

Enterprise Modelling Research Group at University of Hagen

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Abstract: On behalf of the entire team, I present the research programme and research themes pursued by the Enterprise Modelling Research Group at the University of Hagen, Germany.

Keywords: Enterprise Modelling; Conceptual Modeling; Modeling Tool Research; Individual Modeling Processes; Modeling Difficulties; Learning Conceptual Modeling;

1 General orientation

Enterprise models empower us to shape the digital transformation of organisations—of small and medium businesses, large corporations, public administration, unions, clubs and associations of all kinds. Without conceptual models of such enterprises, their social action systems in coaction with their computer information systems, we cannot understand the complex human-computer-interactions that concern us and cannot seize the opportunities of their applications to problems of modern society. At the Enterprise Modelling Research Group, we construct enterprise models, design modeling languages, develop modeling methods and corresponding modeling software tools, study their use in application contexts and evaluate their application to digital transformation challenges including managerial decision-making in business domains such as Strategic Management [BS18], Auditing [HSF14], and Performance Management [St12].

The Enterprise Modelling Research Group at the University of Hagen was founded in 2015 at the Chair for Information Systems Development after a three-year initiation period subsequent to the author receiving the honour to head the Chair for Information Systems Development at the School of Management and Economics, University of Hagen (FernUniversitaet in Hagen) in November 2011. A small research group, the Enterprise Modelling Research Group hosts four full-time researchers at the doctoral and postdoctoral levels as well as several additional staff including undergraduate and graduate research assistants. Thanks to the commitment, ambition and dedication of its group members, an array of research initiatives has been launched since then including the modeling tool and observatory TOOL [Te20, Te19, Te17] and a corresponding series of mixed-methods research studies on individual modeling processes using TOOL for data and business process modeling [RTS20b, RTS20a, RS19, RTS19].

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2 Research Topics

2.1 Foundations

Our research programme operates on the basic assumption that conceptual modeling involves an intricate array of cognitive processes and performed actions including abstracting, conceptualizing, contextualizing, associating, visualizing, interpreting & sense-making, judging & evaluating, and, in group settings, communicating, discussing and agreeing [RS19]. Hence, learning as well as performing conceptual modeling is construed as a complex task based on codified and tacit knowledge that involves mastering theoretical foundations, modeling languages and methods, applying them to practical problems as well as critically thinking and reflecting upon technical terminology and technical language of the targeted application domain. Despite its relevance and complexity, surprisingly little is known about how conceptual modeling is performed by modelers, how the learning of conceptual modeling proceeds, which modeling difficulties modelers experience and why, and how to overcome these difficulties by targeted modeling (tool) support [RTS20b]. We have, therefore, set out to better understand individual modeling processes and the learning of conceptual modeling—pursuing the overarching research objective of designing and implementing targeted tool support for modelers at different stages of their learning and mastering of conceptual modeling. In our pursuit of this research objective, we are convinced that individual modeling processes demand and deserve study from several complementary perspectives including verbalization of modelers' modeling decisions and related thought processes—to account for the richness of conceptual modeling as a learning and performing task.

2.2 Modeling tool research

From the outset, we have been researching, designing and implementing TOOL, a modeling tool and observatory for studying modeling processes [Te17]. In a nutshell, TOOL is a web application with a JavaScript-driven user interface (Web-browser-based frontend) and a Java EE (Enterprise Edition)-based server backend. Presently, TOOL implements two graphical modeling editors: (1) An editor for a variant of the Entity-Relationship Model (ERM) for data modeling and (2) an editor for a subset of the Business Process Model and Notation (BPMN) for business process modeling [Te20]. For supporting modelers in general as well as learners of conceptual modeling in particular, the TOOL prototype implements an ad-hoc syntax validation to point to modeling errors as well as a feedback component to guide the modeling process by making recommendations for sensible and adequate labels based on Natural Language Processing (NLP) techniques [TRS20].

TOOL is not only a graphical modeling tool designed to make modeling processes more productive. For studying individual modeling processes both under laboratory conditions as well as in online settings, TOOL implements multi-modal observation and data generation

techniques complementing different modes of observation of individual modeling processes. Currently, TOOL allows for (1) tracking modeler-tool interactions as timed-discrete events for visualizing modeling processes as heatmaps, dot diagrams, and to allow for stepwise replays of those interactions individually and in comparison with other modelers' tracked interactions, (2) recording verbal data protocols of modeler's thinking out loud following the tenets of think aloud research methods (including remotely in online studies), and (3) pre- and post-modeling surveying of studied subjects, e. g. about their prior modeling experience [Te19].

TOOL has been applied to an initial test series, to pilot studies as well as in a series of research studies on individual modeling processes at the University of Hagen, the Universitat Politècnica de València, Spain and the Katholieke Universiteit Leuven, Belgium (see next section). Moreover, TOOL has supplemented our teaching of a 300+ students course on Modeling Business Information Systems in the undergraduate programmes where students have been using it for the past semester to create data models for their assignments.

2.3 Individual modeling processes and modeling difficulties

Using TOOL in a series of observation studies, we have been studying individual modeling processes of experienced and non-experienced modelers through complementary modes of observation to identify modeling difficulties these modelers face while performing a conceptual modeling task, e. g. a data modeling task [RTS20b]. Observing individual modeling process poses interesting methodological challenges which has led us to run mixed-methods research designs in which we combine data from subject surveys, modeler-tool interaction tracking, verbal data protocols, and video recordings of the modeling subjects while working on the modeling task to arrive at a more complete observation of the phenomenon under investigation. Initial, preliminary findings of these studies indicate regularities among the observed modeling difficulties which leads us to expect to identify regular patterns of types of such difficulties in further, extended studies, and to develop a taxonomic theory of modeling difficulties intended to inform design science research on tool support for experienced and non-experienced models [RS19].

2.4 Learning conceptual modeling

Building upon both our modeling tool research on TOOL and on our research on individual modeling processes, we have been taking a closer look at how conceptual modeling is learned and how software tool support may assist learners in their learning processes. Learning conceptual modeling has for long been a focus in Conceptual Modeling research but has recently received renewed attention as we show in a comprehensive literature study covering contributions from 1986 to 2017 [RTS19, RTS20a]. Our current main research theme is to design and develop a feedback component for TOOL to provide process-oriented

learner feedback by processing the natural language description of a modeling task using NLP techniques to assist learners in identifying candidates for data modeling concepts, e. g. for entity and relationship types as well as attributes, and for formulating labels for these model elements. On a different research path, we have started to think and reflect upon conceptual modeling didactics and have initiated a research project to develop a technical methodology (in German: “Fachdidaktik”) for conceptual modeling for use in (high-)school education and higher education and corresponding curriculum development.

3 Relevance for the EMISA Special Interest Group

Conceptual modeling is at the core of our research programme and, likewise, at the core of development methods for information systems and their application. Our group’s research efforts are aimed at contributing to SIG EMISA’s foci in two interlinked respects: We aim to contribute to a more differentiated understanding of how conceptual modeling is performed and learned which, in turn, is aimed at adding to the foundational knowledge on which we all build development methods and corresponding software tools for information systems development.

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