OPINION

by **Prof. Maria Petkova Hristova, PhD**
on the Thesis for awarding educational and scientific degree PhD
Scientific Field: 4. Natural Sciences, Mathematics and Informatics;
Professional Area: 4.6. Informatics and computer sciences;
Doctoral program: Informatics
Author of the PhD Thesis: **Slaviiana Stoilova Danailova-Veleva**
Thesis Title: **Intelligent Methods for analyzing banking processes**

This opinion was prepared according to order No. 245/ 14.09.2022 of the Director of BAS Institute of Information and Communication Technologies (IICT), by which I was selected as a member of the scientific jury on the procedure for doctoral thesis defense of doctoral student Slaviiana Stoilova Danailova-Veleva, on the subject of Intelligent methods for analysis of processes in banking for the acquisition of educational and scientific degree PhD in professional area: 4.6. Informatics and Computer Science.

General description of the presented materials:

As a member of the scientific jury, I received:

• PhD Thesis;
• abstract in Bulgarian and English;
• attestation for exams taken and credits received;
• a list of printed scientific publications on the dissertation subject;
• copies of printed scientific publications on the dissertation subject;
• reference on the fulfillment of ICT minimum requirements.

The presented set of materials is in accordance with Article 8 of the Regulations on the specific conditions for acquiring scientific degrees and for occupying academic positions at ИКТ-BAS.

Actuality, aim and tasks of the dissertation work

The dissertation work is dedicated to an area that is undoubtedly relevant in recent years, such as the use of artificial intelligence in banking and, more specifically, the use of innovative intelligent methods for analyzing processes in banking. Through artificial intelligence, large volumes of data are processed and analyzed, risks are assessed and intelligent solutions are proposed. Banking is one of the industries that invest the most in artificial intelligence technologies, due to the changes in the economic environment, digitalization of banking services, the need for accurate analyzes and risk assessment, etc.

The aim of the dissertation work is formulated as: to analyze the processes in banking with the means of modern methods from the field of intelligent systems.

To achieve this goal, the following **tasks** are defined:

1. To assess the possibility of applying multi-criteria decision-making approach – Inter Criteria Analysis of the processes in banking;
2. To apply intelligent techniques for analyzing the work of financial institution in the EU, according to which the banking system functions;
3. To conduct an analysis of the activity of the participants in the financial system in EU member countries;
4. To conduct an anlysis of the financial indicators of EU member countries;
5. To conduct a comparative analysis of the financial indicators of banks in EU member states;

6. To propose intelligent techniques for nalysis of knowledge bases and their application in practice.

The dissertation was developed with the support of project No. KP-06-H22/1, „Theoretical studies and applications of intercriteria analysis" and within the framework of No. D01-65/19.03.2021, National Scientific Program „Intelligent Plant Breeding".

Knowledge on the area researched

Short and clearly defined goal, well-motivated and specifically formulated tasks, good and logically consistent structuring of the dissertation text, as well as 137 sources cited (all correctly cited in the text), of which 11 in Bulgarian, 117 in English and 9 internet sources).All this permits me to assume that the doctoral student knows the problem area, the object of the research, at a very high level in theoretical and applied aspects.

Research methodology

Research methodology used to achieve the goal of the dissertation work is appropriately chosen and motivated. It includes the use of a numerical and experimental approach and contributes to the fulfillment of the dissertation work tasks, which is proven by the presented results.

General characteristics of the dissertation work and its contributions

The dissertation consists of 108 pages, 17 figures and 10 tables. The work is structured by an introduction, three chapters and a conclusion, directions for future research, a list of author's publications on the dissertation work topic, a declaration of originality of the obtained results, a bibliography and meets the requirements of Art. 27(2) of the Regulations for Implementation of Development of the Academic Staff in Republic of Bulgaria Law.

In the first chapter, an overview of intelligent methods for analysis of complex processes is made, paying attention to: the main approaches in computer intelligence, intelligent systems, intuitionistic fuzzy sets, indexed matrices and the method of intercriteria analysis defined by Academician Krasimir Atanasov. The second chapter is devoted to an analysis of banking processes in Bulgaria, Europe and worldwide. In the third chapter, obtained experimental results of the conducted intercriteria analysis of the processes in banking are presented. An architecture for a knowledge base in the field of intelligent crop farming is proposed, designed to automate the work of growing different types of agricultural crops.

I accept the six main scientific-applied and applied contributions summarized by the doctoral student at the end of the dissertation, which were achieved by solving the tasks set in the thesis.

I believe that the dissertation work has a high level of applicability.

Fulfillment of the minimum requirements of IICT for doctor degree in Professional Area 4.6. and assessment of dissertation publications

According to the reference submitted by the doctoral student for the fulfillment of the minimum requirements of IICT with the required 30 points for group "D" (Scientific publications referenced and indexed in world-famous databases with scientific information (Web of Science, Scopus, Zantralblatt, MathSciNet, ACM Digital Library, IEEE Xplore and AIS eLibrary) the PhD student collects 56 points from 4 submitted publications, thereby exceeding the requirement. According to the NACID registration reference, the points for this group are 84.

The author's publications in PhD Thesis (all co-authored with the supervisor and other scientists) are 5 in total and are in prestigious journals such as: Lecture Notes in Networks and Systems, Scopus, in an edition with SJR without IF; Proceedings of the 10th International Conference on Intelligent Systems - IS'20 Varna, Bulgaria, IEEE Xplore; Proceedings of the International Symposium on Bioinformatics and Biomedicine, Zentralblatt; Proceedings of the

International Conference Automatics and Informatics - ICAI'21, Varna, Bulgaria, IEEE Xplore. Proceedings of the 11th International Conference on Intelligent Systems _IS'22, Warsaw, Poland, IEEE Xplore.

I think that dissertation results are very well presented to the scientific community and that dissertation work and the original results obtained are personally made by the doctoral student.

No publication citation reference provided.

Abstract

The author's abstract corresponds in volume and content to the requirements of ZRASRB and the Regulations for specific conditions for acquiring scientific degrees and for holding academic positions in IICT.

Critical notes, questions and recommendations

I have the following remark to the PhD student:

• In chapters 2 and 3 (2.7, 3.1, 3.4, etc.) of the dissertation the terms "indicator", "criterion", "sub-indicator" are used differently in different places – at some places the indicator is a criterion, elsewhere the criterion is a sub-indicator or the sub-indicator is an indicator, which is incorrect.

• It is not well motivated and clearly justified the presence in the dissertation of the original knowledge-based architecture presented in point 3.5, with application in the field of intelligent plant breeding.

Question: Could the PhD student formulate additional more specific directions for future research on the dissertation topic?

I recommend the doctoral student to continue working it this research area, as the topic has a high degree of applicability and broad prospects for development.

The remark made do not reduce the positive impression of Slaviiana Danailova-Veleva's dissertation work.

CONCLUSION

My assessment of the dissertation work, the abstract and scientific publications on the dissertation of Slaviiana Stoilova Danailova-Veleva is entirely positive. The doctoral student demonstrates in-depth theoretical knowledge in the specialty of the doctoral program "Informatics" and a high level of proficiency of the terminology related to the dissertation subject.

Considering the scientific and applied contributions, which represent an original contribution to science, I think that the dissertation fully meets the requirements of the Law on the Development of the Academic Staff in Republic of Bulgaria, the Regulations for its implementation, as well as the Regulations for the specific conditions for acquisition of scientific degrees and for holding academic positions in IICT. This gives me confidence to recommend to the respected members of the scientific jury to award **Slaviiana Stoilova Danailova-Veleva the educational and scientific degree "Doctor" in the professional field: 4.6. Informatics and Computer Science, PhD Program: Informatics.**

27.10.2022

На основание

ЗЗЛД