A Research-Driven View of Conceptual Models as Instruments for Information Systems Research

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ABSTRACT
Conceptual modelling deals with the process of building or interpreting a conceptual model whereby the stakeholders reason and communicate about a domain in order to improve their common understanding of it. In this paper, we argue that the common engineering-driven view on conceptual models is only one possible perspective. Based on language critique, we show how conceptual models can be used as an important instrument for information systems research. We argue that researchers need to take on three roles in order to integrate interpretive and positivist approaches, and we combine our view with an existing framework for research based on (Lee 1991).

Keywords: Information Systems Research, Language Critique, Conceptual Modelling, Methodology.

1. INTRODUCTION
The traditional understanding of conceptual modelling focuses on what we call the *engineering-driven view of conceptual models*. From this perspective, conceptual models are part of a method, a planned and systematic (engineering) approach (Braun et al. 2005) which deals with the process of building or interpreting a conceptual model whereby the stakeholders reason and communicate about a domain in order to improve their common understanding of it (Gemino & Wand 2003, p. 80). The engineering-driven view has a long tradition in the information systems (IS) research community, especially regarding the construction and application of conceptual modelling languages and grammars for the specification of business requirements. Conceptual modelling and reference modelling are considered to be important instruments for analyzing and solving several technical and organizational design issues on an application level, enterprise level or industry level (Moody 2005, p. 244). Although conceptual modelling and the construction of modelling languages tailored to specific problem domains are well understood, open questions remain, e. g. regarding the construction of conceptual models (Wand & Weber 2002, Weber 2003), the evaluation of conceptual models (Shanks et al. 2003, Gemino & Wand 2004) or the quality of conceptual models (Moody 2005). From this perspective, conceptual modelling and conceptual models are *subjects* of research.

In contrast, we propose a *research-driven view of conceptual models*. As Silverman argues, IS researchers would do well to think a long time before rushing into yet another interview-based study (Silverman 1998, p. 19). Instead of focusing on how people 'see things', we have to focus on how people 'do things' (Silverman 1998, p. 3). In this regard, conceptual models are a means for forming an interpretive understanding. In practice, they are often used for several purposes, e. g. to support the development, acquisition, adoption, standardisation and integration of IS (Maier 1999). Every organization usually has a large collection of various conceptual models. For example, UML or ERM diagrams are used for software and architecture design, flow chart diagrams or event-driven process chains for ISO or Sarbanes-Oxley Act certification, and BPML/N for workflow specification. Incidentally, conceptual models are a means for the researcher to develop a common understanding of a problem domain with experts and practitioners (Ribbert et al. 2004). This results in a presentation of facts about the system in focus in such way that all stakeholders can understand it and relate it to their objectives.

Clearly, there is a need to address relevant problems for organizations. If a rigorous theory provides backup, why not leverage conceptual models as a useful source of knowledge? The issues that arrive from this understanding of conceptual models are fundamentally different in nature to the engineering-driven view. How can conceptual models contribute to the testing of theories? What are the consequences for research methodologies?

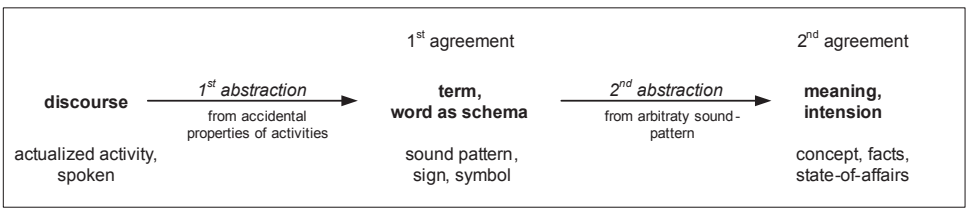
2. AN ARGUMENT: A LANGUAGE-BASED UNDERSTANDING OF CONCEPTUAL MODELS
Several fields like linguistics, philosophy, psychology or neurology inquire about the nature of language. Following this, Lyytinen adequately demonstrated the importance of language for IS research (Lyytinen 1985). Nevertheless, there is no consensual answer to the question as to how meaning is given to language. Wittgenstein argued that every perception of the world is language-bound, so that language becomes the 'mediator' between reality and an individual (Wittgenstein 1922, 5.6). Nothing is an object "inherently"; it only becomes an object as we talk about it. For this reason we use language to represent some meaning that we conceive (Bühler 1934, p. 254).

In linguistics, de Saussure's seminal work conceptualized a linguistic sign as a union of a *concept* – the signified (signifié) – and a *sound image* – the signifier (significant) (de Saussure 1974, p. 66). According to de Saussure, the combination of concept and sound image is arbitrary. Therefore, a language consisting of linguistic signs is based on conventions (de Saussure 1974, p. 67). Following de Saussure, Morris proposed that a language consists of a set of interrelated signs, or *symbols* (Morris 1971, p. 24). Both de Saussure's and Morris' approaches are based on conventions as a precondition for meaningful language-based communication, and both separate a concept from its representation. By symbols, Morris addresses only what de Saussure termed the signifier. As the "lore of symbols", semiotics consists of three subordinate branches: syntactics, semantics, and pragmatics (Morris 1971, pp. 22-43). Syntactics (or syntax) deals with relations of symbols to one-another. People who want to communicate by language need syntactical conventions in order to create a common understanding of interrelated symbols. Semantics deals with the relation of symbols to concepts. These conventions are necessary for language-based communication in order to address one object with the same symbol. Pragmatics deals with the relation of symbols to their interpreters, and addresses the understanding of symbols to language users.

In accordance with Ågerfalk and Eriksson, we argue that traditional conceptual modelling research has focused too much on the syntactic and semantic aspects of language and too little on the pragmatics (Ågerfalk & Eriksson 2004). But where Ågerfalk and Eriksson use speech act theory as a theoretical foundation for conceptual modelling, we focus on language critique in order to explain the role of conceptual models for IS research.

Language critique, a branch of constructive philosophy known as the "Erlangen School" (Kamlah & Lorenzen 1984, Lorenzen 1987) provides useful insights and support for the research-driven view of conceptual modelling. By separating *language* (as a schema which one knows how to speak) and *discourse* (as linguistic action and activities), Kamlah and Lorenzen separate concepts from their linguistic usage (Kamlah & Lorenzen 1984, p. 41). Discourse means the repeatedly actualized usage of concepts in changing combination and variation.

Figure 1. Agreements and abstractions in language critique (Holten 2003, Holten et al. 2005)



Thus, discourse is an actualized activity, whereas language comprises potential activities (activity-schema) (Kamlah & Lorenzen 1984, p. 45). The transition from an actualized activity to its schema is called an *abstraction* (Figure 1). Terms are syntactical representations used in discourse with fixed conventions (1st abstraction), whereas in order to get concepts, we abstract from the phonetic form of terms (2nd abstraction) (Lorenzen 1987, pp. 115-118).

The question of how the conventions that align syntax, semantics, and pragmatics of symbols are formed can be answered using the construct of a *language community*. Kamlah and Lorenzen argue that language as a system of signs promotes mutual understanding as "a 'know-how' held in common, the possession of a 'language community'." (Kamlah & Lorenzen 1984, p. 47). A new term is introduced by *explicit agreement* between language users with respect to its usage (1st agreement) and meaning (2nd agreement) (Kamlah & Lorenzen 1984, p. 57). This agreement leads to a relation of concept and term, and is shared by a language community as the knowledge of using this term. Accordingly, if members of a group of people communicate, and each has an aligned semantic and pragmatic dimension of a symbol (or term) in mind, then this group of people forms a language community. The implications for our work are that the semantic and pragmatic dimensions of symbols need to be introduced together. If a language community has been created, based on a language (re)construction of a domain, the members of this language community share the pragmatic dimension of a symbol. All members have the same concept in mind if they are confronted with a symbol of the language and vice versa.

According to this understanding, conceptual models play a significant role in making language communities explicit: conceptual models are designed through linguistic actions of a language community, and therefore are an expression of a shared language understanding, so-called *marks* (Kamlah & Lorenzen 1984, p. 91, Holten 2003). Marks are written-down or printed writing-signs (Kamlah & Lorenzen 1984, p. 51). They are actualized as activities by the one who produces the marks in *writing* them, and again actualized by the one who *reads* them (Kamlah & Lorenzen 1984, p. 46, Gemino & Wand 2003). Models as marks create persistent things: solidified activities which stay put, are produced and can be read. By this means, conceptual models can be used as a formalized way of stating the intersubjective consensus of a language community (Ribbert et al. 2004). Conceptual models provide a starting point for communication as the written expression of the shared understanding of the language community that is part of every IS as a socio-technical system (e. g. business users, experts, managers, IT experts, programmers et cetera). New concepts and problems that every changing organization constantly encounters need to be introduced and explicitly agreed upon by this language community.

At the moment, it is of no interest for us how a consensus has been achieved, e. g. by enforcing a dominant power position, or by engaging into a reasonable discourse. All that matters is that a mutual understanding of concepts and terms has been created. Then, in accordance with (Ribbert et al. 2004), truth or correctness of statements depends on the consensus of the group of people that constructed the conceptual models (Kamlah & Lorenzen 1984, pp. 101-111).

3. THE IDEA: IMPLICATIONS FOR IS RESEARCH

Every research approach is based on fundamental philosophical assumptions (Myers 1997, Lee 2004). Based on these assumptions, IS researchers have debated competing philosophical paradigms for research, mostly represented by the two labels positivism (Jenkins 1985) and interpretivism (Walsham 1995a). Although the differences and boundaries between research positions have ever been a cause for discussion and argument among IS researchers, recent contributions argue for a conciliation and the acceptance of each others key assumptions and arguments as ontological and epistemological paradigms (Weber 2004).

Different positions not withstanding, given the richness and complexity of the real world, a research approach best suited to the problem under consideration, as well as the objectives of the researcher, should be chosen. The over-riding concern of our research approach is that the research we undertake should be both relevant to the research questions in focus and rigorous in its operationalization. Due to our understanding of language, we believe that a *constructive philosophy* (Lorenzen 1987) which integrates interpretive and positivist approaches is required for this purpose. Consequently, we assume that an objective world exists (ontological realism), but that our cognition of this world is subjective or private (epistemological subjectivism) (Holten et al. 2005, p. 177). We argue that due to this subjectivity, cognition relies upon the (re)construction of reality through (linguistic) action.

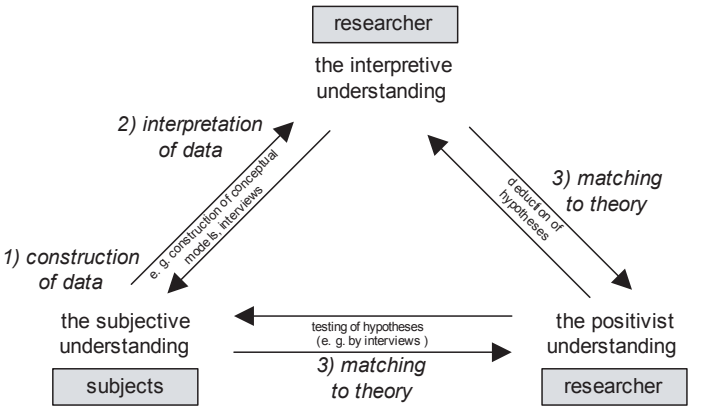
Following our language-based understanding of conceptual modelling and our philosophical assumptions, our research approach is characterized by three roles that the researcher adopts during her or his investigation. By anchoring our approach in language critique, we provide a new and alternative rationale from the philosophy of science. Our approach fits with a framework for the development of scientific theories as proposed by Lee (Lee 1991, Lee 2004). After having created a subjective understanding of everyday meanings and common sense within the observed organization, which provides the basis for the interpretive understanding, the researcher creates a positivist understanding in order to explain the empirical reality – the explanation being a scientific theory which can be tested against the subjective meaning as recorded in the interpretive understanding (Lee 1991, pp. 351-354). The result is an integrated framework for an interpretive and positivist understanding (see Figure 2). By taking up the three roles, the researcher acts in character with the processes described by Lee. Furthermore, she or he is conscious of the boundaries for research which are defined by these roles. The three roles can be applied and embodied during known research methods, e. g. action research (Baskerville & Wood-Harper 1996, Baskerville & Myers 2004), case study research (Yin 2003, Walsham 1995b, Barrett & Walsham 1999) or action case studies (Hughes & Wood-Harper 1999). We argue that engaging into the three roles allows the researcher to collect rich and meaningful data for answering his research questions.

1) Construction of Data

The first role refers to the *construction of data*, wherein the researcher acts as a participant and engages in practical work within an organization as a partner in active problem solving. We exist "all along" within a subjective understanding of the world which is linguistically articulated (Kamlah & Lorenzen 1984, p. 5). Participating in a language community thus becomes a prerequisite for any observation. In order to generate a mutual understanding, researchers and other participants actively create a language community, aligning their language constructs during projects. Thus, an inter-subjective understanding of the research domain is created. In doing so, the researcher gains access to observations in this research domain. Based on the observations, she or he is enabled to collect and construct data. This includes the collection of *existing* conceptual models.

Adopting a strategy akin to Langley, the researcher chooses to plunge deeply into the processes themselves, collecting fine grained qualitative data (Langley 1999, p. 691). This is a common characteristic of field studies which take place in the natural environment of the phenomenon, and where the researcher uses systematic techniques for the collection and recording of data (Cavaye 1996). Like an ethnographer, the researcher should begin by using and participating in

Figure 2. Framework for research (adapted from (Lee 1991))



everyday interactions and focus on "How do participants do things?" (Maynard 1989, p. 144).

2) Interpretation of Data

The second role concerns the *interpretation of data*. The extracted data and observations need to be analyzed and interpreted. The researcher makes statements about the research domain, which are based on common agreement and are understandable for the language community. This is in line with Lee's and Baskerville's generalizing from empirical statements to other empirical statements (Type EE generalizability) (Lee & Baskerville 2003). A researcher must thus repeatedly go from his own interpretive understanding to the subjective understanding and then back again to his own interpretive understanding (Klein & Myers 1999, p. 71).

Following our argument in section 2, the mutual construction of new conceptual models of the IS or organization under examination is a suitable tool for this interpretation. The conceptual models as marks ensure that the researchers actually understand what is happening in the research domain, if these descriptions are created and discussed by the language community consisting of all project participants. Conceptual models based on participatory action in operational processes are actualized activities of how people do things. The jointly discussion and refinement of these conceptual models serves to test the interpretive understanding recorded in the models against the subjective understanding.

3) Matching to Theory

In the third role, a *matching to theory* takes place. The researcher confronts a theory with her or his interpreted observations in order to deduct meaningful hypotheses. Generally, we understand theory as a means for describing, explaining and predicting as for design and action as well (Gregor 2006, pp. 626-630). Consequently, the researcher generalizes from the interpreted observations to a theory (Type ET generalizability) (Lee & Baskerville 2003). From this generalizability concept stems the idea that one case may yield as many information as many cases, since science operates with conjectures and jumps to conclusions, even after one single observation (Popper 1965). In IS research, this means the deduction of hypotheses about the organization and the IS in focus in order to match the findings with a theory.

It is an important accomplishment to construct correct conceptual models (correct in the sense of a correct interpretive understanding of a domain in focus, as in the engineering-driven view). But for science, the interpretation is but one link in the chain. Science interprets a domain, relates this interpretation to theories and subsequently tests these theories. As Lee shows, there is no discrepancy between interpretive and positivist positions. Therefore, we ask for an empirical checking of hypotheses. Consequently, we need to confront the interpretive understanding, and hence the conceptual models, with theories.

An example for an application of our research approach is a recent action case study carried out at a logistics service provider which was acquired by a bigger corporation (Laumann et al. 2007). The new management decided to analyse the reporting within the organization, since reporting consumed a lot of time. A conceptual modelling language was used to model the actual reporting, to get an overview of the company-wide reporting and to establish a fit between the information channels and the new functions after the integration into the corporation. Based on Ashby's Law of Requisite Variety (Ashby 1964) and the Viable System Model (Beer 1985) as underlying theories, hypotheses were proposed for the causes of the identified problems and were subsequently tested. To sum it up, the reporting was not any more appropriate for the new structure and strategy of the organization and had to be reorganized. The reporting information system was redesigned with respect to requisite variety.

4. CONCLUSION

By applying language critique in order to qualify conceptual models as marks, and hence as a formalized way to describe the consensus of a language community, we are able to leverage conceptual models as a source of knowledge and as an instrument for creating and testing an interpretive understanding for IS research.

Based on this, we described how conceptual models and the creation of a language community are important steps in participatory research in order to create an interpretive understanding of a subject matter. In this regard, both existing conceptual models and models mutually created by researchers and participants are useful – the first as collected data, the second as an instrument for interpretation.

As a next step, we plan to apply and refine this framework in different research domains, and to conduct a survey in order to qualify existing research as matching to our approach. Furthermore, other interesting questions for research arise from our approach, e. g. how consensus is actually achieved within a language community. We encourage other research to use this framework, and to criticize it for refinement.

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