ACADEMIC REVIEW

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Regarding the dissertation for the awarding of an educational degree in 'PhD studies' in Academic track 3.“Social, Economics and Legal Science”, Professional field 3.8. “Economics”, Doctoral program “Finance, Insurance and Social Security”

Author: Volodymyr Busygin

Subject: Development and Research of Applied Digital Economy Basis: Blockchain and Optional Approach

Supervisor: Assoc. Prof. Dr. Radostin Vazov

I. Summary of the provided materials

By order № 118 of 05.05.2022 of the Rector of the VUZF University Prof. DSc. Boris Velchev I was appointed a member of the Scientific jury to provide a procedure for defense of a dissertation on "Development and Research of Applied Digital Economy Basis: Blockchain and Optional Approach" for acquiring the educational and scientific degree "Doctor" in Academic track 3.”Social, economic and legal sciences”, Professional field 3.8. “Economics”, Ph.D. Program "Finance, Insurance and Social Security". The author of the dissertation is Volodymyr Busygin – Ph.D. student in an independent form of education at the Department of Finance with supervisor Assoc. Prof. Radostin Vazov from the VUZF University.

During the first gathering of the Scientific jury, held on May 20th, 2022, I was appointed as a reviewer in the procedure.

The materials submitted by the candidate include:

- a CV,
- thesis, abstract,
- reference to the compliance with the minimum national criteria for acquiring the ESD "Doctor",
- summaries of the 29 publications related to the dissertation (in Bulgarian and English),
- author’s publications.

The presented materials correspond to the obligatory requirements of the Law for the Development of Academic Staff in the Republic of Bulgaria (ZRASRB) for acquiring the educational and scientific degree "Doctor" in the professional field 3.8 "Economics".

II. Brief biographic data for the PhD candidate

From the short version of the presentation, it is impossible to express any expectations for the applicant’s qualification and practical experience that could correspond with the related presented scientific work. At the same time, it should be pointed out that the researched subject develops rapidly, though extremely in the recent years, therefore it should not be expected to appear any link between knowledge, experience and scientific research.

III. Topic relevance according the main tasks

The digital economy sets the direction which initiates social and economic systems of micro, meso-, and macro-levels to develop in the long term, requiring the research and comprehensive analysis of digital transformation processes. Previously a priority for individual innovative companies, digital transformation has become a massive phenomenon today, and related projects are vital for the success of respective companies and countries. At t he same time, the conversion is closely

related to the trend of servitization of social and economic systems and is largely implemented on its basis. Moreover, this relationship and the mechanism for its implementation remain insufficiently studied, which necessitates the development of tools for its identification, assessment, and management.

IV. Knowing the problem

In the presented scientific research, the author Volodimir Busigin demonstrates excellent knowledge about the scientific problem, namely: A systematic analysis of the blockchain technology and features of its application, consideration of internal logic (encryption, consensus), are necessary. Simultaneously, one of the main problems of blockchain technology is the data reliability that determines the need for effective encryption algorithms. Such algorithms must ensure sufficient cryptographic strength for information on the network and allow the digital signature implementation.

V. Research methods

The methodological basis is the application of system analysis and integrated approaches, which are based, on the one hand, on the principles of economic theory, blockchain theory, and options, and on the other, on the conceptual principles of economic and mathematical modeling of processes in the digital economy. For the design and implementation of the aggregation procedure for the network interface channels of a multiprocessor computer system, the fundamental provisions of high-performance computing theories, the operating systems construction, parallel computing, and computing systems were applied.

VI. Characteristics and evaluation of the dissertation work

The dissertation on the topic ‘Development and research of applied digital economy basis: blockchain and optional approach’ compiles 190 pages, including lists of acronyms used, 60 figures and 8 tables, introduction, six chapters, general conclusion, bibliography, covering 183 sources.

The **purpose** is to develop theoretical foundations and methodological provisions and scientific and practical recommendations for managing the digital transformation of applied economic systems based on the blockchain technology development and an optional approach; to improve the structure and increase the performance of multiprocessor systems adapted to the problems of the studied class of the digital economy, as well as introducing numerical and analytical algorithms and methods on the basis that can increase speed, accuracy, and reliability of experimental data processing. **11 interdependent scientific tasks** are assigned. The thesis research develops the principles of the modern digital economy based on the blockchain and the option approach and improves the structures and network features of multiprocessor computing systems to successfully solve applied problems of the digital economy, designed for the significant expenditure of processing time. The research **object** was selected information processes in applied problems of the digital economy based on the blockchain and the optional approach and in modular multiprocessor computing systems. The research **subject** is the concept of managing the digital transformation of applied economic systems based on the development of blockchain technology and an optional approach; a methodology for the design of new modular multiprocessor computing systems based on reorganizing the network interface structure to solve the digital economy problems; methods and algorithms for distributed modeling of applied problems of the digital economy.

First chapter demonstrates that the digital economy reveals many opportunities, from remittances and payments to smart contracts and document reconciliation. It noted that its strengths, such as lower costs, increased security, and transparency of transactions, attracted the attention of the banking sector.

The second chapter represents that the advent of such a concept as the "digital economy" should be attributed to the number of significant modern changes in the economic environment. It is noted that such an approach in the development of the contemporary economy integrates the changes that have occurred are occurring and will continue to occur in the economic space under the decisive influence of information and communication technologies. It is emphasized that at present, the digital economy is interpreted as an actual trend in the development of modern society, business, industrial production, government, trade and services, and the life of people.

The third chapter proposes and explores a new blockchain system that operates on a linearly scalable consensus mechanism with a selection method that confirms the shard by stock voting and has scalable random generation using VRF (Verifiable Random Function) and VDF (Verifiable Delay Function) functions.

The fourth chapter shows that the expansion of possibilities in the design of computer technology was always a factor influencing the development of information technology in general and the digital economy in particular. It is shown that the importance of computational tools is of particular importance in solving problems of the digital economy since the study of many processes often requires data on such phenomena, which in real conditions are very complex and costly.

The fifth chapter focuses on the study of real options. Thus, it is noted that a real option is the ability to make flexible decisions under uncertain conditions.

The sixth chapter reveals the trade is the economy’s driving force, and with its digital version development, the options pricing problem becomes more than urgent. It is shown that the Black-Scholes-Merton model can be distinguished among the mentioned analytical methods. The thesis chapter mainly focuses on Merton's approach as an improved version of the Black-Scholes model.

The dissertation ends with 11 well formulated conclusions.

VII. The scientific novelty of the results for the theory and practice

The presented scientific work offers plenty of novelties. The most significant scientific results obtained by the author are as follows:

- The author's interpretation of the formation of a new external environment of enterprises - the "digital environment" - as a space for the manifestation of the competitive advantages of the digital economy transformation is characterized by clarifying the digitalization impact on the activities of corporate entities. At the same time the author's concept of corporate value management was further developed, considering the influence of digital factors, including radical changes in technological processes, which covers recommendations on new digital value management tools adaptation, allowing for viewing the digital component of the modern markets' growth.
- A new method of creating a fully scalable, evidence-based, and energy-efficient blockchain has been proposed by a new consensus protocol, sharding, and distributed randomness generation, which differs from the known methods in stability and reliability.
- A new model for analyzing the blockchain protocols' security based on the segmentation procedure has been developed, which differs in that it allows one to estimate the failure probabilities of one node and then each chain of the blockchain based on the hypergeometric and binomial distributions.
- Proposed approach determining the conditions by which the chains of blocks formed based on the segmentation procedure retain the failure probability less than a given threshold, which, unlike the available approach, allows computing the average number of years during which the blockchain network can fail, which, in turn, allows achieving a given level of security (in terms of the number of years before failure) to compute the minimum size of the blockchain network.

- New option creation of real options in the digital economy has been developed, which, in contrast to the available ones, allows evaluating the business models of corporate governance, considering target orientation towards the generation of digital assets.
- New approach has been developed for evaluating options based on parallel algorithms of the Monte Carlo method, which differs from the available ones instability for any input data, has the maximum similar form, and, therefore, the minimum implementation time on parallel computing devices.
- A module of a multiprocessor computing system with expandable computational domains has been developed, which is distinguished by a two-level procedure for aggregating network interface channels with such advantages as low latency and high performance, which in turn created opportunities for solving applied problems of the digital economy designed for such a computational domain.
- The numerical-analytical method for solving partial differential equations based on modern parallel computing technologies has been further developed to determine the options pricing, which allowed, in comparison with the traditional approach, to increase the accuracy and achieve high efficiency of computations reducing the processing time.

VIII. Evaluation of publications

The main outcomes from the dissertation are reflected in 29 publications, 6 of them in indexed Scopus issues, another 6 accepted for issuing, 8 articles in scientific magazines, 3 monographies and 6 in reports from scientific conferences. It should be noted that all the publications represent a team work and it is impossible to be assessed the individual contribution of Volodymyr Busygin. Although, due to the bug number of publications, it could be considered that the author has overachieved the national minimum requirements.

IX. Personal involvement of the author

In my opinion, the presented doctoral dissertation is a personal deal of the author.

X. Abstract

The abstract is presented in accordance with all the scientific requirements.

XI. Critical remarks and recommendations

The presented doctoral dissertation is an outstanding research, which is outlined by a great extent of novelty. The only critical remark is linked with the Bulgarian translation of the abstract. It is obvious that for this purpose a specialized software is applied without a final review to be performed.

XII. Personal impressions about the applicant

I do not know in person the author Volodymyr Busygin.

XIII. Recommendations for future usage of outcomes from the dissertation

Due to the available novelties in the dissertation, I would recommend to Volodymyr Busygin actively to present in the scientific literature his achievements.

CONCLUSION

The dissertation contains scientific, scientific-applied and applied results, which meets all the requirements of the Law for the Development of Academic Staff in the Republic of Bulgaria and the Regulation for the application of ZRASRB. The presented materials and dissertation results fully comply with the specific

requirements of the Ordinance for admission and training of Ph.D. students at the VUZF University. The dissertation reveals that the author Volodymyr Busygin has in-depth theoretical knowledge and professional skills in Professional field 3.8. “Economics”, demonstrating qualities and skills for independent research. Based on the positive results achieved in the dissertation, the nature of the critical remarks made and in accordance with the accepted criteria for obtaining a scientific and educational degree “Doctor”, I would recommend to the esteemed Scientific jury Volodymyr Busygin to be awarded the educational and scientific degree "Doctor" in Academic track 3.”Social, economic and legal sciences”, Professional field 3.8.”Economics”, doctoral program "Finance, Insurance and Social Security".

29.05. 2022

Reviewer:
Assoc. Prof. DSc. Krassimir Todorov