond to the intrinsic norms in the organisation.
5	Who owns the data warehouse?	The development team.	More than one party, but mostly the users.	Both the involved and the affected.	The data warehouse is a joint responsibility in the organisation, owned by developers and users.
6	What is the impact of the data warehouse on other systems or business?	Not sure, mostly technical.	Impact study was performed. Overall data quality is improved.	Groups that were previously regarded as outside the data warehouse are now part of the data warehouse depending on the scope or boundaries.	Detailed impact study (with regard to the qualifying norm) was performed with emphasis on ethics.
7	Is everything the data warehouse influences, part of how you view the data warehouse?	No.	Yes.	Yes, but also those affected by the data warehouse.	Yes.
8	Do people form part of the data warehouse?	No.	Yes.	Yes, both the involved and the affected.	Yes, but the power of humans is not absolute.
9	How do you determine whether the data warehouse is successful?	Mostly a quantitative answer, or when the specification is achieved.	Qualitative answer; when the business users are satisfied.	When the problem that caused the initiation of the data warehouse project is solved.	When the intrinsic normativity of the organisation is furthered.
10	What are the main advantages of the data warehouse?	Technical answer.	Reach organisation's objectives.	The answer will expose the initiating group or the intended emancipation as well as the underlying structures and boundary judgments.	The data warehouse provides a method for decision making that is guided by the qualifying norm of the organisation.

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	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
11	Which department is responsible for the development of the data warehouse?	Typically the information technology department.	A dedicated business intelligence department.	A detailed process was followed to set up a team consisting of all the involved and affected parties. The question was asked: "Who ought to be part of the team?"	A team is formed consisting of various people representing various functions in the organisation to maximise the understanding of the essence of the organisation.

SECTION B: Data warehouse development methods

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
1	Describe the lifecycle of the development of the data warehouse.	Inmon's lifecycle or a strong waterfall model where user participation is limited to the requirements collection phase.	Strong focus on user participation and the organisation's objectives. Definitely an iterative process.	This would be an iterative approach, but more than one methodology could be used according to the applicability. There is a critical awareness of the weaknesses of each methodology.	The context and qualifying norm of the organisation will be initially investigated. Thereafter methods that are usable by technical and non-technical staff will be selected to further the essence and to allow the fulfilment of responsibilities in the organisation.
2	Describe the relationships between people in the data warehousing team.	People are assigned tasks by the project leader in order to achieve maximum efficiency.	Because consensus is of utmost importance, a facilitator approach is adopted by the project leader to assign roles to team members.	People are motivated to look beyond the organisational structure and hierarchy in order to discuss the project freely. Team members are motivated to discuss all aspects of the work openly and critically by requesting explanations by others.	Responsibilities are awarded to different people. This is done in accordance with the essence of the organisation. The project leader is responsible to ensure that each person performs his/her duty according to the intrinsic normativity or essence of the organisation.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
3	What is the role of end-users in the development lifecycle of a data warehouse?	End-users are responsible for the requirements definition. They are not involved in the development process. They are involved in the final stages of testing of the system.	End-users are involved in as many phases as possible, including requirements collection and modelling, as well as end-user application development. An incremental process is used to accommodate end-user views in the system.	End-users are motivated by their specific goal and involve themselves to ensure their goal is achieved. Participation and emancipation go hand in hand. End-users are on equal status in the data warehousing team. They are central to the boundary judgment of the project.	End-users are involved to disclose the essence of the organisation to the development team and to ensure that ethics are built into the system.
4	What is the role of outside consultants?	They are used to ensure efficiency.	They might help to gain consensus, but they should be clear on the organisation's objectives.	If the in-house technical team cannot deliver the desired outcome, consultants will be used.	It is imperative that the consultants should take ownership of the essence of the organisation. Somebody from within the organisation needs to ensure that the consultants act accordingly.
5	Explain how you divided the project into smaller projects.	Typically according to the SDLC or Inmon's model.	Typically according to Kimball's model of dividing projects in line with business processes.	The key business problem will always enjoy highest priority.	Care is taken not to loose sight of the importance of the qualifying norm or to take it out of context when dividing the project into smaller tasks.
6	How did you specify performance objectives for each of these projects?	Each project's performance objectives are determined independently from the others.	The performance objectives of each sub-project are highly measurable and support the objective of the overall system and that of the organisation.	The performance measures form part of the different methodologies used in different phases. The performance measures depend on subjective judgments of the boundaries of the warehouse.	The objectives of the sub-projects are in line with the essence of the organisation, as in soft systems, but with less emphasis on measurability.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
7	How is the project financed?	Centralised.	Decentralised.	Centralised.	Decentralised.
SECTION C: Requirements definition					
1	Describe the process of requirements collection.	Inmon's idea of the requirements resulting from the data warehousing process, or the users completed pre-designed forms stating their requirements. The users are responsible for their requirements.	A partnership between IS and business was formed, where IS staff and business analysts worked together to determine the requirements. Prototyping was used to design a vehicle for discussion between IS designers and users.	The nature of decision making in the organisation was investigated (both currently and historically). Great effort was taken to ensure that all affected parties in the organisation are involved. Metaphors are used to verify communications.	Many different people were involved to ensure that the context of the data warehouse is understood. The main effort is to research consensus on the identity of the qualifying norm.
2	Who represented which levels of the hierarchy during the requirements specifications?	Limited participation of top management; strong subject orientation.	Strong business sponsor which is independent of a specific subject area.	Strong representation by the group initiating the data warehouse but care is taken to involve all the affected parties.	Many different levels should be represented to ensure better understanding of the essence of the organisation.
3	Do users know what they want? How do you go about assisting them?	No, users don't know, but we deliver typically what they ask us to do. It is their problem. Alternatively, an Inmon approach, where requirements are developed later in the project, after the technical implementation has been completed.	Not always, but the data warehousing team should help them to specify their different views, all of which are combined into user specifications on the basis of consensus.	Mostly yes. The group initiating the data warehouse has strong motivation for the development of the data warehouse. It is the task of the data warehousing team to be critical towards them in order to identify power struggles and negative intentions toward another group or individual in the organisation.	Mostly yes. The users know what they want to accomplish. The data warehousing team is also alert to everybody's objectives, i.e. whether they are ethically acceptable and in line with the essence of the organisation.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
4	How did you reach consensus on requirements?	The users are responsible for consensus; the IS department wants one voice from the users.	Different opinions give a better understanding of the functionality required by the data warehouse. This leads to the creation of different views relating to the data in the data warehouse.	It is accepted that boundary judgment is subjective. Team members are encouraged to share their values that led to their view of the data warehouse.	Requirements were tested against the qualifying norm in the organisation.
5	What is the role of the organisation's objectives in the requirements collection process?	The team don't know the objectives; they do not see it as of crucial importance to their task.	The organisation's objectives are crucial.	It depends on the scope of the data warehouse. The scope (or boundary) ought to be large enough to include the organisation's objectives.	They are important as long as organisational objective are in line with the essence of the organisation and without ethical conflict.
6	How do you keep your requirements documentation up to date?	This is done by filing user requests.	Clear joint ownership between the development team and the users.	Documentation is a priority for all the affected parties, since it defines the boundaries of the data warehouse. The data warehouse team uses an iterative process to keep the documentation up to date.	Documentation should clearly state what is regarded to be the qualifying norm and what aspects of the organisation should not be changed. It is best kept up to date by a joint effort between users and developers.
7	To what degree do existing systems determine the functionality of the data warehouse?	To a large degree, as only data available from the source systems, can be included.	User requirements are paramount when starting the process. Concessions are made for requirements that cannot be supported from existing data.	Changes to existing systems are strongly contemplated to assist user requirements, since existing systems might reinforce the oppressing structures targeted by the data warehouse.	If the existing systems are in conflict with the essence of the organisation, they need to be changed. However, there are many intrinsic restrictions in the organisation that are respected.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
8	Are you satisfied with the requirements documentation?	Yes.	Room for improvement.	Yes, but it can always be improved. It is continuously evaluated.	Yes, as long as it reflects the essence of the organisation as guiding aspect of the data warehouse.
9	Are the users satisfied with the requirements documentation?	The users never see the final documentation.	Yes, but it is an ongoing process.	Yes, because they are involved in the entire process.	Yes, as long as it reflects the essence of the organisation as guiding aspect of the data warehouse.
SECTION D: Data modelling					
1	Do users form part of the modelling team?	No, their inputs are represented by the requirements definition documentation.	Yes, users help to extend the model to represent as many views as true as possible.	Yes, since they are the key to understanding the underlying structures and the boundaries of the data warehouse.	Yes, users are helpful to identify and maintain the qualifying norm during the modelling process.
2	Do you use an ERD or star schema? Why?	Mostly ERD, but those who use star schemas do it for technical reasons, such as quick response time on queries.	Mostly star schemas, because users can understand them and are able to participate in the design process.	Mostly star schemas to allow the user to verify the process.	Star schemas, but the users want to see all the star schemas to form an image of the organisation as a whole.
3	Does the modelling team know the organisation's objectives?	Not necessarily.	Yes.	It depends on the boundary of the data warehouse, but they ought to.	Yes, they are especially aware of business ethics.
4	Do you view business processes different from department to department in the organisation?	Don't understand the question. After explanation: No.	Yes.	Yes, the data warehouse team will have a critical awareness of each function in the organisation.	Different business processes are used to further the essence of the organisation.
5	How often do you change the basic design of the data warehouse?	Not often.	Sometimes to incorporate new user views.	Keep on changing until desired goal is achieved.	Keep on changing in order to represent essence as disclosure continues.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
6	What is a model?	A true representation of the real world.	A vehicle for discussion about reality.	A metaphor would be used to explain the answer. Possible references to boundary judgments.	A model is used to describe something. The modalities are used to describe the essence of something.
7	How often do you talk to the users during the design process?	Not often, the requirements documentation represents their input.	Often, as an iterative process is used.	They are included in the design process. They are truly part of the process.	They are an integral part of the process.
8	Are you satisfied with the model used?	Yes.	Yes, it is an iterative process.	It is often reviewed in terms of strengths and weaknesses and is changed when required.	Yes, but one should be cautious of loosing sight of the essence of the organisation when building the model.
9	What is a data mart?	Inmon's approach.	Kimball's approach.	Kimball's approach.	Kimball's approach.
10	Why do you implement data marts this way?	Technical motivations.	User participation.	To level the playing field between users and "experts".	The data warehouse is divided into smaller parts without loosing the essence in any part.
11	What performance measures do you use?	Technical.	User satisfaction.	The problem situation is reviewed. If the problem is solved the performance is satisfactory.	The essence of the organisation should be incorporated in analytical decision making by using the data warehouse.

SECTION E: Data staging and data quality

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
1	Who is responsible for data quality?	The source system owners as far as availability and accuracy are concerned and the IS team as far as compatibility is concerned.	A joint effort. The source systems should be in line with the organisa-tion's objectives and should therefore be willing to adapt to achieve objectives. The users should indicate which data definitions are most represent-tative of the organisation's practice.	High quality source data is part of a successful data warehouse. The data warehouse team ought to have a representative of the source system. Source systems that provide poor quality data need to be changed.	It is a joint effort of the source system owners and the data warehousing team, accepting restrictions caused by current responsibilities of employees with a strong focus on business ethics.
2	Does the overall objectives of the organisation influence data staging?	No.	Yes, very much.	Yes, depending on the boundary of the data warehouse. But it should.	Yes, assuming that the overall objectives of the organisation support the essence of the organisation and therefore the data warehouse.
3	How do you handle conflicting quality rules?	The source systems owners should issue instructions after having resolved conflict among themselves.	Through consensus.	The history of the data sources is investigated to expose the structures they support. Only after understan-ding the reasons for differences, can the problem be addressed.	Through consensus, with the essence or the organisation as guiding principle.
4	How much do you know of what keep the managers awake at night?	Not much.	Very much.	It depends on the boundary of the data warehouse, but since the data warehouse project is focussed on the total organisation, the answer should be "very much".	Very much, since the essence of the organisation is also the essence of the data warehouse.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
5	How do you measure success?	Check the number of data items. The user is responsible for supplying test cases.	Success criteria are built into each step and different people, such as the source system owner, the design team and the users are jointly responsible for supplying test cases.	Success in data quality indicates that the context and consequences of all the data is understood.	When the essence of the organisation is better reflected in analytical decision making.
6	Do you have contact with the users?	No, we implement the model.	Yes, sometimes.	Yes, very often.	Yes, very often.
7	What is the purpose of data staging?	Only a technical answer is given.	Technical answer and comments on system objectives are made.	To understand the underlying structures or data of the data warehouse in order to understand the problematic structures.	Technical answer, but reference to the essence of the organisation and responsibilities of different people.
8	Are there secondary benefits to the organisation?	Don't know.	Yes, better data consistency.	Yes, since the total organisation is viewed by the data warehouse team, the intervention should have some benefits to everyone.	Yes, sections of the organisation that are not in line with the essence of the organisation can be identified.
9	How does the data warehouse change the way people do their work?	Don't know.	The team members know how the organisation's objectives are achieved.	The team members know exactly what intervention is achieved by the data warehouse.	The analytical decisions also reflect ethical responsibility.
10	Who are your customers?	The application developers and the business users.	Similar to hard systems but also the customers of the organisation.	The answer would also reflect on who ought to be the customers.	Everyone affected by decisions made.

SECTION F: End-user applications

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
1	When did you gather requirements for the end-user applications?	The users use standard access programs for which training was outsourced to the suppliers of these packages.	These requirements formed the foundation of the data warehouse design and were gathered at the beginning of the process and used throughout the lifecycle.	When the boundary judgements were made at the beginning of the project. It is however an iterative process.	At the beginning of the project when the norms were disclosed and the qualifying norm was identified.
2	What role does the organisation's objectives play in end-user applications?	Don't know, the end-user applications are done according to the specifications given by the users.	Very important role.	It depends on the scope (boundary) of the data warehouse, but it should be very important.	Important role, assuming that the overall objectives of the organisation support the essence of the organisation and therefore the data warehouse.
3	Do you develop end-user tools in-house?	Use very often standardised packages.	Yes, if standardised packages are used, contextual training is given.	Yes, to maximise the intended intervention.	Yes, since very few off the shelve packages allows one to model decisions around the essence of the organisation.
4	Are end-user applications part of the data warehouse?	No.	Yes.	Yes, they are central to the success of the data warehouse.	Yes.
5	Did you start with a proof of concept?	No. Our requirements are complete.	Yes. It eases user participation.	Yes, an iterative process holds great benefits.	Yes, it guides conversation around the qualifying norm.
6	What type of training do you give users?	Training is not individualised and sometimes outsourced.	Since the users were part of the design process, and since prototypes were used, they are familiar with the interface. They are trained in their own environment, using examples that correspond to their view of the data warehouse.	Through data warehouse training, the change intended by the development of the data warehouse is enforced.	Training is given to show how the new data warehouse incorporates the essence of the organisation in analytical decision making.
7	Do users change the way they do their daily work by using the data warehouse?	The data warehousing team does not know.	Yes.	Yes, that might have been the main objective of the data warehouse!	Yes, they are much more aware of the implications of their actions.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
8	Does everybody have access to all the information in the data warehouse?	No, the access levels are set by management and are of little importance to the data warehousing team.	No, but it is a contentious issue. The data warehousing team should ensure maximum flexibility in access levels.	No, but they ought to. All affected parties should have access to the information.	Yes, to a large extent and access is only restricted to protect the interest of people and not to hide information.
9	How many users do *ad hoc* queries that they design and implement themselves? Do you encourage this?	Not sure. The team does encourage it, because it means less work for them, as long as the users don't cause damage.	They know the answer and encourage users to make optimum use of the data warehouse in order to reach the objectives.	This indicates the empower-ment of the data warehouse users. Sometimes the data warehouse is designed to emancipate or to empower middle management. All the users ought to do *ad hoc* queries.	They are all motivated to use *ad hoc* queries, as long as they comply with ethical standards.
10	Did the usage of the data warehouse influence the career paths of certain managers?	Don't know.	Do know but not very important.	Do know. This might indicate the real objective of the data warehouse.	Yes, the careers of those sensitive to the intrinsic normativity are furthered.
11	Do you keep an audit trail of data warehouse usage?	Yes, to be able to send an account to each business unit.	Yes, to be able to improve service.	Yes, to determine to what extend the data warehouse is used as well as to clarify the boundary of the data warehouse.	Yes, to provide better service and to check ethical usage of the data warehouse.
12	How do you know when the data warehouse is successful?	When data quality improves and when the specifications are met.	When the organisation's objectives are better achieved.	When the intervention is achieved.	When the essence of the organisation is reflected in decision making.
13	Do you see the data warehouse a control mechanism that management uses to control how decisions are made?	No, or don't know.	No.	Sometimes, yes, but the data warehousing project is also used to expose the power structures in the organisation.	No, but the data warehouse is a tool to ensure that decisions made are ethically sensitive.
14	Do you know the data staging processes?	No, it's not the job of the team.	Yes, a holistic approach is followed.	Yes, it gives insights into the underlying structure of the organisation.	Yes, in order to understand the whole context of the data warehouse.

Table 5-1 Mapping of systems thinking methodologies[1&2] on data warehousing concepts

5.3   Data collection

Interviews were conducted in terms of the data collection method described in section 2.5.3.1. Semi-structured interviews were conducted using the questions in Table 5.1. The questions presented in Table 5.1 formed the basis of each interview, although additional questions were asked to clarify answers given. The answers presented in Table 5.1 were not given to the respondents. Interviews were mainly conducted in Afrikaans which is the home language of the respondents. All the interviews lasted between 60 and 80 minutes, and were recorded and transcribed.

Since most people enjoy talking about their work, the interviews had a conversational tone. It was made very clear at the beginning of each interview that there was no correct or incorrect answer and that the researcher aimed to learn from the respondents. The researcher also demonstrated some data warehousing knowledge early in the interview to establish a high standard of use of terminology. It was important to demonstrate some competence in the field in order to establish the researcher in the data warehousing paradigm.

All the case studies were completed before the data was analysed.

5.4   Data analysis

Interpretive pattern matching was used as method for data analysis. Answers to questions were carefully examined (interpreted) and compared to the pre-formulated answers in Table 5.1. Table 5.1 was used as a template to analyse the interview data in three iterations. During the first iteration an allocation was made of each answer in an applicable cell as explained below. This process was repeated for each case study. This mapping process of analysis was repeated two weeks later, without taking the first allocation into consideration. After this second allocation the two sets of tables were compared and different allocations of specific answers were investigated and corrected.   A third iteration was conducted per question for all the case studies.   Every question's answers were checked across all the case studies to ensure uniform allocation. All three iterations were repeated after any changes to the template (table 5.1) were made.

An analysis report is given for each of the three case studies. Each report consists of two tables. The first table assigns initials to the respondents, while the second table,

a copy of table 5.1, is used to map the answers given by specific respondents. An example is given here to aid the understanding of the case study reports.

Respondent Code	Position in the organisation	Experience in data warehousing
AB	Head of the data warehousing department (Information management department)	10 years
CD	Analysis and design manager	5 years

Table 5-2 Example of respondent profile table

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
SECTION A. Data warehouse adoption (Departmental head: OM)					
5	Who owns the data warehouse?	AB: I don't know.	CD	CD (later)[1]	

Table 5-3 Example of data collected table

Footnote:

[1] It is really the group of people who want the change who owns the data warehouse.

In this example two people were interviewed identified as AB and CD respectively. The question asked is numbered A5 (section A, question 5) and is quoted verbatim. The response "AB: I don't know" in the hard systems thinking column means that the answer given by AB was interpreted to be a hard systems thinking answer. The specific answer is not exactly the same as the answer provided in table 5.1 as a typical hard systems answer to question A5; therefore a brief summary is given of AB's specific answer namely that he does not know who owns the data warehouse.

The CD in the soft systems thinking column indicates that the answer provided by CD is very similar to the answer in the soft systems column provided in table 5.1. The answer in the critical systems column indicates the CD said something else later in

the interview, which may be mapped to critical systems thinking. An explanation of the mapping is required or his answer is too long to fit into the cell, therefore a footnote is used to present the answer given by CD. Since many of the answers were too long to quote, direct quotations are only used in crucial instances and where short answers were given.

The following additional aspects need to be considered when observing the case study results:

1. Confidentiality agreements were signed with the organisations preventing the disclosure of the identity of the organisation.
2. A background discussion is given for each of the organisations.
3. At least three interviews were conducted at each organisation and individual answers are mapped onto the table. The individual respondents are identified by initials identified at the beginning of each study.
4. Whenever a person expressed internal conflict, the answer was mapped to critical systems thinking accompanied by an explanatory footnote.
5. Similar interview and data analysis methods were used for each interview.

In order to facilitate easy reference to table 5.1 when reading the case study results, a removable copy of table 5.1 is provided at the back of this thesis.

5.4.1   Case study one: A large organisation in the financial sector

This first case study was performed on an organisation in the financial sector of South Africa.

5.4.1.1   Background

This is one of the largest organisations in the country's financial sector. It was formed some years ago as a merger of several smaller organisations and has a very large market share. As a result of the confidentiality agreement, limited figures will be reported.

The following should be taken into account when considering the answers given by the managers of the data warehousing department:

1. The data warehouse is seen as the base data store organised with an ERD model according to Inmon's definition.   Managers (except the systems analysis and design manager) limit the boundary of the data warehouse to this central data repository.

2. The data warehouse is maintained and managed by the information management department, which is totally separated from the information technology (IT) department.

3. The size of the data in the data warehouse is about 3 Terabytes.

4. There are about 400 registered users of which 250 are active.

5. Each business unit is serviced by a member of the information technology department, called a business analyst.

6. The middle managers interviewed do not use the data warehouse themselves, but one intends using it in future.

7. The turnaround time for specific reports is about four days.

8. It is a strictly read-only data warehouse; all new data should go through the data staging process.

9. The base database has evolved over a period of 8 years. New developments are only done in terms of additional data marts (Inmon's approach) for specific business units.

From a disclosive systems thinking perspective, one needs to identify the intrinsic normativity of this organisation. This is typically done by asking: "What is the single most important value of the organisation?" After answering this question from the points of view of different customers, it is concluded that integrity or trustworthiness is the essence of this organisation.

5.4.1.2   Interpreted data

The main reason for selecting this organisation was the fact that they developed their own data warehouse with limited assistance from consultants. Their data warehouse has a large amount of data, which they believe influences design practices. The base data warehouse is well established and has already gone through one re-engineering phase.

Table 5.4 contains a description of the people interviewed in terms of position in the organisation, as well as experience. Each person is allocated an identity code that is

used in table 5.5 to represent that person's answer.   At the beginning of each section, the manager of that section in the organisation is indicated.

Respondent Code	Position in the organisation	Experience in data warehousing
OM	Head of the data warehousing department (Information management department).	10 years.
DM	Manager of systems analysis and design for the data warehouse.	5-6 years (18 years with the organisation).
WM	Data warehouse manager, responsible for the infrastructure and data staging.	4 years with this organisation and 3 years prior experience in data warehousing with other organisations.
IM	Information building manager, responsible for building data marts (Inmon style).	10 years, even before the department called their system a data warehouse.
SP	Data staging programmer.	6 years.

Table 5-4 Respondent profile of case study one

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
SECTION A. Data warehouse adoption (Departmental head: OM)					
1	What is a data warehouse?	DM gave a technical description. WM IM[1] SP	OM[2]		OM[3]

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[1]   "In short I would say it is a centralised location for data on different roll-ups….."

[2]   "In theory, people should take the organisation's objectives into account when building a data warehouse, but in practice very few of them do."

[3]   The goal of the organisation as presented by top management is "to be the best for the customers", which is in line with the essence of the organisation, but the goals expressed by the people in this Information Management department are centred around profitability and financial benefits for shareholders.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
2	Who decided the organisation needed a data warehouse?	DM: Don't know. WM: Result from mergers. OM[4] IM SP: Don't know.			
3	What is the root problem to be solved by the data warehouse?	SP	DM: Management Information for high level decision making. WM: Better results for the organisation. IM		
4	If any, what other solutions to the problem were considered?		DM: It was not even called a data warehouse, but the aim was similar. IM[5]		
5	Who owns the data warehouse?		IM: "The whole organisation." IM[6] OM gave the name of the organisation as answer	DM:"Business."	IM: "The whole organisation."
6	What is the impact of the data warehouse on other systems/ business?	IM[7]	OM[8]		
7	Is everything the data warehouse influences part of how you view the data warehouse?	WM: No, source systems can never be seen as part of the data warehouse, Data marts are only data. IM: No, data marts are not part of the data warehouse.	DM: "Yes."		DM: "Yes."
8	Do people form part of the data warehouse?	WM: No.	DM: "Yes." IM: "Yes."		

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4   "It was difficult to convince the guys to get a data warehouse"
5   "We did not call it a data warehouse, we simply talked about the DB2-database"
6   The data marts belong to business, but the technical data store belongs to the information management department.
7   The impact is very limited, perhaps here and there a quality issue.
8   The source system's quality should improve according to the work done by the data warehousing team; there should be a closed feedback loop.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
9	How do you determine whether the data warehouse is successful?	WM[9]	DM: "When users are satisfied." OM[10]		
10	What are the main advantages of the data warehouse?	IM[11] SP OM[12]			
11	Which department is responsible for the development of the data warehouse?		DM WM IM OM[13]		
SECTION B: Data warehouse development methods (Departmental head: OM)					
1	Describe the lifecycle of the development of the data warehouse.	IM SP	DM[14] WM[15]		
2	Describe the relationships between people in the data warehousing team.		OM[16]		
3	What is the role of end-users in the development lifecycle of a data warehouse?	DM IM[17]			
4	What is the role of outside consultants?	WM[18]		WM[18]	
5	Explain how you divided the project into smaller projects.	OM: SDLC			

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[9]   A target of 100 million more revenue for the total organisation was set and 92 million was achieved, which means that the data warehouse is successful.

[10]   "We asked about 300 guys in the organisation: do they know what we do? Are they satisfied with our work?"

[11]   It is to integrate data and to obtain one view of the customer to analyse.

[12]   "I think it is to integrate things and to have one view of a customer in order to analyse things with trends."

[13]   "The data warehouse is definitely separate from IT."

[14]   Get requirements, test requirements feasibility, extend base warehouse, develop data mart, deliver mart, using an iterative process.

[15]   "In most cases we start with a proof of concept… If they don't buy into in the benefit they will get – our work is worthless."

[16]   Managers differ greatly but this leads to the enrichment of the data warehousing department and a better mutual understanding.

[17]   "…That is what happens, you need to think on behalf of the users ."

[18]   One may use consultants for technical advice, but the responsibility stays with the internal staff.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
6	How did you specify performance objectives for each of these projects?	WM	DM[19]		
7	How is the project financed?		DM[20] IM WM OM[21]		DM[20] IM WM OM[21]

SECTION C: Requirements definition (Person responsible: DM)

1	Describe the process of requirements collection.	DM: Business is responsible to draw up specifications.	OM[22]		
2	Who represented which levels of the hierarchy during the requirements specifications?		DM: Communications are with business analysts, as well as the entire executive committee.		
3	Do users know what they want? How do you go about assisting them?	DM[23] IM[24] SP			
4	How did you reach consensus on requirements?	DM[25]			

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[19]   "..their measures are more on the line of accuracy and user satisfaction ultimately."
[20]   Each business unit contributes a fixed amount per year irrespective of usage.
[21]   Contradictory to DM, each business unit is billed according to estimated usage.
[22]   Users need to be assisted to define their requirements, especially on a strategic level.
[23]   Business completes a fixed form, including aspects like the sources of the data they want, written in a combination of business and technical terms. The business analyst should assist the business unit.
[24]   "The users don't know what they want. He wants this MIS system, but he doesn't know what he wants. He wants me to figure out what he needs."
[25]   The form completed by the user is checked by a data warehouse systems analyst. He then goes back to the user indicating the technical feasibility of the requirements. The moment they get charged for specific requirement, the importance of that requirement is less. Business users are responsible for clearing conflicting requirements.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
5	Does the requirements collection team know the objectives of the organisation? What is the role of the organisation's objectives in the requirements collection process?		DM[26]		
6	How do you keep your requirements documentation up to date?	DM[27]			
7	To what degree do existing systems determine the functionality of the data warehouse?	WM			DM: Historic factors are a big influence that cannot be changed over night.
8	Are you satisfied with the requirements documentation?	DM: "Yes, it works well."	OM[28]	OM[28]	OM[28]
9	Are the users satisfied with the requirements documentation?	WM: "Some will always be unhappy."			
SECTION D: Data modelling (Person responsible: DM)					
1	Do users form part of the modelling team?	DM: "No." WM[29]			
2	Do you use an ERD or a star schema? Why?	DM[30] IM: Not sure.	WM[31]	DM[32]: In future. WM[31]	

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[26] "They actually do their business requirements from the strategy, and they divide that down to drivers."

[27] It is the role of the data warehouse systems analyst to keep the requirements always up to date; it is signed off to the programmer.

[28] Not quite satisfied with the current approach to user requests, because all the users are not on the same level of understanding the system.

[29] Users are not able to understand ERDs. WM believes an Inmon approach is not the best approach and would like to change the model of the system to make it more user-friendly. It is however too expensive to change the system.

[30] They use a combination of Inmon and Kimball, but from further explanation it is closer to an Inmon's approach. They have 400 tables and 24000 files.

[31] WM would like to move away from Inmon to a Kimball approach to involve users.

[32] An Inmon approach is used and *some users* have access to the data in the ERD directly, without a data mart. This is the case according to DM and this should only be allowed for *users at a certain level*.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
3	Does the modelling team know the organisation's objectives?	DM[33]	DM: "Yes."		
4	Do you view business processes different from department to department in the organisation?	DM[34]			
5	How often do you change the basic design of the data warehouse?	DM: Only to expand. SP			
6	What is a model?	IM	DM[35]		
7	How often do you talk to the users during the design process?	DM: "Not very often."			
8	Are you satisfied with the model used?	DM: "Yes." IM: "Yes."			
9	What is a data mart?	DM : Inmon. WM[36]: Inmon. IM: Inmon.			
10	Why do you implement data marts this way?	DM: Size of data.			
11	What performance measures do you use?	DM gave technical answer.			

SECTION E: Data staging and data quality (Person responsible: WM , programmer: SP)

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[33] They should be able to work from business unit specifications.

[34] "Sometimes in departments, sometimes across departments. We don't actually look at the cross department ones that much."

[35] "A model is a representation of the ideal world, not the real world."

[36] The star schemas used are copies from the ERD; they do not have a data warehouse bus.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
1	Who is responsible for data quality?	WM[37] IM: Source systems. SP	OM[38]		
2	Does the overall objective of the organisation influence the data staging?	SP	WM[39] WM[40] (later) WM[41](later)		
3	How do you handle conflicting quality rules?	WM[42] SP			
4	How much do you know of what keep the managers awake at night?	SP	WM: Expenses and income. OM[43]		
5	How do you measure success?	WM gave a technical response. SP			
6	Do you have contact with the users?	WM: "No." SP			
7	What is the purpose of data staging?	WM: Centralise data. SP			
8	Are there secondary benefits to the organisation?	WM: Possible to do outside consultation.			
9	How does the data warehouse change the way people do their work?	WM: Don't know.			

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[37]   "Operational system owners are responsible for quality. It is your data; we get it from your systems. If you can not tell me what you want clean and what you want dirty, I cannot help you."

[38]   "I won't say it is only the production system owners – I think we have a role to play, since it is easier for us to put everything together."

[39]   If you don't have data staging, you don't have a data warehouse. The overall objective of the organisation is to make money, bring down costs and to increase income. Managers can limit financial risk by using the data warehouse.

[40]   The data warehouse can support all the strategic goals by supplying numbers.

[41]   There is a trade-off between speed and quality. Some people are happy with data that is not 100% correct as long as they receive it quickly.

[42]   Each source system has an owner. These owners are responsible for data quality of their systems. These source system owners are also seen as customers.

[43]   "Yes, I know a lot, because our vision is built on the strategic goals of Exco. In other words our strategic themes and targets."

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
10	Who are your customers?	WM IM[44] OM[45] SP	DM[46]	DM[46]	DM[46]
	SECTION F: End-user applications (Person responsible: IM)				
1	When did you gather requirements for the end-user applications?	DM[47]	IM[48]		
2	What role does the organisation objectives play in end-user applications?	IM[49]			
3	Do you develop end-user tools in-house?	DM: No. IM[47]: No.	OM[50]	OM[51]	
4	Are end-user applications part of the data warehouse?	IM: "No."	DM: "Yes."		DM: "Yes."
5	Did you start with a proof of concept?	DM: "No."			
6	What type of training do you give users?	IM[52] OM	DM: Training should be on the user's marts.	DM: Training should be on the user's marts	

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[44]   "Any person who wants data from the data warehouse. It won't be the guy in the street."

[45]   "My customers are the business users and up, to the top."

[46]   "Business units and the man in the street; sometimes the business units are secondary to the clients in the street."

[47]   No end-user applications were written; off the shelf software is used. But user requirements are used to build data marts. The requirements are gathered as the need arise for more business unit data marts.

[48]   When fixed reports are written, the users are directly consulted without the use of an analyst. Users are part of the report design effort and it is very successful.

[49]   It is possible for business units to get end-user applications from outside parties, but it will not be supported by this department. There are only a few power users that are able to do *ad hoc* queries.

[50]   Other departments are serviced with data and each of them creates their own application for analysing the data. Later describer the tool used: "It is very flexible, I think it is going to be much more for top management."

[51]   "Yes exactly, we want to empower the guys with a tool such as Discover."

[52]   The training is provided by the software vendor. Users are only trained on parts of the product, because it is feared that they will do damage to the base design.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
7	Do users change the way they do their daily work by using the data warehouse?	WM: "No."	DM: Yes, also different perceptions. IM: Yes, believe so.	IM[53](later) OM[51]	
8	Does everybody have access to all the information in the data warehouse?	DM: "No." IM: Manager of business unit decides who gets access.			
9	How many users do *ad hoc* queries that they design and implement themselves? Do you encourage this?	WM: Need to spoon feed users. IM[54]	DM: 15 power users in one business unit. OM: Overall 40.	OM[55]	
10	Did the usage of the data warehouse influence the career paths of certain managers?		DM: "Yes." OM: "Yes."		
11	Do you keep an audit trail of data warehouse usage?	DM: "No." WM[56] IM[57]	DM would like to have an audit trail to improve service.	DM would like to have an audit trail to improve service.	
12	How do you know when the data warehouse is successful?		DM: When users are satisfied. IM		
13	Do you see the data warehouse a control mechanism that management uses to control how decisions are made?	DM: "No."	DM: "No." OM: "No."	IM[58] OM[59]	
14	Do you know the data staging processes?		DM has an overall knowledge. IM		

Table 5-5 Data collected during case study one

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[53] Ideally, all the users should do *ad hoc* queries through a web-based application; they should be able to do all their work this way.

[54] Only a few after extensive training and support is given.

[55] Want to empower the user to be able to take control of his situation.

[56] WM wants an audit trail to be able to charge people for specific use of the data warehouse.

[57] IM wants to know whose actions cause problems on the system.

[58] It would be great if this can happen.

[59] "In future it might be the case, mainly due to governmental regulations."

5.4.1.3 Conclusions

The senior manager stated the following: "In theory I think people should take the organisation's objectives into account when building the data warehouse, but in practice very few of them do." It is interesting to note how many more answers given by senior management (denoted by OM) can be mapped to soft systems thinking, compared to those given by middle management. The programmer interviewed (SP) gave almost all hard system thinking answers. Another interesting fact is the large amount of soft systems answers, which are not representative of current actions, but of how the respondents believe the work should be done.

The view of this particular data warehousing team of the data warehouse as a data store, limits their influence in the organisation. They are aware of many of the shortcomings in the usage of the data warehouse, but they view end-user applications as outside the boundary of the data warehouse and the scope of the data warehousing team.

It is clear that critical systems thinking are only practised to a limited extent. It is also clear that little effort is made to determine the intrinsic normativity of the organisation. One can argue that this organisation mainly follows a hard systems thinking approach, and that they experience many problems associated with this approach.

5.4.2 Case study two: An organisation in the health services industry

The second organisation investigated provides healthcare insurance management and administration services to a major mining group in South Africa.

5.4.2.1 Background

The organisation forms part of a chain of organisations, including hospitals, clinics, and pharmacies that provides healthcare to 50000 employees of a major mining group in South Africa. This organisation is responsible for the administration of health care insurance transactions, new product research and the supply of information to the other organisations in the chain. The information supplied to the other organisations consists of performance measurements, management accounting information and new business performance information.

The main motivations for studying this specific organisation are the following:

1. They utilise the services of data warehouse consultants during the development lifecycle.
2. They design and develop data warehouses for other companies in their group.
3. Since their data warehouse operation only started recently, they are currently working on all the phases of the data warehouse lifecycle.   Interviews were conducted over a three month period.
4. Being in the healthcare industry, one would be able to separate the essence of the organisation from its financial objectives.
5. At present, the organisation is going through major changes and management expects significant cost saving measures from all the employees.
6. The operational information technology services of the organisation have been outsourced to an external organisation.

5.4.2.2   Interpreted data

Table 5.6 contains a description of the people interviewed in terms of position in the organisation as well as experience. Each person is allocated an identity code that is used in table 5.7 to represent that person's answer. At the beginning of each section, the manager of that section in the organisation is indicated.

Respondent Code	Position in the organisation	Experience in data warehousing
IM	Chief information officer (member of the executive committee of organisation).	Two years prior experience in management information, as well as a qualified medical practitioner with applicable specialisation fields.
WM	Data warehouse manager.	Six months in this organisation and 5 years as data warehouse consultant.
SA	Systems analyst and designer.	One year experience and formal training in data warehousing as part of a four year degree in computer science.

TS	Person responsible for data staging and data warehouse repository management.	Eighteen months data warehousing, as well as prior programming experience.

Table 5-6 Respondent profile of case study two

It should be noted that this organisation is still in the initial phases of their data warehousing project. They delivered working proofs of concept, but still need to complete their first project. This is not a result of poor project planning, as they are relatively on target with their project dates.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
SECTION A. Data warehouse adoption (Departmental head: IM)					
1	What is a data warehouse?		IM[60] SA WM[61] TS[62]		IM[63] WM[64]
2	Who decided the organisation needed a data warehouse?	TS: "The chief information officer." SA	IM[65] WM		
3	What is the root problem to be solved by the data warehouse?		IM[66] TS and SA both stated business objectives. WM[66]		
4	If any, what other solutions to the problem were considered?	SA gave technical explanation.	IM[67] TS[68]		

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[60] "A data warehouse contains reliable integrated information used in decision making."

[61] "A data warehouse is a collection of business data used for decision making."

[62] "A data warehouse is a large collection of data that is easy to access in a suitable format."

[63] "The data warehouses in the chain (group of companies) are representative of very different industries e.g. finances and health and therefore very difficult to compare."

[64] WM referred to "patient care" as an objective of the organisation, but did not refer to it again in answering any question.

[65] Previously, the IT department, but it did not work. A data warehouse will never work if the motivation does not come from top management. The data warehouse is now developed in the Information Management department.

[66] "The root problem to be solved is the provision of fast reliable information for decision making."

[67] A manual system was used prior to the data warehouse to provide management with information.

[68] "The organisation used to print out paper reports. This caused problems, since some of the people wanted to do further analysis, but not everybody received these reports."

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
5	Who owns the data warehouse?	TS: "The chief information officer."	SA[69]	IM[70]: Business owns the data warehouse. WM	
6	What is the impact of the data warehouse on other systems/ business?	TS[71]	WM: Better quality. IM: Better quality.	SA[72] TS[71]	
7	Is everything the data warehouse influences part of how you view the data warehouse?		SA: "Yes." WM: "Mostly." IM TS		SA: "Yes." WM: "Mostly." IM TS
8	Do people form part of the data warehouse?		IM: "Yes." SA: "Yes." WM: "Yes." TS: "Yes."		
9	How do you determine whether the data warehouse is successful?		IM: If it is used. TS: If it is used.	SA[73] WM[74]	
10	What are the main advantages of the data warehouse?		IM[75] SA: To support decisions. WM: Good management information. TS		
11	Which department is responsible for the development of the data warehouse?		IM[76] SA WM TS		
	SECTION B: Data warehouse development methods (Departmental head: WM)				

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[69]   There is a lot of conflict between the business users and the development department; the business users don't always accept their responsibilities of ownership.

[70]   One needs to have a business sponsor who is willing to take full ownership of the data warehouse.

[71]   "The other information systems people might feel threatened because the data warehouse team is taking their data and their knowledge so they might feel we are taking their jobs."

[72]   It depends on how good relationships between IS and the data warehouse team are; the result can be very positive, but the communication is not always open enough.

[73]   If it is used. At the moment, it is regarded as successful if successful measures for cost saving is provided.

[74]   The data warehouse team should not determine whether the data warehouse is successful, business should. It is always difficult to determine the value of good information.

[75]   Fast accurate information. We want to study the diversity within the organisation.

[76]   The data warehouse is developed in a separate department for management information. IM is the manager of this department and is a member of the executive committee of the organisation. One needs collaboration with IT services.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
1	Describe the lifecycle of the development of the data warehouse.		SA explained an iterative requirements-driven method. IM WM[77] WM[78] TS explained an iterative process.		
2	Describe the relationships between people in the data warehousing team.		TS: Good relations with minimal conflict (solved by consensus).	WM[79] SA[80] IM: Conflict between more technical and more business oriented team members.	
3	What is the role of end-users in the development lifecycle of a data warehouse?	TS[81]	SA[82] WM[82] IM described the role of users in every phase.	SA[82] WM[82]	
4	What is the role of outside consultants?		SA[83] WM[84] TS[85]	IM[86]	

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[77] They use an iterative SDLC with strong emphasis on feasibility study strongly based on the SDLC process described by Kimball.

[78] "You can not understand the business quickly and one is not able to build a prototype before understanding the business, therefore I'm sceptical of people stating that one can make a prototype in six weeks."

[79] There is conflict between technical and non-technical team members, but it is handled through open communication.

[80] There is a lot of internal conflict but it is seldom expressed openly.

[81] "End-users should only be part of the requirements analysis and the end-user application development phases."

[82] User should be part of entire process to solve difficulties, for example quality issues.

[83] Their role should be that of facilitator. It is very important for them to understand the business issues. Not enough information is given to them.

[84] It is very important that consultants study the organisation's objectives first, for them to be useful.

[85] "The outside consultants do not understand the meaning of the data. They incorporate their misconceptions into their designs, … the data warehouse team must then redo the work because they (the consultants) don't know anything about the business."

[86] "One can easily loose control of the situation. The consultants deliver results and leave. They do not always keep the specific business problems in mind."

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
5	Explain how you divided the project into smaller projects.	WM[87] TS[88]	SA[89] IM: "According to business processes." TS[88]		
6	How did you specify performance objectives for each of these projects?		SA: User satisfaction. IM TS		
7	How is the project financed?	SA: don't know.	IM[90] TS	WM[91]	IM[90] TS
SECTION C: Requirements definition (People responsible: SA and WM)					
1	Describe the process of requirements collection.	TS[92]	IM[93] SA[94] WM[95]		
2	Who represented which levels of the hierarchy during the requirements specifications?		IM[94] SA[94] WM[94]		

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[87]   A project is broken up according to the availability of the data in three groups; those where the data is immediately available, those where the data is difficult to obtain, and those where external data is required.

[88]   The business processes are so interrelated that it is difficult to design a data warehouse for a single business process.

[89]   Collect overall requirements before selecting one business process. Keep overall requirements in mind in the modelling phase.

[90]   One should keep track of the data warehouse time spent on all the different projects. Each business unit should share in the total cost according to the time spent on their project.

[91]   A return on investment (ROI) should be calculated, but it is difficult to determine how to do it. "The data warehouse project manager should not compute the ROI, the managers should."

[92]   TS does not know the process very well, he/she was not a part of the process. When asked whether he/she read the requirements specification, TS replied negatively.

[93]   Users need facilitation to determine their exact needs. This is done through facilitated sessions led by IM.

[94]   Facilitated sessions are held with top management followed by interviews with heads of departments. The entire data warehousing team spent time with the operational systems' data capturers in order to form a better understanding of data with regard to the operation of the organisation.

[95]   "We will do anything to understand the needs of management in terms of the availability of management information."

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
3	Do users know what they want? How do you go about assisting them?	TS[96]:"No"	SA[97] WM[98] IM	SA[99]	
4	How did you reach consensus on requirements?	IM[100]	WM[101]		
5	Does the requirements collection team know the objectives of the organisation? What is the role of organisation's objectives in the requirements collection process?		SA[99]: "Yes." IM TS: "Yes."	SA[99]	WM[102]
6	How do you keep your requirements documentation up to date?		SA: Versioning, include users. WM IM		
7	To what degree do existing systems determine the functionality of the data warehouse?	SA: To a large extent. WM[87] IM[87] TS[103]			
8	Are you satisfied with the requirements documentation?		SA[104] WM IM: It is used also to manage the user's expectations.		

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[96]   One works from sketchy requirements and after the project is completed, the users will be able to identify the shortcomings of the project.

[97]   "They know in high level abstract terms, but someone should help them to get practical requirements."

[98]   "Users are not able to articulate their needs; one should ask the right questions. … Most data warehouse consultants think that it is the user's problem to decide what they want, but this is incorrect. You need to understand the entire project before you start."

[99]   SA reported frequently on specific cost saving objective of management. SA's work is currently dominated by this objective.

[100]   Somebody on the executive committee of the business unit should make the decision; it cannot be made for them.

[101]   One needs more than one opinion; a prototype is a good idea.

[102]   The requirements collection process should yield a data warehouse that provides a better service for everybody, from patient to shareholder.

[103]   "The users want the data staging team to perform miracles and to produce something from nothing."

[104]   If more information is needed, the users are asked, which indicates an open line of communication.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
9	Are the users satisfied with the requirements documentation?		SA: "Yes." WM: "Yes." IM		
	SECTION D: Data modelling (People responsible: SA and WM)				
1	Do users form part of the modelling team?	SA[105] WM[105] IM: They don't understand the model. TS: They should definitely not.	SA[106] WM[107]	WM[107]	
2	Do you use an ERD or a star schema? Why?	WM[108] SA: Star, it is easy to understand (for the data warehousing team). IM TS		WM[107]	
3	Does the modelling team know the organisation's objectives?		IM[109] WM TS	SA[99]	SA[110]
4	Do you view business processes different from department to departments in the organisation?		SA: Some-times. WM: "Yes." IM: "Yes." TS: "Yes."		
5	How often do you change the basic design of the data warehouse?	WM: Change indicates poor requirements analysis. SA: Mainly for growth. TS			

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[105]   Users are not involved currently.

[106]   "They should be part of the team, but one should select a user who is really interested to help."

[107]   "They will be able to identify missing attributes, therefore we should include users. Users will not be able to understand ERDs, but this is not a problem, since mainly star schemas are used, which are easier to understand."

[108]   Star schemas, since it is easy to get the data out. WM thinks other methods may also work, but the star schema works best. Most systems built on ERDs are older than the introduction of dimensional modelling by Kimball in *ca*.1997.

[109]   The person responsible for requirements analysis should understand the business rules of the data warehouse environment.

[110]   SA argues that the essence of the organisation is patient care, but that keeping patient care in mind when modelling, will not change the final model.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
6	What is a model?	SA[111] TS[112]	IM		
7	How often do you talk to the users during the design process?	TS[113]	IM[114] SA[106] WM	IM[114]	IM[114]
8	Are you satisfied with the model used?		SA: "Yes." WM: "Yes." TS: "Yes."		
9	What is a data mart?	TS[115]	SA[116] WM[116] IM: It is a subsystem of a data warehouse.	SA[116] WM[116]	SA[116] WM116
10	Why do you implement data marts this way?		SA: Trained to do so. WM: It works well. IM: It is not very important how a data mart is viewed. TS: "Who knows?"		
11	What performance measures do you use?	SA[117] WM[117] IM[118]			
	SECTION E: Data staging and data quality (People responsible: TS and WM)				

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[111]   It is a representation of a business process.
[112]   A model is a logical design of something actual and physical. Most people should arrive at the same model for the same situation.
[113]   "No, it is too late to talk to users during the design phase, but who knows?"
[114]   "Very often, to clear any misunderstanding and to enhance your understanding of their business."
[115]   It is a smaller data warehouse. When asked whether people form part of a data mart TS answered negatively.
[116]   A group of fact tables with their dimensions that models a single business process.
[117]   One should be able to source requirements.
[118]   It is very difficult to determine the success of the star schema before data staging takes place.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
1	Who is responsible for data quality?	SA: Mainly source system owners. TS: Source data capturers.	IM[119] WM[120]		
2	Does the overall objective of the organisation influence the data staging?		WM: "Yes." IM[121] TS: Very important.	SA[122]	
3	How do you handle conflicting quality rules?	TS[123]	IM[124] SA WM[125]	IM[124] TS[123]	
4	How much do you know of what keep the managers awake at night?	TS: "I can guess, but it is all about money."	IM gave detail. SA WM gave detail.	SA[99]	
5	How do you measure success?		WM[126] TS	WM[126]	WM[126]
6	Do you have contact with the users?	TS[127]: Limited contact.	SA[128] WM: "Yes."	SA[128] WM: "Yes."	SA[128] WM: "Yes."
7	What is the purpose of data staging?	SA[129] TS[130]	WM: To gather data to support decisions.		

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[119] "The data warehouse team is jointly responsible for data quality. It is our job to identify quality problems in the source systems and to give feedback to the source systems to rectify problems."

[120] "It is a joint effort between source systems and data warehousing team.. but there should be a strategically managed feedback loop from us to the source systems."

[121] The people responsible for data staging should know the organisation's objective, but it is rather difficult for the technical staff to internalise these objectives.

[122] "If one is part of an organisation, all your actions are influenced by the main objective of the organisation, which in our case is to minimise expenses."

[123] Some conflicts are never resolved. (TS gave an example of such a conflict.)

[124] It is very important to understand the minor differences in the data and to be able to explain these. Consensus is important for the final decision on which data element is correct.

[125] One needs standards that everybody accepts. These standards should determine data quality. Metadata should be used to indicate ownership. One needs a holistic approach.

[126] "The data warehouse is successful when managers make better decisions."

[127] "It is difficult to say who the business users are… some of them – yes, the others- no."

[128] The staging team should have contact with end-users, but one should not overwhelm users with too many people.

[129] The aim of data staging is to extract data from the source system and to solve problems in the data.

[130] "The aim of data staging is to get everything into the data warehouse."

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
8	Are there secondary benefits to the organisation?	IM: It is also a backup copy of all the data. TS did not understand the question.	SA: "Yes, improved data quality of source systems." WM		
9	How does the data warehouse change the way people do their work?		IM SA[131] WM[132]		
1 0	Who are your customers?	IM[133] TS: "The chief information officer and the end-users."	SA[134] WM: Also the patient.	SA[134] WM: Also the patient.	SA[134] WM: Also the patient.

SECTION F: End-user applications (People responsible: IM and WM)

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
1	When did you gather requirements for the end-user applications?		WM: At the beginning of the project. TS[135]	SA[136]	
2	What role does the organisation objectives play in end-user applications?		IM: It is of major importance. SA: It is crucial for success. WM TS		
3	Do you develop end-user tools in-house?	IM: No. SA: No. TS	WM[137]	WM[137]	WM[137]
4	Are end-user applications part of the data warehouse?	IM: No, it depends on how a data warehouse is viewed.	SA: "Yes." WM: "Yes." TS: "Yes."	SA: "Yes." WM: "Yes." TS: "Yes."	SA: "Yes." WM: "Yes." TS: "Yes."

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[131] "All the managers are not always aware of what they can do with the data warehouse. A business sponsor is needed to show them the advantages of the data warehouse and exactly how to use it."

[132] "It gives them information they did not have before."

[133] The business users in the first instance, but the value chain inside the organisation is always kept in mind.

[134] SA highlighted the fact that although the organisation's customers are not their direct customers, they are beneficiaries of the data warehouse.

[135] "Some time at the beginning of the project; there is no point in delivering wrong things."

[136] It is very difficult to know exactly when to gather these requirements. The end-users do not understand the practical implications of the project at the beginning and requirements gathered later on may have serious implications on the design.

[137] You should do whatever is needed to cater for different users' requirements.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
5	Did you start with a proof of concept?	TS[138]	SA: "Yes." WM[139]: "Yes." IM: "Yes."	SA: "Yes." WM[139]: "Yes." IM: "Yes."	SA: "Yes." WM[139]: "Yes." IM: "Yes."
6	What type of training do you give users?	TS[140]	IM[141] WM[142]		
7	Do users change the way they do their daily work by using the data warehouse?		IM: "Yes." SA: "Yes." WM: "Yes." TS[143]		
8	Does everybody have access to all the information in the data warehouse?	TS: "No, it is too dangerous…It should be limited to a need to know basis only."	IM[144] WM[145]	IM[144] WM[145]	IM[144]
9	How many users do *ad hoc* queries that they design and implement themselves? Do you encourage this?	TS: "Not many."	IM: *Ad hoc* queries are very important. SA[146] WM[142]		
10	Did the usage of the data warehouse influence the career paths of certain managers?		WM IM TS: "Possibly, yes."	SA[147]	
11	Do you keep an audit trail of data warehouse usage?		IM: One should keep an audit trail to improve service. WM[148] TS	IM: One should keep an audit trail to improve service. WM[148] TS	

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[138] "A proof of concept was developed, but the users did not use it. The proof of concept helped to develop the technical skills of the data warehousing team."

[139] "It takes time to understand the business, so one can not deliver a prototype quickly."

[140] "One needs somebody with a lot of patience."

[141] It is very important to give users training to make sure they use the data warehouse.

[142] "One should start by explaining fixed reports and as user confidence grows, introduce *ad hoc* queries."

[143] "Yes, if is incorporated with a portal".

[144] Everybody should have equal access, but it does not realise in practice. It depends on the management style of the business unit. There may also be physical restrictions, for example network availability that prevents widespread access.

[145] Everybody should get the advantage of using the data warehouse.

[146] "The data warehouse can still be successful even if the users do not use *ad hoc* queries."

[147] "Yes, positive for those using the data warehouse and negative for those who don't."

[148] One should know which *ad hoc* queries to change into fixed reports to improve the service.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
1 2	How do you know when the data warehouse is successful?		IM: When it is used. SA: When it is used. WM: When management makes better decisions. TS: When the users requests additions.		
1 3	Do you see the data warehouse a control mechanism that management uses to control how decisions are made?		IM: "No." SA: "No." WM[149]	WM[149] TS: It is possible.	WM[149]
1 4	Do you know the data staging processes?		SA: Yes, all team members should. WM: "Yes." IM has technical knowledge.		

Table 5-7 Data collected during case study two

In addition to the interviews conducted, operational documentation was studied and a data warehouse project planning meeting was attended. Information gathered from these sources includes the following:

1. The chief information officer (IM) explained the role of this organisation within the chain of organisations in great detail to the researcher without being asked. Explanatory documentation was provided to "give the researcher a holistic view" of the organisation.

2. The first question on their planning documentation used in business analysis of other business units, enquires about the unit's strategic objectives.

3. The chief information officer (IM) gave background on all the projects to all the data warehouse team members during the project planning meeting attended.

In addition to the questions tabled above, questions were asked to explore the role the essence of the organisation played in the practices of the team members. IM, SA and WM gave similar answers confirming their awareness of patient care being the

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[149]   "The entire organisation, from patient to shareholder, should benefit from the data warehouse. As many people as possible should use it."

essence of their organisation, but they are of the opinion that their models and practices would not be different, even if they actively take patient care into consideration during their daily activities. TS answered that in his/her opinion, the hospitals in the mining group do not have patient care solely as highest priority, while their essence includes an economic element as well, in so far as they want the miners fit to continue with their mining activities as soon as possible. TS stated that the miners are very distant from his/her thoughts when data staging tasks are being performed. This statement indicates clearly a hard systems thinking approach.

5.4.2.3   Conclusions

The researcher was well informed by the chief information officer (IM) before the first interviews were conducted.   It is clear that this person shows respect for the objectives of the organisation while dealing with external parties.

It is interesting to note the consensus of the answers of IM, WM and SA. Some people, by nature, are more suspicious than other. It is clear that SA is more suspicious of the intentions of others than the other respondents.   When the researcher attended the project plan meeting, internal conflict among members of the data warehousing team was detected. It is interesting to note that TS reported that the data warehousing team has little internal conflict, while the others identified TS as a source of conflict.

The technical warehouse team member (TS) primarily followed a hard systems approach, as specific questions on practical detail revealed.   However, the influence of the rest of the team on TS was noticeable, since many of the more general questions were answered from a soft systems point of view.

The team members, who leaned towards soft systems thinking, did not follow a soft systems approach throughout.   Users were excluded from the data modelling process, mainly because they would not understand the models, but everyone said that star schemas are used because they are easy to understand.

Everyone interviewed had mixed feelings towards the role of outside consultants. On the one hand the consultants provided technical skills that were not present in the organisation, but on the other hand team members had to redo a large part of the work done by the consultants, because the latter did not understand the business.

It is clear that patient care, which is the essence of this chain of companies, does not play a major role in the practices of the data warehousing team. However, it is difficult to understand each person's personal attitude towards the patients, in this case the miners. IM had been a medical practitioner before and in general discussion did show compassion towards the miners, but did not refer directly to patient care when detailed questions were asked. One may finally conclude that, although the healthcare institution's essence lends itself to a disclosive systems approach, soft systems thinking was predominant, with even some evidence of a hard systems approach.

This case study proved to be extremely helpful in the development of the final framework, since it was apparent that the team members' answers to general questions differ from their answers to specific questions. Sometimes they were thinking of a data warehouse as a system, incorporating people, while at other times, it was seen as a data store. The framework should assist practitioners to extend this broader view to all data warehousing practices.

5.4.3   Case study three: A data warehouse consulting firm

The third case study was conducted at a data warehouse consulting firm, which is also the exclusive distributor in South Africa of a well-known internationally developed integrated data warehousing software package.

5.4.3.1   Background

For the past four years, the organisation has built a reputation as one of the best data warehousing consulting firms in the country. Their clients are major corporations in South Africa, ranging from financial to telecommunication institutions, most of which use the integrated data warehousing tool distributed by this organisation. They recently underwent a relaunch to separate their business activities from the specific tool they market. At present, their consultation service encompasses much more than just the technical assistance related to the usage of the software tool. The overall success of their client's data warehouse is of the utmost importance to them.

The main motivations for studying this specific organisation are the following:

1. As a consulting firm, it would be interesting to know how much of their clients' objectives they know.
2. They are able to reflect in a wider sense on practices.
3. They are able to describe what they view as best practice.
4. This case study will aid the researcher to develop guidelines for the use of external consultants for data warehousing development in organisations.

5.4.3.2   Interpreted data

Table 5.8 contains a description of the people interviewed in terms of position in the organisation, as well as experience.   Each person is allocated an identity code that is used in table 5.9 to represent that person's answer.

Respondent Code	Position in the organisation	Experience in data warehousing
MC	Manager of the organisation; also does consultation work.	6 years.
SC	Senior consultant.	7 years.
DC	Data warehouse consultant.	5 years.

Table 5-8 Respondent profile of case study three

This case study differs from the previous case studies, as it mainly reflects on ideal practices expressed by the respondents. These respondents have seen many organisations attempting data warehousing and using a wide variety of methods. They reported that, although they have witnessed many different methods of implementing each aspect of a data warehouse, they developed strong ideas of practices that would lead to successful data warehouses.

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	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
SECTION A. Data warehouse adoption					
1	What is a data warehouse?	SC[150]	DC[151] MC[152]		
2	Who decided the organisation needed a data warehouse?		DC[153] SC MC		
3	What is the root problem to be solved by the data warehouse?	DC: Integration problems.	DC: Business information. MC: Difficult to generalise.	SC[154]	
4	If any, what other solutions to the problem were considered?	DC: Don't know.	SC[155] MC		
5	Who owns the data warehouse?		SC[156] MC	DC: Business, not IT.	
6	What is the impact of the data warehouse on other systems/ business?		DC[157] MC[158]	SC[159]	

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[150]   A data warehouse is a special kind of data store, and data warehousing is everything required to create a data warehouse.

[151]   "A data warehouse is a collection of the most important information in an organisation modelled around key performance areas - to be used in decision making."

[152]   A data warehouse is a system (of which people form a part) and data warehousing is the process of creating a data warehouse.

[153]   The project should be driven from the highest level of the organisation, ideally the CEO.

[154]   "You cannot start a data warehouse project hoping that the business managers will utilise the data warehouse. The organisation must have a specific problem they need to fix with the data warehouse."

[155]   Management identified a problem to be solved. IT should come up with the technical solution to management's problem in the form of a data warehouse.

[156]   "Management owns the business data in the data warehouse and the IT department owns the architecture and the access tools."

[157]   "Management can see information of different aspects of the business. It is all put together in a meaningful way."

[158]   "The data warehouse has a large impact on decision making systems."

[159]   Some people who become power users, take the opportunity to learn as much of the business as possible. "A generation of people emerges that really understands business, and who has the technical skills to use the data optimally. They are tasked to provide information to the rest of the organisation. The rest of the people will become dependent on them, they will be the most powerful people in the organisation."

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
7	Is everything the data warehouse influences part of how you view the data warehouse?		DC: "Yes." SC[160] MC	SC[160]	DC: "Yes." MC
8	Do people form part of the data warehouse?	SC[161]	DC: "Yes." MC: "Yes."		
9	How do you determine whether the data warehouse is successful?		DC[162] MC[163]	SC[164]	
10	What are the main advantages of the data warehouse?		DC[165] SC	MC[166]	
11	Which department is responsible for the development of the data warehouse?	DC[167]	MC[168] SC[169]		
	SECTION B: Data warehouse development methods				
1	Describe the lifecycle of the development of the data warehouse.		DC: Iterative process using SDLC. SC MC		

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[160] No, the data warehouse influences the marketing strategy of the organisation, and marketing is not part of the data warehouse. The source systems are however part of the data warehousing project.

[161] People form part of data warehousing (everything that's needed to built a data warehouse), but people are not part of a data warehouse.

[162] "If all the reports in the organisation come from the data warehouse and all the users are satisfied with the reports and the quality of the data."

[163] "Switch it off and see how many people are dissatisfied. It is difficult to determine the value of the data warehouse before it has been implemented."

[164] "The data warehouse is successful when the key business question is answered."

[165] "It provides quick and easy access to the data by business users."

[166] "The main advantage is to empower business users with quick reliable information."

[167] "Mostly the IT department, but they need input from the business users."

[168] "IT and business should work together, but unfortunately, many times mostly the IT department."

[169] Although IT teams are used to build data warehouses, it should be dedicated teams only working on the data warehouse, but there should be business users that are actively involved.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
2	Describe the relationships between people in the data warehousing team.		MC: Use consensus to solve conflict.	DC[170] SC[171]	SC[171]
3	What is the role of end-users in the development lifecycle of a data warehouse?		DC[172] SC[173] MC gave a description of the role of the user in every phase.		
4	What is the role of outside consultants?		DC[174] MC[175]	SC[176] MC[177]	
5	Explain how you divided the project into smaller projects.	DC[178] SC gave technical answer.	MC: Study whole organisation and then prioritise.		
6	How did you specify performance objectives for each of these projects?		DC: User Satisfaction. MC[179]		SC[180]

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[170]   "There are conflicts present, mostly between technical and business users. Some of these result from differences in personalities. Many conflicts are a result of clashes between Inmon's and Kimball's approaches."

[171]   "Most conflict on a data warehousing team results from the project leader not identifying clear roles and responsibilities."

[172]   "It should be interactive, but it helps if there is a business user (somebody that is technical but understands the business) on the data warehousing team."

[173]   One needs a business user on the team to aid in prototyping.

[174]   The consultants cannot work alone on the project; they need a strong business driver. The aim of the consultants should be to transfer knowledge to the organisation.

[175]   "Consultants who do not know the business objectives are not able to contribute to the organisation. As consultants, we want to help the organisation to help themselves."

[176]   "The first thing a consultant does, is to understand the business problem that the data warehouse aims to solve. …It is not a case of "Here is a warehouse we developed for you", but rather: "Here is the warehouse we developed together." There is a joint ownership of the project between the consultant and the organisation."

[177]   "We want to know who are involved and from where the data warehouse is driven. Only after we are sure that we understand how the data warehouse supports their objectives, can we help them with prioritisation."

[178]   Start with one key performance indicator. DC did not state the fact that the whole organisation's requirements should be gathered first. When asked if the organisation's overall objectives are important to start off with, he/she answered that it might help to read the pamphlets that are handed out.

[179]   "Yes, … one can subdivide the performance measures of the total data warehouse into performance measures of separate data marts." (This answer was provided in response to a follow-up question.)

[180]   It is difficult to specify performance objectives for different phases of the project, because of the nature of the project. It works best if one has a relative small data warehousing team that shares the responsibilities in the different phases. They need to have an overall view of the project.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
7	How is the project financed?	DC: Don't know.	SC: Initially organisation-wide and later on per project. MC: Jointly.		SC: Initially organisation-wide and later on per project. MC: Jointly.
SECTION C: Requirements definition					
1	Describe the process of requirements collection.		DC: Iterative. SC[181] MC	SC[181]	
2	Who represented which levels of the hierarchy during the requirements specifications?		DC[182] SC MC[183]		
3	Do users know what they want? How do you go about assisting them?		DC[184] MC[185]	SC[186]	
4	How did you reach consensus on requirements?		SC[187] DC[188] MC		
5	Does the requirements collection team know the objectives of the organisation? What is the role of organisation's objectives in the requirements collection process?		DC: Yes, very important. MC	SC: "They should understand the business problem."	

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[181] "You need to ask the correct questions to understand the key business problem."

[182] One needs to talk to the clerks who produced the reports manually, as well as their superiors. One should talk to people on all management levels, always keeping business objectives in mind.

[183] Need a chief information officer from business to serve as interface between business and data warehousing team.

[184] They have a broad view, but they need some guidance. Prototypes help to show them what is possible.

[185] The users don't know, but one should ask the right questions.

[186] "They know what their biggest business problem is. They need help to identify how a data warehouse can help them."

[187] Consensus is very important. There are simple techniques to reach consensus on a rational way by using measures. There is always a lot of politics in an organisation regarding the data warehouse, but it is overcome by using different methods aimed at reaching consensus.

[188] "One needs to set priorities to the requirements. These priorities should be similar to business priorities."

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
6	How do you keep your requirements documentation up to date?		DC[189] SC MC[190]		
7	To what degree do existing systems determine the functionality of the data warehouse?	DC[191]	MC[192]	DC[191] SC[193]	
8	Are you satisfied with the requirements documentation?		DC[189] SC	MC[194]: No.	
9	Are the users satisfied with the requirements documentation?		DC[189] SC	MC[194]: No.	
	SECTION D: Data modelling				
1	Do users form part of the modelling team?		DC: One needs a business analyst. SC MC		
2	Do you use an ERD or a star schema? Why?		DC: Star, easy to understand. SC: User understand-ability. MC: Easy to change.		
3	Does the modelling team know the organisation's objectives?		DC: It helps if they know it. SC: They should. MC: Yes.		

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[189] "It is an iterative process…. The users have access to the requirements, but they don't look at it often, they rather ask the development team when they want information."

[190] "It is very important that everybody has access to the specification documentation. It should always be up to date."

[191] To a very large extent, if the quality of the source systems is poor, you need to fix those problems first.

[192] It is important to listen to the requirements without knowing the limitations of the source system. After gathering the requirements, the source systems are studied and a report is given to the organisation on the limits the source data imposes. This is used as part of the prioritisation process.

[193] "One needs to do a gap analysis between the aim of the data warehouse and the available source system data. This analysis will give an indication of what must be changed to solve the business problem addressed by the data warehouse."

[194] "The processes of keeping the requirements up to date do not function well enough and the users do not look at the requirements often enough."

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
4	Do you view business processes different from department to department in the organisation?		DC: Sometimes. SC: Yes definitely. MC: Yes.		
5	How often do you change the basic design of the data warehouse?		DC[195] SC[196]		
6	What is a model?		SC[197] MC[198]		
7	How often do you talk to the users during the design process?		DC: Very often. SC[199]	SC[199]	
8	Are you satisfied with the model used?		DC: "Yes." SC: "Yes."		
9	What is a data mart?	DC[200]	DC[200] SC: Represents a business process.	DC[200] SC: Represents a business process.	DC[200] SC: Represents a business process.
10	Why do you implement data marts this way?		SC: One needs a holistic approach. MC		
11	What performance measures do you use?	DC[201]	SC MC		
	SECTION E: Data staging and data quality				

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[195] "The design changes as the organisation changes."

[196] After the initial model has been finalised, the data warehouse is on an anatomic level and the specification investigation was done well, all the changes will focus on growth. The initial modelling is however an iterative process where the model changes often.

[197] "It is a visual representation when you aim to do something. It also shows how a business user views the business."

[198] "A model is a representation of how something is supposed to be. It is a perception of a certain individual, … more perceptions enrich the model."

[199] "There should be a business user on the data warehousing team."

[200] Part of the data warehouse that can be linked to a specific department's questions. Not a copy of the data. (This is a mixture between a Kimball and an Inmon approach)

[201] One should check whether the business requirements are represented in the model.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
1	Who is responsible for data quality?	DC: Source system data capturers.	DC[202] SC[203] MC[204]		
2	Does the overall objective of the organisation influence data staging?	DC: "It is not crucial, as long as the documentation is up to date."	MC: Will be able to do a better job.	SC[205]	
3	How do you handle conflicting quality rules?		DC[202] SC: By consensus. MC[204]	MC[206]	
4	How much do you know of what keep the managers awake at night?	DC: Not much.	MC[207]: Not enough.	SC: Very much.	MC[207]
5	How do you measure success?	DC gave a technical answer. SC[208]			
6	Do you have contact with the users?	DC: Limited contact.	MC and SC: It helps to have a small team doing all the phases.	MC and SC: It helps to have a small team doing all the phases.	MC and SC: It helps to have a small team doing all the phases.
7	What is the purpose of data staging?	DC gave a technical answer. SC MC			
8	Are there secondary benefits to the organisation?	DC	SC: Solves quality issues. MC		

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[202] "One needs a person on the team that is full-time occupied with reconciliation of data warehouse data quality with source system data quality."

[203] "The business users need to identify data quality issues, but the IT department should implement them."

[204] Data quality should not be such a big problem, because all the information systems in the organisations should aid the overall objectives.

[205] It would help a lot if everybody knew the key business problem. Everyone should buy into the solution of that problem.

[206] "Language creates barriers; different people do not mean the same thing when using the same words."

[207] "The client organisations do not always trust consultants with their detailed problems. This prevents the consultant from understanding their business in full, which has a negative effect on the consultant's success rate. I could add more value of I knew more of their business."

[208] The data staging programmer can do very good work, but if the design is poor the data warehouse objectives will not be satisfied.

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
9	How does the data warehouse change the way people do their work?	DC: Don't know.	SC MC		
10	Who are your customers?	DC: Business users only. SC: Business Sponsor.	MC[209]		
	SECTION F: End-user applications				
1	When did you gather requirements for the end-user applications?		DC: At the beginning of the project. SC MC		
2	What role does the organisation objectives play in end-user applications?		DC: Very important role. SC MC	SC[210]	
3	Do you develop end-user tools in-house?	DC: No. SC: No.	MC[211]	DC[212]	
4	Are end-user applications part of the data warehouse?		DC: "Yes." SC: "Yes." MC: "Yes."	DC: "Yes." SC: "Yes." MC: "Yes."	DC: "Yes." SC: "Yes." MC: "Yes."
5	Did you start with a proof of concept?		SC: "Yes." MC: "Yes."	DC[212]	
6	What type of training do you give users?			DC[213] SC MC[214]	

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[209] There are two types of customers: the business users and the customers of the client organisation.

[210] "The end-user applications need to be designed in such a way that will enable the users to solve the critical business problem."

[211] The tools are not preventing the users from doing *ad hoc* queries. A tool can be used well or poorly.

[212] DC reminded the researcher that these consultants also do marketing for their own product. They show the users how their product can solve their problems.

[213] "We give users training on sample data at a neutral site. If we use their own data, their attention is taken up by their own business problems and we do not succeed in providing them with proper training."

[214] "Ideally one should first train the users on sample data to use the tool and then train them on their own data. It is very expensive for us to do that, because we have to set up individualised training for each organisation."

	Question to data warehousing team member	Hard systems thinking	Soft systems thinking	Critical systems thinking	Disclosive systems thinking
7	Do users change the way they do their daily work by using the data warehouse?	DC: It frees up some of their time.	SC[215] MC: More effective.		
8	Does everybody have access to all the information in the data warehouse?		MC: "Every body should have the same level of access, but it doesn't work like that in practice."	MC: "Every body should have the same level of access, but it doesn't work like that in practice."	
9	How many users do *ad hoc* queries that they design and implement themselves? Do you encourage this?	SC: Very few.	DC[216] MC[217]		
10	Did the usage of the data warehouse influence the career paths of certain managers?	DC: Don't know.		SC[159] MC[218]	
11	Do you keep an audit trail of data warehouse usage?		SA: To improve service. MC		
12	How do you know when the data warehouse is successful?		DC: When it is used. SC: When it is used to make decisions. MC		
13	Do you see the data warehouse a control mechanism that management uses to control how decisions are made?		DC: "No." SC: "No." MC: "No."	SC: Might be a good idea.	
14	Do you know the data staging processes?		DC: "Yes." SC: "Yes." MC: "Yes."		

Table 5-9 Data collected during case study three

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[215] "The data warehouse is a supporting tool for users. They don't change their job. They have a tool to support their managerial functions. They do their daily work better."

[216] People start mainly with fixed reports, but as their knowledge of the data warehouse grows, they start doing more *ad hoc* queries.

[217] Ideally 50% of all usage should be managers doing their own *ad hoc* queries, but we are not there yet.

[218] "If a specific manager chooses a part of the work in the organisation which is in line with the business objectives it could fast-track his career."

5.4.3.3   Conclusions

The interview with DC was conducted first during this case study. Half way through the interview, DC was asked whether the answers given are a true reflection of reality, or whether DC was providing the correct textbook answers. DC answered that the answers are how it should work ideally. This proved to be central to most of the answers provided by all three respondents. As consultants, they see different organisations dealing with problems in different ways, and they developed fixed ideas on how they would want organisations to handle specific situations.

It is clear that MC has a broader approach to a data warehouse. MC views a data warehouse as a system. SC however, refers to data warehousing as the broader approach to developing a data warehouse and views the data warehouse as a data store organised in a specific manner.

SC stated that a data warehouse aimed to be a general tool for managers of an organisation, will not be utilised. SC argued that a data warehouse should address a well-defined need in the organisation. There should be a specific problem of major importance, for which information on a different level than that available in the source systems, is required. This shared problem should motivate everybody involved in the project to perform to the best of his/her ability. Such a view has a very strong critical systems characteristic. SC also expressed empowerment of business users as an effect of the data warehousing project, but not as the overriding aim of the data warehouse. The researcher interprets the answers given by SC as more towards critical systems thinking than the other respondent, but not overwhelmingly critical.

Although MC stated that the consultants discuss data warehouse aspects frequently from a client's objectives viewpoint, DC has a typical hard systems approach to data staging.

The overall importance of the client's objectives was central to most answers given by the more senior consultants interviewed. They agreed that data warehouse consultants who do not understand their client's organisation's objectives, cannot be successful.

The respondents of this case study provided more critical systems thinking answers than any of the other respondents. Although very few hard systems answers were given, most of them were given by the junior consultant with the least experience.

5.4.4   Research difficulties

Since the research methods used in this study are untested it is necessary to highlight the difficulties posed by the selected method. The quotes provided in this section to highlight problems are direct translations from Afrikaans. Many respondents spoke in incomplete sentences and no attempt was made to rectify this during translation.

One of the first problems encountered was to choose between full quotations and summaries in the footnotes of the data representation tables. Although one does not want to lose any information by summarizing the data, some of the answers are too long to quote and the key aspect is spread out in the answer. The answer of respondent IM of case study 1 given for question F9 can be used as an example of this problem:

Question: "How many users do ad hoc queries that they design and implement themselves? Do you encourage this?"

IM's response: "At this stage they have one guy who is really clued-up and our agreement with them is that if we say to the users: "Right, you have to give us one or two power users, then those guys must do proper courses at Oracle since they are the guys that are going to do your *ad hocs*," and if they want to come, if they want to do certain *ad hocs* and they can see for example they don't have enough data, we will add the data for them, but we will no longer be responsible for creating reports for them. We will create initial reports for them and thereafter these guys should do it. If they encounter problems we will help them."

The researcher summarized this answer as:

"Only a few, after extensive training and support is given."

Respondents did not always understand the question and asked whether the researcher could give them examples. It is very difficult to formulate examples without leading the respondent. In most cases the researcher repeated the question using an alternative formulation. If the respondent still did not understand the question, the conversation was gently moved forward to the next question.

One of the biggest problems was the hermeneutic interaction between a specific answer of a person and his/her other answers. Sometimes a person for example gives a typical soft systems answer to a question which appears to be contradictory to other hard systems thinking answers given by that person. The dilemma then arises whether to take the answer on face value or to ask clarification questions. It is very difficult not to categorise given answers intuitively while you listen to them. It is as if one starts to use the answers to support a specific systems thinking methodology[1&2] one associates with a person. When a conflicting answer is given one is tempted to reason that the person did not formulate his/her thoughts correctly. If a clarification question is asked it is very difficult not to influence the respondent. From a data analysis point of view these follow-up questions also creates difficulties. One might speculate whether follow-up questions should have been asked for every question, and if it had been done whether it would have influenced the outcomes of the analysis.

Quite often respondents only answered "yes" or "no". Although the questions were formulated to avoid these simple answers some respondents manage to avoid longer answers. It did not even helped to ask them about their motivation in a simple "why do you say that?" type of question. The researcher used such short answers as being meaningful themselves by concentrating on what was not answered. For example if the qualifying norm of patient care was guiding the actions of the data stager in case study two, he/she might in stead of just answering "No" have said "No, it is not good for the patient."

Such an example also highlights the problem of similarity of answers between different methodologies[1&2]. Different ontological viewpoints do not always lead to different practices in data warehousing. As an example one might consider end-user involvement during the more technical phases of the development lifecycle. A hard systems thinking approach limits end-user involvement to the first and last stages. The other three systems thinking methodologies[1&2] encourage end-user involvement in all the phases of the development lifecycle of the data warehouse. The motivation

for this differs however.   It was extremely difficult to understand the specific motivations of different respondents without asking leading questions or giving alternatives.   The problem with giving alternatives is that the respondent might choose the "most impressive" option.   It was therefore concluded that if the respondent had a strong critical or disclosive motivation they would have mentioned it spontaneously as indicated in the previous paragraph.   It might be interesting to train a group of data warehouse practitioners in systems thinking methodologies$_{1\&2}$ before asking them about the applicability of these methodologies$_{1\&2}$ in data warehousing.   The framework developed in chapter 6 can serve as a tool in such a research project.

Another difficulty is the fact that answers differed substantially from the template answers given in table 5.1.   The literature review according to the philosophy, methodology and practice structure helped in the allocation of these answers.   It is easier to allocate such answers to a specific methodology$_{1\&2}$ when one understands the philosophical underpinning of a methodology$_{1\&2}$.   It did however result in changes to table 5.1 to include these alternative answers.

Such changes to table 5.1 create new difficulties in the analysis of the interview data. The researcher decided that any changes to table 5.1 have a serious impact and required all the analysis to be redone.   It was therefore important to first complete one iteration for all the case studies in order to evaluate all the answers before finalizing the template table.

In hindsight some of these problems would have be avoided if a pilot case study was done before the actual three case studies. It would have highlighted problematic questions before the actual interviews and follow-up questions could have been formulated prior to the research activity for such questions.   It is important when doing such a pilot study that the researcher completes the process of analysis on the pilot data before embarking on the actual case studies.   The difficulty with following this approach of a pilot study is finding a willing respondent for the study.   It was already difficult to find three organisations that were willing to participate in the research.

5.5   Research conclusions

The aim of the case studies reported in this chapter was to understand data warehousing practices from a systems thinking methodology$_{1\&2}$ perspective. Since this part of the research had a strong interpretive nature, the intended outcome was to understand motivations rather than to determine clear answers to questions. One cannot for instance count the number of hard systems or critical systems answers to compute statistical measures in order to formulate research findings.

Although specific conclusions were drawn after each case study analysis table, more general conclusions can be derived when considering the combined results of the three case studies.

When the report tables of the case studies are viewed in terms of completed columns, one can easily see the most influential systems thinking methodology$_{1\&2}$. The completed tables indicated that soft systems methodologies$_{1\&2}$ are most often used in data warehousing practices. One should however be careful not to lose sight of the fact that many critical and disclosive answers have a similarity to the soft systems answers. The critical and disclosive answers in table 5.1 include a specific motivation for the answer which was not stressed in the soft systems approach. If the specific motivation was not given, the given answer was only allocated to the soft systems approach.

Although some actions (especially in case study one) reflected hard systems thinking, the problems with such an approach in data warehousing also came to the fore. When a predominantly hard systems approach is used, the boundaries of the data warehouse narrow to such an extent that the data warehousing team creates an artefact rather than a solution to a problem. The data warehousing team focuses on specification rather than on problem solving. All the respondents in managerial positions reflected on the disadvantages of such an approach to data warehousing.

Case studies two and three also reflected some critical systems thinking actions. No negative consequences of these critical actions were observed as in the case of hard systems thinking. The impression was created that if more direct questions were asked such as: "Which of the following two options would you prefer…" followed by the soft and the critical answers, more critical answers would have been selected than revealed by the open ended approach followed. The aim, however, was to

obtain the spontaneous reaction of the team members, which were better achieved by the open question approach. Considering the objective of the study namely to understand current data warehousing practices, it would have been counterproductive to ask multiple choice questions. Respondents would have chosen the ideal answer which would not necessarily have reflected their current practices. The respondents would have been confronted with options they have never considered themselves.

The reader is reminded that the respondents are not knowledgeable on system thinking methodologies[1&2].   This fact should also be taken into account when considering the worth of critical and disclosive systems thinking in data warehousing. It is the position of the researcher that critical and disclosive systems thinking can not simply be disregarded since the respondents answers did not reflect these methodologies[1&2].

A similar argument may be used for disclosive systems. The fact that very few disclosive systems answers were formulated does not indicate that disclosive systems thinking cannot enhance data warehousing quality. It may indicate that people are more motivated by monetary objectives than by furthering the intrinsic normativity of the organisation. One can only speculate whether a strong awareness of the normativity of the organisation would have yielded better results in terms of data warehousing quality.

On a more technical note, it is interesting to note that everybody interviewed in case studies two and three gave similar answers to question B1 on the phases of the life cycle of a data warehouse. This indicates the movement towards the methods described in Kimball *et al*. (1998). This monograph is becoming an industry standard in South Africa. The methods used in case study 1 reflect ideas from Inmon (1996). The reason for this might be that their data warehouse is older. Some of the respondents commented on a possible shift towards the methods described in Kimball *et al*. (1998). This motivated the researcher to use the life cycle presented by Kimball *et al*. (1998) as basis for the framework presented in chapter 6.

5.6   Chapter summary

The aim of this chapter is to map data warehousing practices to systems thinking methodologies$_{1\&2}$. In order to do such a mapping, one should work in both directions; from systems thinking to data warehousing practices and then from data warehousing practices to systems thinking. Table 5.1 represents the first of these directions.   Data warehousing practices were identified from a systems thinking methodology$_{1\&2}$ point of view, thus providing a mapping from systems thinking methodology$_{1\&2}$ to data warehousing practices.

In the second part of the chapter, table 5.1 was used to evaluate the data warehousing practices in terms of the different systems thinking methodologies$_{1\&2}$. This was done by starting at the practices reported by the respondents. The tables representing the respondents' answers represent the mapping backwards from data warehousing practices to systems thinking methodologies$_{1\&2}$.

When studying the tables compiled from the case study data, it is clear that different organisations follow different systems thinking methodologies$_{1\&2}$.   The first organisation follows a typical hard systems approach, the second and third more of a soft systems approach. The third organisation, although following mainly a soft systems approach, did show some critical systems thinking characteristics. It is clear that none of the organisations' practices could be mapped exclusively to a specific systems thinking methodology$_{1\&2}$. When investigating the use of disclosive systems thinking in data warehousing practices, it became clear that data warehousing teams are mainly motivated by the financial aspects of an organisation, and that the intrinsic normative principles, such as patient care, do not have a formative influence on data warehousing practices.

Case studies two and three afforded the researcher the opportunity of gaining insight into the use of external consultants in data warehouse development projects. It was evident that the success of consultants is dependent on their ability to share in the ownership of the organisation's objectives.   Therefore, any framework on data warehousing practices in South Africa should provide specific guidelines as to the role of external consultants.

The researcher used the results of these case studies to develop a framework for the explicit use of systems thinking methodologies$_{1\&2}$ in data warehousing practices.

This framework is presented in the next chapter, and represents the reconstruction part of the critical social research methodology for this study. The presentation of the framework includes specific references to answers given by the case study respondents.