A Program for Modeling the Perception of Success Factors of an IT-Project Using Fuzzy Cognitive Maps

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Abstract — This research work presents a novel program for modeling the perception of success factors in Information Technology projects using Fuzzy Cognitive Maps (FCMs). The study aims to provide a comprehensive understanding of the complex relationships and interdependencies among various factors that contribute to the success of IT projects. The proposed program employs FCMs, a cognitive modeling technique that captures the inherent fuzziness and uncertainty in human reasoning and decision-making processes. The program's effectiveness is evaluated through a series of case studies involving real-world IT projects. The results demonstrate the program's potential in accurately modeling and analysis of the success of IT projects, thereby aiding project managers in strategic planning and decision-making.

Keywords — Cognitive maps, Fuzzy cognitive maps, IT-project, Success Factors, Risk Management, Success Perception, Project Management, Fuzzy Logic, Decision Making, Fuzzy Set Theory.

I. INTRODUCTION

The general purpose of the developed program is to visualize, analyze and understand the success factors of IT projects. This is achieved by using fuzzy cognitive maps, which allows you to include any variables (factors) in the model, even those that are difficult or impossible to measure in quantitative terms. The main purpose of this software is to identify and visualize the relationships between various factors from the point of view of stakeholders.

The program implements fuzzy computing models, with which analysts can evaluate and analyze the data obtained based on the proposed fuzzy computing models. Fuzzy Cognitive Maps (FCM) make it possible to model the same system in different ways, depending on the goals and professional skills of people or groups of people, fixing the time-varying values of the simulated situation.

The program generates FCM that can be used to visualize complex systems and display their development over time. At the same time, in some cases, SWOT analysis is used - this allows us to more fully characterize the factors under study.

Over time, not only the factors themselves can change, but also the connections between them. The program allows you to take this into account by rebuilding and modifying maps. This makes it possible to iteratively adjust the model and search for new dependencies and vulnerabilities.

The target audience of this program is mainly specialists working in the IT sector, namely analysts, project managers and IT directors. This is due to the fact that the program allows you to model the perception of success factors of IT projects and can be useful for researching and managing various aspects of such projects.

At the same time, this program can be used for educational purposes and has the potential to be useful for students and teachers of IT specialties, especially for those who study or teach courses related to IT project management, data analysis, artificial intelligence or cognitive science.

Finally, potential users of this program may also be authors of scientific research in the field of IT and cognitive science. It can be useful in studying the perception of factors influencing the success of IT projects, and in researching decision-making mechanisms within such projects.

At the same time, it should be noted that this program can be operated mainly by people who have the necessary skills and knowledge to work with fuzzy cognitive maps. It implies the use of the program by one analyst and many stakeholders to create the result of a collective discussion.

Recently, in light of the growing dependence of business on technology, the successful implementation of IT projects has become especially important for organizations of various fields of activity and scale. However, measuring and predicting success in the case of IT projects is still a difficult task, as they depend on many factors characterized by ambiguity and mutual connection with other aspects of consideration.

In this regard, the program for modeling the perception of success factors of IT projects using fuzzy cognitive maps is gaining significant relevance. The success factors of a project are often vaguely defined and interpreted, which makes the use of fuzzy cognitive maps an appropriate choice for their analysis and modeling.

The methodology of cognitive modeling was proposed by the American political scientist and economist Robert Axelrod [1]. Cognitive modeling was designed to make decisions in poorly defined situations. Fuzzy cognitive maps, first proposed by Bart Kosko [2], are a mixed type of graphical representation of knowledge that includes elements of cognitive maps and fuzzy logic.

In recent years, they have again attracted the attention of researchers, just as neural networks, after their "oblivion" in the 90s of the 20th century, are now experiencing their peak popularity again. For example, fuzzy cognitive maps are used in research papers written in 2018, 2019 and 2022 [3, 4, 5]. Like neural networks, fuzzy cognitive maps can be used to model complex relationships and obtain results based on vague and fuzzy information.

In numerous research papers, the authors consider fuzzy cognitive maps as a convenient and visual modeling tool. Factors and relationships between factors are located in FCM in a structure similar to the structure of the human brain (in a very simplified form), so the resulting model is easily perceived and convenient for discussion. Fuzzy cognitive maps are also versatile, which allows them to be used in many different areas [6].

Despite the neural network-like structure of fuzzy cognitive maps, the use of complex neural network algorithms is not expected within the framework of this final qualification work. This is mainly due to the specifics of the chosen methodology — fuzzy cognitive maps. This approach involves creating a model using a network structure that reveals the direct and inverse relationships between various success factors of an IT project.

II. LITERATURE REVIEW

Modeling the success factors of an IT project is one of the areas in which fuzzy cognitive maps are successfully applied. For example, in the work "Modeling IT projects success with Fuzzy Cognitive Maps" [7], the authors use FCM to model the success factors of a mobile payment system, a project related to the rapidly developing world of mobile telecommunications. The methodology described in this paper uses four matrices to represent the results that the methodology provides at each of its stages. These are the Initial Success Matrix (IMS), the Fuzzified Success Matrix (FZMS), the Relationship Strength Success Matrix (SRMS) and the Final Success Matrix (FMS). The authors of the article conclude that Critical Success Factors (CSF) are the necessary conditions that a project must meet in order to be perceived as successful. Improved processes for identifying and evaluating suitable CSFs for IT projects are required due to increased complexity and uncertainty.

In the work "Using cognitive maps for modeling project success" [8], published in the same year, cognitive maps are used. For clarity, it examines a real construction project implemented in Turkey. The paper also describes the advantages and disadvantages of cognitive maps. Among the advantages of cognitive maps, the authors note their ability to present complex ideas and information in a simple and understandable form. Cognitive maps also help to improve the understanding and organization of knowledge, as well as contribute to more effective decision-making. However, cognitive maps also have disadvantages. They can be difficult to create and interpret, especially if they involve a large amount of information or complex relationships. In addition, they can be subjective because they are based on the knowledge and perception of an individual or a group of people.

The article "Assessing it projects success with extended fuzzy cognitive maps & neutrosophic cognitive maps in comparison to fuzzy cognitive maps" [9] presents a study in which the authors compare the use of extended fuzzy cognitive maps and neutrosophic cognitive maps in assessing the success of a mobile payment system project. To do this, they created various cognitive maps with several groups of stakeholders. As a result, the authors concluded that neutrosophic cognitive maps showed better results than fuzzy cognitive maps and improved cognitive maps.

An analysis of the literature shows that the use of cognitive maps is an effective tool for modeling and evaluating the success factors of IT projects. These methods allow you to present complex ideas and information in a simple and understandable form, improve the understanding and organization of knowledge, and contribute to more effective decision-making.

However, as noted in the analyzed papers, these methods have their drawbacks, including the complexity of creating and interpreting maps, especially with a large amount of information and complex relationships, as well as subjectivity, since they are based on the knowledge and perception of an individual or a group of people.

It is also worth noting that the importance of identifying and evaluating critical success factors (CSF) for IT projects is emphasized in all the papers reviewed. This confirms the relevance of our research and the chosen topic of the final qualifying work.

Thus, the development and use of a program for modeling the perception of success factors of IT projects using fuzzy cognitive maps is a useful and relevant approach to solving the complex problem of IT management and planning.

III. METHODS

IV. RESULTS ANTICIPATED/ACHIEVED

V. CONCLUSION

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