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Peer Review

Review of: "Conceptual Entity-Relationship Model: Beneath the Simplicity and Staticity"

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I believe this paper makes a valuable contribution to the field of system modeling and database design through the use of TMs. It would likely stimulate further research and advancements in how complex systems are conceptualised and implemented. I find the following main strengths:
- Theoretical grounding. The methodology is situated within the context of modeling theory and establishes connections to other frameworks.
- Innovative conceptual framework to bridge the gap between static and dynamic models. The integration of static and dynamic elements addresses an important limitation of static descriptions.
- As the methodology shows its compatibility with relational database models, it might seem suitable for real-world implementation problems.

I bring the following suggestions to the author. These are mostly minor changes that might help the reader to understand the work and to clearly state the main points and achievements of this work.

The introduction is well written and structured. It establishes a working framework, identifies a problem, and opens an approach to tackle certain challenges. Here, the concept of thimacs might be briefly introduced.

In the introduction, the authors should highlight the gap in knowledge, or make it more explicit. What is the state-of-the-art and the step leap forward? I am missing an overview of the approach; only aims and general

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purposes of this work are treated from a conceptual point of view. Briefly, describe the methods used in this work.

The work highlights TMs' one-category ontology, contrasting with UML's object-oriented paradigm. However, the ontological basis of TM requires a deeper explanation (such as the definition of thimacs, as combined "thing/machine" entities).
As far as I understood from this manuscript, a thimac is a dual entity that acts simultaneously as a static structure (thing) and a dynamic processor (machine). This contrasts with UML's separation of classes (structure) and behaviours. This is well represented in figure 3, but further explanation might help the reader.

Some reference should be made to address multiplicity vs singularity.
The work emphasizes TM's singular model approach vs UML's model multiplicity. In this sense, section II should clarify how TM resolves inconsistencies arising from UML's fragmented diagrams.
While the structure in TM modeling consists of a single integrated model, we find multiple diagrams in UML, which require cross-diagram checks. Also, the temporal management is different as UML contains static/dynamic elements.

A visual representation of TM's spatio-temporal partitioning might be very helpful for the reader to understand conceptually the methodology and the scope of this work. Maybe figure 2 would be a good starting point, which could be adapted to an additional figure showing also thimac states (static structure) and event-driven transitions between states (dynamic behaviour).

I find very nice diagrams, such as figures 7 and 8, to clarify the system. Additionally, I would include a flowchart showing how sets evolve during the different actions, such as arrive/process/release, or the hierarchical partitioning of sets across time intervals. I am not sure if it might be more convenient to include this set of additional information in the existing diagrams or in an additional one. A color coding for the different states might help to make it visually easy to understand.

The example test case is a very good opportunity to show a daily situation where the model could be applied. A diagram could show active and inactive sections, or the different actions needed in this problem, among others. It could help to show strengths against alternative approaches and establish conclusions.

The conclusion section might better strengthen the main outputs of your research. Restate the main findings and insights gained from the study. What are the main advantages over traditional ER modeling of TM modeling, based on the singular concept of thimacs?

- Do they provide greater flexibility in representing both static and dynamic aspects of systems?
- How are the scalable levels of detail preserved from the technical requirements? For ER modeling, this was introduced as an issue in the introduction.
- Can they simplify complex systems while retaining essential information, or is it more complex?

Clearly state what the knowledge gap is with current modeling techniques and the advancement provided by your research. Do not focus only on positive things; limitations and further challenges might be highlighted, which could bring future research lines on this topic.

Declarations

Potential competing interests: No potential competing interests to declare.