

Characterizing Conceptual Modeling Research

1. Provide bibliographic information.

Title:

Authors:

Other bibliographic information:

CM-related research communities¹ this work is mainly associated with:

2. Identify the significant contribution of this work.

What key questions are addressed in this work?

What is the central contribution of this work?

How is this work relevant to conceptual modeling?

Other significant aspects of the work

If relevant to the contribution, who are the CM users mentioned, assumed, or targeted in this work?

If an application of CM is a significant part of the contribution, what is the application domain?

3. Characterize the significant contribution of this work.

Depending on the type of conceptual modeling contribution, fill out (**typically just ONE**) subsection. Focus on the main contribution related to conceptual modeling.

I. Model: the "what" of conceptual modeling.

Fill out this section if the work contributes a conceptual model or a language, metamodel, notation, or other artifact related to the statics of CM.

Describe the specific accomplishment

What is its purpose?

What is the nature of the significant contribution? (check all that apply)

- Definition
- Extension
- Comparison
- Evaluation through a case study
- Evaluation through a user study
- Discussion of philosophical basis
- Formalization
- Investigation of expressive power or other formal properties
- Other (describe)

Which of the following dimensions of CM² does this contribution address? (optional)

Describe the contribution

- Semantic grounding
- Modeling artifacts
- Linguistic development

II. Method: the "how" of conceptual modeling.

Fill out this section if the work contributes a method, process, algorithm, tool, or other contribution related to the dynamics of CM.

Describe the specific accomplishment

What is its purpose? (check all that apply)

- CM validation, simulation, verification
- CM instance generation
- CM extraction, reverse engineering
- CM translation downward (to other representations/implementations)
- CM integration, exchange, migration
- Query or keyword search over data in a CM
- Reuse of a CM
- Other (describe)

What is the nature of the significant contribution? (check all that apply)

- Definition
- Extension
- Comparison
- Evaluation through a case study
- Evaluation through a performance study
- Evaluation through a user study
- Discussion of philosophical basis
- Formalization
- Investigation of expressive power or other formal properties
- Other (describe)

III. Reflection: perspectives on conceptual modeling.

Fill out this section if the work contributes to the field of CM by providing a vision, philosophy, principles, review, or other perspective on CM.

Describe the specific accomplishment

What type of contribution is made?

- Vision for the field of CM (or a subfield)
- Theoretical or philosophical issues surrounding CM or CM research
- Principles for CM, CM languages, tools, or CM research
- Proposal or viewpoint
- Broad survey of (perhaps part of) the field of CM
- Pedagogy or education for CM
- Application of CM to a significant or challenging domain
- Other (describe)

4. Provide additional information — comments, explanations, insights, descriptions (optional).

¹ Knowing the research community (or communities) an author identifies with can help a reader understand the background and point-of-view of the author and the terminology used in the work. Examples of CM-related research communities (with some common terms and venues) include the following:

Community	Common Terms	Typical Venues
Business process modeling	process, activity, task, ...	BPM, CAiSE, ER, MODELS, ISD, RE, ...
Database design	schema, data model, entity, ...	SIGMOD, VLDB, ER, TODS, J. on Data Semantics, ...
Ontology	foundational ontology, upper/lower ontology, ...	FOIS, ER, ...
Requirements engineering	requirements model, ER diagram, goal model, ...	RE, CAiSE, ESEM, ER, ...

This table only shows a *few* CM-related research communities. There are **many** more.

²Dimensions of Conceptual Modeling

The [Triptych of Conceptual Modeling](#) is a paradigm used to illustrate the three dimensions of conceptual modeling:

1. The **linguistic dimension** defines the language used for model representation. “Language” is used here in a broad sense and can include textual, graphical, audio-visual, and other physical forms of representation. In the case of well-known modeling languages such as UML or BPMN, it is the respective notation together with the grammatical composition rules.

If in this language terms are borrowed/used from a natural language (e.g., English), sentences (textual, diagrams etc.) can be formed with it, from which a speaker of this language can intuitively derive meaning.

2. The **model dimension** defines the structure of the models in different levels of an abstraction hierarchy. This is roughly comparable to OMG’s MetaObject Facility (MOF) where a metamodel defines the intended modeling concepts; for example, in the original entity-relationship model, these include “Entity Set,” “Relationship Set,” “Attributes,” “Value Set,” “Role”. For a concrete application, these modeling concepts can be instantiated, for example, as an entity set “Customer” to which certain attributes such as “Name”, “Phone Number”, etc. are assigned. This in turn can be instantiated to represent a concrete object such as the customer Smith.

Note that the combination of model structure and natural language identifiers results in a construct which can be interpreted not only (as in the linguistic dimension) based on the natural language terminology and syntax but also on the basis of the modeling concepts and their interdependencies defined in the metamodel. We refer to this as “a priori semantics”. However, even such models might be ambiguous due to the multi-faceted nature of natural language.

3. The **semantics dimension** provides a unique meaning of the elements of the model dimension (at all levels). In fact, the presence of the semantics dimension is what distinguishes a conceptual model from other types of models: *A model is conceptual if it has a complete foundation in the semantics dimension, i.e., if all its constituents are defined there.* There are various ways to provide the semantics for each concept that appears in the model dimension. One is to provide an ontological or encyclopedic grounding for each concept. Other possibilities include providing a thesaurus, data dictionary, or glossary such as a “company manual” that defines all the terms used in the company in question.

For more details, see [“The triptych of conceptual modeling”](#) by Heinrich C. Mayr and Bernhard Thalheim, published in *Software and Systems Modeling*, Vol. 20, issue 1, Springer, February 2021.