

REVIEW

from Prof. Assia Petrova Rousseva – Landjeva, DSc

on a thesis for awarding the educational and scientific degree „Doctor“

Scientific field: 4. „Natural sciences, mathematics and informatics“

Professional field: 4.6 „Informatics and computer science“

Author: **Penko Zhelev Ivanov**

Scientific goals

The presented PhD thesis declares two main scientific goals. The first one is to develop and present a methodological framework for the successful integration of analytics in the management of IT-projects. It is expected that this can solve problems like data duality, integration and iterative development of projects. To this end industrial standard and best practices are investigated. The IT-professionals are offered a structured approach, which can be adapted to diverse real-life situations. The second goal is the development of educational framework for applied analytics that alligns with the evolving demands of the labor market for professionals skilled in applied business analytics. A further aim is the validation of the presented methodological framework on real IT-projects.

Brief description of the thesis

The PhD thesis entitled „Analytics in IT-Projects“ is written in English with a summary in Bulgarian. It comprises 360 pages of text. The main part of the thesis includes 300 pages and the remaining 60 pages are appendices. The thesis is structured in nine chapters and a list of references including 149 items. It also contains 12 tables, 80 figures and 8 listings with program code. In what follows, I am going to describe the main results in the presented PhD thesis.

The first chapter is introductory. The candidate explains the necessity for using analytics in IT-projects as a key requirement for their successful realization. It is clarified how the analytics improves decision making, increases the productivity in the realization of projects as well as the involvement of the participating parties. In the end, this leads to innovations and to advantages in the realization of IT-projects. The author describes the goals and the problems tackled in this PhD thesis, as well as its scope, structure and logics. A brief description of the obtained results in the thesis is also given.

The second chapter contains a summary of the used literature. The systematic review aims to provide a comprehensive and critical evaluation of the existing research. The author estimates the existing analytical approaches in the realization of IT-projects. He analyzes all the existing methodologies and frameworks in the analytics of IT-projects. In the same time the candidate comments on their strengths and weaknesses. He describes how analytics is being integrated in the processes of the project management. In addition, he discusses the challenges standing before

business analytics related with the generative artificial intelligence. Through this systematic review, the dissertation aims to address the critical needs of integrating business analytics within IT-project management.

Chapter 3 presents the research methodology adopted to explore the application of applied analytics in IT-projects. The author outlines the systematic approach to collection, analysis and validation of data using qualitative and quantitative methods. Various strategies of validation of the described frameworks using examples of the real-world IT-industry and the educational practices. In this chapter the candidate describes also methods of evaluation of the existing sources in the literature. He also identifies the limitations of this study that may influence its generalizability and the scope of the findings. Attention is paid also to ethical considerations like informed consent, confidentiality and integrity (i.e. avoiding bias, data manipulation, or unethical practices).

Chapter 4 is central for this PhD thesis. The candidate develops and presents herea methodological framework for applying analytics in IT-projects. In the beginning of the chapter the author describes some limitations and shortcomings of the traditional methodologies for IT-project management. The main difference in the approach of the candidate is that while in the past the management was based on intuition and facts from the history of the project in the present this is replaced by the collection and the complex analysis of data whose size is huge. This is forced by the increasing complexity of the IT-projects that include among other things work with large data bases in real time, as well as advanced technologies like artificial intelligence and machine learning. In addition, there are some (non-academic) requirements by the investors for transparency, predictability and accountability of the IT-projects.

The methodological framework which is a central issue in the fourth chapter is described in detail in sections 4.3 through 4.5. Section 4.3 contains a general overview of this framework and its compliance with the existing standards in the IT-industry. It is stressed that this framework is tailored to the complex demands of the modern IT-environments. Section 4.4 is the key section for this chapter (and in the whole thesis). In it the candidate explains the components of the proposed methodological framework. The framework is partitioned in eight components (phases), and they are presented in full detail.

Phase 1 is initiation and planning of the project. It includes activities for understanding the business environment, the engagement of the stakeholders, as well as conducting feasibility studies. This engagement turns out to be critical for defining important issues like the business problem, the scope and the direction of the project, the success criteria. The feasibility study evaluates the project's technical, financial and organizational viability. A key moment is the development of a project charter which is a formal document describing the scope, goals, timeline, resources and roles of the participants in the project. Here the author includes the strategic planning that sets the course of the project execution, and a comprehensive project governance plan that ensures coordination between the different parts of the project.

The second phase includes the so-called data management. It ensures that the data collected from various sources is accurate, clean and ready for analysis. This phase includes data understanding, collection, preparation and preprocessing as well as the quality management. This in turn requires the use of various quality metrics and advanced monitoring methods. Data governance involves policies and procedures for managing the data assets ensuring compliance with the regulations and maintaining data integrity.

The third phase is called „Analytics and modelling“ and is essential for the methodological framework. It is focused on development, evaluation and validation of analytical models to generate models for action and support the decision making process. It involves the selection of

appropriate models, the integration of advanced techniques like the generative artificial intelligence and the iterative training of these models. When the models are developed they must be evaluated and validated rigorously to ensure their correctness and effectiveness. This process involves the use of comprehensive evaluation metrics and other cross-validation and testing methods.

The fourth phase is the the phase of deployment and operationalization of the project. It is critical for the transition from an analytical model to a live environment. This phase includes the development of a comprehensive deployment strategy to ensure a smooth transition from development to production. This strategy should outline the infrastructure setup, the software and hardware requirements and define the different development, testing and production environments.

The fifth phase is called „Knowledge Base Management“. It ensures that the insights and the generated data throughout the project are effectively documented, organized and utilized. Essential is the development of a robust knowledge management system which ensures readiness for artificial intelligence and big data applications. This phase includes also adequate documentation and continuous learning that are of big importance for sustaining the knowledge base and ensuring that the team members acquire the latest skills and knowledge.

Phase 6 includes the integration of the emerging technologies which is crucial for keeping the IT-projects at the forefront of innovation and maintaining competitive advantage. Here the candidate reviews technologies like generative artificial intelligence, blockchain for data security, cloud computing services etc.

Phase 7 is entitled „Collaboration and Education“. Collaboration and education are critical components of any successful IT-project. They create and foster a culture of continuous improvement, innovation and shared knowledge. This phase includes various interdisciplinary activities, as well as the creation and utilization of tools for collaborative interdisciplinary work. Phase 7 includes also the development of a robust educational framework which is essential for providing continuous development of the team members and equipping them with knowledge and skills needed to tackle all the arising challenges.

The eighth phase is called „Continuous Improvement and Innovation“. It guarantees that the IT-projects remain dynamic, responsive and at the cutting edge of the technologies and the best practices. This phase consists in the regular collection of feedback for refinement and fostering an environment that encourages innovation through research, shared knowledge and collaboration. It is essential to establish mechanisms for regular feedback and for the application of agile methodologies, which should allow the organizations to enhance continuously and respond effectively to the changing environments.

In section 4.5 the author demonstrates how advanced analytical tools and project management solutions are essential for the proposed methodological framework.

Chapter 5 is devoted to the practical application of the suggested methodological framework for analytics in IT-projects. The author discusses four examples (case studies) for its application in various practical situations.

Chapter 6 is devoted to the development of the educational framework for applied analytics. Here the candidate proposes a comprehensive educational framework that should equip the students with the necessary practical skills to perform different roles in an IT-project. The key section here is 6.3 in which the author discusses the principles for creation of an educational framework for applied analytics for IT-projects. It integrates various educational strategies, that are coordinated with the demands of the IT-industry. A review of the possible educational strategies is made, as well as

possibilities for aligning the educational objectives with the dynamic needs of the IT-industry. An important place is given to the emerging technologies in the course of the educational process. The focus is set on courses on Artificial Intelligence and Machine Learning, that are the most important components in the suggested educational frame work. In this chapter, the candidate sketches also the most important parts of a possible educational program focused on business analytics. It is structured in four parts: basic courses, optional courses, projects and internships and continuous education (including seminars and short courses).

In chapter 7 the candidate presents concrete examples for application of the described strategies in the educational programmes of various academic institutions (New Bulgarian University and Boston University). These examples include:

- Data Mining and Applied Business Analytics at Boston University;
- Data Mining and Applied Business Analytics using hand-out tutorials at Boston University;
- Practical Model Deployment from Hands-on Experience in Applied Business Analytics Courses;
- Data Generation for Capstone Projects in Applied Business Analytics in Boston University.

Chapter 8 is devoted to the generalization and analysis of the obtained observations on the methodological and educational strategies in the applied analytics in the realization of IT-projects.

Chapter 9 is the concluding chapter in this thesis. It summarizes the findings in this investigation and provides a list of recommendations for practitioners and educators. It contains also suggestions for directions of future research in the field of applied analytics and IT-projects.

Main results

The main contributions of this thesis are in the area of business analytics and can be described briefly as follows:

1. A methodological framework for the integration of analytics in the realization of IT-projects is developed.
2. The proposed model incorporates innovative analytics techniques like machine learning and big data analysis.
3. An educational framework in applied business analytics is developed which is integrated in the existing programs in information technology.
4. The presented methodology incorporating business analytics in IT-projects is applied and validated in real-life projects.
5. Using analytics the DevOps processes are improved.
6. A large number of educational innovations is presented.

Remarks and comments

I have the following questions, remarks and comments related to this thesis:

- The PhD thesis is written in English and is very nicely presented. The size of the thesis exceeds considerably the usual size expected from such a thesis. One possible explanation is that the candidate has aimed to create a relatively closed and full text which summarizes his investigations in the area of business analytics.

- How is the notion „artificial intelligence“ to be understood? Should it be accepted that this name is given to a certain technology (technologies)?
- I have known the candidate for about ten years. I have been present at many of his talks given at the international conferences „Computer science and education of computer science“. They have always been very carefully prepared and excellently presented.

Publications related to the thesis

This PhD thesis is based on twelve publications in refereed journals and books from conference proceedings as follows:

- 1 paper in the volume *Entrepreneurship, Innovation, and Technology: A Holistic Analysis of Growth Factors*. Cham, Switzerland: Springer, 2023, ISBN 978-3-031-65313-1
- 1 paper in the journal „Mathematics and Informatics“ (refereed and indexed in Web of Science) IF: 0.2 (2023), JIF: Q4 (2023)
- 10 papers in the proceedings of the International Workshop on Computer Science and Education in Computer Science

The presented publications cover the minimal national requirements as described in the corresponding documents. The candidate has not presented a list of citations of his scientific publications. (But such a list is not obligatory.)

The results in this PhD thesis have been presented at numerous scientific conferences most of which are international.

Authorship of the obtained results

In three of the presented papers the candidate is the only author. Eight of the papers are with one co-author, and one is with three co-authors. I accept that in all joint publications the contribution of Penko Ivanov is equal to that of the other coauthors.

Author's summary

The author's summary is made according to the regulations and reflects properly the main contributions of this thesis.

Conclusion

In my opinion, the presented thesis “Analytics in IT-Projects” by Penko Zhelev Ivanov is a serious investigation dealing with the problems of the application of business analytics in the realization of IT-projects. This thesis is clearly focused on the applications and generalizes the long-term interest of the candidate in this area. Penko Ivanov presents a methodological and educational framework for the successful integration of business analytics in IT-projects. This is an original contribution in the area of information technology. The candidate exhibits profound knowledge in this subject. No plagiarism has been detected in this thesis and the scientific papers used in this thesis. Based on this, I conclude that he meets the national requirements prescribed by the corresponding law and the specific regulations of the New Bulgarian University for the professional field 4.6 Informatics and

computer sciences. No plagiarism has been detected in this thesis and the scientific papers on which it is based.

I assess positively the presented thesis and recommend this panel to award Penko Zhelev Ivanov the scientific degree „Doctor“ in the scientific field 4. „Natural sciences, mathematics and informatics“, professional field 4.6 „Informatics and computer sciences“.

(Prof. DSc Assia Rousseva-Landjeva)

Sofia, 25.08.2024