INDUSTRY NEEDS FOR DATA WAREHOUSING STUDENTS: USING SSM AS HERMENEUTIC DATA ANALYSIS TOOL FOR INTERPRETIVE INTERVIEW DATA

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ABSTRACT

The soft systems methodology was developed by Peter Checkland over an extended period of time to assist organisational improvements. It provides tools to assist different stakeholders to articulate their perspectives on the best action to be taken in problem environments. It is grounded in the ideas of soft systems thinking, where systems are viewed as conceptual models to make sense of a messy real world environment. The original focus of soft systems methodology is organisational use rather than academic use. In this paper we demonstrate how the soft systems methodology can be used to guide and analyse interpretive interviews with participants in an academic research project in the context of interpretive research methodology.

We reflect on the hermeneutic nature of interpretive qualitative data collection and analysis and then we show that an activity diagram as used in the soft systems methodology, is a valid data analysis technique in terms of the epistemological context of interpretive data analysis.

We demonstrate our proposal by means of the data analysis of interpretive interviews of data warehouse practitioners on their perspectives of the required skills of information technology students majoring in data warehousing. We compiled activity diagrams and used them in communication with our participants, thus enabling our participants to verify our data analysis and enhance our understanding of their perspectives. We show how different perspectives can be represented and reflected upon after compiling activity diagrams and how different perspectives can be accommodated to develop a single strategy for change.

Our main contribution is to demonstrate the suitability of the soft systems methodology in data collection and analysis in interpretive cases studies where strategies for changes are studied.

The paper is organised in four main sections, starting with a discussion on the ontological and epistemological assumptions of interpretive case studies in order to show that it is possible to use the soft systems methodology from an interpretive research perspective. The second section provides a very brief discussion of the soft systems methodology. Our main contribution is in section three, providing justification and guidance for using the soft systems methodology to guide data collection and analysis in the context of interpretive research methodology. We demonstrate our proposal in the fourth section,

where we show how we analysed interpretive interview data. Our paper concludes with reflection and recommendations.

Keywords: soft systems thinking, interpretive data analysis, qualitative data, data warehousing

INTRODUCTION

The theme of the 2017 meeting of the international society of the systems sciences (ISSS) is "From science to systemic solutions – systems thinking for everyone". In this paper we want to show how systems thinking, specifically soft systems thinking and the soft systems methodology (SSM) can be used by interpretive researchers to achieve their research objectives.

The objective of interpretive research is to understand a phenomenon or research environment from the perspectives of the participants (Walsham, 2006). The objective of SSM is to guide purposeful action by articulating different perspectives in a problem environment (Checkland & Poulter, 2006). We argue that SSM can be used, similar to how grounded theory developed by Glaser and Strauss (1967) is used, to guide interpretive data collection and analysis. We argue that when the goal of the interpretive case study is to investigate improvement or purposeful change, the research team can use SSM to develop their own understanding of different perspectives.

We show that the ontological and epistemological assumptions of SSM enable it to be used as methodology in the interpretive research paradigm. SSM is a mature methodology that can be used to guide understanding of different perspectives in a problematic environment. We provide guidance and a demonstration of the use of SSM by interpretive researchers.

In order to justify the use of SSM in the interpretive paradigm we discuss the ontological and epistemological assumptions and methodology of the paradigm in the first section of the paper. We provide a brief introduction to SSM in the second part of the paper. The purpose is to introduce the reader to the tools of SSM in context of soft systems thinking. In the main part of the paper (third section) we justify the use of SSM in interpretive research. We demonstrate our proposal in a study on the industry needs for information technology students doing a module in data warehousing.

INTERPRETIVE RESEARCH METHODOLOGY

The aim of this first section to provide a brief introduction to the interpretive research paradigm and the associated data collection and analysis methods. The aim is to provide enough information to be able to demonstrate in the second part of the paper that the soft systems methodology can be used as a valid data analysis technique in this paradigm.

Interpretive research as paradigm

On a philosophical level "a paradigm is the underlying assumptions and intellectual structure upon which research and development in a field of inquiry is based" (Kuhn, 1962, p. 5). We cannot practice science without some set of perceived beliefs and perspectives (Kuhn, 1962). A research paradigm can be discussed in terms of ontological and epistemological assumptions. Epistemology refers to our theory of knowledge (i.e. how knowledge developed) and ontology refers to our view of reality; these underpin the researcher's theoretical perspective and methodology.

In most research areas, four research paradigms are identified, namely: positivism, interpretivism, critical social theory, and design science. In this paper our focus is on interpretivism.

The ontological assumptions of interpretive research are based on the notion that social phenomena, or the world, is not objective; rather, it is experienced. Social phenomena are subjective because reality changes and people's perceptions also change (Mingers, 2001). The goal of interpretive research is to uncover the truth about a phenomenon in order to bring understanding of why things are the way they are (Klein & Myers, 1999). For example, a question like 'why are students not doing well or coping in the industry after leaving the university?' is a descriptive interpretive study question.

The epistemological assumptions of interpretive research are grounded in the idea that experience brings knowledge and understanding. The social world consists of, and it is constructed through, the meanings that humans attach to it (Walsham, 2006). A researcher is not limited to the idea that there is only one view of the world that is realistic (Walsham, 2006). Interpretive research methods seek to understand the world in the view of the involved (Walsham, 2006). A traceable consolidation of human perceptions of the world is a key activity in interpretive research. Data collected are not separated from context that adds meaning to it. Variables and their interrelations are not predefined in interpretive research (Krauss, 2005). Table 1 gives a summary the characteristics of the interpretive paradigm. The characteristics are presented in first (left) column with a short description on the second column.

Table1: A summary of interpretive research characteristics - Adapted from Joubish, Khurram, Ahmed, Fatima, and Haider (2011)

Characteristics	Description
Purpose – to understand	Seeks to understand peoples' perceptions and their interpretations.
Reality – is dynamic	Peoples' perspectives are influenced by reality changes.
Viewpoint – requires insider or active participant	Reality is not what is it but what people perceive it to be.
Values – value bound	An account of values should be taken into consideration when conducting and reporting research.

Focus – is holistic	A total view of all perspectives is sought.
Orientation – discovery	Data collected serve as the basis for theories and hypothesis.
Data – is subjective	Peoples' perceptions serve as input data in the environment.
Instrumentation – human	The researcher and participants are the primary data collection instruments.
Conditions – naturalistic settings	Research investigations are conducted under natural settings.
Results – valid	The main focus is of the research is on the design and procedures to gain deeper meaning.

Data collection and data analysis methods are presented subsequently from the perspective of the assumptions of the interpretive research paradigm.

Interpretive data collection and analysis

The aim of interpretive data collection is to understand the participant's perspective of the phenomenon under investigation. Before data collection can take place decisions need to be taken regarding participant selection. Participant selection in interpretive research is based on purposeful selection of participants; the number of participants is not generally predetermined (Sargeant, 2012). According to Sargeant (2012), purposeful participant selection refer to those who can best inform the research questions and enhance the researcher's understanding of the phenomenon. The research elements are fully informed (rich) when the data saturation point is reached (i.e. no further refinements to the resulting theory are identified) (Glaser & Strauss, 1967).

In interpretive studies, data collection and data analysis are used iteratively to develop a theory. Grounded theory, was first published in 1967 by Glaser and Strauss (1967), and is very influential in interpretive research (Walsham, 2006). Glaser and Strauss (1967) define grounded theory as "the discovery of theory from data systematically obtained from social research". Data is collected and then coded to systematically develop a theory until all new collected data supports the theory. Iterative theory development implies that analysis guides data collection further; each interview conducted leads to analysis, and enhancement of the theory. When applied in a grounded theory method, this iterative process between data collection and analysis continues until saturation is reached (Glaser & Strauss, 1967). Data is typically collected by using qualitative data collection methods such as semi-structured and unstructured interviews or observations in ethnographical studies. The detail of these methods are outside the scope of this paper.

Grounded theory as an analysis method is used to understand social phenomena that are not abstract (Glaser & Strauss, 1967). It is used to uncover basic social processes such as integral social relationships and the behaviour of groups. The rigor of grounded theory comes with a continuous theory development process. A boundary of proper scope of the area of investigation must be set. Continuous collection of data and analysis continues until no more additions to the developing theory can be made within the defined scope.

The concepts that are identified from the theory and their relationship must be confirmed. Data analysis is achieved by using a coding method. Coding is used to extract patterns from qualitative data for quantitative analysis (Seaman, 1999). According to Glaser and Strauss (1967) there are three different level types of coding a researcher can use for data. Level one is open coding where conceptual categories are formulated from sorted raw data. On level two, axial coding is applied to find and verify the relationship between the identified categories. In level three, selective coding is applied to connect categories that develop the theory.

Since the researcher chooses the concepts to focus on, Walsham (2006) argues that grounded theory has an element of coding that is subjective. He suggests a free approach where the researcher writes impressions during the research; after each interview he/she then organises them into sets of themes and issues. The emerging new data are used to develop, enhance, confirm, or even discount theories.

Content analysis is a less formal method of interpretive data analysis and is described as: "any technique that is used to make inferences by systematically and objectively identifying special characteristics of messages" (Holsti, Loombs, & North, 1968, p. 608). According to Zhang and Wildemuth (2009, p. 5) "qualitative content analysis uncovers patterns, themes, and categories important to a social reality." Zhang and Wildemuth (2009) recommend a process for content analysis: data are gathered, units of analysis are identified, and categories of schemes are developed. The development of categories involves developing coding schemes for inductive and deductive content analysis. Deductive reasoning that generates concepts or variables from previous studies or theory is largely used. The coding scheme is about testing on sample data for consistency before all text is coded. On completion of all text coding, conclusions are drawn from the coded data.

From this brief discussion of interpretive data collection and analysis, it should be clear that there is a hermeneutical interaction in the process of developing an interpretive theory. Hermeneutics, originated as a theory of text interpretation. The hermeneutic circle suggests that the whole body of relevant literature for a specific phenomenon is made up of multiple small texts that need to be understood from the perspective of single words, as well as from the perspective of the whole text (Boell & Cecez-Kecmanovic, 2010). In turn, the individual texts are seen as parts of the whole body of relevant literature. The understanding of small texts is never isolated. It is interpreted in the context of other small texts from the literature. Human understanding is achieved by iterating between the small parts and the whole formed by them. The understanding "is built up through the understanding of individual texts" (Boell & Cecez-Kecmanovic, 2010, p. 5).

The question posed in this paper is whether the soft systems methodology can be used to facilitate data collection and analysis in the interpretive research paradigm. In order to reflect on this matter we provide a brief account of the soft systems methodology.

SOFT SYSTEMS METHODOLOGY

Checkland and Poulter (2006) describes soft systems methodology (SSM) as a methodology for 'wicked' problems that resist sharp definitions or structured approaches; it is used to formulate conceptual models for structural thinking in complex human situations and the understanding thereof. SSM uses a collection of models; it is viewed as an organised learning system. Checkland (1981) categorises the individual's perception of a system as either hard (a structured systemic approach) or soft (ill-structured real world problem areas representing multiple worldviews). Hard systems can be predicted to some extent, while soft systems are not predictable – they are messy and involve human activity (Patel, 1995).

The SSM explores the notion that humans act purposefully (Checkland & Poulter, 2006). Purposeful action implies that "something needs to be done about this". The ultimate goal of this process is to improve the problematic area. Checkland and Poulter (2006) oppose using the words "problem" and "solutions"; they say that "problem" suggests that there is a clearly defined problem at hand and that "solution" implies that SSM will fix it. They also argue that the goal of SSM is to seek accommodation rather than consensus; this accommodation must be desirable and culturally feasible to the all parties that are involved.

Checkland and Poulter (2006) explain that the SSM learning cycle is a process consisting of four main activities as indicated on Fig 1.

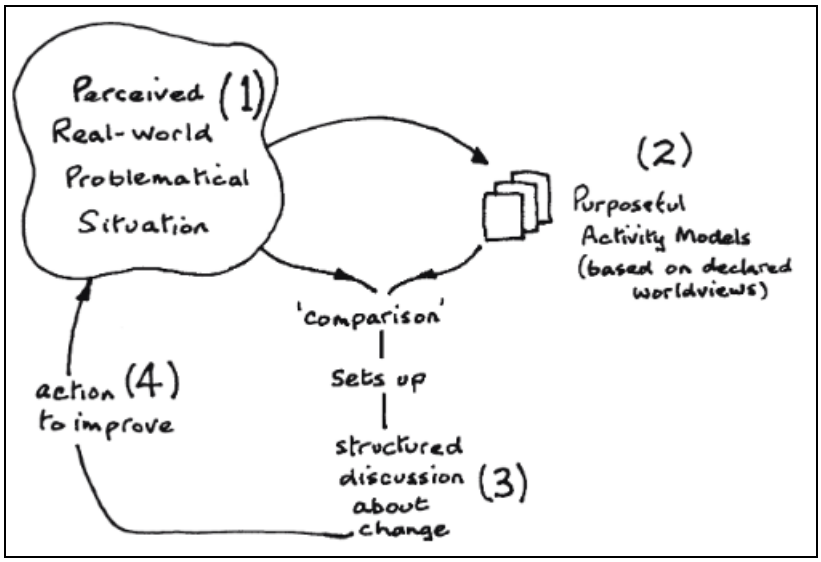

Figure 1 SSM learning cycle (Adopted from Checkland and Poulter (2006, p. 207))

Perceived real-world problem situation

The first activity entails exploring the initial problematical situation. Checkland and Poulter (2006) suggest analysing the problem situation in an unstructured format. The problem situation may also be experienced by the researcher, which leads to assumptions about the nature of the situation. The first step is to formulate the problem situation in terms of input, transformation, and output.

The second step is to express the problem in terms of a detailed rich picture, within which the problem occurs. The main goal of this rich picture is to capture logic, culture, and relationships. Checkland and Poulter (2006) provide structures, processes, climate and people, issues expressed by people, and conflicts as guidelines to be included in the rich picture. A rich picture is a holistic drawing or an impression of a problem area of interest that is formulated using interviews and existing documents (Checkland & Poulter, 2006; Patel, 1995).

Creating relevant purposeful activity models

The second activity is to make relevant purposeful activities based on perspectives grounded in worldviews. Each perspective guides a particular model; a model thus can never be a definitive description of the real world but rather represent a desired course of action from a particular perspecitive (Checkland & Poulter, 2006).. The models are ideal situations. They model one way of visually examining involute authenticity of the world. The modelling process is depicted on Fig. 2 (Checkland & Poulter, 2006).

The PQR formula
A sentence of the form: 'Do **P** by **Q** in order to contribute to achieving **R',** must firstly be constructed by a SSM practitioner. The PQR formula is used as the enriching process for the root definition (RD). The RD enrichment is achieved by answering questions such as: what? how? and why? Checkland and Poulter (2006) give the transformation formula PQR meaning: Do P (what?) by Q (how?) in order to help achieve R (why?). The key element in this formula is Q, which represents the transformation process. The other two (P and R) are the supporting elements that define Q in the equation. Transformation is the process of converting or achieving the output given a specific input.

CATWOE
The second step is the application of the CATWOE model. One of the known SSM tools, and central to the process of deriving a root definition, is CATWOE. The CATWOE pneumonic is used to define the customer (C), actors (A), transformation process (T), Weltanschauung (the worldview) (W), ownership (O), and environmental constraints (E) (Checkland & Poulter, 2006). The CATWOE analysis is used to articulate the scope and components in a problem situation (Checkland & Poulter, 2006).

The evaluation criteria elements, i.e. efficacy, efficiency, and effectiveness, are used in regard to the problem situation. This evaluation process is to assess if the transformation process is: (1) producing the intended outcome, (2) achieved with minimal resources, and (3) achieves a long term goal (Checkland & Poulter, 2006).

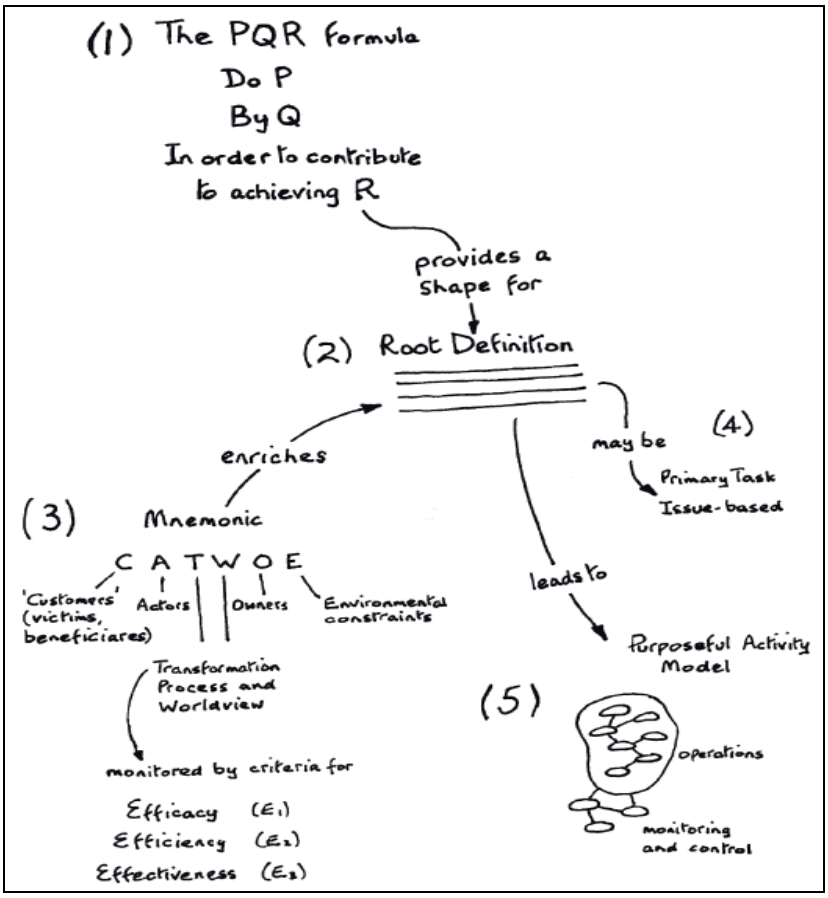

Figure 2: Purposeful activity building guidelines (Checkland & Poulter, 2006, p. 40)

Root definition
The RD is a rich description of the activity formulated in order to improve the efficiency of the analysis (Checkland & Poulter, 2006). It is a narrative describing the problem environment in terms of the components of PQR; CATWOE and the evaluation criteria.

Primary vs issue based model
In the fourth step, Checkland and Poulter (2006) advocate that a choice must be made between: (1) a primary task, and (2) an issue based RDs. Primary task RDs are based on the notion that they accept problem situation area boundaries, while issue based RDs are those that require a broader consideration in a problem situation.

Purposeful activity models
The fifth step is the development of activity models based on the RDs. At this stage activities required to achieve the transformation outcome are bound together.

Comparison and structured discussions

The result of the second activity is a set of conceptual models representative of the worldviews of the different stakeholders. The third activity uses the models to question the real situation; its purpose is to structure a discussion about the situation and changes that will be 'arguably' desirable (Checkland & Poulter, 2006).

The conceptual models are used in comparison (and contrast) with reality and with each another. The difference between the models and the real world are used as the basis for a discussion that intents to find the changes that are both arguably desirable and also culturally feasible (Checkland & Poulter, 2006). These are often misunderstood; the aim is accommodation of different worldviews rather than consensus.

Define or take the action to improve the problem situation

The last activity is to define or take the action to improve the problem situation. The previous activity identifies some potential changes. These changes may be technical (or not); these changes must be appropriate for the future. Now, the most desirable and feasible changes identified are implemented. The end results of the fourth activity point back to the first activity, i.e. the perceived real world problem situation. This is a repetitive process.

USING SSM IN DATA COLLECTION AND ANALYSIS

The purpose of this paper is to propose and demonstrate how SSM can be used in interpretive data collection in analysis. As preparation, we provided, in part one, a brief description of interpretive research methodology and, we provided, in part two, a brief introduction to SSM. We are now ready to justify and propose how SSM can be used in interpretive studies where change is studied.

We propose SSM to be used in interpretive studies of a specific nature: *Studies aiming to understand different perspectives on improvements to be made*. The nature of SSM is to guide purposeful action. At this point it is important to distinguish our proposal from classical use of SSM. The participants in our proposed environments are not all directly involved in the system that requires improvement. In other words, our participants give their perspectives on change in another system. In our demonstration, presented in the next section, we study how a university module in data warehousing should be redeveloped in order to support the development of industry-ready data warehousing practitioners. We are interested in amongst others, the perspectives of alumni, although they are not part of the system to be improved.

Metaphysical justification of interpretive use of SSM

We justify our use of SSM in the interpretive paradigm first from an ontological and then from an epistemological perspective. The ontological perspective of interpretive research is rooted in constructivism (Andrade, 2009). The ontological perspective of SSM has been linked to phenomenology (Checkland, 1981). In Checkland (1981)'s description

of phenomenology he uses Husserl (1936)'s notion that "the everyday world is in fact 'constructed through human activity'" (Checkland, 1981, p. 274). This statement is similar to the ontological stance of constructivism. Checkland (1981) supports the notion of phenomenology in its concern of thinking about the word rather than a concern about the world itself, as is the case in positivism. Checkland (1981) explicitly links SSM to interpretive social science: "And at a more detailed level, too, there are many parallels between the operations within the methodology and the philosophical/sociological tradition of interpretive social science." (Checkland, 1981, p. 279). We can therefor argue that there are no ontological conflicts between SSM and interpretive research.

On an epistemological level, interpretive research states that knowledge is created through understanding of a phenomenon. Klein and Myers (1999) accentuate the use of the hermeneutic circle to achieve understanding and to develop a theory in interpretive studies. The cyclic approach of the hermeneutic cycle discussed by Dilthey is supported by Checkland when he writes the "methodological cycle and proceed in any direction makes it resemble Dilthey's account of the hermeneutic circle". (Checkland, 1981, p. 180). Checkland (1981) also links SSM to action research where change is guiding knowledge creation. Learning and therefor new knowledge is created as a result of the evaluation of intervention in a problem situation. In research projects, action research is often used from a critical social research. Checkland (1981, p. 283), argues that SSM is different from critical social theory because of its less "overly political stance". Myers (1997) indicates that action research can be conducted from an interpretive perspective. Therefor we argue that the epistemological focus of SSM of learning through action is not in conflict with the epistemological stance of interpretive research. We do note that not all interpretive studies focus on change and hence we argue for the use of SSM for studies where purposeful change is studied.

SSM to guide data collection and analysis

The SSM provides a methodology for articulation of perspectives, therefore also for understanding perspectives. We propose that a researcher who is interested in understanding a situation where change is sought, should develop a semi-structured interview based on the components of SSM. In South Africa where our research takes place, very few practitioners are trained in SSM or even aware of its existence. It is therefore not feasible to require research participants to create SSM models without facilitation. Our proposal of developing a semi-structured interview based on the components of SSM does not require any knowledge of SSM by the participants.

Our proposal for data collection is thus that a researcher develops open-ended questions formulated in terms of the life-world of the practitioners based on the components of the model building methodology depicted on Fig 2.

When analysing interview data, the researcher can then link the answers of the participants directly to the components of SSM in order to develop rich pictures, activity diagrams and root definitions. Attempting to develop these SSM models from the data collected will identify gaps in the data (or the understanding of the participant), and the researcher may then develop follow-up questions. We argue that a research team can only

claim that they have developed an understanding of a certain perspective when they are able to develop a coherent SSM model, which is verified by the participant.

Although participants are not knowledgeable on SSM and not able to create SSM models without facilitation the intuitive nature of the models are such that practitioners are able to read composed models representative of their perspective and are able to give constructive comments on these models.

The proposed process of iteration between data collection (interviews) and analysis (SSM model building) is similar to the iterative nature proposed by the developers of grounded theory (Glaser & Strauss, 1967) as discussed in the first section on interpretive research methodology.

We are now ready to demonstrate our proposal with an example study on improvement of a module in data warehousing for fourth year IT students.

DEMONSTRATION OF USING SSM TO GUIDE INTERPRETIVE RESEARCH

The aim of this section is to provide a demonstration on how SSM can be used to guide interpretive research.

Background of the demonstrated study

In terms of data management, information technology (IT) degree programmes are designed for students to learn general IT concepts regarding the usage of data, and the application of strategies to organise and query data. Universities face the challenge of how to make students data warehouse/business intelligence (DW/BI) ready. Mrdalj (2007) argues that one of the basic challenges in teaching a DW/BI course is its high overlap with statistics, databases, and various business disciplines. Separate domains of knowledge become interconnected, and integration become essential.

There is a need to establish what is, or ought to be, the purpose of DW/BI modules, such that it serves the interests of those who must benefit from it. Whose interests are served by DW/BI? The involved and affected stakeholders must be identified and their views should be shared or incorporated in DW/BI modules' development. Different stakeholders may have different viewpoints of what expertise is, or ought to be, possessed by DW/BI professionals; or what counts, or should count, as relevant knowledge in this field. For this reason, it is very difficult for universities, being service providers, to meet and exceed expectations when expectations are not known. A holistic approach, to make unknown expectations of stakeholders known, is needed.

Universities face a challenge to meet stakeholders' expectations whilst operating within certain academic boundaries, i.e. the National Qualifications Framework (NQF) and other sub committees such as faculty boards that, amongst others, govern the scientific content and required hours of academic programmes. Furthermore, there is a delay between the

design and implementation of curriculum changes. There may be other challenges that universities face and they need to be unearthed.

The problem addressed by this demonstration is that there is a lack of guidance to universities to assist them to develop of DW/BI modules that truly prepare students for the needs of industry, while satisfying the needs of an academic programme. There is a greater need for universities to know what content to teach, and what processes steps to follow to improve DW/BI modules.

Data collection and analysis

The targeted participants are experienced data warehousing (DW) and business intelligence (BI) professionals in the industry, former students, and faculty members of universities. Sixteen participants, representative of the above mentioned groups participated in an interpretive case study using semi-structured interviews. The interpretive interview was made up of four sections, i.e. biographical information, stakeholder identification, actions to be taken to improve DW/BI education, and module content. Our SSM analysis focused on the third section of the interview. The other sections were analysed using interpretive content analysis.

In the second and third sections of the interview, we asked context related questions aiming at identifying the elements of CATWOE. These included questions such as: "Who do you think should be the beneficiaries of a good DW/BI module?" and "Who should be involved in the development of an improved module?" We also asked all our participants an open-ended question on how we should go about improving the module. After analysing the responses for this question, we grouped our participants into three groups: past students, employers and university professionals, since the responses for specific participants related to others.

Thereafter, we used an incremental process to develop SSM diagrams to represent the perspectives of stakeholders regarding the actions to be taken to improve DW/BI education:

- First, we analysed the responses to the original questions for all the participants representative of the specific group, in terms of the SSM components in order to identify specific gaps in the responses.
- Secondly, we identified one participant in each of the identified groups to collaborate with further. The level of detail for the general question guided our selection. We chose participants who gave answers with a high level of detail. This process resulted in the identification of three participants who each gave a detailed initial answer on their perspective of the process to improve the DW/BI module. For each of the groups (past students/ academics/ industry) we followed the following process:
    - We conducted a follow-up interview with the chosen participant to fill the gaps. We then developed initial diagrams for the rich picture, CATWOE and activity diagrams and discussed them with the participant. This was an iterative process

until the participant was satisfied that the diagrams were representative of his/her views.

- We then distributed the specific set of SSM diagrams to other members of the identified group (past students, academics and industry) and changes were recommended. The process was repeated until no more changes were requested. The aim in SSM is accommodation rather than consensus, so extensions rather than alterations were mostly made to the diagrams.

Findings

The final diagrams were used to represent the specific views of the different groups involved. It should be noted that the rich picture depicts their perspective on the current situation and the activity diagram depicts the desired action.

In order to demonstrate how perspectives differ, we provide a rich picture developed on behalf of the past student group (Figure 3) and the academic group (Figure 4).

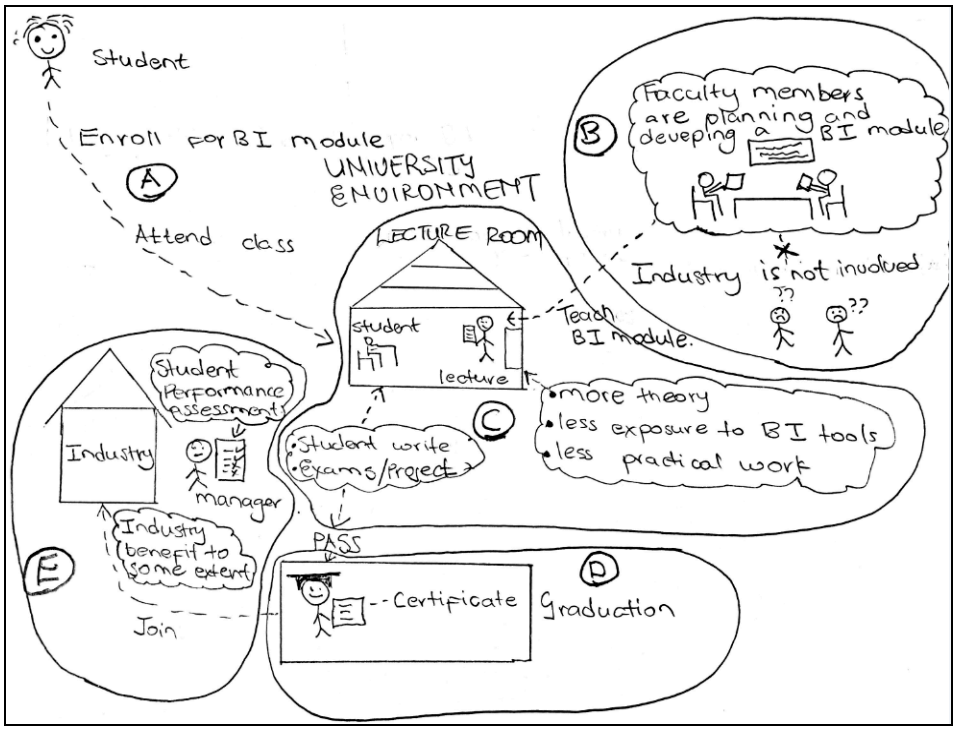

Figure 3: DW/BI education rich picture according to student's perspective

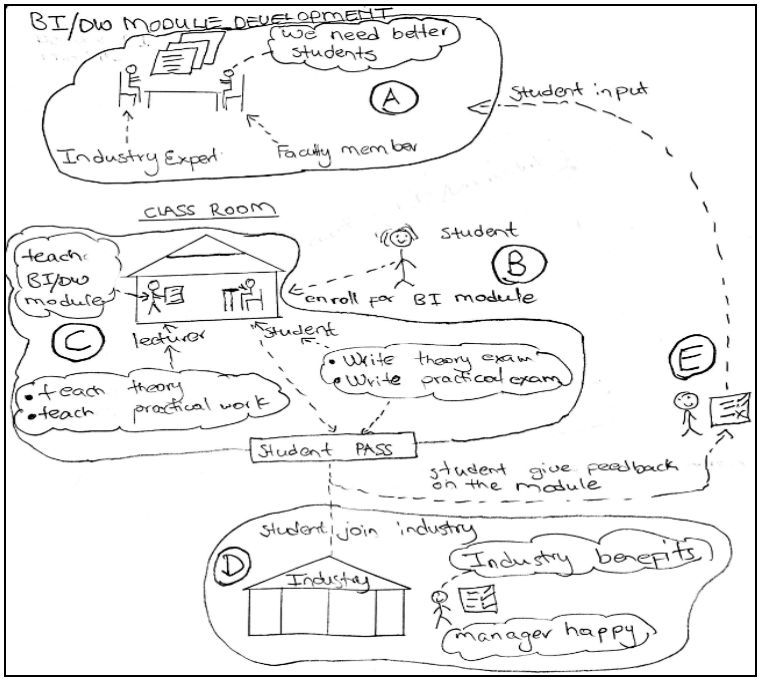

Figure 4: DW/BI education rich picture according to faculty member

After developing the rich pictures, we used the rich picture components specified by Checkland and Poulter (2006) to compare the diagrams as presented in Table 2.

Table 2. Comparison of rich pictures

Elements	Student	BI professional	Faculty member (
1. Structures	• University lecture room • Industry work place	• University lecture room • Industry work place	• University lecture room • Industry work place
2. Processes	• Students enrolment • DW/BI module development • DW/BI module teaching and learning • Graduation • Students joins and work	• Students enrolment • DW/BI module development • DW/BI module teaching and learning • Graduation	• Students enrolment • DW/BI module development • DW/BI module teaching and learning • Students joins and work • Student feedback
3. Climate	• Nothing explicitly presented		
4. People	• Student • Industry manager • Faculty members • Business people	• Student • Industry manager • Faculty members • Business people • Industry experts	• Student • Industry manager • Faculty member
5. Issues	• Manager says industry	• Industry is not	• Faculty member

expressed by people	benefits to some extent. • Industry is not involved in the DW/BI module development. • Student are taught a lot of theory. • Student are taught less of practical work. • Student are less exposed to DW/BI tools.	involved in the DW/BI module development. • Student(s) is taught a theory. • Student (s) is to some extent taught practical work. • Student takes three years to know his/her value and to add value in the industry. • Industry recruits graduates from universities but it is not contributing towards building the academic field.	thinks universities need better student intake • Industry is involved in DW/BI module development. • Student are taught theory. • Student are taught practical work. • Industry benefits from graduates quality and the manager is happy.

Different findings are evident from this comparison, such as the role of student feedback. The students are not aware that their feedback is used in the development of the module.

Similar to the development of the rich pictures for each group, we developed a CATWOE model for each of the groups as presented in Table 3. The square bullets indicate items added iteratively after initial analysis of open ended interviews.

Table 3. Comparison of CATWOE- analysis

CATWOE	Student	BI professional	Faculty members
C- Customers	• Business • Students ▫ Business analysts	• Industry • Students • Business ▫ BI professional	• Industry • Students • Business
A – Actors	• Universities (faculty members) • BI professionals • Business ▫ Former (past) students	• Universities (Faculty members) • BI professionals • Business ▫ Former (past) students	• Industry experts • Universities (faculty members)
T - Transformation process	• Developing DW/BI programme that can better prepare students for industry.	• Developing DW/BI programme that can better prepare students for industry.	• Developing DW/BI programme that can better prepare students for industry.
W - Worldview	• Universities can improve DW/BI module to meet the needs of industry.	• Universities can improve DW/BI module to meet the needs of industry.	• Universities can improve DW/BI module to meet the needs of industry.
O – Owners	▫ Industry (experts) ▫ University (faculty	• Industry (experts) • Business	• Industry (experts) ▫ Business

	members)	▫ University (faculty members) ▫ Students	▫ University (faculty members)
E - Environmental constraints	• Universities can't control DW/BI technology and its trends (hardware and software licensing costs). • Lack the practical component. ▫ Universities can't control industry input of real life problems. ▫ Industry can't control programme requirements ▫ Industry can't control modules to complement DW/BI. ▫ Universities can't control technical expertise.	• Universities can't control packaging of DW/BI programmes such that it adds value. ▫ Universities can't control industry input of real life problems. ▫ Universities can't control student's employability. ▫ Universities can't control technical expertise. ▫ Industry has no control how academic programmes should run. ▫ Universities can't control cost of hardware and software. ▫ Industry can't control modules to complement DW/BI.	• Universities can't control BI technology and its trends (hardware and software licensing costs). • Industry can't control programme requirements. • Universities can't control real data. ▫ Universities can't control industry input of real life problems. ▫ Universities can't control cost of hardware and software.

We repeated the process of developing rich pictures to develop activity diagrams for each group. We analysed all responses to all answers and indicated (grounded) our selection of activities in themes identified after the data was analysed using content analysis. We present the activity diagrams for the students (Figure 5) and for the faculty members (Figure 6).

Comparison of the various diagrams enabled us to develop a better understanding of different perspectives. It shows that although there are differences the similarities are more than what we expected. Although students were negative towards the current theoretical training when the rich picture was developed, they do appreciate the importance of BI literature in their training.

After developing the SSM diagrams for the specific perspectives, our aim was to develop an accommodative diagram as result of our empirical interpretive investigation. We developed a diagram that accommodates the activities of the three diagrams. This diagram was presented to the three representatives and after minor changes it was finalised as presented in Figure 7. Although we were able to have one result to implement we continuously appreciate the value of the individual diagrams representative of the past students, industry and faculty members respectively.

SSM for interpretive data analysis

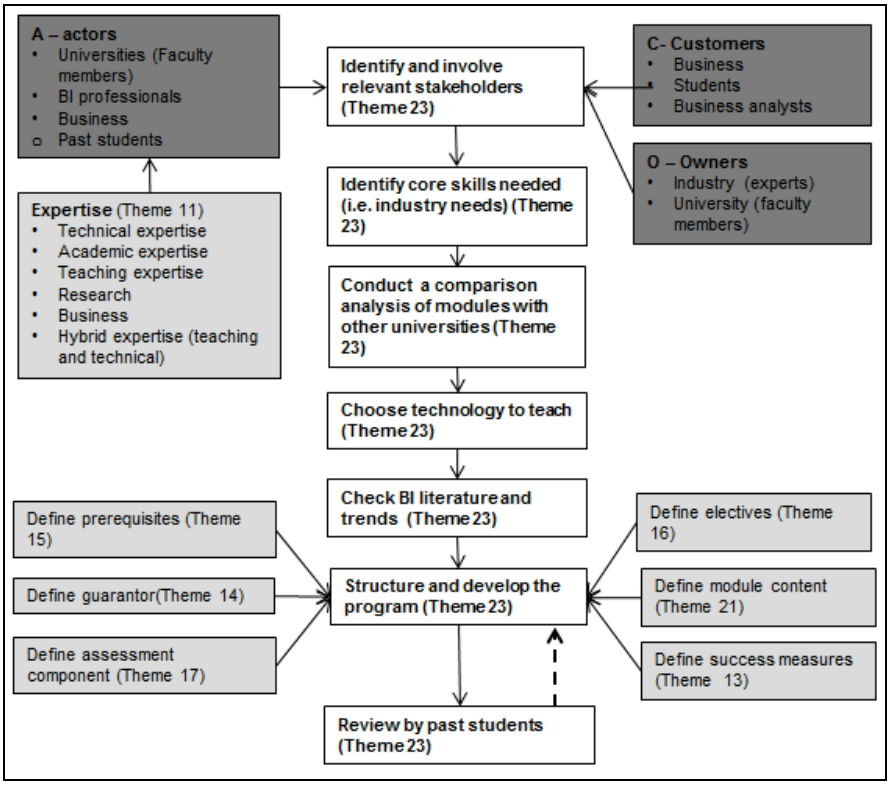

Figure 5: Conceptual activity module according to student group

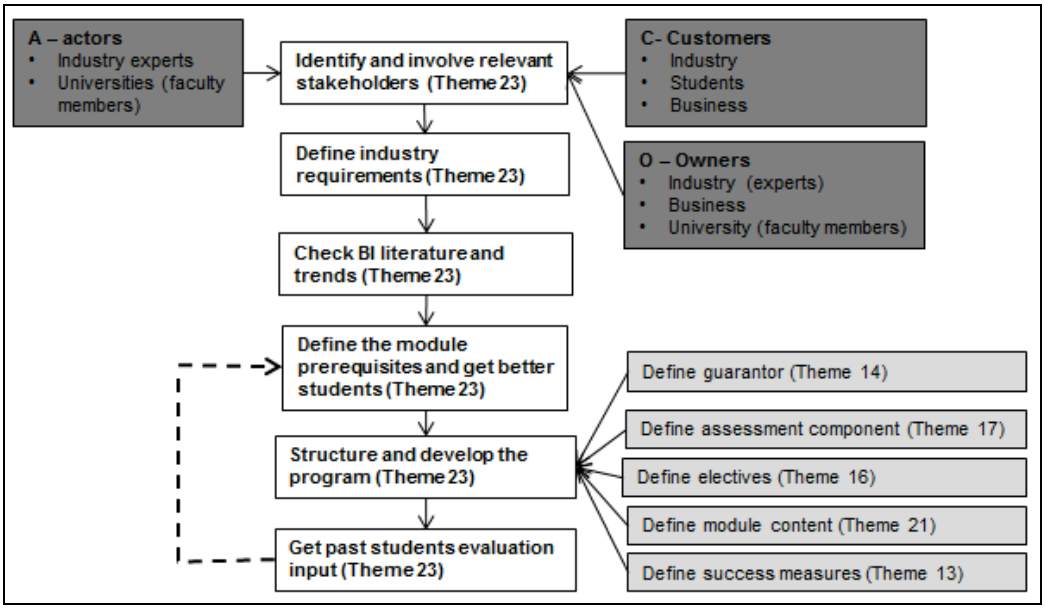

Figure 6: A conceptual activity model according to university faculty members

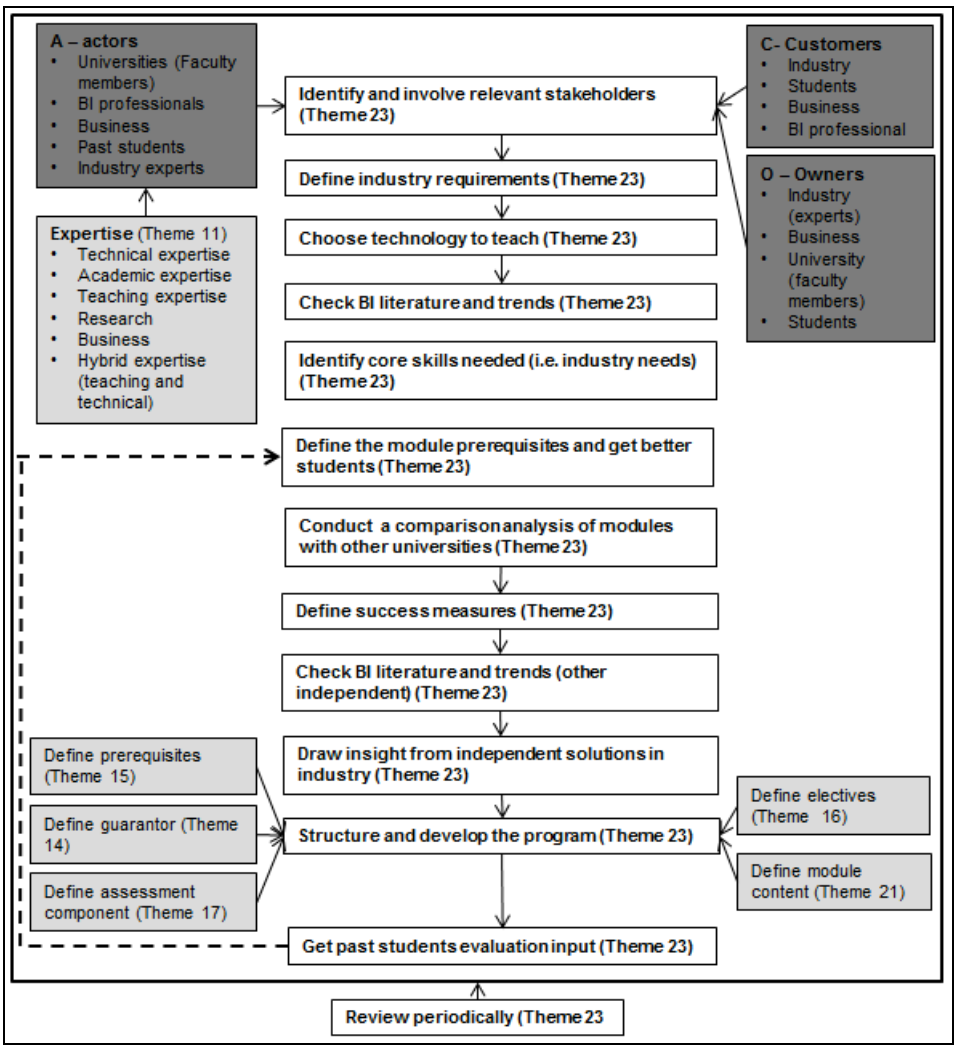

Figure 5: Conceptual activity module accommodative of all the group diagrams

REFLECTIONS AND CONCLUSIONS

The aim of the paper is to show that it is beneficial and possible to use SSM to guide interpretive data collection and analysis. We first provided a theoretical justification on the assumptions of interpretive research and the SSM to show that it is justifiable. Then we gave a description and an example to show that it is possible. Now as a conclusion to the paper we reflect on whether it is beneficial to use SSM as interpretive research method. The study presented here as example is an excerpt of a Master of Science study that underwent rigorous examination. We present both our positive and negative experiences here to enable other researchers to learn from our inexperience. We have learnt the following:

- The first of three main reflections is that we did not know the short-comings in our understanding of the participants' perspective after general content analysis of the interview data. If was only after we started drawing SSM diagrams that we identified gaps in our own understanding.
- The second of our three main reflections is that our participants were forced to give more coherent and consistent responses. We could show them the gaps in their own reasoning. A number of times we had conflicting responses from the data provided by a single participant and we had to conduct a follow-up interview, in order to clarify certain ideas expressed by a participant.
- The third of our three main reflections is that we had an awareness of different perspectives, all of which we documented. We developed three rich pictures, we had three root definitions, three CATWOE descriptions and finally three activity diagrams. We can go back when we redevelop the module to these individual perspectives, before they were combined, to verify that our new module will meet the needs of a specific group.
- In general, one should remember that one cannot use a theory to prove the same theory. One cannot use the SSM to develop an interview and then conclude that participants used a SSM approach to reflect on a problem – this is not what we have done. We used SSM to develop an interview so that we can use SSM to articulate the perspectives. We do not conclude that our participant are using SSM. SSM is the tool we used to guide our understanding and communication with participants.
- In terms of workload, SSM does not replace content analysis, it does not make the data analysis burden less, if anything it increases the burden.
- The examiners of the Master's study complemented us on the rigorous data analysis and the grounding of the findings in the data.

We conclude that although SSM was developed to be used in organisational settings by people in the system, we used it in a research project with people who are not part of the system to be improved. SSM gave us an opportunity to identify the shortcomings in our own understanding of different perspectives in a problem situation. Although our participants did not know SSM, they were able to understand and improve our rich pictures, CATWOE, root definitions and activity diagrams. We do recommend the use of SSM to guide data collection and analysis in interpretive studies where improvement is studied.

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