

REVIEW

by
Prof. Dr. Eng. Vladimir Monov

*on a dissertation thesis for obtaining of educational and scientific degree
"Doctor"*

Author of the dissertation: mag. Boris Atanasov Staykov
Title of the dissertation: "Methods, algorithms and software systems for
decision support "
Field of higher education: 4. "Natural sciences, mathematics and
computer science "
Professional field: 4.6. "Informatics and Computer Science"
Scientific specialty: "Informatics"
Scientific adviser: Prof. Dr. Eng. Vasil Stefanov Vassilev
Scientific consultant: Assoc. Prof. Dr. Tatiana Atanasova

By Order No. 112 / 09.06.2020 of the Director of IICT-BAS I have been elected as a member of the Scientific Jury for conducting the defense of the dissertation. By decision of the Scientific Jury from a meeting held on 11.06.2020 I was appointed reviewer of the dissertation. As a member of the Scientific Jury I received:

1. Dissertation thesis for obtaining the educational and scientific degree "Doctor".
2. Abstract of the dissertation in Bulgarian and English.
3. Copies in full text of eight dissertation publications.
4. Information on fulfillment of the minimum requirements of IICT-BAS for acquisition of the educational and scientific degree "doctor".

In the evaluation of the dissertation, I have followed the requirements for acquiring the educational and scientific degree "Doctor", determined by the Law for development of the academic staff in the Republic of Bulgaria (art. 6, par. 3), the Regulations for application of the law, (art. 27, par. 1 and par. 2), as well as the Regulations for specific conditions for acquiring scientific degrees and holding academic positions in the Institute of Information and Communication Technologies (art. 3).

1. Structure and content of the dissertation thesis.

The dissertation contains 174 pages and consists of Introduction, 4 chapters, Conclusion, Summary of the achieved results and Bibliography. It contains 43 figures and 15 tables. 6 scientific-applied contributions have been formulated. The list of bibliographic sources contains 181 titles. Data on 11 citations of the dissertation publications are provided. According to the requirements, a Declaration of originality of the obtained results is attached to the dissertation.

The dissertation was discussed and proposed for defense at an extended meeting of the section "Modeling and Optimization" of IICT-BAS, held on 27.03.2020.

2. Relevance of the problem developed in the dissertation in scientific and scientific-applied terms

Decision support systems (DSS) are computer-based interactive systems designed to solve informal or poorly formalized problems arising in a number of areas such as planning, manufacturing, transport, ecology, education, etc. The problems are defined as tasks for multicriteria optimization or multicriteria analysis and are characterized by the presence of multiple criteria that are optimized simultaneously in the presence of given acceptable alternatives. The goal and tasks of the dissertation work include research, design and implementation of DSS for solving different classes of problems for multicriteria optimization in order to assist the human decision maker. Both internationally and in our country, the development of this type of systems, including the use of modern Internet technologies is of considerable interest and requires in-depth theoretical and applied knowledge in the field of informatics and computer technology. All this undoubtedly determines the relevance of the research and solved problems in the dissertation, as well as the usefulness of the scientific-applied results and practical solutions obtained by the author.

3. Degree of knowledge of the problem and creative interpretation of the literature material

In the introductory chapter of the dissertation an analytical literature review is made on the basis of the used 181 bibliographic sources by Bulgarian and foreign authors. The importance of the topic is emphasized in view of the use of Internet technologies and the development of web-based DSS. The two main classes of problems are analyzed in detail: for multicriteria optimization and multicriteria analysis, modern approaches in the development of platforms for decision support are considered. The review and analysis of the current state, current trends and problems in the thematic area of the dissertation are characterized by precision and accuracy, which shows in-depth knowledge of the subject. This allowed the author to make a well-grounded formulation of the goal and tasks of the dissertation.

4. Correspondence of the chosen research methodology and the goal and tasks of the dissertation with the achieved contributions

The general goal of the dissertation is formulated as design and realization of DSS, based on selected methods for solving different classes of problems for multicriteria optimization. To achieve this goal, the following tasks are formulated.

- Selection of methods for solving problems for multicriteria optimization, which will be the basis of the built systems.
- Algorithmic and software implementation of the selected methods, which will represent the core of the developed systems.
- Development of syntax for defining tasks for multicriteria optimization and its software implementation for the purposes of the developed systems.
- Realization of DSS for use in a working environment under the WINDOWS operating system.

- Realization of web-based DSS.
- Development of communication modules allowing data exchange with external systems.

In the field of multicriteria decision making there are many methods and approaches, differing both in the scope of the tasks and the different possibilities for their algorithmic and program implementation. On this basis, the author has methodically correctly estimated the need for systematic analysis and has made a motivated choice of methods underlying the core of the developed systems. The methodology of the conducted research includes algorithmic and program implementation of methods for solving certain classes of multicriteria optimization problems, architecture design and development of functional capabilities, control and interface modules of desktop and web-based DSS. This approach fully corresponds to the general goal and specific tasks of the dissertation. The obtained results show that the author has successfully used the chosen methodology for obtaining new results with scientific-applied and practical contribution.

5. Characteristics of the dissertation thesis

The author has a thorough knowledge of the dissertation topic and has demonstrated this in the presented thesis. Compared to several preliminary versions, a positive development and improvement of the overall content of the dissertation can be noted, in view of the remarks and recommendations made.

Chapter 1 describes scalarizing problems for multicriteria optimization (problems of the desired and acceptable levels) and the approaches for their solution. An interactive algorithm based on the GENS-IM method has been developed and implemented, which serves as a basis for the computational modules in the developed MCO-2.1 system and WebOptim system.

Chapter 2 presents a desktop-based DSS MKO-2.1. The author's developments for the purposes of this system include: syntax for defining multicriteria optimization tasks; control module; optimization module. A detailed description and illustration of the work with the system is made.

Chapter 3 presents the web-based software system WebOptim which employs technologies such as SOAP, XML and WCF. The author's developments include: the overall software architecture of the system and the database; interface and control modules; security and user management module; module for management and maintenance of computational procedures; intermediate system for communication of modules; public API module for connection and data exchange with external systems. A detailed description of the work with the system is made.

Chapter 4 describes the conducted experimental research for testing and validation of the developed systems and the algorithms implemented in them. The operability of the systems is illustrated by solving a real example of multicriteria optimization and a comparison of the results is made when working with another independent similar system.

The final part of the dissertation summarizes the results obtained and lists the contributions, which are essentially defined as scientific-applied.

In general, the dissertation is characterized by an in-depth analysis of the studied problems, the use of appropriate methodology and useful applied results obtained for their solution.

6. Scientific and scientific-applied contributions of the dissertation

I accept and appreciate the following scientific and applied contributions, formulated in the dissertation and the abstract.

- Various methods for solving problems of multicriteria optimization are systematized and specific ones are selected for algorithmic and software implementation.
- A syntax has been developed for defining linear and linear-integer problems for multicriteria optimization with the respective program parser for the purposes of the realized DSS.
- The control and computation modules of the MKO-21 system for operation under the WINDOWS operating system have been designed and developed.
- The general architecture, functionalities and user interface of the web-based DSS WebOptim have been designed and implemented.
- For the purposes of the WebOptim system, communication modules for information exchange with external systems have been developed.
- Experimental studies have been conducted to prove the operability of the developed systems.

7. Assessment of the degree of personal participation of the author in the contributions

I know the author personally and I have direct impressions of his systematic work, both individually and in a team in the field of methods and systems for multicriteria decision making. In the presented dissertation he has synthesized his personal experience, knowledge and results in the development and implementation of DSS. The acquaintance with the dissertation, the author's abstract and the publications give me a reason to consider that the work on the dissertation and the obtained results are personal contributions of the author.

8. Evaluation of dissertation publications

8 publications on the dissertation topic were presented, of which 2 by the author and 6 co-authored, all in English. Three of the publications are in editions with SJR rank, two of them in quartile Q3 and one in quartile Q4 of Scopus. One of the publications is a chapter from a book in an international edition. Data for 11 citations are presented. The published works reflect the main results of the dissertation and as a volume and quality meet the requirements for obtaining the educational and scientific degree "Doctor". With the publications made, the results of the dissertation have become available to our and the international scientific community in the field.

9. Significance of the results of the dissertation work in science and practice

The dissertation presents developed algorithms and software modules, architecture, functional capabilities and software implementation of two types of DSS: desktop-based system MKO-21 and system with web-based architecture WebOtpim. Both types of systems carry out the overall interactive process of defining and solving problems for multicriteria optimization, graphical and tabular visualization of the results, selection of the final decision by the decision maker. Experimental studies have been conducted to demonstrate the advantages and practical applicability of these systems. In general, the results obtained have a scientific-applied and practical nature, and represent a contribution to the development of modern computer systems designed to support decision-making in the presence of many alternatives.

10. Assessment of compliance of the abstract with the requirements for its design

The abstract is presented in Bulgarian and English in a volume of 35 pages and meets the requirements for its design. Its content corresponds to the content of the dissertation and presents exactly the main results in the dissertation.

11. Assessment of compliance with minimal national requirements

According to the Law for development of the academic staff in the Republic of Bulgaria and Regulation № 26 of 13.02.2019 for amendment and supplementation of this law concerning Scientific field 4, for obtaining the educational and scientific degree "Doctor" in professional field 4.6 "Informatics and Computer Science" it is required at least 30 points in group of indicators G. The same minimum number of points is required in the regulations of BAS and IICT, respectively. The total amount of points of the author in indicators from group G is 111, which significantly exceeds the specified minimal national requirements.

12. Opinion, recommendations and remarks

The dissertation is developed in detail and presents a completed research work containing original scientific-applied results and useful practical solutions in the field of multicriteria decision making. The obtained results fully correspond to the goal and tasks of the dissertation.

At the preliminary discussion of the dissertation I had remarks and recommendations regarding the overall design of the work, formulation of the author's contributions, the used literature and publications on the dissertation, as well as remarks of technical and editorial nature. I am satisfied with the way and the extent to which they are reflected in the final version of the text.

My recommendation to the author is to continue his research in the contemporary and promising field of multicriteria optimization and DSS and to present the results in prestigious international journals.

CONCLUSION

I positively evaluate the work done and the results obtained in the dissertation. The dissertation meets all the requirements of Law for development of the academic staff in the Republic of Bulgaria, the Regulations for its application, as well as the specific conditions for obtaining scientific degrees and holding academic positions at the Institute of Information and Communication Technologies. I strongly suggest to the esteemed Scientific Jury to give the mag. Boris Atanasov Staykov educational and scientific degree "Doctor" in the field of higher education: 4. "Natural Sciences, Mathematics and Informatics", professional field: 4.6. "Informatics and Computer Science".

Sofia,
25.06.2020 г.

Reviewer:
/ Prof. Dr. Eng. Vladimir Monov /

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