

REVIEW

of the dissertation for obtaining the scientific degree "**Doctor of Sciences**"

in the professional field 3.8. **Economics**

on the topic: "**Automated approaches to operational risk management**"

with author: **Assoc. Prof. Dr. Anton Antonov Gerunov**

Reviewer: **Acad. Vasil Sgurev** – Institute of Information and Communication

Technologies at BAS

By order of the Rector of Sofia University "St. Kl. Ohridski" I was included in the scientific jury for obtaining the scientific degree "Doctor of Sciences" by Assoc. Prof. Dr. Anton Antonov Gerunov. This review is based on the relevant requirements of the ACT for the Development of the Academic Staff in the Republic Bulgaria, the Regulations for its application, the Regulations for the terms and conditions for acquiring a scientific degree and holding an academic position at Sofia University "St. Kliment Ohridski" and a corresponding order of the Rector of this university.

Detailed information about the author of the peer-reviewed dissertation is contained in the materials to the dissertation, therefore in the present review these data will not be described.

1. Assessment of the relevance of the topic

In recent decades, there has been a constant complication of the processes in material production and public practice - inside and outside the country. This complication increases the risk of adverse events and these processes are accelerated.

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2. Structure and volume of the dissertation

The work consists of an introduction, five chapters, a conclusion, used literature and three appendices – a total of 363 pages. This structure is in line with the scientific, applied and methodological problems in the field of operational risks.

The bibliography includes 39 pages, of which 2 pages with sources in Bulgarian and 37 pages with sources in English. A significant number of sources are contemporary, of the several recent years. The appendices provide lists of the names of tried and tested classification algorithms and tried and tested regression algorithms, as well as the distribution of the samples according to the calculated models.

3. Description and evaluation of scientific-research results

In general, the subject of the research in the dissertation are operational risks, which the author considers as risks of poorly functioning internal processes, people and systems, as well as external events. Groups of interrelated risks are considered, each of which is described as a separate economic task. Based on these assumptions, a task is set and methods for managing these operational risks are proposed. A set of steps is sought to reduce management processes to algorithmic procedures and even to automated decision making.

The survey part of the dissertation contains a significant amount of descriptions and definitions characterizing the risks in public practice and material production, but the definition of risk, and in particular operational risk, such that it is subject to direct numerical assessment, is not given in the dissertation. And direct risk assessment enables it to be managed effectively. Using indirect risk assessments leads to rougher management.

The dissertation proposes that the management of operational risk be carried out on the basis of indirect risk assessment, and in some cases this also has its meaning and application. After all, the same object can be described by different mathematical models that reflect its different basic characteristics.

The dissertation provides a rich literature survey of the problems of classification of operational risks, their features and difficulties in classifying them.

Various standard approaches in risk management, problems in their modeling and management are also considered. Qualitative risk assessment models are also described. Formulas (8) to (11) provide estimates of annual losses from operational risks. Risks are considered as expected losses. The general distribution function of the expected operating losses is indicated. Of interest is the critical analysis of the various methods for quantitative assessment of operational risk.

The survey and dissertation do not include a widespread method for risk assessment in technogenic, technological, environmental and other disasters, when

the risk is considered as a product of two measures – risk resources, including financial, and the probability of adverse event in their manipulation – transportation, processing, energy production, financial transactions. Based on this definition, a coherent mathematical theory of risk management has been developed, including network risk.

Based on the statistical methods, the dissertation proposes new approaches to operational risk management. A general description of the economic environment and operational risks is provided. Algorithms for assessing operational risks are considered, but there are only words and not a formal description of algorithms. The same applies to the texts on their management. The following are descriptions of well-known formal models of neural networks, Bayesian networks, trees and forests such as network structures, methods for classification by logistic regression, clustering algorithms and others. It is obvious that the author of the dissertation has no scientific claims for the development of these models.

Five basic requirements for operational risk management are described, which are not formalized. There is no strict description of the process for iteratively searching for an optimal risk modeling algorithm. The steps described are essentially a sequence of rules. It is claimed that a general algorithm for automated management of operational risks has been derived, but the possibility for a formal description of this algorithm has been missed.

Based on the proposed selection criteria, classification algorithms for operational risk management are proposed. Methods for assessing the sensitivity of the classification algorithms used have been selected. An algorithm for risk management in direct marketing is proposed. In all these procedures, classical statistical methods are used, which are described in great detail. Published data from various sources are used for illustration. Based on their analysis, it is concluded that the prognostic accuracy between different algorithms can be assessed in wide intervals.

An automated application of a regression algorithm for operational risk management is proposed on the basis of known methods and through appropriate selection criteria. The case of online communications is also considered.

The need of using relatively new methods and algorithms for machine learning is pointed out, but there is no data on the use of the latest methods of so-called "deep learning". Data from the "Entertainment" sector are used for illustration. Cases of risk behavior in market demand, real estate valuation, changes in market demand are considered. This is done through the scheme used to search for appropriate management actions. A heuristic method for determining the most appropriate of different regression

dependences is proposed. A module for automatic search of risk observations is described in words, but its formal interpretation is missing.

Various possible structures of information systems are considered. This is in the field of the well-known computer and communication technologies – local and global. Most of the text should be shortened, as it has no direct relation to the tasks solved in the dissertation. This also applies to a number of other texts in the dissertation.

4. The Most General Assessment of the Scientific and Scientific-Applied Contributions

These contributions can be summarized as follows:

1. Based on a review of a significant number of reference sources, the concept of “operational risks” is specified in terms of their management capabilities. These contributions are important in view of future research on operational risk management;
2. Methods for assessment of operational risks using classification algorithms from machine self-learning are proposed;
3. A method for using regression dependencies to assess operational risks has been developed;
4. A heuristically based sequence of rules for using the methods from the previous items 2 and 3 in the management of operational risks is proposed;
5. Rules are proposed for the use of the obtained results in the management of operational risks in practical applications;
6. The requirements for construction of automated systems – including the relevant information subsystems, for operational risk management are formulated.

5. Publications on the Dissertation

Ten publications are presented on the dissertation: one monographic textbook, one chapter of a collective monograph, two studies and six papers. Four of them are in English and six in Bulgarian.

The main research results in the dissertation have found a place in the publications. They are representative enough.

6. Abstract

The abstract is prepared in a volume of 66 pages of printed text. It is structured in six sections: introduction, general characteristics, structure of the dissertation, main results of the dissertation, publications on the dissertation and conclusion. The author’s abstract reflects the main provisions of the dissertation.

7. Critical Remarks and Recommendations

1. The dissertation lacks a separate review chapter, and the citation of numerous sources is scattered throughout the voluminous dissertation. Therefore, it is very difficult to specify what are the new scientific results of the dissertation. There is no clear line between one's own and another's results;
2. The volume of the dissertation is too large – 363 pages. It is not clear why the functioning of well-known structures such as neural networks, Bayesian networks, regression and statistical dependencies, different classification procedures, etc. should be described in detail. The dissertation is not a reference book, it is written for professionals. Whatever the results obtained, they can be written concisely, accurately, and in the peer-reviewed paper through at least twice as much textual material;
3. It is too bold to assume that the management of operational risks in complex systems, such as the financial and economic sphere, can be done only with computers. This presupposes full adequacy between human and machine intelligence, and until then many decades will pass, if it is possible at all in the current state of computer technology;
4. The opportunity to evaluate the proposed algorithms and tasks as it is generally accepted – through the concept of “computational complexity” is missed. It characterizes their asymptotic behavior, measured by Landau parameters. Instead, inaccurate techniques from the early stages of computer technology are used;
5. The algorithms proposed in the dissertation are described as a rule in words – the generally accepted tools for this purpose are not used;
6. A number of established and generally accepted mathematical terms are used and interpreted too freely and inaccurately – automated algorithm, algorithm activity, limited artificial intelligence, etc. It is not accepted to use the term “most optimal algorithm” – there is an optimal algorithm and all others of the same class, which have worse indicators, are pseudo-optimal algorithms, or approximately optimal algorithms;
7. The choice of the term “automated approaches” in the title of the dissertation is unsuccessful. Approaches are approaches, regardless of the degree of their formalization.

The mentioned critical remarks and recommendations do not in the least reduce the obtained and described in the dissertation research results.

8. Conclusion

The dissertation is dedicated to an important problem that is of growing interest among researchers – the risk assessment and its management, and in particular the operational risk. The author is an established researcher in his field of science. He shows a good

knowledge of the state of science and practice not only in operational risks, but also in other neighboring areas.

Within the framework of his assumptions, the dissertant has received a number of meaningful research results that meet the requirements for obtaining the scientific degree “Doctor of Science”.

This gives me grounds to propose to the esteemed jury to award Assoc. Prof. Dr. Anton Antonov Gerunov the scientific degree “Doctor of Science” in professional field 3.3. “Economy”.

Sofia, Sep 1st 2020

REVIEWER:

/Acad. V. Sgurev /