O P I N I O N

by Associate Professor Vanya Angelova Ivanova, PhD,

University of Plovdiv "Paisii Hilendarski", Plovdiv

of a dissertation for awarding the educational and scientific degree "**Doctor**"

Field of higher education: 4. Natural sciences, Mathematics, and Informatics,

Professional field: 4.6 Informatics and Computer Science

Doctoral program: Informatics

Author of the dissertation: Sebiha Ahmedova Madanska

Topic: Semantic modelling of the Bulgarian cultural and historical heritage

Scientific supervisor: Prof. Stanimir Nedyalkov Stoyanov, PhD

1.   General presentation of the procedure and the doctoral student

By order № RD-21-200 of 26 January 2023 of the Rector of the University of Plovdiv "Paisii Hilendarski", I have been appointed as a member of the scientific jury to participate in a procedure for the defense of a dissertation on the topic of "Semantic modelling of the Bulgarian cultural and historical heritage" for acquiring the educational and scientific degree "Doctor" in field of higher education: 4. Natural sciences, Mathematics, and Informatics, professional field: 4.6. Informatics and Computer science, doctoral program: Informatics. The author of the dissertation is Sebiha Ahmedova Madanska – a full-time doctoral student at the Department of Computer Systems, with scientific supervisor Prof. Stanimir Nedyalkov Stoyanov, PhD, from the University of Plovdiv "Paisii Hilendarski".

The set of materials presented by the doctoral student is in accordance with Article 36 (1) of the Law on the Development of the Academic Staff of the University of Plovdiv and includes the following documents on electronic media:
–   An application form to the Rector for initiating a procedure;
–   CV in European format;
–   A protocol of the preliminary discussion in the department;
–   An abstract in Bulgarian and in English;
–   A declaration of originality and authenticity of the attached documents;
–   A certificate of compliance with the minimum national requirements;
–   A list of publications;
–   A dissertation;

- Copies of the publications on the topic of the dissertation;
- A certificate № 340 of 16 December 2022 for participation in projects from the Department for Scientific Research;

The doctoral student has submitted 4 publications, 3 of which are in English and 1 in Bulgarian; one of them was presented at a conference abroad.

This set of documents complies with the requirements of the Act for the Development of the Academic Staff in the Republic of Bulgaria, the Rules for its implementation, and the Law on the Development of the Academic Staff of the University of Plovdiv "Paisii Hilendarski". The dissertation was discussed and approved for defense at a department meeting on 9 December 2022 at the Department of Computer Systems at the Faculty of Mathematics and Informatics of the University of Plovdiv. The procedure for the defense of the educational and scientific degree "doctor" is organized according to the law. The dissertation and the author's abstract correspond to the requirements of the Rules on the Conditions and Procedure for Acquiring Science Degrees and Holding Academic Positions at the University of Plovdiv.

The doctoral student Sebiha Ahmedova Madanska received her bachelor's degree in 2017 in "Information Technology, Mathematics, and Educational Management" at the University of Plovdiv "Paisii Hilendarski", Smolyan Branch, and she acquired a qualification as a teacher of mathematics, informatics, and information technology. Sebiha Madanska received a master's degree in "Software technology with a specialization in systems with artificial intelligence" (a merged two-year study plan) from the University of Plovdiv "Paisii Hilendarski" in 2018. From 2019 until now, the doctoral student has been working as a part-time assistant at the Faculty of Mathematics and Informatics at the University of Plovdiv "Paisii Hilendarski" in the academic subjects of Databases, Ontological Engineering, and Practical Projects. The doctoral student has completed a number of additional certified courses such as "Knowledge graph for beginners", "Ontologies for business analysis", "SQL (Intermediate)", and others. She was a member of the Student Council of the University of Plovdiv and the Faculty Council of the Faculty of Mathematics and Informatics of the University of Plovdiv, and is currently a member of the Academic Council of the University of Plovdiv "Paisii Hilendarski".

All this shows the desire of the doctoral student to increase her qualification and develop in the field of informatics, which is successfully complemented by her teaching activity at FMI from 2019 to today.

2. Relevance of the topic

The dissertation describes the semantic modelling of the Bulgarian cultural and historical heritage, particularly houses from and around the Renaissance period. The buildings are semantically modelled from elements and systematized according to architectural and construction norms and regional diversity. A detailed description of personalities and organizations from the

Bulgarian Renaissance to the present day is included, building materials, techniques, and constructions used by the old masters are illustrated as well as a periodization of Bulgaria in historical and architectural terms. The dissertation examines important events of the Renaissance period and the buildings, and it ontologically presents the localization of the objects with their administrative, physical, geographical, coordinate, and cadastral characteristics.

Sebiha Madanska's dissertation is in-depth innovative research work dedicated to a current problem, the aim of which is to build a unified ontological model with standardized data based on semantic representation for its future integration into a network of ontologies under the name of Cultural and Historical Heritage Ontology Network (CHH-OntoNet) and use as an intelligent tourist guide. The aim is clearly defined and supported by specific objectives, reinforcing the dissertation work. Specific and logically consistent tasks are defined, the implementation of which leads to the realization of the objectives, including analysis of the current state and creation of a concept, consideration, and integration of multiple sources, construction of a model of a Revival house and a comparative analysis of Revival houses in Bulgaria, as well as integration of all project modules into an ontology, as the developed ontological knowledge base can be expanded, improved, and implemented in different applications and contexts.

3. Knowledge of the research problem

The topic implies in-depth studies of the problem area. The theoretical foundations are presented in the first introductory chapter, which establishes the topic, and in the second chapter, which describes the state of the scientific field in an overview, applications, and existing developments. The doctoral student has taken an interdisciplinary approach, bringing together knowledge from the fields of informatics, architecture, and machine modelling, researching a variety of paper and electronic sources, architectural and historical books and dictionaries, and consulting with experts, architects, and specialists.

Sebiha Madanska develops ontologies according to the concept of semantic modelling of the Bulgarian cultural and historical heritage using an international standard for cataloging cultural objects.

This gives reason to assume that the doctoral student knows the researched problem in the necessary depth.

4. Characterization and evaluation of the dissertation work and contributions

The dissertation has a volume of 158 pages and the bibliography includes 277 sources. The dissertation consists of an introduction, four chapters, a conclusion, participation in projects, a list of 6 publications, and a bibliography.

The introduction is the foundation of the topic and scope of the dissertation work, namely semantic modelling of the Bulgarian cultural and historical heritage, and in particular the houses

from and around the Renaissance period with architecture and a prototype realization of the relevant ontologies. In this part, the doctoral student justifies the topicality of the topic, defines her main goal, and sets specific tasks for its implementation.

In the second chapter, Sebiha Madanska describes studies and existing developments regarding the problem domain and defines basic concepts such as ontology and semantic modelling. In addition, this chapter examines semantic models in historical terms, various technologies, and languages related to the concept of the Semantic Web, as well as the specifics of the application area – the cultural and historical heritage (CHH).

The third chapter describes the development of an ontology architecture (the topic of the dissertation) using the international CCO (Cataloging Cultural Objects) standard, tailored to the needs of the ontology network for the intelligent tourist guide. The tourist guide was created for the purposes of the project for digitization of the Bulgarian cultural and historical heritage.

The fourth chapter specifies semantic modelling in the context of the dissertation work and the development of six ontologies on the topic, namely the Objects, Materials, Subjects, Agents, Locations, Functionalities. and OldHouses ontologies.

The fifth chapter considers the possibility of merging the separate ontologies into a single ontology and its possible applications in the field of education and tourism.

In the concluding sixth chapter, the results of the doctoral student's work are formulated, the five talks on the topic of the dissertation work are presented, the publications are described, a summary of the results is made, and the noted citations are added. In addition, the doctoral student has included a description of possible future developments and applications of the created ontology and knowledge base.

5. Assessment of the publications and personal contribution of the doctoral student

The main results of the research have been published in journals and conference proceedings.

In total, there are four publications on the topic of the dissertation. One of the publications is in Bulgarian and the other 3 in English, which makes them accessible to a wide range of readers. One of the publications is in a journal and three are in proceedings of international scientific conferences. Three of the publications are referenced in Scopus and/or Web of Science. Two of the doctoral student's publications are independent, and two are co-authored: one with three co-authors and the other with four.

The submitted publications are proof of the good promotion of the results of the dissertation work and of the doctoral student's ability to work in a team, assume responsibilities, and be accountable. The doctoral student's contribution to the publications is indisputable.

The number and quality of the publications meet the requirements of the Rules on the

Conditions and Procedure for Acquiring Science Degrees and Holding Academic Positions at the University of Plovdiv and their content reflects basic results that are sufficiently presented to a specialized scientific audience.

6. Abstract

The abstract reflects the content and contributions of the dissertation and meets the requirements. Here, as in the dissertation work, the clear position of the author and the consistency and completeness in the realization of the set goals are evident.

7. Recommendations for future use of the dissertation contributions and results

Each chapter of the dissertation begins with an overview and ends with conclusions, which, together with the correct written language and excellent graphic layout, outline a good style of work, which I fully approve.

The doctoral student formulates realistically the future improvement, use, and development of the dissertation results. In this regard, I would like to ask the doctoral student the following question – is the developed ontology of Revival houses applicable in the smart tourist guide, as mentioned in the purpose of the dissertation (page 8 of the dissertation work)?

CONCLUSION

The dissertation contains scientific-applied and applied results, which represent an original contribution to science and meet all the requirements of the Act for the Development of the Academic Staff in the Republic of Bulgaria (ADASRB), the Rules for the Implementation of the ADASRB, and the Rules on the Conditions and Procedure for Acquiring Science Degrees and Holding Academic Positions at the University of Plovdiv "Paisii Hilendarski".

The dissertation work shows that the doctoral student Sebiha Ahmedova Madanska has in-depth theoretical knowledge and professional skills, demonstrating qualities and skills for independent conduct of scientific research.

Due to the above, I confidently give my *positive assessment* of the conducted research, presented by the above-reviewed dissertation work, abstract, achieved results, and contributions, and I **propose to the honorable scientific jury to award the educational and scientific degree "doctor"** to Sebiha Akhmedova Madanska in field of higher education: 4. Natural sciences, Mathematics, and Informatics, professional field: 4.6 Informatics and Computer Science, doctoral program "Informatics".

23.02.2023   Reviewer: ....

Assoc. Prof. Vanya Ivanova, PhD