

OPINION

by Assoc. Prof. Dr. Eng. Veselin Gerov Nachev,
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of dissertation for awarding the educational and scientific degree "**Doctor**"
in the field of higher education *5 Technical sciences*
professional field 5.3. *Communication and computer technology*
doctoral program "*Automation of areas of the intangible field (medicine, education, science, administrative activities, etc.)*"

Author: M.A. Anna Ilieva Bekyarova-Tokmakova

Topic: "Technology-based solutions for process management in telecommunications"

Supervisor: Prof. Nevena Mileva - Paisii Hilendarski University of Plovdiv

1. General presentation of the procedure and the doctoral student

Based on the order of the Rector of the Paisii Hilendarski University of Plovdiv (PU) № ПД-22-92/17.01.2025, I have been appointed as a member of the scientific jury to ensure the procedure for defending the doctoral thesis on the topic "**Technology-based solutions for process management in telecommunications**" for the acquisition of the educational and scientific degree "Doctor" in the field of higher education 5. Technical Sciences, professional direction 5.3. Communication and Computer Engineering, doctoral program "Automation of Areas in the Intangible Sphere (medicine, education, science, administrative activities, etc.)".

The author of the dissertation is **Anna Bekyarova-Tokmakova**, with a supervisor **Prof. Nevena Mileva**, PhD, from PU "Paisii Hilendarski".

The set of materials presented by the doctoral student complies with Article 36 (1) of the Regulations for the Development of the Academic Staff of PU and includes the following documents:

- Application to the Rector of PU to initiate the procedure for defending the doctoral thesis;
- CV in European format;
- opinion from the doctoral student's supervisor;
- Protocol of preliminary discussion in the department;
- Doctoral thesis;
- Abstract in Bulgarian and English;
- List of scientific publications on the topic of the dissertation;
- Copies of scientific publications;
- Declaration of the originality and authenticity of the attached documents;
- Reference for meeting the minimum national requirements specified in the Regulations for the Development of the Academic Staff of PU for obtaining the educational-scientific degree "Doctor" in the professional direction 5.3 Communication and Computer Engineering.

All documents meet the requirements and based on this I determine the candidate's eligibility for further evaluation.

2. Relevance of the Topic

The dissertation is related to the study and application of modern technological solutions for the optimization of business process management in the telecommunications sector. The specific problem in the dissertation is forecasting and managing the customer retention process in telecommunications companies.

The topic of the dissertation is relevant and significant. In the conditions of modern competition, the use of intelligent methods to support management decision-making is an important part of the sustainable development of any organization.

The reason for the high degree of relevance of the dissertation stems from:

- the complexity of the tasks, related to the dynamics of technologies, services offered, requirements for flexibility and quality;
- the sector to which the dissertation is directed, characterized by a significant role in the country's economy;

- the goal set for improving and creating tools based on automated, digitized data collection and modern methods for data analysis.

In view of the above, I find that the topic of the dissertation of M.A. Anna Bekyarova-Tokmakova is relevant in a scientific and applied field directly related to the scientific specialty of the doctoral program.

3. Understanding the Problem

In the development of the dissertation work, 132 literary and electronic sources were used. With the exception of certain fundamental sources concerning basic algorithms in machine learning, publications from the last 10-15 years are mainly present.

Their citation in the text, in the presentation of the work, shows their direct connection with the topic of the dissertation.

The overview part of the dissertation work shows a very good knowledge of the state of the problem and sufficient literary awareness regarding new conceptual solutions and results of project developments of external teams. This allowed for correct and accurate interpretation of the information and definition of the goal and objectives of the dissertation.

The dissertation work shows the accumulated experience and knowledge from the professional path of the doctoral student and it can also be accepted as a result of work in the field.

I believe that the doctoral student is familiar with the problem and has creatively assessed and interpreted the reference literature.

4. Research Methodology

The main part of the dissertation consists of three chapters. "CHAPTER I" is an overview and it examines existing technology-based solutions for process management in telecommunications. I would define the presented material as a thorough and comprehensive from the point of view of factors system analysis of business processes in telecommunications. On this basis, a categorization of business processes in telecommunications companies is proposed, in order to improve the possibilities for consistency and superiority of the services offered. Solutions in process management in telecommunications are presented when integrating with various technologies such as "IoT", cloud technologies, "Big Data Analytics", artificial intelligence and hybrid structures. Applications with artificial intelligence for predicting customers who abandon a service, as well as a number of other functionalities are comprehensively presented: purchase prediction, targeted advertising, associations, geolocation, cybersecurity, generation of innovative services for customers, "chatbot", resource allocation, etc. The overview section identifies processes related to the use of artificial intelligence in marketing and business customer service for which in-depth research is lacking.

"CHAPTER II" is related to the development of a technology-based system for managing the "Business Customer Retention" process in telecommunications. At the beginning, an analysis of the market for providing mobile services in Bulgaria was made. The key factors that influence the duration of the customer life cycle were analysed in detail. Attention was paid to the need for sufficiently representative samples to track the evolution of customers at risk of dropping out and the availability of a reliable forecasting model. Based on interviews and direct observation, a model of the "Business Customer Retention" process was proposed, which was modelled with the "Enterprise Architect" software product.

The processes were analysed through a SWOT analysis, which would help in preparing improvement strategies. A logical consequence of this analysis is the proposed redesign process (to-be). A system for predicting churn of business customers (the loss of customers who switch to a competitor) is presented systematically, in stages. A prototype of a customer churn prediction system is proposed on the *Hugging Face Hub* platform.

"CHAPTER III" presents the settings of experiments and the results obtained. The classification accuracy of nine classifiers in combinations - with and without pre-processing of the data was assessed. Based on the results on real data from a telecommunications provider, the hypothesis of finding a predictive model with sufficient accuracy is confirmed. In conclusion, I believe that there is a correspondence between the chosen research methodology and the set goal and tasks of the dissertation. An element for assessing the effectiveness of these methodologies is the achievement of models, experiments with them and the possibility of analysing results.

5. Characterization and Evaluation of the Dissertation and its Contributions

The dissertation contains scientific-applied and applied contributions. The achieved results are based on proposed conceptual models of processes and prediction, and a completed electronic platform, with the aim of using real data sets.

Although an individual approach has been applied to the object of research (telecommunications service providers), consistent with the relevant specifics, part of the results can be used in other applications. The main contributions of the dissertation can be noted:

- Expansion and deepening of knowledge about the "Customer Retention" process, based on the opinions of participants;
- A new design of the retention process is proposed, in order to optimize interaction with customers and increase the effectiveness of retention strategies;
- Various machine learning models have been implemented and evaluated in the task of predicting customer churn.

I accept the contributions made by the doctoral student and believe that they are sufficient in number and significance for a dissertation work for the acquisition of the educational and scientific degree "doctor".

6. Evaluation of Publications and the Doctoral Student's Personal Contribution

Three publications are attached to the materials on the procedure. Two of the publications are in English. In them, M.A. Anna Bekyarova-Tokmakova is the first author, together with her scientific supervisor. In one of the publications, the doctoral student is the author herself.

The topics and content of the publications are directly related to the dissertation work, reflecting its parts. I believe that the degree of personal participation in the contributions is significant.

The approach to presenting the developments in the dissertation speaks of expert knowledge and competence on the topic. There is no information about citing the publications.

7. Dissertation abstract

The abstract is presented in Bulgarian and English. It consists of 32 pages, including contributions and publications related to the dissertation work. The structure of the abstract follows the main structure of the dissertation and presents it correctly.

8. Recommendations for future use of dissertation contributions and results

The proposed methodologies and the obtained results have practical utility. When popularizing the results of the dissertation, there are real prerequisites for their use in other industries. The chosen platform for implementation would also help with this. Important prerequisites for future use of the dissertation contributions and results, is my opinion that the doctoral student must develop his research and popularize his results among interested users of similar systems.

As remarks, I would note:

- Some of the descriptions of the procedures in point 2.4.4 "Stage 4: Training a predictive model" are not entirely clear.
- The results from Table 5 (p.105) should be analysed in more detail. It may be appropriate to examine the compactness of the clusters graphically.
- It would be good to note other important aspects – parameterization of the prediction method, reduction of the feature space, removal of errors and deviating objects "outliers" in the data.

CONCLUSION

It is my opinion that the dissertation meets the normative requirements for receiving the educational and scientific degree "doctor".

The dissertation shows that the Ph.D. student **Anna Bekyarova-Tokmakova** possesses in-depth theoretical knowledge and professional skills in the scientific specialty "Automation of areas of the intangible

field (medicine, education, science, administrative activities, etc."), demonstrating qualities and skills for independent implementation of scientific and applied research.

Due to the above, I give my positive assessment of the developed dissertation work, abstract, achieved results and contributions, and I propose to the members of the scientific jury to award the educational and scientific degree "doctor" to **Anna Bekyarova-Tokmakova** in scientific field 5. Technical sciences, Professional direction 5.3. Communication and computer technology, doctoral program "Automation of areas of the intangible field (medicine, education, science, administrative activities, etc.)."

Date: 5.02.2025

Author of the opinion:

Assoc. Prof. Dr. Eng. Veselin Nachev