

Review of doctoral thesis

Thesis name: Design of Systems Supporting Compliance Management

Candidate: Ing. Marek Skotnica

Supervisor: Ing. Petr Křemen, Ph.D.

The submitted thesis deals with the topic of supporting the design of compliance management systems by means of proper languages, formalization and execution. The candidate distinguishes centralized and decentralized compliance management and discusses different strategies for modeling, formalization and model execution, claiming different contributions across this structure. The key thesis contributions are the execution language for the DEMO models and the modeling language DasContract for smart contract generation. The problems addressed as well as the thesis contributions are relevant with obvious future potential.

From the formal perspective the thesis is well-structured, written in a good English (as far as I as a non-native speaker can judge) with some typos, and styling issues (see below). The candidate's research papers from which the thesis has apparently been compiled are traceable (e.g. p.11 – "1. Introduction" – reviewing the introduction does not seem very useful at this point, p.74 – Acknowledgments should not be here, p.62 – "DEMO ..." - DEMO has already been introduced in more detail in section 2, so no need to repeat it here, etc.). Yet, it does not hinder readability.

To speed up my reading, I would have appreciated smoother introductions of some parts (e.g. p.23 – "Important concepts from PSI Theory" - information about what PSI actually is and which purpose it serves would be helpful, p.25 – "Figure 2.4." - more detailed explanation of the individual diagrams and their usage and how to read them, or put the syntax of the graphical language into the Appendix, or p.46 – What is T03?, or p.131 – an introduction what the reader can find in section 9.3 would be helpful). Citations and references are extensive and adequate.

There are two key research questions addressed:

1. how to execute the DEMO models (either by transformation to BPMN or by a direct novel algorithm),
2. how to digitize business processes using the blockchain technology

As for 1, the objective has been addressed by an ontology-based DEMO Machine (resp. transformation to BPMN). Since Step 8 on p.59 mentions the DEMO Engine, I assume that DEMO Engine is the commercialized implementation of the abstract DEMO Machine. The candidate shows the DEMO machine working on illustrative examples. While the candidate cannot present the DEMO Engine (claiming it being proprietary), some indications about the scale of the commercial use would still be helpful. The transformation to BPMN is presented as another approach to make the DEMO models executable. The transformation is depicted in Fig.5.5. which I find very illustrative. So far the transformation has not been automated, leaving testing on larger models (due to their size and complexity of the resulting BPMN models) for future work, as also mentioned by the candidate. As for 2, the candidate introduced a technique for generating a smart contract from a visual representation, using on a novel language, designed by the candidate, DasContract and presented its usage on two case studies. From this perspective, both research questions were addressed and goals achieved.

Basing the design of a DEMO machine on an ontology (FAR ontology) is claimed as one of the contributions. Having its full description in the thesis (e.g. in the appendix) would be good. For example, "InternalFactIdentifier" and "ExternalFactIdentifier" do not seem further explained on

p.47. Also what would improve readability is to unify the language presentation (some Definitions in section 4.1.2. use EBNF, while some other are explained in plain text).

Visual modeling languages as tools to share laymen's intentions with the machine (either for centralized enterprise modeling or for smart contract generation) often have weak expressiveness, or unclear semantics as pointed out by the candidate - for example in section 5.4.8 (the unclear BPMN semantics), which was probably the reason why the presentation of the designed algorithms/techniques is done using semi-formal descriptions and illustrative examples.

The experiments performed show feasibility of the approaches developed. Yet, a few more pieces in the puzzle would help to make the global picture – for example, how would the example in section 4.2. look like in the alternative solutions mentioned in section 4.3? Also, the size and extent of the experiment in chapter 6 is admirable. Yet, a clearer statement on how it relates to the thesis goals would help.

Overall, the candidate embraced quite a large research area covering decent amount of research experiments. The publication track of the candidate involves three WoS publications, two of them having the candidate as a main author, which demonstrates his ability to defend his research within the scientific community. Thus, **the author of the dissertation proved the ability to conduct research and achieve scientific results. In accordance with par. 47, letter (4) of the Law Nr.111/1998 (The Higher Education Act) I do recommend the thesis for presentation and defense with the aim of receiving the Ph.D. degree.**

During the defense, the candidate might address the following question:

- How does the FAR ontology relate to other existing ontologies, e.g what is the level of reuse of external concepts? Do you see any potential for reuse the ontology in other scenarios (i.e. not as a backbone of the DEMO machine)?

Prague, 1.6.2023

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Minor comments:

- p.10, p.37, p.155 – “table Table” → “Table”
- p.23 – “good support for shared reasoning between stakeholders” – I would add that for a “formal” ontology its internal computational properties are crucial – (internal) consistency, (efficient) computability, etc.
- p.30 – “Figure 2.8” – Image quality is quite low.
- p.35 – “On Figure” → “In Figure”
- p.38 – “Figure 3.3” looks the same as “Figure 1.1” (also “Table 3.1” as Table “1.1”), referencing might be enough
- some abbreviations are not explained first time the reader sees them (or are not explained at all) – might be better to put these into the List of abbreviations (e.g. p.43 – FAR in the title, p.53 – OFD, p.75 – C4E, p.116 – MVVM)
- p.43 – “True, false, unknown” – how does “unknown” differ from “undefined” at p.45

- References section has some minor styling problems (e.g. text “tex.howpublished” in [150] and a few more).
- p.51 - “One and only one model can represent any enterprise that may exist in the real world. In addition, anything that is not an enterprise cannot be represented.” - I do not understand these statements.
- p.62, p.63 – “The main goal of this *paper*”
- p.66 – “P-(f)acts” – Is 5.4.3 supposed to defined them? I didn’t get what they actually are.
- p.66 – “As mentioned in section 5.1, a C-fact becomes existent ... ” - I haven’t found it there
- p.78 – “Section 6.1.1 then ...” - but this text is *right inside* Section 6.1.1.
- some subsections seem to be misaligned in the hierarchy (e.g. p.79 – “6.2.0.1”, p.101 – “7.4.0.1”)
- p.108 – “Section 8.2.1” should explicitly refer to Figure 8.4.
- p.132 – what the different colors in the Figure depict?
- e.g. [140] and [A.1] (and several other pairs) seem to refer to the same publication. Unfortunately, the link on p.43 speaks about [A.1] but points actually to [140]. Probably, not a problem with the printed version, but with the electronic version I was confused thinking at first that the references are wrong. Although I understand your motivation for having two numberings, I think that it is enough to reference one publication just once.
- I would recommend adding the information about when a URL was accessed to each URL – for example “<http://digitalchamber.org/assets/smart-contracts-12-use-cases-for-business-and-beyond.pdf>”, “http://80.link.springer.com/dialog.cvut.cz/chapter/10.1007/11557432_51” are not resolvable any more.
- some typos: p.5 – “inSection”, p.24 – “fig.”, p.24 – “Tontological”, p.35 – “to use to use”, p.39 – “methodology;”, p.39 – “implementation;”, p.62 – “Accept” should be in a monospace font, p.64 – “or each”, p.64 – “diploma theses”, p.88 – “;”, p.98 – “BMP”, p.117 – “DasContrct”, p.152 – ref [39] “doi:https”.