REVIEW

by Gergana Valcheva Taneva, Ph.D.
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of a dissertation thesis for the awarding of the educational and scientific degree **Doctor**

in: field of higher education 3. Social, economic and legal sciences

in professional field 3.8. Economics

Doctoral Program *Finance and Accounting*

Author : Georgi Petrov Kaloferov

Topic : Success Factors of Start-Up Companies

Research supervisor: Professor Stanimir Ivanov Kabaivanov, Ph.D.**,** Plovdiv University *Paisii Hilendarski*

1. General description of the presented materials

By order No. PD-21-669 dated of 24.03.2023. of the Rector of the University of Plovdiv *Paisiy Hilendarski*, I have been appointed as a member of the scientific jury to ensure a procedure for the defense of a dissertation thesis on the topic *Success Factors of Start-Up Companies* for obtaining the educational and scientific degree Ph.D in field of higher education 3. *Social, economic and legal sciences*, professional direction 3.8. *Economics*, Ph.D. program *Finance and Accounting*.

The author of the dissertation thesis is Georgi Petrov Kaloferov - a full-time Ph.D. student at the Department of *Finance and Accounting*, with scientific supervisor Professor Stanimir Ivanov Kabaivanov, Ph.D. Plovdiv University *Paisii Hilendarski*.

The set of materials presented by Georgi Kaloferov on electronic media **is in accordance** with Art. 36 (1) of the *Regulations for the Development of the Academic Staff* of the Plovdiv University and includes the following documents:

- an application to the Rector of the Plovdiv University to open the procedure for the defense of a dissertation thesis;

- CV in European format;

- protocol from the departmental council related to reporting the readiness to open the procedure and preliminary discussion of the dissertation thesis;

- dissertation thesis;

- abstract in Bulgarian and English languages;

- a list of scientific publications on the topic of the dissertation;

- copies of scientific publications on the subject of the dissertation thesis;

- declaration of originality and authenticity of the attached documents;

- official notes certifying participation in projects

- opinion from the scientific supervisor about the readiness to defend a doctoral thesis

- certificate of compliance with the specific requirements of the relevant faculty

- list ot scientific publications.

Brief biographical data of the Ph.D. student

Georgi Petrov Kaloferov was born on 24.06.1991. In 2014, he obtained a bachelor's degree in *International Economic Relations* at the Plovdiv University *Paisii Hilendarski*. He has a very good background in the field of information technology and the ability to work with a computer programs and applications. In 2017, he obtained a Master's degree in *Banking and Finance* from the *University of Sheffield*. In 2017, he obtained a master's degree from the *Higher School of Insurance and Finance*, majoring in *Banking and Finance*. In 2019 Georgi Kaloferov was enrolled as a full-time doctoral student at the Departement *Finance and Accounting* of the Plovdiv University *Paisii Hilendarski*. During the elapsed period of full-time doctoral studies, he has completed the training activities and successfully passed the examinations specified in the individual study plan for the doctoral student's self-training. In the period 2014 - 2022, he worked as a part-time teacher, and from September 2022 as an assistant at the Plovdiv University *Paisii Hilendarski* PU, *Faculty of Economic and Social Sciences*, Department of *Finance and Accounting*, which gave him the opportunity to gain certain pedagogical experience. The student works over a long period (from 2019 to 2022) on the dissertation thesis, revising and supplementing it several times, striving for greater clarity and completeness.

3. Actuality of the topic and appropriateness of the set goals and tasks

The topic of the dissertation thesis being developed is current, both in scientific and applied terms, and it responds to the need of the financial market to build a more accurate criteria system that distinguishes the factors for the successful development of start-up compagnies and small and

medium-sized enterprises. The actuality of the topic stems from the influence of venture capital on the economy and the development of innovations. The topic is significant, both for the purposes of finance education, and in a wider general education context for the development of attitudes towards working with computer programs, given that one of the sub-goals of the Ph.D. student is the selection of an appropriate machine learning algorithm that predicts with high accuracy (over 85%) the success of start-ups compagnies. Financial and digital technologies are particularly suitable because of their appeal to students in the *3.8 Economics*. The doctoral student has formulated the purpose, tasks and hypotheses of the dissertation research in accordance with the scientific problem that he sets himself.

4. Knowing the problem

From the analysis of the literature on the topic under consideration and from the overall presentation of the dissertation thesis, as well as from the results obtained, it is clearly seen that the Ph.D. student is well oriented and familiar with the state of the scientific problem, with the main sources of information related to it and with modern financial theories it presents that could be used in the education of Finance students.

5. Research methodology

The dissertation uses an experiment based on a machine learning algorithm that is supposed to predict with higher accuracy the success of start-ups and infer the significant factors that influence the success of start-ups. Appropriate quantitative and qualitative methods of analysis were applied by the doctoral student in the dissertation. To conduct the empirical research, the doctoral student used Logistic Regression, Support Vector Machines, Adaptive Boosting -AdaBoost, Decision Tree, etc. classification techniques. The research methodology and the corresponding procedure, which Georgi Kaloferov has focused on, make it possible to obtain valid research results, to achieve the goal indicated in the introduction and to realize the tasks set for resolution in the dissertation thesis.

6. Characterization and evaluation of the dissertation thesis

The dissertation thesis is organized and structured in an introduction, three chapters, a conclusion, a bibliography, a list of abbreviations used, a list of tables (52 tables), a list of figures (35 figures) and appendices (3 appendices). Of them: introduction, three chapters and conclusion – 153 pages, appendices – 32 pages, bibliography of used sources – 16 pages. It consists of a total of 201 pages. The bibliography consists of 159 sources.

In **the first chapter**, theoretically, issues generally related to the description of the startup ecosystem are discussed. Particular attention is paid to methods of evaluating start-ups and their relationship to the application of machine learning algorithm. Contemporary startup valuation

methods, traditional and alternative valuation methods, and their application to startup valuation are reviewed. The factors that influence the success of start-ups companies are presented and described in detail, as well as technology and innovation as a factor for predicting their success. A positive aspect of the Ph.D. student's thesis is his exploration of current research on the factors that determine the likelihood of success of start-ups. Concepts related to technology and innovation as a factor in predicting success, the impact of patents, risk management, the impact of technology and social media, and the applicability of machine learning in predicting project success are also presented. An essential merit of this chapter is the systematic and comprehensive study, overview and description of various methods and models for valuation of start-ups, as well as the application of various techniques for valuation of given companies, assessment of probability of bankruptcy proceedings, as well as valuation of the probability of achieving a given event. The positive and negative sides of the different methods are indicated - Berkus Method, Risk factor summation method, Scorecard method, Discounted cash flow method (DCF), Venture capital method and First Chicago Method, peer review and past transaction analysis.

What emerges as a weakness in the structure of the main text of this chapter is the presentation of multiple methods, which lack a more detailed description of their applicability in practice, advantages, disadvantages, as well as their interrelationship with the problem under consideration. Thus, the Ph.D. student is not sufficiently reasoned about the obstacles and weaknesses in applying these methods to the evaluation of start-ups. This also contributes to the insufficient comparative analysis and summary at the end of the chapter, from which the author's opinion regarding their applicability in future experimental work is clear.

An advantage of this part of the dissertation thesis is the detailed analysis of the factors that influence the greater success rate of startup projects. This allows to bring out the most important success factors and emphasize their practical applicability by venture capital funds. The author has derived the most important variables that are used in the dissertation work.

In **the second chapter** *A model for assessing the probabilities of success of start-up enterprises* presents the scientific parameters, the methodology and the organization of the study: the research methods, the toolkit and the criteria for evaluating the results, the stages of the study and other important elements of the experimental work. A description of the developed author's model is also presented. The aim, object, subject and tasks of the research are clearly and accurately formulated. The design and overall organization of the experiment involving machine learning in predicting the success of start-ups, with detailed evaluation criteria and description of the phases through which the model is built, as well as the selection of variables that participate in the model are original and outline

the aspiration of the Ph.D. student to achieve maximally accurate and valid results in the experimental part.

A major weakness in this chapter is the lack of greater depth of the author's analysis. In places in the text, the advantage of the narrative style is observed without the author's analysis. Also, in places in the work, instead of analysis in the form of text, the author presents his views in tabular form. Regarding the methods that the Ph.D. student has narratively presented, the lack of analysis of their financial significance and application. The doctoral student should provide a more well-argued presentation of what it will be and what the applicability of the specific model is in relation to the problem under consideration. The descriptive presentation of a given method does not automatically allow an assessment of its financial significance.

In **the third chapter,** the research results are presented in detail in the form of graphical figures with comments and some analyses. The basic self-learning machine learning models are applied and the top three such as *Extra Trees, Random Forest, Decision Trees* are derived. This chapter shows the doctoral student's desire for a detailed presentation of the results of the experiment and their processing. The reliability and validity of the data and results are beyond doubt. They are presented correctly and in detail, illustrated with numerous graphic figures.

At the same time, a number of weaknesses in the structure, the way of presenting the logical analyzes and the technical layout make an impression in the dissertation work, namely:

1) given that the model has not been tested, it cannot be done without establishing whether its accuracy is greater compared to other models already applicable in practice;

2) the presented 12 algorithms that are offered as analysis tools in the dissertation are briefly described without examining their applicability to the specific problem and for what reason the doctoral student uses them in the present research, i.e. what is the relationship between the investigated financial problem and the described methods;

3) the Ph.D. student analyzes companies on a global scale, which complicates and complicates the possibilities for a more in-depth concrete logical analysis;

4) it is established that we diverge between the numbering of the figures in the text and the numbering under the graph itself (example on page 81 the author describes *distribution of companies by country*, the numbering under the figure is 6, and in the text it is indicated *figure 9*) - a similar discrepancy is also observed on the following pages;

5) the results of various graphs are not thoroughly commented on (for example, figure 9, page 83 – *distribution of companies by degree of financing* - in the specific case, the cause-and-effect relationship between the researched problem and the specific graph is not presented);

6) the description of the models for balancing the data set are mathematically formulated without specifically presenting their interrelationship with the problem;

7) logical weakness is the lack of conclusive conclusions regarding the confirmation or rejection of the two hypotheses;

8) the doctoral student's self-assessment of contributions should not be recorded in the dissertation, but in the abstract;

9) an important not only technical, but also logical gap in all three chapters is the lack of connection between the appendices and the main text, which hinders clarity and makes the appendices detached and self-serving from the overall logic of the dissertation work.

7. Contributions and significance of the development for science and practice

I believe that in the dissertation thesis of Georgi Kaloferov there are contributions of scientific and practical value, which can be outlined in the following:

- the systematic overview and description of the different analysis models suitable for the construction of a criteria system for the selection of start-up projects through the main success factors is of a scientific-applied nature and will be useful, both in the field of risk management of venture capital funds, as well as in scientific circles with a view to future research;

- the presentation of the conceptual concepts of foreign authors and their positive practical experience in the use of technologies to improve the process of selection of start-up enterprises and the study of the most important success factors;

- an experimental formative model based on machine self-learning was proposed, which was applied in a large sample of companies worldwide;

- a system of criteria for evaluating the results was developed.

8. Evaluation of publications on the dissertation thesis

Georgi Kaloferov presents three publications on the topic of the dissertation thesis from collections of scientific studies referenced in Scopus. Two of the publications are independent and not co-authored. Some of the texts are included in the dissertation thesis.

9. Personal participation of the Ph.D. student

I believe that the dissertation thesis and the ideas and research presented in it, which have a contributing character, as well as the publication activity, are clearly with the personal participation of the doctoral student and are undoubtedly his personal merit.

10. Abstract

The abstract has a volume of 32 pages, and its structure roughly follows the content of the dissertation work. The abstract meets the technical requirements, and in terms of content it reflects the main results achieved in the dissertation.

11. Critical remarks and recommendations

My critical remarks regarding some weaknesses of the dissertation are presented in the discussion of the relevant chapters in the point *Characterization and evaluation of the dissertation* above. In connection with them, I can formulate the following **recommendations**:

1) It is necessary to make *comparative analyzes with conclusions and summaries* at the end of some of the paragraphs of the theoretical and experimental research. At the end of the paragraphs, a comparative analysis should be made and summarized results of it should be presented with a focus on the experimental research. In paragraph 1 of the third chapter, summarized results and conclusions of the comparative analysis should be presented with a focus on the objective, the research subject and the hypotheses; **2)** In order to achieve greater clarity and concentration of the main text of the dissertation to the purpose and subject of research, I believe that a comparative analysis should be made in the main text with conclusions about their applicability from the point of view of the upcoming experiment; **3)** The third chapter should be restructured into two paragraphs: in the first, the data from the various methods and primary analyzes should be presented, and in the second, the comparative analyses, their results and conclusions, which should not be separated into a separate paragraph; **4)** It is mandatory to create logical and technical connections between the main text of the dissertation work and the appendices as evidentiary material.

12. Personal impressions

I have known Georgi Kaloferov since 2014 as a student, doctoral candidate, part-time assistant and assistant at the Department of *Finance and Accounting*. He makes an impression on me as a hardworking person who takes responsibility for his tasks and respects his colleagues.

13. Recommendations for future use of dissertation contributions and results

I definitely believe that the systematic overview and description of the models, analytical tools and approaches will be useful for financiers, analysts, risk managers of venture capital funds. I recommend the author to remove the omissions and remarks that were presented and if possible to

issue the text as a textbook or guide that will help to increase the competence of students, financial analysts and managers.

CONCLUSION

The dissertation *contains scientific-applied results that are a contribution to science* and **meet everyone's needs** requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), the Regulations for the Implementation of the ZRASRB and the relevant Regulations of Plovdiv University *Paisiy Hilendarski*.

The dissertation shows that the doctoral student Georgi Kaloferov **has** in-depth theoretical knowledge and professional skills on the topic of the dissertation and on the scientific specialty *Finance and Accounting,* as **it shows** qualities and skills for conducting scientific research.

Due to the above, I give my *positive assessment* of the conducted research, presented by the above-reviewed dissertation work, abstract, achieved results and contributions, and *offer to the honorable scientific jury to award the educational and scientific degree "doctor"* to *Georgi Kaloferov* in the field of higher education: 3. *Social, economic and legal sciences*, scientific direction 3.8. *Economics*, Doctoral Program *Finance and Accounting*.

02.05.2023 ....

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<div align="right">/ Assoc. Prof. Gergana Taneva/</div>