REVIEW

Of PhD thesis for acquiring educational and scientific degree "PhD"
In Scientific Area **5.Technical sciences,**
By Professional Field **5.2.Electrical Engineering, Electronics and Automation,**
Doctoral Program of BAS "Application of the Principles and Methods of Cybernetics in Various Fields of Science"
On the topic of: **"INFLUENCE OF THE SUBJECTIVE FACTOR IN DECISION-MAKING SYSTEMS"**
Author of the PhD thesis: **Master-Eng. Ekaterina Spasova Tsopanova,**
Scientific lead: **Academician Vassil Sgurev**
Reviewer: **Prof. Ivan Krumov Kurtev, PhD-Eng.**
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By Order No.26 of January 29, 2024 of the Director of the Institute of Information and Communication Technologies at the Bulgarian Academy of Sciences (further down IICT-BAS), on the basis of the Law on the Development of the Academic Staff in the Republic of Bulgaria (LDASRB) and on the basis of Article 30, paragraph 3 of its Implementing Rules (IRLDASRB), I am appointed a member of a scientific jury in the procedure for acquiring the educational and scientific degree "Doctor" in the above-mentioned dissertation. At that meeting on February 08, 2024, the Scientific Jury selected me as a reviewer of this doctoral thesis.

As a member of the scientific jury, I have received electronically:

1. Order No.26 of January 29, 2024 from the Director of IICT at the Bulgarian Academy of Sciences, issued on the grounds of Article 4, paragraph 2 of LDASRB and a decision of the Scientific Jury of IICT at BAS, reflected in Protocol No. 1 of January 24, 2024;

2. PhD thesis for acquiring educational and scientific degree "PhD" in Bulgarian;

3. Abstract of the dissertation in Bulgarian

4. Abstract of the dissertation in English;

5. Copies of author's publications on the topic of the PhD thesis;

6. List of all publications on the dissertation;

7. Reference for the fulfillment of the minimum requirements of IICT at BAS for the educational and scientific degree "PhD";

8. CV of the author of the PhD thesis.

The review of the above documents showed that all of them fully comply with the requirements of the LDASRB, its IRLDASRB and Implementing Rules for the Terms and Conditions of Acquiring Scientific Degrees and Occupying Academic Positions in IICT-BAS.

All requirements under Article 3 of the Rules for the specific conditions for acquiring scientific degrees and for occupying academic positions in IICT-BAS in terms of the minimum number of points on indicators for professional field 5.2. Electrical Engineering, Electronics and Automation for acquiring the educational and scientific degree "PhD" are also met. By Group of indicators A the PhD student has the required number of 50 points, and by Group of indicators D with the required number of points at least 30, the PhD student has 40 points.

The PhD thesis in a volume of 156 pages has a structure: **Introduction, Four chapters, Conclusion-summary of the results obtained, List on the publications on the dissertation work, Declaration of originality of the results, Thanks, Bibliography**. Bearing in mind the relevance of the dissertation, I do not find synthesized guidelines for future research of this topic and the place of the author in this research.

The Introduction defines the object and subject of this scientific study, which is the construction of a human-machine system for decision-making taking into account motivation. Thus, the purpose of this dissertation is to study the influence of the subjective factor and in particular the

motivation in the decision-making systems. To achieve the set goal, the following four tasks are defined:

1. To analyze the types of motivation and the main motivational patterns.

2. To analyze the support systems for the decision-making process.

3. To analyze discrete decision-making systems with motivation in mind.

4. To realize a numerical example of a discrete decision system with consideration of motivation.

The proposed methodology, which is used to realize the set goal of the study, is to carry out an overview and analysis of motivation and decision-making systems, followed by the preparation of a mathematical model with a practical focus, including the creation, development and evaluation of a specific computer system for decision-making.

Chapter one is devoted to an overview of selected theoretical elements of motivation, such as: nature of motivation, types of motivation, motivational process and factors influencing motivation. Content and procedural theories, the created motivational models of support systems for the decision-making process, as well as the role of aggression in motivation are discussed. **This part of the dissertation solves the first of the tasks set.** The review is quite detailed, making up almost 40% of the entire volume of the dissertation and, without harming its contribution, can be significantly reduced in volume. *There is no choice of a relevant theory and an appropriate motivational model of such a system.*

Chapter two discusses the theoretical aspect of the theory of decision-making with motivation in mind, and a formal description and analysis of discrete decision-making systems with consideration of motivation has been made. The types of processes in the context of decision making are also discussed, as well as mathematical models and the classification of mathematical models and structured systems. The problems of modeling at different levels of decision-making are also addressed. Special attention is paid and the importance of "learning from experience" in decision-making is emphasized. The right connection, in my judgment, between decision theory and innovation has also been made. The advantages and disadvantages of different models of such decision systems are discussed, highlighting the positive qualities of the author's preferred models. Here, the extensive part, comparable to the volume of the first chapter of the study of these theoretical aspects of decision theory, proves the need for this volume for the accurate and correct solution of the problem set out in this chapter. This chapter gives a solution to the second problem in the dissertation.

Chapter three presents a formal description of discrete decision-making systems taking into account motivation, using for this purpose the mathematical concepts sets, graphs and network flows. Separate set types and their elements for describing a function are indicated in order to analyze the decision support systems. At the end of this chapter, it is pointed out that two of the defined network-flow models make it possible to take into account some psychological features when making decisions, but the rationale for the specific choice is not indicated. Furthermore, at the end of chapter three, the author concludes that these possibilities will be shown in the subsequent chapters of this work. Here the correct text is probably *"... will be shown in the next chapter of this work"*. Nevertheless, I believe that **Chapter Three solves the third task set in the dissertation, namely "To analyze discrete decision-making systems taking into account motivation".**

Chapter four, according to my assessment, is the strongest part of the dissertation, and after the detailed analyses in the previous chapters, dedicated to the topic and the purpose of this dissertation, the fourth problem **solves the fourth task by synthesis of a numerical example of a discrete decision-making system with motivation in mind.** Using the graphs defined for the target in the previous chapter and a defined generalized network flow, three optimization problems were generated — A, B and C with an appropriate mathematical apparatus, any of them with different target functions. The results obtained by the author in this chapter make it possible to account for motivation in a discrete decision system by a generalized network approach. This

illustrates the usefulness of such an approach that allows **to link individual psychological processes, in particular motivation, with rigorous models of discrete decision-making systems.**

At the end of this chapter, *the guidelines for continuing work on this topic with new directions for research and for the creation of new decision-making systems with consideration of other psychological processes are briefly indicated, as well as through the class of discrete decision-making systems described above through generalized network flow, the behavior of such systems is studied, if the motivation changes dynamically and has a partially stochastic character.* The above lines could have been formed a little more in detail *as synthesized guidelines for the future development of this topic and the place of the author in this development,* **which would further increase the level of the current study.**

The Conclusion of this paper summarizes the **11 results** achieved by the author, which I accept as contributions of this dissertation - a major part of each dissertation. The fifth result achieved is rate by me as the strongest and with a scientific and applied contribution, putting it first:

➢ **A numerical example of a discrete decision-making system with motivation has been implemented.**

I then propose the following four results – 6, 7, 8 and 9, evaluating them as scientific and applied contributions:

➢ **A grouping of motivation theories is proposed on the basis of an overview in order to take into account their influence in decision-making systems or to support these decisions, with a preference for the motivations related to the work of operators in real-time control systems;**

➢ **It was been found that in most cases motivation best fits into discrete decision-making systems;**

➢ **Discrete decision systems based on network flows have been found to enable fairly accurate and adequate modeling of discrete decision systems taking into account motivation;**

➢ **It has been found that the most suitable are the aggregated network flows with coefficients to increase or decrease the flows on the individual arcs. They can create models for decision-making in which elements of the theory of motivation, graphs and flows on them are used. These arc coefficients (KIJs) affect the influence of motivation on decision-making – positive (if KIJ > 1) or negative (if 0 < KIJ < 1).**

The remaining six results (1, 2, 3, 4, 10, and 11), I propose for applied contributions, grouped as follows:

The first three of the results presented by the author (1, 2, and 3) refer to the analysis and review required for one thesis work, which I propose to combine into one applied contribution. The fourth result (4) refers to the achievements in Chapter Three of the dissertation and also brings an applied contribution.

The last two results (10, 11) also I believe to carry **an applied contribution** with an indication of the operability of the selected aggregated network flow (10) and **as a final contribution (11) of an applied nature** - the possibilities for modeling with a wider scope than motivation.

In the list of Publications on the topic of the dissertation paper present two independent publications of the author on the subject of dissertation research, reviewed, referenced and printed in the journal of the publishing house of BAS "Marin Drinov".

The necessary **Declaration of originality of the results** is also presented, which I do not dispute and accept.

The literature used by the author is presented in the **Bibliography** to this work and contains 151 literary sources in a period mainly after 2000, which period characterizes it as sufficiently relevant and which I assess as directly related to the subject of this thesis work.

The abstract of PhD thesis in a volume of 55 pages correctly and accurately reflects the essence and content of the dissertation, including the purpose, the tasks of dissertation research and the ways of their realization, and the contributions of the author.

On the thesis paper I could make remarks and recommendations, and in addition to those mentioned so far, in many places in the text of the thesis paper and in the abstract of PhD thesis there are spelling, stylish and technical errors (for example, in the thesis paper on pages 22, 32, 36, 38, 48, 55, 65, 125). The latter could be avoided when checking through an editing program.

The notes and recommendations mentioned in my review **do not call into question or diminish** the results achieved by the author of this PhD thesis paper, proving his contributions.

CONCLUSION

Taking into account the contributions achieved in the dissertation I have reviewed, as well as the fact that all the requirements of the relevant national and specific BAS normative documents for **the educational and scientific degree "Doctor"** have been met, I dare to give **my positive assessment** and recommend to the honorable **Scientific Jury to award a Master-Eng. Ekaterina Spasova Tsopanova the educational and scientific degree "Doctor",** in Scientific field **5.Technical sciences,** Professional field **5.2. Electrical Engineering, Electronics and Automation,** Doctoral Program of BAS **"Application of the Principles and Methods of Cybernetics in Various Fields of Science".**

05.03.2024
Sofia

На основание

ЗЗЛД