

# A Critical Systems Thinking Perspective on Data Warehouse Stakeholders

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## ABSTRACT

Strategic decision makers require good quality data integrated from different data sources to aid their decisions. Data warehouses are used to integrate data from different sources and to ensure accurate, timeous data for use by business users. Many different parties are involved in this process. Critical systems thinkers focus on the boundary of a problem situation; they consider whether the interests of all the affected parties are represented in the decision making process in organizations. The aim of this paper is to investigate the traditional role-players in a data warehouse project from a critical system perspective. It investigates the question on who should at least be represented if not involved in data warehouse development and it provides conflicting views on the role of a data warehouse in the organisation.

**Keywords:** Data warehousing, critical systems thinking, boundary judgment and critical social heuristics.

## 1. INTRODUCTION

Data warehouses are information systems used to integrate data from different sources to provide managers of organizations with good quality holistic data to support strategic business decisions. Figure 1 indicates how data is collected from different sources, integrated into a centralized area called the presentation server, and used by end-users in making strategic business decisions. Many people are involved in this process to

ensure that good quality data enters the data warehouse and that the analysis done has integrity.

Critical systems thinking is a development in the systems thinking movement. Systems thinkers have a more holistic view of problem situation than traditional management scientists. Systems thinking developed from what is called “hard” systems thinking to soft systems thinkers which focus on the idea that different people has different perspectives on a problem situation, which must be taken into account. Critical systems thinkers extend this idea into a focus on the political powers in a situation. They argue that there are parties affected by decisions who are not represented in the decision making process.

The aim of this paper is to investigate the people that are involved in the data warehouse process from a critical systems thinking perspective. Werner Ulrich [1] provides guidelines for identifying boundaries of a system in terms of the involved and affected.

The paper starts with a description on data warehousing, focusing on the involved parties in the data warehouse development process in section 2. Section 3 provides a brief overview of systems thinking, hard and soft systems thinking and the critical turn in systems thinking. The main contribution of the paper is the application of Critical Social Heuristics (CSH) developed by Ulrich [1] in the development of data warehouses reported in section 4. Section 5 provides concluding remarks on who should be involved in data warehouse planning and development.

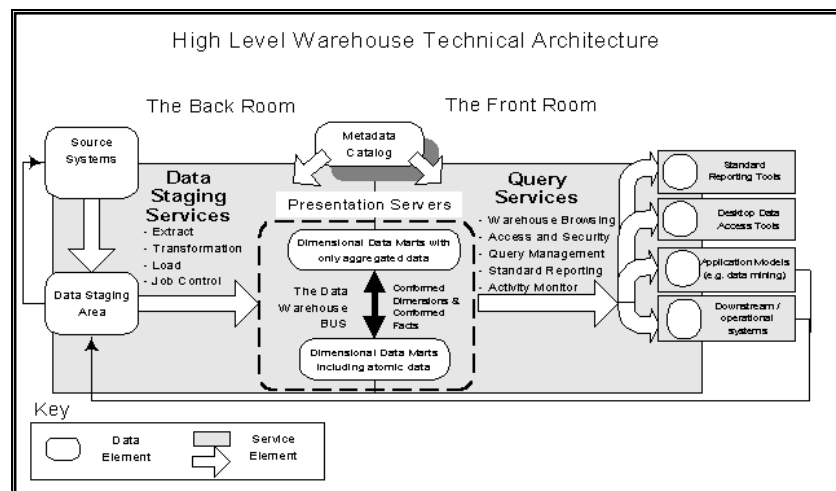


Figure 1 Data warehouse development in terms of back room and front room activities [3]

## 2. ROLE-PLAYERS IN DATA WAREHOUSE DEVELOPMENT

Inmon, generally accepted as the “father” of data warehousing, describes a data warehouse “as a subject oriented integrated, non-volatile, and time variant collection of data in support of management decisions.” [2]. It takes a while for trained information technology (IT) developers to grasp the ideas central to data warehouse development, since a data warehouse has a different role in the organization than an everyday online transactional processing (OLTP) system. OLTP systems are used to capture data representing everyday activity in an organisation. They are often used at the point of sale (POS) to capture transactions. Other OLTP systems are used to keep track of resources in an organisation; these are called Enterprise Resource Planning (ERP) systems. All these OLTP systems are aimed at recording the day to day activities in an organization. They are designed to optimize data capturing and data storing. The use of barcodes illustrates how these systems have evolved from the days of writing product names on invoice slips. These information systems are central in the way business is conducted.

A data warehouse differs from every day information systems in various ways. First, its primary goal is to supply data (information) rather than capturing it. It contains data from different OLTP sources, providing the user to search for trends in the data. Although the data warehouse data is loaded from the OLTP systems periodically, they do not influence the operation of the OLTP systems. It is the task of the data warehouse team to integrate data from different sources and to solve standardization problems. Some authors [2] argue that the process should not be requirements driven. The data integration should be done first and the requirements should follow later. Other authors [3] argue that there should be a compelling business motivation to develop a data warehouse.

Kimball, representative of the requirements-first school, depicts the lifecycle of a data warehouse project in terms of three main streams of development as indicated on Figure 2. Kimball proposes that the readiness of the organization to start a data warehousing project must be investigated. Two key features are investigated in this regard. Firstly there must be a compelling business motivation for the data warehouse [3]. In other words, there should be a business problem to provide information for. Secondly there must be a business sponsor from the management team of the organisation. Data warehouses that

are initiated and motivated from the IT department are seldom successful [3].

From Figure 2 indicating the three tracks in the development of a DW, it is possible to identify role-players in the data warehousing project. There is a need for a business sponsor or driver as identified in the previous paragraph, then there is a DW program manager responsible for overall direction and leadership. Larger projects require a separate project manager to manage the daily activities of the DW team. Requirements definition requires business analysts who form the interface between business needs and the technical specification.

The technical track comprises of the planning and selection of architecture and infrastructure for the technical operation of the data warehouse. This is technical IT work done by technical architects and support specialists.

The middle track involves the modeling of the data warehouse from user requirements done by data modelers. The physical design requires technical database administrator and data security experts. Data staging from source systems requires interaction with source system owners and technical programmers.

The bottom track representing end-user application development is not that different from general application development and requires application developers. Data mining experts are used to guide the development of analytical applications of the data warehouse.

Meta data managers keep track of all the project and descriptive data that are not part of the primary data in the warehouse. Kimball promotes the inclusion of an educator to guide the users [3].

Kimball [3] refers to free agents (consultants) to be included in the team to provide ad hoc solutions. Care should be taken to allow key roles to be filled by these consultants [3]. Kimball promotes communication with the following not involved but “interested parties:” general executive management, IT staff not involved in DW, and the business community at large. The latter could involve a newsletter on a webpage conveying a “consistent message across the organisation rather than letting the corporate rumor mill serve as the primary source of information” [3].

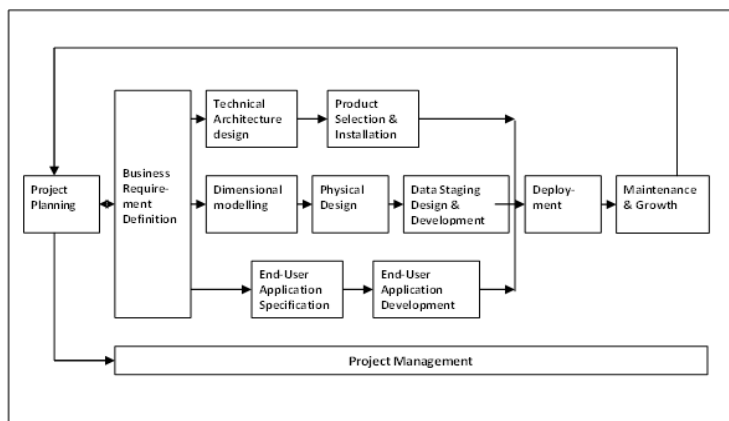


Figure 2 Kimball's business lifecycle of a data warehouse [3]

### 3. CRITICAL SYSTEMS THINKING AND CRITICAL SOCIAL HEURISTICS

A systems thinker views the world in terms of larger wholes or systems that have objectives and where the parts function together to achieve the overall objective of the system. Systems

thinking developed over the years from hard systems thinking to soft systems thinking and later also critical systems thinking. Peter Checkland, one of the key authors in soft systems thinking, provides a diagram to describe the difference between hard and soft systems thinking, shown here as figure 3.

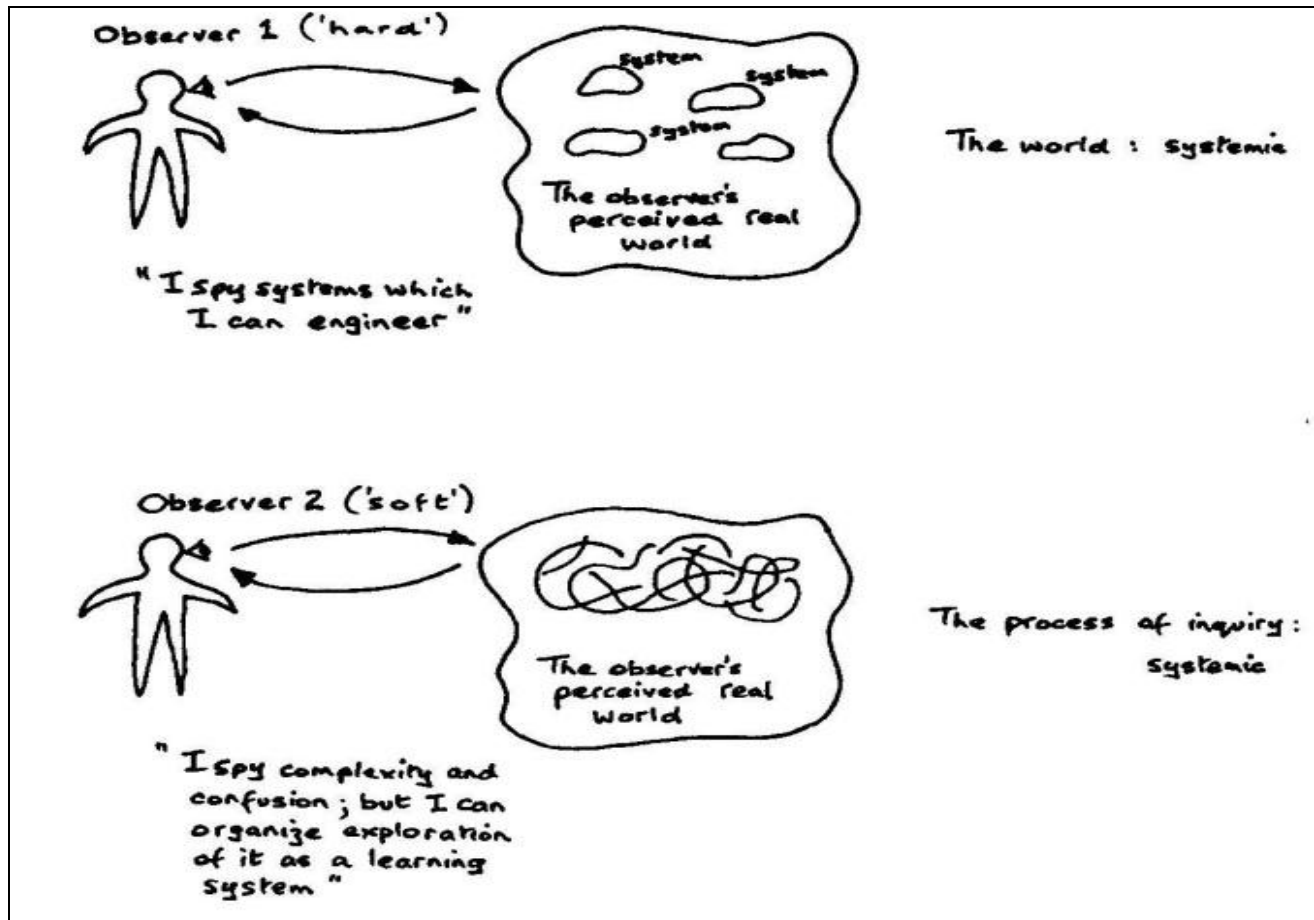


Figure 3. Hard versus Soft systems thinking [4]

Checkland argues that a hard systems thinker sees systems in the real world while the soft systems thinker uses systems to make sense of a complex reality [4]. Critical systems thinking is systems shares this view of soft systems thinking. The critical turn in systems thinking means that one must add critical reflection (analysis) to your thinking when thinking about the world in terms of systems.

Critical systems thinkers aim to highlight real objectives of the involved in the situation and to provide a solution sensitive to all the role-players' benefit. Care is taken not to provide an outsider's solution to the problem, but rather to focus on the context of the problem and try to understand as much of the problem as possible.

When confronted with a problem situation one must reflect on your own claims about that problem situation: claims such as

what you perceive the real problem to be, claims on how to address the problem, and claims of the results of an intervention. One should reflect on these claims in terms of: are they comprehensible to others, truthful, right and the truth? Critical systems thinking is an extension of soft systems thinking – that means that one should facilitate a process where others are to formulate their understanding of the claims of the situation – without expecting high level analytical thought from them. One should not reject the claims of others only because they are not well articulated

Boundaries judgment is key to critical systems thinking [1]. In understanding the context of the problem one should obtain a larger picture to understand. To understand the larger picture one again needs a larger picture – this leads to an unending enlargement of the problem boundary. Part of the problem is when to stop adding new empirical information. Empirical work

is not the only source of information – one can reflect from different worldviews on a situation. The answer seems to be to focus on quality in-depth understanding. The role of the critical systems thinker is to analyze the merit of claims of worldviews in terms of the criteria of comprehensibility, truthfulness, rightness, and truth.

Ulrich argues that there is always the promise of improvement in a problem situation [1]. From a critical perspective it is required to first understand the current situation in terms of claims and assumptions but also in terms of history. Then there is an ideal state – the ideal state is to be described after various perceptions were analyzed. This ideal state might be identified by some role-players, it does not however implies that the others are wrong [1].

Jackson [5] discusses the five major commitments of critical systems thinking:

1. Critical systems thinking seeks to demonstrate critical awareness. This critical awareness means that the assumptions and values of current and future designs should be critically examined. The strengths and weaknesses of the theoretical underpinnings of available systems methods, techniques, and methodologies need to be examined.
2. Critical systems thinking shows social awareness. This social awareness means that the organizational and societal pressures that lead to certain system theories and intervention methods used at particular times should be recognized. System practitioners should also study the possible consequences of their actions more carefully than before.
3. Critical systems thinking is dedicated to human emancipation. It seeks to achieve for all individuals the maximum development of their potential. This is accomplished by raising the quality of work and life in organizations and societies in which they operate (Jackson, 1991:186). Methodologies aim to improve the technical, practical, and emancipatory interest in organizations and society.
4. Critical systems thinking is committed to the complementary and informed development of all the different schools of systems thinking at the theoretical level. This means that different points of view of systems must be respected.
5. Critical systems thinking is committed to the complementary and informed use of systems methodologies in practice. A methodology that respects the other four features of critical systems thinking is required.

In order to facilitate boundary judgment from the perspective of various role-players Ulrich developed twelve boundary questions as part of Critical Social Heuristics (CSH). The questions are all stated in 2 forms: “is” and “ought to”. Users of the questions are urged to answer each question in terms of the current reality and in terms his/her own preferred reality.

The twelve questions are reproduced in the first column of Table 1. The questions can be divided into four groups of three questions each enquiring the sources of motivation, control, expertise, and legitimation respectively. The environment of a system the constraints in which the system has to operate and over which it has no control.

Contrasting “is” and “ought to” boundary judgments provides a systematic way to evaluate the normative content of planning as well as identifying the normative basis of the evaluation itself

[1]. Since experts and affected parties in a system have to justify their boundary judgments, the power of the expert is reduced. The affected party can argue on the same level as the expert on the consequences of specific boundary judgments.

#### 4. USING CRITICAL SOCIAL HEURISTICS IN DATA WAREHOUSING

When answering the boundary questions of CSH, one is forced to examine your own perspective or worldview regarding the role of the data warehouse in the organisation. Each group in the organisation can complete these questions to more clearly communicate their world view. The researcher asked a number of data warehouse practitioners these question informally before and received a wide range of answers. Table 1 contains an initial reflection on the boundary questions by the author of the paper. The aim is to first reflect on the questions from the “what is” perspective given in data warehousing literature, but also to give a personal view on the “what should” perspective. The purpose of these questions is to provide a vehicle for discussion and the author is convinced that the answers in the “what should” column will provoke reaction in the reader’s mind.

After thinking about these questions and their possible answers it is clear that there are different perspectives of the role of the data warehouse in the organisation. Stated differently, there are different perceptions on the boundary of the data warehouse. One may argue that the data warehouse is a tool to be used in management and what management requires is reflected in the requirements documentation. How it is used is to a certain extent independent of the warehouse development team. Another view is the data warehouse is central to decision making in the organization and that the business objectives should drive the development of the data warehouse. Such a view also entails that the data warehouse team share the responsibility of how the data warehouse is used.

Who the affected is and how they should be involved generated much internal debated when the questions were answered. The affected parties are the ones affected by the decisions made when using the data warehouse. This might be staff members of the organization when the data warehouse is used in decisions about expansion or closure of activities. The external clients of the organization are also affected by decisions taken.

As described at the end of section 2 Kimball [3] advocates a notice board for information about the DW development. A direct quote was used in that section to relay the tone of the statement in the source text. All staff members should receive the correct information. It demonstrates a one direction communication. Should the general staff members be allowed to give input in data warehouse development? Once again one is force to open your worldview on the role of the DW in the business and even further: should the general staff member have input in the decision making process in the organisation?

The purpose of this paper is to demonstrate how CSH can enrich conversation and thinking about the DW and its role in the organization.

<b>Question</b>	<b>Perception of the author of this paper of “what is”</b>	<b>Perception of the author of this paper of “what should be”</b>
<i>1. Who is / ought to be the client (beneficiary) of the system S to be designed or improved?</i>	In the first instance the business user.	Perhaps also the client of the organisation.
<i>2. What is / ought to be the purpose of S; i.e. what goal stated ought S be able to achieve so as to serve the client?</i>	To provide good quality data to be used in decision making.	Perhaps also to be a tool in the solution of the compelling business question.
<i>3. What is / ought to be S’s measure of success (or improvement)?</i>	When the system is delivered on time, in budget and it meets the requirements.	Perhaps also when the compelling business question is solved in a way that does not harm the affected.
<i>4. Who is / ought to be the decision taker, that is, have the power to change S’s measure of improvement?</i>	The business sponsor and the warehouse director.	Perhaps a top executive has the most power in this regard.
<i>5. What components (resources and constraints) of S are / ought to be controlled by the decision taker?</i>	Data warehousing staff and infrastructure.	Perhaps the source systems should be more controlled by the DW initiative.
<i>6. What resources and conditions are / ought to be part of S’s environment, i.e. should not be controlled by S’s decision taker?</i>	The source systems.	The source systems to an extent, but certain aspects of the source systems should be able to be more influenced than is the case.
<i>7. Who is / ought to be involved as designer of S?</i>	Project leader overseeing the modeling from the requirements	Perhaps the models should be reviewed by the business users as dimensional models are not too complex to be understood by non-IT experts.
<i>8. What kind of expertise is / ought to flow into the design of S; i.e. who ought to be considered an expert and what should be his role?</i>	The project leader and his team as described in section 2.	Perhaps the team should be extended to include representatives of the people affected by the decisions taken with the data in the data warehouse.
<i>9. Who is / ought to be the guarantor of S; i.e. where ought the designer to seek the guarantee that his design will be implemented and will prove successful, judged be S’s measure of success (or improvement)?</i>	The business sponsor and DW director	The business sponsor, but success here also refer to the solution of the business problem rather jus to the functioning of the DW. In this regard the executive management should be the guarantor.
<i>10. Who is / ought to belong to the witnesses representing the concerns of the citizens that will or might be affected by the design of S? That is to say, who among the affected ought to get involved?</i>	This is not addressed; it is assumed that the requirements created by the business users will not contain aspects harmful to others.	The general staff of the organization and the clients of the organization should be represented in some way.
<i>11. To what degree and in what way is / ought the affected be given the chance of emancipation from the premises and promises of the involved?</i>	This is not addressed; it is assumed that the requirements created by the business users will not contain aspects harmful to others.	The staff and the clients of the organisation should have voice in strategic business decision making.
<i>12. Upon what world-views of either the involved or the affected is / ought S’s design be based?”</i>	The data warehouse is a tool for decision making and it is the DW team’s responsibility to provide good quality information and a usable interface for the business users.	The data warehouse is central to decision making and the development team should have a certain ownership for the specific business objectives of the organisation.

*Table 1 Boundary questions [1] answered for data warehousing development*

## 5. CONCLUSIONS AND FUTURE WORK

From Table 1 it is clear that the critical systems worldview described in the third column takes a broader view of the role of the data warehouse in the organization and affected of the data warehouse.

Some people in the organization are involved in the data warehoused and others affected by the data warehouse. Even the more technical data warehouse team members can be viewed as affected if they are not represented in the use of the data warehouse. By using CSH the role of the data warehouse in the organisation has surfaced. Is the data warehouse comparable to the telephone in the organisation which gets picked up and is used independent of the designer or is the data warehouse a central part of decision making in a way that the development thereof shapes the future of the organisation.

Users of CSH are forced to consider the affected in their decision making. Thus the data warehouse team utilizing CSH should be aware of the affected. How to involve the affected in decision making and data warehouse development will depend on the attitude of the executive management of the organization.

An interpretive research project can be launched at different levels of the organisation to better understand the attitude of participants towards the identification of those affected by the use of the data warehouse and there representation in the project.

Such a project can be done as an extension of traditional data warehouse development methodology. CSH calls just for an attitude change in the first place and it provides a methodology for practicing a changed attitude.

## 6. ACKNOWLEDGEMENT

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