Review

by Prof. D.Sc. Ivan Dragov Trenchev

on the dissertation of Nayden Kirilov Naydenov
entitled: "Investigation and Modeling of Business Processes Supporting Decision-Making Related to Digital Transformation"
submitted for the award of the educational and scientific degree "Doctor" in the professional field 4.6. Informatics and Computer Science

The dissertation of Mr. Nayden Naydenov lies within one of the most rigorous and conceptually intensive areas of applied mathematics – Decision Theory, with a particular focus on multi-criteria analysis. The very formulation of the problem implies working under conditions of multifactorial uncertainty, involving numerous competing criteria that are often incommensurable in their natural dimensions.

The models developed in the dissertation are not trivial derivatives of classical optimization apparatus, but instead require a synthesis of vector evaluation methods, normalization transformations, alternative vector spaces, and aggregation of subjective and expert weights within generalized utility functions. In this context, the research can be positioned at the intersection of utility theory, Pareto sets, and social choice theory.

From the perspective of mathematical complexity, the work requires mastery of not only linear algebra and analysis but also combinatorial optimization, aggregated opinions with weighting functions, and vector normalization in multidimensional spaces, ensuring the comparability of alternatives.

In other words, the study rests upon a challenging and analytically profound branch of contemporary applied mathematics, where the combination of rigor and practical significance is not merely desirable but a necessary condition for the validity of the results.

Following a thorough check for originality, it is confirmed that the dissertation is entirely the author's own work. No evidence of plagiarism or unauthorized use of other scientific results has been found.

I. General Characteristics and Structure

The dissertation of Nayden Kirilov Naydenov is logically and coherently structured, comprising an introduction, three main chapters, a conclusion with findings, explicitly formulated scientific contributions, a list of publications, and an extensive bibliography. The total length of the work is 126 pages, containing 22 figures, 16 tables, and 187 bibliographic sources. The core content is organized into three chapters, addressing the theoretical framework, the proposed models, and their practical implementation through numerical experiments.

The submitted abstract, along with the accompanying materials and documents, fully meets the formal and substantive requirements for the defense of a dissertation for the award of the doctoral degree.

CHAPTER 1: ANALYSIS OF BUSINESS PROCESSES AND DIGITAL TRANSFORMATION TASKS, AND SOME MATHEMATICAL MODELS SUPPORTING DECISION-MAKING

In this chapter, the author presents a systematic review and critical analysis of the processes and factors accompanying digital transformation in modern organizations. Emphasis is placed on the role of the human factor, customer relationship management (CRM) systems, and changes in organizational structure and culture. The second part of the chapter provides

an analytical overview of multi-criteria decision-making (MCDM) techniques, defining core concepts, problem categories, and applicable methods for selecting among alternatives based on both quantitative and qualitative criteria. This section serves as the mathematical foundation for the entire study.

CHAPTER 2: MODELS SUPPORTING DECISION-MAKING IN VARIOUS PROCESSES RELATED TO DIGITAL TRANSFORMATION

This chapter introduces original mathematical models developed by the author to support decision-making in the context of digital transformation. First, an integrated model for assessing organizational digital maturity through both objective and subjective indicators is presented. Subsequently, a model is formulated that considers three key aspects of transformation – operational readiness, organizational readiness, and business value – through groups of quantitative indicators and optimization criteria. The chapter successively examines models supporting the work of the Chief Information Officer (CIO), including models for group decision-making in selecting remote work software tools. Special attention is given to a model for selecting a Chief Digital Transformation Officer through the aggregation of expert assessments and weights. All models are presented in mathematically complete form, with clear constraints and conditions for optimality.

CHAPTER 3: NUMERICAL TESTING OF PROPOSED MODELS SUPPORTING DECISION-MAKING IN DIGITAL TRANSFORMATION

This chapter is dedicated to the empirical validation of the proposed models. Numerical experiments are presented, conducted through simulations and sample data, to assess the progress of digital transformation and compare different alternatives for selecting software platforms and executive personnel. The studies illustrate the practical potential of the

proposed models and confirm their applicability and flexibility in diverse managerial scenarios. The author demonstrates strong analytical skills in interpreting numerical results and justifying the value of the developed methodologies.

II. Scientific Significance and Originality

The author substantiates that digital transformation is not a one-time technological act, but a multi-component and iterative process requiring comprehensive organizational adaptation. This necessitates solutions whose optimality cannot be defined unambiguously, thus calling for mathematical approaches that simultaneously account for multiple criteria, both quantitative and qualitative.

In this regard, Naydenov proposes original formalizations of key processes:

- An integrated model for assessing digital maturity through objective and subjective indicators;
- A mathematical model dividing indicators into three categories (operational readiness, organizational readiness, business value) with substantiated weight structures;
- Group decision-making models applying the SAW (Simple Additive Weighting) method and combinatorial optimization for software platform selection;
- A model for selecting a Chief Digital Transformation Officer through group evaluation across multiple criteria with expert weights.

Each of these models is well-grounded, formally derived, and illustrated through numerical experiments.

Mathematical Contribution

Although the study has an applied focus, the author demonstrates mathematical maturity in constructing functional dependencies, defining evaluation functions, and structuring multi-stage optimization problems. The developments are based on fundamental MCDM techniques such as SAW and WPM but are extended through the integration of subjective and expert weights, which is a substantial contribution to adaptive group decision-making models.

Particularly noteworthy is the approach to modeling evaluation functions through normalization conditions and flexible weight parameters (α and β), enabling calibration of the role of objective versus subjective indicators in the global assessment of digital maturity.

The dissertation is characterized not only by a high level of theoretical density and clearly defined mathematical models but also by its contributory nature, expressed in original formalizations of processes and procedures applicable to the dynamic field of digital transformation.

The author's contribution is especially valuable in integrating subjective and objective criteria into generalized utility functions, representing a conceptual extension of classical MCDM models. This unification of deterministic evaluation and expert knowledge is both practically significant and theoretically sound, with potential for adaptation across a broad range of managerial, logistical, and technological tasks.

Key scientific contributions include:

- A flexible assessment framework for digital transformation, based on a three-level indicator structure (operational, organizational, and value components);

- A model for selecting a digital leader using aggregated expert evaluations with dynamic weights, valid in both centralized and decentralized management contexts;
- The development of optimization models for software selection, applying combinatorics and linear aggregation to maximize utility under resource constraints.

The candidate's publication activity is adequate and fully aligned with the thematic scope of the dissertation. His scientific articles have been published in peer-reviewed outlets and conferences, demonstrating a deep understanding of the subject matter and the ability to communicate complex ideas with precise scientific language. The presented publications confirm both the originality of the contribution and the author's established presence within the relevant research community.

III. Critical Remarks

Some aspects deserve further attention:

- The formalization of the selection process for the Chief Digital Transformation Officer could be enhanced by incorporating stochastic components that account for uncertainty in expert assessments or by applying fuzzy logic, particularly given the subjective nature of some criteria.
- A comparison with alternative MCDM methods (such as AHP, TOPSIS, VIKOR) would enrich the analysis and provide opportunities to contrast outcomes across different approaches.
- In Chapter 3, where numerical experiments are presented, there is a lack of statistical analysis of the results. Metrics such as standard deviation, sensitivity to weights, and ranking stability under minor variations in evaluations would be beneficial.

These critical notes do not diminish the value of the research but rather open avenues for future development.

IV. Conclusion

The dissertation of Nayden Naydenov constitutes an independent, logically complete, and significant scientific study, distinguished by solid theoretical foundations, original models, and adequate applicability in the field of digital transformation. The problem formulation, mathematical toolkit, and analytical approach fully satisfy the criteria for awarding the doctoral degree.

I recommend that the esteemed Academic Committee confer upon Nayden Kirilov Naydenov the educational and scientific degree of "Doctor" in the doctoral program "Informatics," professional field 4.6 "Informatics and Computer Science."

На основание ЗЗЛД