PhD. thesis review form

Author: RNDr. Adam KUČERA
Title: Semantic BMS: Semantics-Driven Middleware Layer for Building Operation Analysis in Large-Scale Environments
Supervisor: doc. RNDr. Tomáš Pitner, Ph.D.

Topicality

I consider the reviewed PhD. thesis as highly topical with the aim of extending basic and applied research in the domain of Building Management Systems (BMS). The thesis follows and enhances current IT trends related to the topic of sensor networks (W3C/OGC Semantic Sensor Network Ontology, OGC Observations and Measurements, Internet of Things etc.). The author’s basic research is supported by a novel ontology for the BMS domain. The applied research is represented, among others aspects, by the transfer of semantic approaches to the facility management domain. Both the basic and applied research in this PhD. thesis are supported by several applications.

The thesis is, however, in some cases, not linked satisfactorily with other relevant research. For instance, several ontologies are being developed in the facility management domain, though (as far as I know) none of them to the depth of author’s contribution. Furthermore, section 4 omits Directive 2014/61/EU of the European Parliament and of the Council of 15 May 2014 on measures to reduce the costs of deploying high-speed electronic communications networks, which is connected also to the area of facility management.

Addressing goals

The goals are not explicitly defined at the beginning of the thesis, though such definition is considered usual at the Faculty of Science (other conventions may exist at the Faculty of Informatics). I would expect, therefore, the definition of null hypotheses that are later in the text proven or rejected. In contrast, the thesis presents broader descriptions that may act as cornerstones for null hypotheses in the Discussion section.

Nevertheless, the goals such as the development of an OWL-based ontology for the BMS domain, development of Data Access API, or benchmarking of the developed system are

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followed constantly throughout the thesis. The effort and time invested by the author to achieve those goals is obvious.

Methods
The methods used within the thesis are contemporary, appropriate, and successfully employed. From the clarity point of view, I would expect a more formalized approach in some cases; such as the presentation of requirements in the form of a matrix rather than in the form of a textual description or the presentation of API method definitions by means of a simple (formal) tool, e.g. Swagger⁴, especially when formalisation is crucial in semantic approaches. I appreciate that security aspects as well as the development of front end applications are beyond the scope of the thesis. Their omission demonstrates the ability of the author to select, in this case, aspects that are directly relevant to the thesis.

I would expect more comparison with other studies, particularly in section 5.

Achievements
The achievements are in line with the goals of the thesis.

I believe that the biggest achievement is the ontology itself, as presented in section 6. The ontology seems very complex and coherent. The author describes two versions of the developed ontology; however, it remains unclear whether the developed ontology was discussed with facility managers and/or other stakeholders. I appreciate the backward compatibility of the Semantic BMS Ontology with the Semantic Sensor Network Ontology.

The developed Data Access API is well defined as a simpler and (from a user perspective) more efficient replacement for a SPARQL endpoint.

The benchmarking seems the least convincing part of the whole thesis. It also raises several unanswered questions. For instance, a question related to hardware versus software performance; see also the question related to the OpenLink Virtuoso triple store.

Use cases are clearly described.

The thesis could be significantly shortened in some parts without losing relevant information, such as sections 3 and 4 as well as the Discussion, which is sometimes too vague. The conclusions seem more like an extended abstract.

Formal aspects
The thesis is written in English and, as a non-native speaker, I do not feel qualified to judge the quality of the language. Of the remaining formal aspects, the thesis is supported by a number of well-selected publications, tables, and figures. One reference, curiously, may be found on page 41, where the Service Oriented Architecture concept is defined through Wikipedia. I would rather see a more credible source. I would have liked to see a list of abbreviations, especially when the same abbreviation may have different meanings in various domains.

⁴ https://swagger.io/
Author’s contribution

As far as I understand (from the thesis’ declaration, project repository etc.), the whole concept of Semantic-Driven Middleware Layers is solely the author’s contribution. A clearer statement on the author’s contribution to the thesis would be welcome.

Publication activity

The publication activity of the author is average from the Faculty of Science perspective (though, again, the metrics may differ at the Faculty of Informatics). On the positive side, one paper appeared in the Advanced Engineering Informatics journal (Q2 in the domain). The majority of the remaining publications consist of conference-based papers that are indexed at the Web of Science, i.e. peer-reviewed ones.

Questions/Issues for PhD. defence

- Page 9: I understand the financial constraints related to software selection. Why, therefore, for example, was OpenLink Virtuoso not used, as it provides an open-source as well as commercial version?
- Page 40: I see that JSON encoding is sufficient at this stage of development. Nevertheless, I believe that more enhanced derivations like GeoJSON or TopoJSON would be better for integration that follows the Observations and Measurements scheme.
- Page 60: Why were the requirements formulated in a rather informal way and not through a more formalised approach like a requirements matrix? I understand the iteration process; however, this could be handled by a requirements matrix as well.
- Page 69 and others: The author describes the relevance to the Semantic Sensor Network Ontology; however, he does not refer to an explicit version.
- Page 105, Table 6.3: What are the benefits of this table? For instance “ratio” uses real values in the same way as “count”.
- Was the developed ontology discussed with facility managers and/or other stakeholders?

Overall assessment

Despite some reservations and questions (which I believe will be satisfactorily addressed by the author) I declare that in the reviewed PhD. thesis Adam Kučera has demonstrated his erudition in science. I therefore believe that he has fulfilled all the requirements for presenting a valid PhD. thesis as well as the established conditions for graduating with the title of Ph.D.

I recommend this thesis for oral defence and propose a B grade, i.e. “very good”.

In Brno, 3 April 2018

Doc. RNDr. Tomáš Řezník, PhD., reviewer