R E V I E W

in competition for the academic position of *"Professor"*

in the field of higher education *4.* ,
professional field *4.6. Informatics and Computer Science*,
specialisation *Informatics (Blockchain Technologies and Models)*,

for the needs of the section "Intelligent Systems", Institute of Information and
Communication Technologies - BAS

with candidate **Assoc. Prof. Irina Alexandrovna Radeva, PhD**
Reviewer: **Prof. Maria Petkova Hristova, PhD**

1. General rules of the competition

By Order No. 312 of December 13, 2024, issued by the Director of the Institute of Information and Communication Technologies, Bulgarian Academy of Sciences, Corresponding Member Sv. Margenov, I have been appointed as a member of the scientific jury for the competition announced in the "State Gazette", issue 87/15.10.2024, for the academic position of "Professor" in the professional field 4.6. Informatics and Computer Sciences, scientific specialty "Informatics (blockchain technologies and models)". By decision of the scientific jury at its meeting on December 17, 2024, I was appointed as a reviewer. The review complies with the Act on the Development of the Academic Staff in the Republic of Bulgaria (ADASRB), Regulations for its Implementation (RIADASRB), Regulations on the Conditions and Procedure for Acquiring Scientific Degrees and for Holding Academic Positions at the Bulgarian Academy of Sciences, Regulations on the Specific Conditions for Acquiring Scientific Degrees and for Holding Academic Positions at the Institute of Information and Communication Technologies, Bulgarian Academy of Sciences, and is based on the documents submitted for participation in the competition by the only candidate - Assoc. Prof. Irina Alexandrovna Radeva, PhD.

All documents that I received as a member of the scientific jury comply with Art.10.(1) of the Regulations on the Specific Conditions for Acquiring Scientific Degrees and for Holding Academic Positions at IICT.

2. Brief biographical details of the candidate

Assoc. Prof. Irina Alexandrovna Radeva, PhD graduated from the University of National and World Economy, Sofia in 1995 with a degree in "Finance", qualification "Economist". In 2012, after defending a dissertation thesis at the Institute of Information Technologies (IIT), she obtained an educational and scientific degree "Doctor" (PhD), specialty 01.01.12 "Informatics".

She worked as a consultant at ISOGROUP Ltd. and Astratech NET Ltd. Since 2000, she has held consecutive positions: Research Associate at IIT, "Modeling and Optimization" department, Research Associate II degree, "Soft Computing" department, Research Associate I degree and Chief Assistant in "Intelligent Systems" department (IICT). She was a part-time lecturer at the "Business Administration" department, New Bulgarian University, Sofia (2001 - 2010). From 2018 to present, she is Associate Professor (Certificate for holding academic position Associate Professor № 001286/issued on 18.06.2018, BAS IICT) in "Informatics and Computer Sciences" in "Intelligent Systems" department, IICT - BAS. Since 2020, she is also

Associate Professor at Trakia University - Stara Zagora, Faculty of Economics, Department of "Informatics and Mathematics".

3. General characteristics of the candidate's research and applied scientific activities

General description of materials submitted

In the competition for professor, Assoc. Prof. Irina Radeva, PhD participates with 28 publications, including: one book chapter, 12 journal publications, 13 conference papers, and 2 chapters from a collective monograph. Of these, 24 are in English, the remaining 4 are in Bulgarian (two are in a BAS journal and two are chapters from a collective monograph). One of the publications is single-authored.

No plagiarism has been found and proven through the legally established procedure in the works submitted for evaluation. After reviewing the competition materials and conducting the necessary checks, I confirm this statement.

None of the works duplicate publications presented during the defence of the educational and scientific degree "Doctor" (PhD) and for holding the academic position of "Associate Professor", therefore all publications are considered in the final evaluation for this competition.

Meeting the Requirements for the Academic Position "Professor"

According to Art. 61 of RIADASRB (respectively Art. 29 of the Act on the Development of the Academic Staff), candidates for the academic position "Professor" are evaluated against the conditions in Art. 60, para.1 and para. 2 and in accordance with the information from the references under Art.60, para.3. According to Art.2 para. 4, item 4.4. of the Regulations on the Conditions and Procedure for Acquiring Scientific Degrees and for Holding Academic Positions at the Bulgarian Academy of Sciences", a candidate for the academic position "Professor" must hold an educational and scientific degree "Doctor" (PhD), have the required work experience specified in the Act, and meet the minimum requirements of BAS for the respective field of higher education or professional field, as well as the requirements determined by the Scientific Council of the research unit.

Review of the documents establishes that Assoc. Prof. Irina Radeva, PhD satisfies the requirements of the above regulatory documents. A certificate of total work experience of 35 years is presented, of which 6 years and 5 months are as Associate Professor, thus proving fulfilment of the required work experience condition.

Regarding the fulfilment of minimum national requirements by groups of indicators for holding the academic position "Professor" in professional field 4.6 "Informatics and Computer Sciences" (according to Art. 2b para. 2 and 3 and Art. 29, para. 5 of the Act), as well as the specific conditions for acquiring scientific degrees and holding academic positions at IICT, the following summaries can be made:

- **For group A**, the candidate has presented Diploma № 999213/08.11.2012 for defended dissertation thesis titled "Decision-Making Models for Clusters Design " and obtaining educational and scientific degree "Doctor" (PhD).

- **For group C**, (indicator 4: Habilitation thesis - scientific publications in editions that are referenced and indexed in world scientific databases (*Web of Science, Scopus, Zentralblatt, MathSciNet, ACM Digital Library, IEEE Xplore, and AIS eLibrary*), 3 publications indexed in Web of Science are presented, all three with SJR (Scopus) and IF (WoS), in JCR quartile Q2. The publications are in: Electronics, MDPI, Basel, Switzerland; Cybernetics and Information Technologies, Prof. Marin Drinov Academic Publishing House.

- **For group D,** (under indicator 7), 17 publications are presented. Of these, 4 have SJR, with 2 in Q2, 1 in Q3, and 1 in Q4. The remaining 13 are indexed in Scopus without SJR. The publications are in: Cybernetics and Information Technologies journal, Prof. Marin Drinov Academic Publishing House; International Journal of Computing; Computers; Intuitionistic Fuzziness and Other Intelligent Theories and Their Applications, Series: Studies in Computational Intelligence; Proceedings of the IEEE International Conference on Intelligent Systems; Proceedings of the IEEE International Conference Automatics and Informatics; Conference on Big Data, Knowledge and Control Systems Engineering - BdKCSE and others.

- **For group E,** a list of 140 citations in WoS and/or Scopus is presented for the period 2019-2024 for 28 publications of the candidate. The citations are in publications in: Studies in Computational Intelligence, Cybernetics and Information Technologies, Studies in Fuzziness and Soft Computing, Research in Computer Science in the Bulgarian Academy of Sciences, Advances in Intelligent Systems and Computing, International Conference on Information Fusion (FUSION), Ottawa, ON, Canada, Journal of Intelligent & Fuzzy Systems, Recent Advances in Computational Optimization, Studies in Computational Intelligence, International Journal of Intelligent Networks, Journal on Agricultural and Food Economics - Agric Econ, Computers and Electronics in Agriculture, Electronics, MDPI and others.

- **For group F,** the indicators from this group are covered by: participation in 18 national scientific or educational projects; participation in 4 international scientific or educational projects; leadership of 7 national scientific or educational projects and attracted funds for 4 projects led by the candidate.

The candidate meets the minimum requirements as shown in the table:

Group of indicators	Content	Professor	Assoc. Prof. Irina Alexandrovna Radeva, PhD
A	Indicator 1	50	50
B	Indicator 2	...	••••
C	Indicator 3 or 4	100	120
D	Sum of indicators 5 to 10	260	290
E	Sum of points in indicator 11	140	840
F	Sum of indicators from 12 onwards	150	515

According to data reference (23.01.2025) from Web of Science, Scopus, Google Scholar and Research Gate, the candidate shows the following scientometric characteristics:

- **Web of Science:** H-Index 5, 12 publications in Web of Science Core Collection, 50 citing articles without self-citations, 51 citations without self-citations
- **Scopus:** h-index 9, 30 publications, 214 citations in 142 documents (Without self-citations: h-index 8, 30 publications, 145 citations)
- **Google Scholar:** h-index 14, i10-index 24, citations: 501
- **Research Gate:** h-index 13, citations: 410

These data provide additional evidence of the candidate's high professional level of scientific work and international visibility.

The candidate Assoc. Prof. Irina Radeva, PhD fully meets and exceeds the minimum national requirements, as well as the specific conditions for acquiring scientific degrees and

holding academic positions at IICT, BAS according to indicators for holding the academic position "Professor" in professional field 4.6 "Informatics and Computer Sciences".

4. Evaluation of the candidate's teaching activities

Assoc. Prof. Irina Radeva, PhD taught courses at the Master's Faculty of NBU in 2001-2010. She has developed curricula for: "Validation and Verification of Software Systems", "Interactive Systems", "Software Architectures", "Internet-based Technologies II" for the speciality "Information Technologies", as well as programmes for: "Digital Image Processing", "Interoperability of Information Systems", "Administration of Server Technologies I and II" and "Internet-based Technologies II" for the speciality "Software Engineering" in the professional field 4.6 Informatics and Computer Science at Trakia University - Stara Zagora.

Assoc. Prof. Radeva was the scientific supervisor of a full-time PhD student who was given the right of defence.

5. Brief description of the scientific work presented

Thematically, all of the candidate's scientific work falls within the competition's 4.6 area of specialisation in Informatics and Computer Science. The scientific work presented covers current topics in computer science: blockchain technologies, risk management models, inter-criteria analysis and multi-criteria decision making.

The main part of the candidate's work is in the field of blockchain technologies. The research focuses on blockchain-based models and approaches. In [8], a blockchain-based decentralised network model is presented for tracking scientific research for reliability. A blockchain-based supply chain management model for smart agriculture is described in [10, 17, 18], while [12] creates a framework for internal audit planning focusing on the implementation of blockchain technology in organisations.

In [15], a framework for a smart crop production platform called SCPDx (Smart Crop Production Data Exchange) is proposed to facilitate decentralised data exchange among smart agriculture participants. The approach integrates two technologies, blockchain and a distributed file system (IPFS), for managing and sharing large scientific datasets. A prototype blockchain wallet with biometric user verification is presented in [20]. The wallet uses smart contracts for digital asset management in a data sharing platform.

Various approaches and examples of applications of blockchain technology are presented in publications [16-24, 28]. A comprehensive overview of blockchain technology, describing its principles, models and applications, is provided in the independent chapter of the collective monograph "Artificial Intelligence in 24...", published by BAS "Prof. Marin Drinov" Publishing House [27].

Publications [2-4], [11], [13] present models and methods for risk analysis and risk management in the context of Industry 4.0. [2] explores the possibilities of risk analysis as a method for technology selection in Industry 4.0, including the quasi-multi-criteria SIGMA model. A decision model is proposed for managing digital risks associated with disruptive technologies in agriculture [6]. Based on the SIGMA algorithm, the model provides a multi-step approach including identification, evaluation and management of eight digital risk categories and selection of appropriate technologies for these risks. In [11], an Enterprise Global Risk Management (EGRM) framework incorporating blockchain technology is presented to address the risks associated with Industry 4.0. The evolution of risk management approaches in the context of Industry 4.0 is reviewed and an EGRM concept is proposed,

including an analysis of existing risk management standards and frameworks (ISO, FERMA, NIST, etc.), as well as risks related to Industry 4.0 and artificial intelligence in cyber-physical systems [13].

Publication [1] reviews the research development stages for determining thresholds in intercriteria analysis. Publication [9] develops a group multicriteria model for blockchain software selection under fuzziness according to organisational needs and expert judgments. The proposed framework improves decision making and increases the efficiency of blockchain software selection. The applicability of the model is demonstrated through an agricultural blockchain software example, and its reliability is proven through a sensitivity analysis comparing two MARCOS (Method of Compromise Solution) models with different weight coefficient sets.

In the field of intelligent applications (through personal assistants, intelligent agents and ontologies, language models, etc.), works cover areas such as: knowledge base for intelligent crop production [14]; use in Virtual Educational Space (VES) [5], generation of virtual or real cultural routes based on user preferences or location [7], open source Large Language Models (LLMs) [25].

From the analysis of the scientific works submitted by Assoc. Prof. Irina Radeva, PhD for the "Professor" academic position competition, it can be concluded that the candidate has sufficient quantity and quality of scientific production corresponding to the competition profile.

6. Research contribution identification

I accept the proposal in the author's summary for original contributions in the works of Assoc. Prof. Irina Radeva, PhD to be divided into 3 groups - *scientific, scientific-applied, and applied.*

Based on the candidate's publications, the following assessment can be made: **the scientific contributions** are:

- ***Developed models for decentralized blockchain applications representing useful scientific novelty:***
  - decentralized network model using blockchain for scientific research tracking [8];
  - data exchange model using blockchain technology and decentralized data storage for information management and traceability with smart contracts [15].
- ***Multi-criteria blockchain software selection under uncertainty.***

  Proposed [9]:
  - group decision-making approach integrating fuzzy evaluation methods and classical multi-criteria methods;
  - innovative evaluation system with fuzzy sets and adaptive weights for functionality, implementation, maintenance, training, and user evaluations of blockchain software;
  - decision matrix formation method using linguistic variables and seven-point evaluation scale;
  - approach for determining expert evaluation weight coefficients using five-point Likert scale and software characteristics categorization;
  - algorithm for aggregating individual expert evaluations into collective decision matrix through arithmetic operations with fuzzy numbers.

- *Automated evaluation with Natural Language Processing (NLP) metrics of Retrieval-Augmented Generation (RAG) for open-source Large Language Models (LLMs)*

Performed:

– evaluation of LLMs-generated answers accuracy in RAG using NLP metrics for quality analysis and information relevance [25];

– similarity threshold evaluation through Composite Performance Score (CPS) from NLP metrics for contextual relevance in RAG [25];

– dynamic RAG parameter tuning for managing similarity thresholds, number of retrieved documents, and flexible setting adjustments [26];

– blockchain integration for storing LLMs testing results in RAG [26].

<u>Scientific-applied contributions:</u>

- *Risk management models and procedures developed:*

– technology assessment and selection model based on SIGMA algorithm for multi-criteria analysis of disruptive technologies' risk exposures [2];

– model for systematizing eight risk categories in "human-digital environment" paradigm for Industry 4.0 [3];

– adaptation procedure for digital ecosystem risk factors through Industry 4.0 impact management approaches [4];

– Enterprise Global Risk Management (EGRM) procedure integrating Industry 4.0 risks [13];

– extended EGRM procedure incorporating Industry 4.0 risks into corporate risk management models [11];

– multi-step decision-making model for digital risk assessment in agriculture [6].

- *Development of applications and models for blockchain technology in smart agriculture:*

– supply chain traceability model with five information channels on consortium blockchain [10];

– framework integrating blockchain and distributed file systems for smart agriculture data exchange [15];

– platform for decentralized data storage and exchange (SCPDx) using Antelope blockchain and IPFS private networks [17, 19, 28];

– decentralized application (dApp) for SCPDx platform [23].

- *Data and event traceability with blockchain technologies proposed:*

– dynamic route generation and tracking approach using ontological and ambient networks as knowledge base [7];

– smart contracts vulnerability analysis, scanning, testing, and verification procedure [16];

– blockchain model for smart agriculture supply chain traceability and transparency [17];

– blockchain oracles integration in smart agriculture platform for external data verification [22];

– internal audit and control procedures using blockchain technologies [12].

- *Smart contracts integration for decentralized data exchange:*

Developed:

– two server software blockchain oracles for: 1) real-time sensor data extraction and processing; 2) blockchain network monitoring [22];

– decentralized application with smart contracts for data exchange for smart crop production (SCPDx) platform integrating Antelope blockchain and IPFS infrastructure

– [23];

– Authentication and proof-of-event evaluation procedure for smart contracts in agricultural data exchange platform [24].

Applied contributions are related to developed *smart crop production data exchange platform* [19, 20, 21, 23, 24, 28] and *Web application for testing Retrieval-Augmented Generation with large language models* [25, 26];

No information is provided on the distribution of individual authors' contributions in co-authored publications. I accept that the contribution of Assoc. Prof. Irina Radeva's contribution is equal to the contributions of all co-authors.

Significance of contributions to science and practice

Based on the overall assessment of the candidate's scientific, scientific applied and applied contributions, it can be concluded that they are significant for science and practice in the professional field of the competition. Their significance is evidenced by the numerous and authoritative citations. The contributions can be characterised as enriching an existing scientific field with new knowledge, models and applied aspects.

7. Critical comments and recommendations

In my opinion, the author's summary of original scientific, scientific applied and applied contributions could be more consolidated and synthesised, with scientific and scientific applied contributions presented more explicitly, emphasising novelty and utility.

The presentation of separation protocols for co-authored scientific publications would more clearly distinguish the candidate's personal contribution.

I have the following recommendations for Assoc. Prof. Irina Radeva, PhD:

– to show greater activity in scientific supervision and training of PhD students in Subject Area 4.6 Informatics and Computer Science, which she undoubtedly possesses, judging by her potential as an experienced researcher;

– on the basis of her scientific work, to publish a monograph in order to disseminate the recognised scientific novelties of her work.

These remarks and recommendations do not detract from the positive impression of the candidate's scientific production results in the competition.

8. Personal impressions of the candidate

I know Assoc. Prof. Irina Radeva, PhD from joint participations in scientific juries for academic staff development procedures and I have an impression of her high professionalism in the field of informatics and computer sciences.

CONCLUSION

The documents and materials submitted by the candidate Assoc. Prof. Irina Alexandrovna Radeva, PhD meet the requirements and criteria for the academic position of "Professor" according to the Act on the Development of the Academic Staff in the Republic of Bulgaria, its implementing regulations, the Regulations on the Conditions and Procedures for Acquiring Scientific Degrees and for Holding Academic Positions at the Bulgarian Academy of Sciences, and the Regulations on the Specific Conditions for Acquiring Scientific Degrees and for Holding Academic Positions at the IICT.

The research and teaching activities of Assoc. Prof. Irina Radeva are related to problems and specific tasks in the field of the announced competition and characterize the candidate as a scientist with high professional qualification.

All this gives me grounds to give my entirely **positive assessment** of the submitted materials and I propose to the esteemed scientific jury to vote on a proposal to the Scientific Council of the Institute of Information and Communication Technologies, BAS **to elect Assoc. Prof. Irina Alexandrovna Radeva, PhD to the academic position of "Professor" in professional field 4.6 Informatics and Computer Sciences, specialty "Informatics (blockchain technologies and models)" for the needs of "Intelligent Systems" department at Institute of Information and Communication Technologies, BAS.**

28.01.2025   Review

На основание

ЗЗЛД