

## OPINION

by **Assoc. Prof. Olympia Nikolaeva Roeva, PhD**  
Institute of Biophysics and Biomedical Engineering  
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on the Thesis for awarding educational and scientific degree PhD  
under the Scientific Field 5. Technical sciences  
Professional Area 5.2.  
Electrical engineering, Electronic and Automation,  
Ph.D. Programme: Application of the principles and methods  
of cybernetics in different areas of science (Technical sciences)

Author of the Thesis:

**Dilian Chavdarov Korsemov**

Theme of the Thesis:

**Models and Algorithms to Support Group Decision-Making**

In accordance with Order 170/11.07.2019 г. of the Director of the Institute of Information and Communication Technologies at the Bulgarian Academy of Sciences (IICT-BAS), I have been appointed as a member of the Scientific Jury regarding the PhD thesis of the PhD student Dilian Chavdarov Korsemov for awarding the educational and scientific degree "Doctor of Philosophy" (Ph.D.).

As a member of the Scientific Jury, I have been provided with:

1. A copy of the dissertation thesis for awarding the educational and scientific degree "Doctor of Philosophy" (Ph.D.).
2. A copy of the Ph.D. thesis synopsis.
3. Copies of the publications related to the PhD thesis.
4. Reference by Dilian Korsemov regarding the fulfilment of the minimal requirements formulated by IICT for awarding the educational and scientific degree "Doctor of Philosophy".

Information processing and transmission is a particularly topical area, which is determined by national priorities in the specific research area, namely: development of methods and tools for research and improvement of systems and tools for automatic control and processing of information. In this context, the purpose of the dissertation – to propose mathematical models for support of group decision-making and algorithms for their implementation, regarding the differences of the expertise of the different group members – is topical, both in scientific and applied aspects.

Ph.D. student Dilian Korsemov formulated the following tasks that enable quality problem solving:

1. To perform analysis of the existing models and techniques for group decision making;
2. To propose models for group decision-making and algorithms for their implementation, rendering account of the expertise of each individual from the group, by using:
  - the weighted average model;
  - the weighted product model;
  - the SMART model;
3. To propose a generalized algorithm for group decision making, integrating various strategies – for selection of a single best alternative, for selection of several good alternatives, for ranking of all alternatives;
4. To propose models for group decision-making under uncertainty, by using the criteria of Wald, Laplace, Hurwitz and Savage.

The Ph.D. thesis consists of 121 pages, including a Bibliography with 136 references. The work consists of an Introduction, three chapters, a Conclusion, formulated scientific contributions, a list of seven publications related to the Ph.D. thesis, a list of citations and a declaration for originality of the results obtained.

The first chapter of the Ph.D. thesis presents an overview and analysis related to the decision-making process. The goals of work and the tasks with which these goals can be achieved are formulated.

Chapter 2 describes a modified simple additive weighting, modified weighted product model, and a modified SMART based model. The proposed models for group decision-making support have been implemented. A generalized algorithm that implements three different strategies is considered – to choose one alternative, to select several alternatives, or to rank all alternatives according to their degree of preference. Models for selection of alternatives under uncertainty conditions using Wald, Laplace, Hurwitz and Savage principles are also proposed.

The numerical experiments performed on the proposed modified models and on the proposed generalized group decision-making algorithm are described in Chapter 3. The practical applicability of the group decision models under uncertainty using the Wald, Laplace, Hurwitz and Savage principles is proved.

I believe that the Ph.D. student has the following scientific and applied contributions:

1. Modifications of weighted sum model, weighted product model and SMART model for selection of alternative(s) under group decision-making are formulated. Corresponding algorithms for practical application of the formulated models are proposed.
2. A generalized algorithm for group decision-making integrating three different strategies is proposed: for choice of a alternative, for selection of several good alternatives, for ranking of all alternatives.
3. Modified models for group decision-making under uncertainty conditions using the Wald, Laplace, Hurwitz and Savage principles are proposed. Corresponding optimization tasks are formulated to determine the optimal alternative for each of these criteria.
4. Spreadsheets have been developed in the MS Excel environment of part of the proposed modifications to the group decision-making models. The results obtained are verified through the Lingo system.

The main results of the Ph.D. thesis are presented in 7 publications – three of them in journals with Impact Rank. Presented information about the four citations of publications on the Ph.D. thesis shows the high level of results obtained.

The presented synopsis of the Ph.D. thesis, in a volume of 40 pages, is well structured, correctly reflects the content of the thesis and gives an idea of the problems discussed, as well as the contributions of the Ph.D. thesis.

### **Recommendations and notes**

A number of technical and linguistic inaccuracies are noted, but they in no way diminish the qualities of the dissertation and I do not consider it necessary to discuss them.

I have the following questions to the Ph.D student:

1. From Fig. 3.2 it can be seen that Pure Integer Linear Program and Branch-and-Bound Solver were used to solve the optimization problems with the LINGO software. Justify your choice. It would be good to have brief descriptions of the LINGO software, as well as of the selected solvers and settings.

2. In Fig. 3.4 the objective function values at different coefficients for the group members' expertise are presented. What are the values for the different cases (Case-1, Case-2 and Case-3) of alternatives, respectively A-2 and A-3; A-1 and A-2; A-1 and A-3? The figure presents only the best alternative, but it is of interest to see the values of the other two alternatives for the each case.

My opinion is that the Ph.D. student Dilian Korsemov demonstrates good knowledge in the specific field and scientific potential to achieve original ideas. The Ph.D. thesis is in the form and volume corresponding to the specific requirements. In the Ph.D. thesis the scientific and applied results are achieved, which represent an original contribution to science. The results are published in reputable specialized scientific publications and / or presented in international scientific forums.

Based on the above, I confirm that the Ph.D. thesis of Dilian Chavdarov Korsemov meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, as well as the Internal Regulations for its application in the Institute of Information and Communication Technologies of the Bulgarian Academy of Sciences, for awarding the educational and scientific degree "Doctor of Philosophy". The results achieved give me reason to express my positive assessment of the thesis and to recommend to the respected Scientific Jury to award Dilian Chavdarov Korsemov the educational and scientific degree "Doctor of Philosophy" in Professional Area 5.2. Electrical engineering, Electronic and Automation, Ph.D. Programme: Application of the principles and methods of cybernetics in different areas of science (Technical sciences).

04 September 2019

Sofia

Signature: ...

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(Assoc. Prof. Olympia Roeva, Ph.D.)