Towards an Empirical Perspective on Multi-Level Modeling and a Comparison with Conventional Meta Modeling

Sybren de Kinderen, Monika Kaczmarek-Heß, Kristina Rosenthal
{sybren.dekinderen,monika.kaczmarek-hess}@uni-due.de,
kristina.rosenthal@fernuni-hagen.de

UNIVERSITÄT DUISBURG ESSEN
Offen im Denken

Prof. Dr. Ulrich Frank
Research Group Information Systems and Enterprise Modeling
Institute for Computer Science and Business Information Systems (ICB)
University of Duisburg-Essen, Essen, Germany

Motivation: a comprehensive assessment of Multi-Level Modeling

- Multi level modeling promises:
  - `simpler' domain representation (reduction of accidental complexity) (Atkinson and Kühne, 2008)
  - `empowering' the end user (Frank, 2014)
- Promises are:
  - largely of a conceptual nature
  - at least partly, supported by simplified scenarios only
- Good first step, but a more comprehensive assessment is called for, e.g.:
  - to support - `triangulate' – arguments of a largely conceptual nature
  - to understand how prospective users / modelers design and use multi-level models
  - to potentially inform design of future artifacts

Overall study idea: an empirical take on Multi-Level Modeling

Overall study objective: introduce an empirical take on MLM in terms of:
(1) users' understanding and comprehension of multi-level models;
(2) multi-level model creation;
(3) differences between conventional and multi-level modeling approaches.

- Proceeding, I will discuss:
  - The overall study design, and main research questions / theoretical lenses
  - A pilot study, and its first outcomes

Overall study design

Phase 0: preliminaries. Define questions, theoretic lenses, initial study set up
Theoretic lenses: empirical studies on conceptual modeling, cognitive sciences

Phase 1: Pilot. Feasibility / sensibility of study set up, clarity. Focus: comparison MLM / DSML design

Phase 2: Student study. Comparison of MLM / DSML , e.g., in terms of design and use

Phase 3: MLM experts, esp. in comparison / contrast w/ student studies

Phase 4: formulate lessons learned, recommendations (e.g., on MLM design)

Overall study: Questions and Theoretic Lenses (excerpt)

- Question: How do users design a multi-level model?
- Rationale:
  - *Understand* model design, e.g.:
    - how do modelers decide on a classification level?
    - how are abstractions selected among a set of candidate ones?
    - what heuristics, if any, do modelers use to make the decisions?
  - *Constructive* use of findings:
    - inform guidelines for the design of multi-level models
    - help users in avoiding potential pitfalls.
- Planned Theoretic Lenses:
  - Combined use of schematicity and productivity (Langacker, 1987; Clausner and Croft, 1997)

The M&M Pilot study: design and first results

- Allowing for a mix of bottom up and top-down design
  - e.g., subject two: Subject 2: *“Generally speaking, the higher the level of a class was supposed to be, the harder it was to chose a specific level. That’s why I would have preferred to model from a bottom up approach at times.”*
- Once the classification level of a concept was determined, intrinsicness of attributes / association ends appeared relatively straightforward (for the domain description).

Conclusions and Outlook

- First step towards an empirical take of multi-level modeling
  - Overall study set up, questions and theoretic lenses
  - First results of a pilot study with students
- Limitations/next steps
  - limitations inherent to think aloud sessions, limited set of participants…

Invitation: volunteers for participating in an expert study on multi-level modeling. 30-45 minutes for a modeling exercise using a tool / language of choice, accompanied by a think-aloud, 5-10 minutes for a post-hoc modeling survey

References

- C. Atkinson and T. Kuehne, “Reducing accidental complexity in domain models,” SoSyM, vol. 7, no. 3, pp. 345–359, 2008.
- S. de Kinderen and M. Kaczmarek-Heß, “Making a case for multilevel reference modeling – a comparison of conventional and multilevel language architectures for reference modeling challenges,” in Wirtschaftsinformatik 2021 Proceedings. aisnet, 2021, paper 10.
- U. Frank, “Multilevel modeling – toward a new paradigm of conceptual modeling and information systems design,” BISE, vol. 6, no. 6, pp. 319–337, 2014.
- R. W. Langacker, Foundations of Cognitive Grammar: descriptive application. Volume 1. Stanford university press, 1987, vol. 1.
- T. C. Clausner and W. Croft, “Productivity and schematicity in metaphors,” Cognitive science, vol. 21, no. 3, pp. 247–282, 1997.

Back up

Overall study design: Questions and Theoretic Lenses /2

- Question: What are the main challenges while designing a meta model using a conventional approach and what are the main challenges while designing a multi-level model?
- Rationale: restricts question on use of MLM, but with focus on challenges to be identified.
- Planned Theoretic Lenses: cognitive load theory, esp. cognitive breakdowns (i.e., where someone is struggling)

Overall study design: Questions and Theoretic Lenses /3

- Question: What is the actual fit of the selected MLM-approach to user cognition?
- Rationale: assessing the fit of abstraction hierarchies to those naturally employed by users.
- Planned Theoretic Lenses:
  - Categorization, i.e. “our ability to identify entities as members of groups”
  - Different levels of categories: basic, sub ordinate, super ordinate
  - Assumption: indicate what abstraction level a user feels comfortable working with

The M&M Pilot study: design

- Materials and Preparation
  - For the same domain, participants develop a conventional meta model, and a multi level model
- Participants
  - Five Business Informatics Master Students, having all followed at least one modeling course in prior
- Procedure