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Cutting through the Jungle: Disambiguating Model-based Traceability Terminology (Extended Abstract)

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Abstract: This extended abstract summarizes our distinguished paper [Ho20], published and presented in 2020 at the 28th IEEE International Requirements Engineering Conference (RE'20).

Keywords: Traceability; Requirements Engineering; Model-based Engineering; Terminology

Natural language remains the dominant documentation format for requirements specifications for software-intensive systems. At the same time, models are increasingly applied in the engineering of such systems: Embedded systems development heavily relies on model-based systems engineering for interdisciplinary communication and model-driven software development for early automated analyses and code generation. In combination, the development processes for software-intensive systems include intertwined development phases producing, among others, informal system requirements, semi-formal system design models, informal software requirements, formal software design models, code, and tests.

At the same time, traceability is demanded by many development and safety standards for software-intensive systems and has to be established throughout the development lifecycle. The term traceability and its definition originate in the Requirements Engineering (RE) research community, which also provides a terminology for this area. However, existing definitions even only within the RE research community partially contradict each other.

Looking moreover into the modeling research community, its literature on model-based traceability uses the same terms with different meanings. Furthermore, additional aspects that go beyond the traceability terminology shaped by the RE community are relevant when working with models. For example, when models are transformed during development to yield other models with more fine-grained granularity and additional details, trace links between the source models and the target models can be established automatically. In addition, trace links are often stored in external trace models or are included in models in languages such as the Unified Modeling Language or the Systems Modeling Language. The traceability definitions from the RE community do not yet cover such cases. Thus, there is the need to extend these definitions to cover cases from model-based engineering.

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Whereas existing secondary studies list the terminology from both communities, they do not resolve conflicts or add missing aspects. They also circumscribe concepts rather than naming them concretely while reusing existing terminology with additional identifiers. However, a domain terminology is the common ground for a set of people communicating with each other. Thus, a scientific community has to define its own terminology as the basis for an efficient communication and conduct of research. Consequently, with the inclusion of the modeling research community it becomes necessary to extend the RE terminology, include new terms, dissolve term conflicts, and dismiss terms that cannot be defined unambiguously.

In order to disambiguate the terminology on traceability of both the RE and the modeling research communities, we conducted a multi-stage literature review. Figure 1 sketches our research method, which consists of several iterative refinements of the yielded terminology and an accompanying taxonomy. Our results are based on and validated with a tertiary literature review and samples from primary literature. We include a mapping to how the secondary and primary studies in the review use the concepts in our terminology.

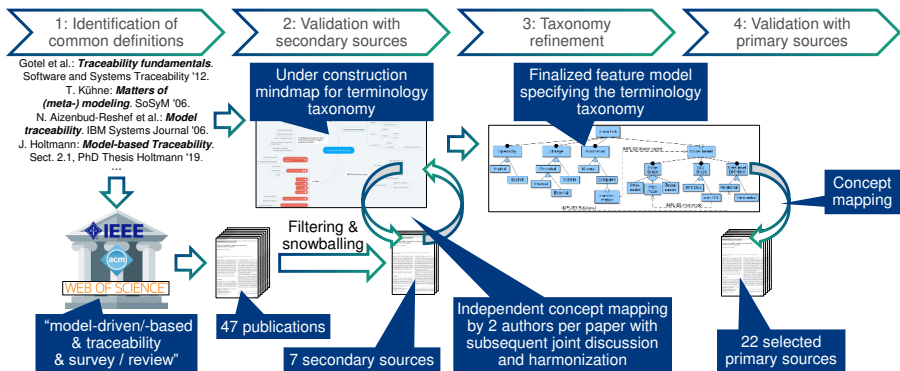


Fig. 1: Overview of our research method—iterative refinement of the terminology and its taxonomy

Thus, the contribution of our paper is a terminology that disambiguates the different terms used in model-based traceability. Furthermore, we provide a taxonomy specified by means of a feature model, which conceptually visualizes the structure of our terminology and formalizes the relationships between certain terms. As a side effect, this terminology serves as a classification scheme for how trace links are used in model-based environments. Since primary studies rarely define the properties of the traceability approach they propose, our work helps comparing and contrasting different approaches. Summarizing, we believe our work will simplify discussions between requirements engineers and engineers working with models since they can now use a set of unambiguous terms to discuss traceability concepts.

Bibliography

[Ho20] Holtmann, Jörg; Steghöfer, Jan-Philipp; Rath, Michael; Schmelter, David: Cutting through the Jungle: Disambiguating Model-based Traceability Terminology. In: 28th IEEE International Requirements Engineering Conference (RE'20). IEEE, pp. 8–19, 2020. Distinguished Paper.