OPINION

from Prof. PhD Kolyo Zlatanov Onkov,

"Mathematics and Informatics" department, Agricultural University - Plovdiv,

appointed a member of the Scientific Jury according to Order №: РД-21-2229/27.11.2023

of the Rector of Paisii Hilendarski University of Plovdiv

on PhD thesis for awarding educational and scientific degree "Doctor",

domain of Higher education 4. Natural sciences, mathematics and computer science,

in professional field 4.6 Informatics and computer science,

doctoral program "Informatics"

Author of the PhD thesis: **Veselina Rumenova Naneva**

Subject of the PhD thesis: **Web-Based Data Visualization Tools**

Scientific supervisors: **Prof. Angel Atanassov Golev, PhD**

Prof. Nikolay Velichkov Pavlov, PhD

1. Relevance of the problem developed in the PhD thesis in scientific and applied terms

Modern and dynamically developing business works with increasingly large and complex data sets. In a number of cases, there is a need for customized data visualization with the ability to integrate with the Application Programming Interfaces (APIs) of the two main visualization systems Microsoft Power BI and Tableau. These systems have been accepted as an element of Business Intelligence (BI). The PhD thesis is developed with the aim of building architecture for creating custom visualizations that work correctly in Microsoft Power BI and Tableau and testing the architecture by implementing visualization prototypes. All this determines the relatively high degree of relevance and significance of the problem developed in the PhD thesis in scientific and applied terms.

2. Level of knowledge of the state of the problem

The literature review is located in Chapter 1 of the PhD thesis „Web-based data visualization". 26 scientific publications, 23 books and 37 Internet sources are cited in the PhD thesis. The number of refereed scientific publications is small, but this can be explained by the specificity of the subject of PhD thesis. The standard reference method for scientific works in the field of informatics and computer science is used through the number of source in the bibliography, which allows the reader to establish more easily a connection between the reference in the text and the full description of the source in the bibliography.

PhD student has a systematic thinking and the ability to extract knowledge and information from the studied literature. An analysis of the features and functional capabilities of the data visualization systems Microsoft Power BI and Tableau is made. PhD student has excellent knowledge of these systems and understands the scientific and applied nature of the PhD work.

3. Research methodology

The PhD thesis has a strict logical sequence regarding the development of TabWerBI architecture for unified creation of custom visualizations that work correctly in the software environments Microsoft Power BI and Tableau. The basic steps in developing visualizations are presented. Methods for accessing information which cover the needed level of abstraction have been created and as well as the software techniques for styling.

I consider that there is a complete correspondence between the chosen approach, research methods and technologies and the set goals and objectives of the PhD thesis.

4. General characteristics and evaluation of the PhD thesis

The PhD thesis contains the legally required structural elements – introduction, 4 chapters with conclusions to each of them, conclusion, perspectives for future development, claimed contributions, list of publications on the PhD work, bibliography and application.

In addition to a literature review, Chapter 1 presents a comparative analysis of important features of Microsoft Power BI and Tableau.

Chapter 2 presents a precise description of the features, dependencies, and limitations of the APIs of software environments for visualization Microsoft Power BI and Tableau. PhD student focuses on important aspects such as data access, possibilities for custom stylized visualization and implementation techniques. The detailed knowledge of the both studied software environments by the PhD student is indisputable. This is a very important prerequisite for building the architecture functionalities for unified creation of custom visualizations.

Chapter 3 presents the architecture TabWerBI for unified creation of custom visualizations. The implementation of unifying dependencies on external services by defining inheritance configuration patterns as well as specifying abstractions in the data access model is discussed. Special attention is paid to the overall change of visualization and ways of styling it. The following technologies can be distinguished with a high degree of efficiency: Node.js multi-platform environment for running network applications; TypeScript language with object-oriented capabilities, which is an important element in building functionalities. An essential part of the PhD thesis is the algorithms diagrams for developing and loading a custom visualization and for accessing the data to Microsoft Power BI and Tableau.

In Chapter 4, based on the developed architecture TabWerBI, example visualizations of data from the insurance case are demonstrated. The visualizations meet personal client requirements in terms of functionality, styling and data accessibility. I accept the statement that TabWerBI under certain requirements from the client contributes to optimizing the process of building custom visualizations.

The PhD thesis is intelligently written, in excellent language and style, and the diagrams and images are made precisely. The realistic view on the future development of obtained results, including an orientation to other current software systems for business analyses, data integration and visualization such as QlikSense and Dundas BI, is an indicator of the professionalism and intelligence of the author of PhD thesis.

5. Contributions and significance of the PhD thesis for science and practice

The contributions of the PhD thesis are as follows:

1. Contributions 1 and 2 are of scientific-applied importance, which relate to the study of dependencies, common characteristics and specifics of APIs of the software environments Power BI and Tableau and building architecture for unified development of custom visualizations for these environments.

2. Contributions 3 and 4 are of applied nature. They refer to studying the specific requirements of insurance as an applied field for building high quality visualization of insurance portfolio. Prototype visualizations are presented that demonstrate the developed architecture.

I estimate the significance of the PhD student's contributions as follows: a) the scientific-applied results would be a valuable experience for IT specialists dealing with the building software tools for personal stylized data visualization both for research and in real practice; b) applied contributions are more oriented towards experts, specialists and managers working in business.

6. Evaluation of publications related to PhD thesis

PhD student presents a list of four scientific publications related to the PhD thesis. All publications are co-authored. One article has been published in journal, the rest in the proceedings of international conferences. Analyzing the publications, I claim that all publications reflect important research and results of the PhD thesis, and the personal contribution of the PhD student is substantial. I found no citations of these publications. Scientific publications [1] and [2] are indexed in Scopus and for year 2021 have SJR 0.214 and 0.189. They bring the author a total of 60 points. Thus, the requirement for acquiring the educational and scientific degree "Doctor" for a minimum of 30 points from group "G" according to the "Regulations for the implementation of the law on the development of the academic staff in the Republic of Bulgaria" in professional field 4.6 Informatics and computer science is fulfilled.

7. Opinions, recommendations and critical notes

I would limit myself to the following two notes: a) "Business Intelligence" is translated to Bulgarian in the sense of "Obtaining Information". In the context of PhD thesis, it is more correct to translate „Бизнес интелигентност", which sounds close to "data analysis, visualization"; b) algorithmic diagrams are underestimated as a result of the PhD student's work. They can even be accepted as contribution.

Let's consider expanding the functionalities of the developed architecture regarding specific data analysis, the results of which are integrated with custom visualization. The idea seems valuable for financial and marketing research in a large-scale business organization. This is a recommendation to the PhD student for future research.

The Author abstract reflects all essential elements of the PhD work – structure, aims, tasks, main results, contributions, publications and bibliography. Its volume of 32 pages is at the usual accepted level for professional field 4.6 Informatics and computer science.

8. Conclusion

On the basis of presented analysis, I consider that PhD thesis of **Veselina Rumenova Naneva** fulfils the requirements of the Law of Academic Staff in Republic of Bulgaria and Regulations for its implementation to aware educational and scientific degree **"Doctor"**.

I evaluate **POSITIVELY** the PhD thesis and propose the members of Honorable Scientific Jury to vote positively for

Veselina Rumenova Naneva to award educational and scientific degree **"Doctor"**
in domain of Higher education **4. Natural sciences, mathematics and computer science**,
professional field **4.6 Informatics and computer science**

December 21, 2023   Opinion prepared by: ....

                                        / **Prof. PhD Kolyo Onkov** /