

## Habilitation thesis review

*Title:* **Semantic Heterogeneity in Knowledge Representation**  
*Author:* RNDr. Martin Homola, PhD.  
*Field of study:* 9.2.1 Computer Science  
*Reviewer:* Ing. Ivana Budinská, PhD., Institute of Informatics, Slovak Academy of Sciences, Bratislava, Slovakia

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The habilitation thesis contains an eigen text within the three chapters: Introduction, Knowledge Representation, Results overview. The work contains a list of author's publications and a list of other references. Copies of the author's publications are attached. There are 15 full texts of publications that together form an organic entity related to the subject of habilitation work.

Chapter 1 provides a brief introduction to knowledge representation as a new field of science. It clarifies the term of semantic heterogeneity and defines three different cases of heterogeneity: time heterogeneity, conflicting sources and conceptualization of heterogeneity. Chapter 2 introduces semantics in context of knowledge representation. Basic definitions are introduced and explained.

Chapter 3 summarizes the results of the research ongoing since 2004. The results in the area of semantics fall into this early period. Further results are related to the field of distributed ontologies. In order to combine, interlink, integrate and reuse decentralized modular ontologies, three main approaches were studied: mapping, linking, and importing. All paradigms were formally defined and described. The results from this area were published in 2008-2010. The area of Contextualized knowledge modelling includes the most current results.

I appreciate that all the presented results have been published in highly rated scientific journals, reviewed proceedings and in two cases it were chapters of the scientific monographs. Due to the fact that the results have certainly gone through a rigorous review process, I do not need to comment on their significance, which is clearly confirmed by this publications.

The issue to which the thesis is focused is extremely up-to-date and its significance is increasing with advancing digitization and the volume of available online data resources. The issue of heterogeneity, distributed resources and contextual modeling is the most up-to-date. The results presented in this habilitation thesis are also relevant to the open and linked data initiatives. The theoretical results were appropriately illustrated except simplified artificial examles also on examples of existing ontologies – e.g. Music ontology and Biological classification ontology. Further results have been verified on the domain of FIFA World Cup 2010, which is the most investigated ontology as part of the SmartWeb research project.

The results of the work can be applied in the development of information resources and knowledge bases, in the transfer of existing knowledge bases, in conflict resolution in structural argumentation and in assumption based framework. Nowadays, one can see many limitations that have an ontological approach to knowledge modelling and information and knowledge retrieval. Nevertheless, it is still important to further develop the theoretical framework that will encourage the further expansion of existing knowledge bases, their interoperability, integration and reusability. The results are aplicable also for multidimensional and multilingual information and knowledge context modelling.

I also consider very important the fact that the results obtained have been achieved in cooperation with many foreign institutions and researchers. Dr. Homola obtained several fundings from scientific grant agencies, that is also interesting and noteworthy.

The significance of the results is testified by the amount of publications and the responses to them.

There are 89 entries in the publications list, including 2 chapters in scientific monographs, 2 papers in foreign journals indexed in Current Contents, and 49 papers published in other foreign journals. He has recorded 144 responses to his works (data from the List of Publications as of 17 April 2018).

The contribution of dr. Homola to improvement of pedagogical processes at the university is also significant. It is mostly about engaging models of constructivist and social learning in teaching subjects at university.

Based on my study of the habilitation thesis and attached publications, I would like to discuss with the habilitant the following issues:

1. Is it possible to make a quantitative assessment of the achieved theoretical results from the point of view of the reasoning effectiveness and from the point of view of information retrieval? Have you been evaluated the effectiveness of some of the methods you have designed comparing to other similar methods? What is the applicability of results for BigData? How real is the usability for linked open data?
2. Ontological approach to knowledge modeling is not only a way of modelling and acquiring knowledge from large, distributed and heterogenous sources. Building knowledge on an ontological basis is a challenge requiring great domain expert knowledge and systematic approach. Could you discuss the advantages and disadvantages of the ontological approach comparing with other approaches that are currently being used?
3. One of the possible applications you refer to e.g. in an article *What if no hybrid reasoner is available? Hybrid MKNF in multi-context systems*, by Knorr M., Slota M., Leite J., Homola M., is a security domain. There is an airport scenario introduced. Could you discuss whether there are real application possibilities for using this approach in the domain of security?
4. Could you comment on the term „external objective point of view“?
5. Could you comment on the possibility of parallelization and distribution of reasoning?

I conclude that the submitted habilitation thesis fulfills the prerequisites for this type of scientific work.

I recommend the habilitation thesis for further consideration and after successful defence I recommend to award RNDr. Martin Homola, PhD., scientific-pedagogical title

„associate professor – docent“

in the study field 9.2.1 – Computer Science.

In Bratislava, July 3rd, 2018

Ing. Ivana Budinská, PhD.