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METHOD FOR SELECTING A SOFTWARE DEVELOPMENT METHODOLOGY TAKING INTO ACCOUNT PROJECT CHARACTERISTICS

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ABSTRACT

Context. With the development of the software industry, the number of applied methodologies and hybrid approaches based on them constantly increases, that is why, the choice of the most suitable/optimal methodology for the project is an urgent problem of software engineering, since the selection process is poorly formalized, requires sufficient experience of the person who will make this decision and depends on many related factors.

Objective. The support of decision-making in the process of choosing a methodology for the software project development and increase of the level of adequacy of the above choice.

Method. Based on the previously developed algorithm by the author, a generalized method for selecting the best software development methodology is proposed, which consists of 14 steps and takes into account the characteristics of the project, based on the multi-criteria analysis approaches, taking into consideration the opinions of experts for a more reasonable choice of the most suitable methodology for this project. The method uses the aggregated expert evaluation. It was decided to use the AHP to calculate the criteria weights. Based on the established values of criteria, their weights and expert evaluation, the score is calculated for each methodology using the weighted sum and TOPSIS methods.

Results. The application of the developed method to the data of actual projects showed a match in 83% of cases (in five out of six cases, the application of the method resulted in the selection of methodology that corresponded to the one actually used in an existing project). In cases when the methodology chosen by the proposed method differed from the one that was actually used, the application of the proposed method recommends going to the stage of the initial determination of criteria and their weights, which will allow making a more adequate choice of methodology.

Conclusions. The proposed method can be applied in practice by software project managers to support the decision-making process, and will allow reducing time spent on project management.

KEYWORDS: software; software development methodologies; software engineering.

ABBREVIATIONS

TOPSIS is Technique for Order of Preference by Similarity to Ideal Solution;

AHP is Analytic Hierarchy Process;

PAPRIKA is Potentially All Pairwise Rankings of all possible Alternatives;

XP is Extreme Programming;

DSDM is Dynamic Systems Development Method

RAD is Rapid Application Development

ROC is Rank Order Centroid;

SDLC is Software Development Life Cycle;

SWEBOK is Software Engineering Body of Knowledge;

PRINCE is Projects in Controlled Environments;

PMBOK is Project Management Body of Knowledge;

SMARTER is Specific, Measurable, Achievable, Realistic, Time-Bound, Evaluate, and Reviewed

INTRODUCTION

The modern process of creating software products is based on different aspects of software engineering, including the use of various software development methodologies. Currently, there is quite a large number of software development methodologies, that formalize and optimize the processes of creating software components in particular and software projects in general and significantly facilitate and speed up the software development. Due to the diversity of these methodologies and software projects, the question arises of the optimal selection of methodology for a particular project based on the information about it, since each software development methodology is designed for different types of teams, number of their members, different types of projects and their complexity, etc. In turn, the software products become more diversified, they have more characteristics, the consideration/ignorance of which can have a significant impact on the success of the project. Besides, the process of choosing a methodology for each project may depend on a number of subjective factors, such as experience of the person making the decision, experience of applying a particular methodology by the development team, wishes of the customer, industry trends, and many others. Therefore, when choosing a software development methodology, project managers face certain difficulties, which, in addition to the above aspects, are that different types of software projects require different approaches, as each category of projects has different priorities and goals; moreover, the clear and standardized criteria for choosing a software development methodology have not yet been defined [1–3]. Given the above, it can be argued that the development of new methods for choosing the best software development methodology, which will take into account various characteristics of software projects, is an urgent scientific task. Thus, the **objective of the study** is to create a generalized method for selecting the best software development methodology, taking into account the characteristics of the project and opinions of experts, based on the approaches of multi-criteria

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analysis. **The object of the study** is the process of selecting a software development methodology, **the subject of the study** is the methods and tools for choosing the most suitable software development methodology for the project, taking into account its characteristics and expert opinions.

1 PROBLEM STATEMENT

Given: the set $Y = \{Y_1, Y_2,\ldots, Y_7\}$ of alternatives (software development methodologies) and the set of $N = \{N_1, N_2,\ldots, N_{23}\}$ criteria (project characteristics) with the weight of the *i-th* criterion w_i. It is necessary to determine the best alternative out of *Y*s. For this purpose, it is necessary to construct a hierarchy in the form of a multitree and calculate the global priorities of alternatives: the priorities of alternatives for the entire hierarchy.

The input data are the results of a survey of experts in the form of matrices of pairwise comparisons at all nodes of the hierarchy. Hierarchical synthesis is used to weigh the own vectors of matrices of pairwise comparisons, as well as to calculate the general priorities of alternatives. As a result of constructing a hierarchy and implementing paired comparisons, matrices of paired comparisons should be constructed for all vertices of the hierarchy except leaves. The pairwise comparison method to calculate the aggregate evaluation (global priority) of alternatives (development methodologies) should be applied.

2 REVIEW OF THE LITERATURE

One of the approaches to solving the problem of selecting a software development methodology is the SMARTER multi-criteria analysis method, which is used to select the agile methodology for small and medium-sized projects [1]. The selection process is as follows: a set of 13 criteria is determined; alternative solutions are defined (for DSDM, SCRUM, XP and Crystal methodologies); a matrix of methodology evaluation with regard to the criteria is created (based on the number of scientific papers which indicate that a certain value of the criterion is suitable for a certain software development methodology); the relative importance of criteria is determined and values of criteria weights are calculated using the ROC method; then the multi-attribute value of the function of each of the alternatives is set by the aggregation of functions, and as a result, the alternatives are ranked from best to worst [1].

The rule-based expert systems are also used to solve problems of such class [4]. The questionnaire consists of different questions about the characteristics of the project (project size, project type, level of possible risks, reliability, complexity, etc.), which can be updated or added by experts. The “set of facts” contains facts about recommendations for different possible values in rules. The “rule repository” is maintained as a set of “if...then” rules and it provides recommendations according to the characteristics of the project. A cascade model, spiral model, incremental model, XP, Scrum or RAD model can be proposed based on these characteristics. The answers provided by a user are placed in the relevant rules of the “rule repository”, which are used by the “rule engine” for comparing the “set of facts”, structuring and displaying recommendations to a user through the display module (“SDLC recommendation display module”) [4]. As a drawback here, it should be noted that it is impossible to change the priority of criteria and the complexity of filling in the knowledge base, since it is necessary to take into account a large number of criteria and methodologies, which makes it difficult to expand the knowledge base, especially given that expert opinions often differ.

In addition, the AHP hierarchy analysis technique and TOPSIS method are used to solve similar tasks. TOPSIS is based on the concept that the ideal alternative has the shortest distance from the positive ideal solution and the longest distance from the negative ideal solution. AHP is used to calculate the criteria weights and to verify their consistency, using the relative consistency ratio. In the work [5], a method for selecting a project testing technique using these methods is described. In the work [6], for the selection of practices for organizing the software development process, it is proposed to use the PAPRIKA method, which is based on the users expressing their preferences regarding the relative importance of the criteria or attributes of interest for the made decision or choice, by pairwise comparison (ranking) of alternatives. 31 practices are evaluated in pairs against 11 criteria; a user is interviewed and based on the answers a list of practices recommended to use in the project development is formed [6].

A mathematical model and a method for choosing an approach to project management, taking into account the fuzzy representations of the applicability of existing approaches, is proposed in the work [7]. The choice is made between such approaches as PMBOK, ISO21500, PRINCE2, SWEBOK, Scrum, XP and Kanban. A number of project parameters that affect the result of the choice are also identified here, and the degree of their impact is determined.

The works [8, 9] are dedicated to the issue of the selection of methodology and the study of factors (organizational structure, characteristics of the team and software project) that affect the choice of the best software development methodology. A conclusion is drawn that the process of selecting the methodology is associated with certain organizational, project and team characteristics, and therefore is a non-trivial task. It is also noted that although flexible methodologies have become increasingly popular over the past decade, traditional methodologies still remain popular in the software development industry, and a hybrid approach is also often used [8].

The work [10] deals with a comparative analysis of the most widespread software development methodologies with an emphasis on the features of project management. The author focuses on taking into account those factors that affect the software development

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process, namely: frequent software requirements changes, high dynamics of the technology stack and development standards, qualificationi of the development team and the team globalization and dispersion.

The paper [11] presents an approach that analyses the basic concepts of structural models and modelling in software engineering, using representation theory, investigates different types of interpretive reflections needed to track model entities with the entities they represent, as well as explains the difference between forward- and backward-looking models and considers the need to integrate products and processes into methodologies.

The Weighted sum and TOPSIS multi-criteria analysis methods were used in work [12]. To select a methodology for the development of software projects, taking into account their characteristics, experts evaluate the extent to which it is permissible to use a certain methodology for each possible characteristic of the project, i.e. each possible value of the criterion. The weights of expert opinion may vary. Given these weights, the expert evaluation is aggregated. Also in work [12] it was decided to use the AHP [13] to calculate the weights of criteria used to evaluate alternatives. A user makes a pairwise comparison of the criteria, and the absolute weights of criteria are calculated using the AHP. The pairwise comparison is made on a scale from 1 to 9. The AHP uses a consistency ratio as a measure to check the consistency of the weights obtained. This ensures that the weights are consistent. Based on the user-defined values of criteria, their weights and expert evaluation, the score for each methodology is calculated using the weighted sum and TOPSIS methods. The higher the score, the better the applicability of the methodology to the project [12].

Thus, having considered the above materials, it can be said with confidence that the number of used methodologies and hybrid approaches based on them constantly increases [14], therefore the choice of the most suitable/optimal methodology for the project is an urgent problem of software engineering, since the selection process is poorly formalized, requires sufficient experience of the person making this decision and depends on many related factors. Therefore, there is a need to develop a generalized method for selecting the best software development methodology, which will take into account the characteristics of the project, based on the methods of multi-criteria analysis, and opinions of experts for a more reasonable choice of the most suitable methodology for this project.

3 MATERIALS AND METHODS

To solve the problem of selecting the methodology for the development of software projects, taking into account their characteristics, the method was proposed, which is based on the algorithm presented in [12] and consists of 14 steps below, its block diagram is shown in Fig 1.

Step 1. Analysis of the initial data of the project. At this step, it is necessary to analyze the requirements to the project (functional, non-functional, etc.) as well as to analyse the quality attributes of the future software with stakeholders. This should be done in order to get an overview of the project (large/small/medium, complex/simple in terms of implementation, critical in terms of reliability/security requirements, real time, etc.)

Step 2. Determination of the list of methodologies most suitable for the project (expert evaluation). At this step, the experts should determine a list of six methodologies that will be most appropriate for this type of projects in general and for this specific project, in particular. If the experts cannot unambiguously determine the required list due to insufficient data of requirements analysis, it is necessary to go back to Step 1, otherwise, proceed to Step 3.

Step 3. Initial determination of a set of criteria and their weights. At this step, it is necessary to determine a set of required criteria by which the characteristics of projects will be determined, with the appropriate setting of initial values and their gradations. The set of 23 criteria presented in [7] is proposed as the base one, but if required, this set and values of criteria can be adjusted by experts, taking into account the information obtained during further steps.

Step 4. Providing expert evaluation of the possible criteria values in relation to methodologies. At this step, it is necessary to gather the expert evaluation of all possible values of criteria in relation to the list of methodologies specified in Step 2. If the experts determine that the list of criteria and the corresponding range of scores fully reflect the characteristics of the project, then proceed to Step 4, otherwise, go back to Step 3 and adjust the set of necessary criteria with the appropriate setting of the initial values and their gradations.

Step 5. Setting the values of criteria and their weights according to the characteristics of the project. At this step, the current values of criteria and their weights are set according to the characteristics of a specific project; if required, some of the criteria may be omitted.

Step 6. Specifying the evaluation of criteria values by hierarchy analysis technique. At this step, it should be determined whether it is necessary to clarify the evaluation of criteria values by the hierarchy analysis technique, taking into account the expert evaluation consistency index, if yes, proceed to Step 7, if not, skip to Step 9.

Step 7. Pairwise comparison of the importance of criteria. A pairwise comparison of the importance of all set criteria with each other takes place here and the relative consistency is determined, if it is more than 0.2, then it is necessary to go to Step 6, if it is less than 0.2, proceed to Step 8.

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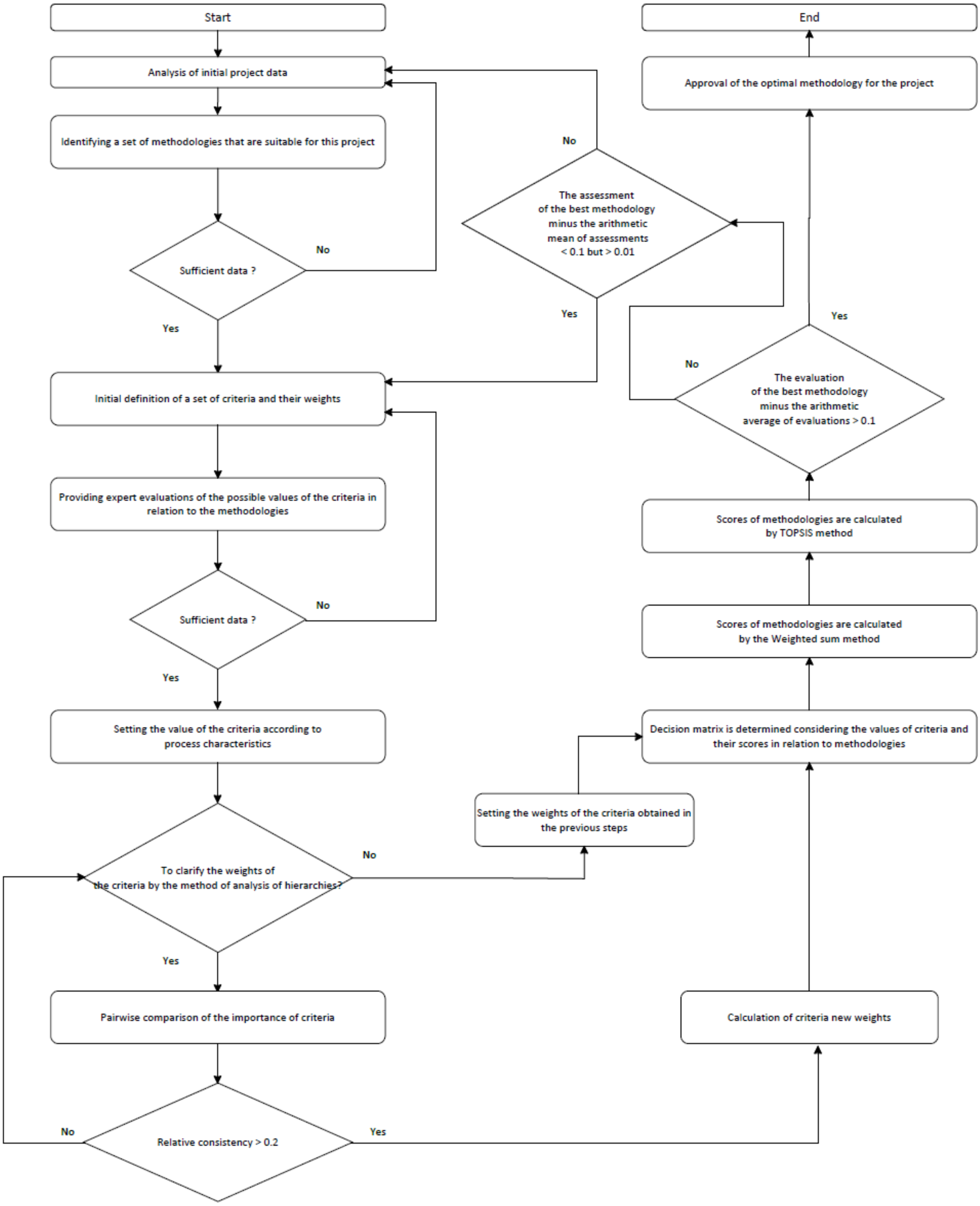

Figure 1 – Block diagram of the method for selection of a software development methodology taking into account project characteristics

Step 8. Setting new criteria values. At this step, it is necessary to set new criteria and their weights, taking into account the information obtained in the previous steps. Then proceed to Step 10.

Step 9. Setting the values of criteria obtained in the previous steps. The values of criteria and their weights are taken as those set in Step 5.

Step 10. Determination of the decision matrix taking into consideration the values of criteria and their scores in

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relation to methodologies. At this step, the decision matrix with $m \times n$ dimension is determined, where m is the number of methodologies and n is the number of criteria, the values of which are set by a user. The matrix consists of evaluation of the established values of criteria in relation to methodologies.

Step 11. Calculation of scores for methodologies using the weighted sum method. At this step, the scores for methodologies using the weighted sum method are determined.

Step 12. Calculation of scores for methodology by the TOPSIS method. The scores for methodologies are determined using the TOPSIS method:

a) A weighted normalised matrix is determined.

b) A positive and a negative decision is determined.

c) The Euclidean distance and relative proximity of each of the alternatives (methodologies) to ideal solutions are calculated.

Step 13. Determination of the most suitable methodology. If the score of the best methodology minus the arithmetic mean of scores is >0.1, then this methodology is the most suitable one, and you proceed to Step 14, if not, then it is necessary to check whether the score of the best methodology minus the arithmetic mean of scores is <0.1 but >0.01, if yes, then you should proceed to Step 3, if no, go back to Step 1.

Step 14. Approval of the most suitable methodology. At this step, the most suitable methodology for this project is approved.

4 EXPERIMENTS

Six anonymized commercial projects developed by LinkUp Studio (https://linkupst.com/) were selected for the experiment and all were implemented using the Scrum methodology. The main characteristics of the projects are shown in Table 1, which contains a set of 23 criteria and their corresponding values. The justification for the selection of criteria and the scale of values for each criterion is given in [12]. In this table, to simplify the presentation, the ranked criteria values from 1 to 4 are shown, where 1 is the lowest value and 4 is the highest. A brief description of the subject area of the projects: Project1 (P1) and Project2 (P2) – software products for the advertising business, Project3 (P3) and Project4 (P4) – mobile games, Project5 (P5) – house rental web platform, Project6 (P6) – web platform for arranging meals for groups of people. The common features for these projects are that the project budgets are less than 100 thousand US dollars, the number of people in the team is less than 10 and the requirements change is not high (< 7% per month).

Table 1 – The criteria values for the projects involved in the experiment

N	Parameter	Projects					
		P1	**P2**	**P3**	**P4**	**P5**	**P6**
1.	Project cost	1	1	1	1	1	1
2.	Requirements change percent/month	1	1	1	1	1	1
3.	Number of people involved in the project	1	1	1	1	1	1
4.	Consequences in case of unsatisfactory project outcome	1	2	2	2	2	1
5.	Work experience in the given field	1	2	1	2	2	1
6.	Requirements to the realization period of the project	2	3	3	2	3	2
7.	Teams ability to work effectively in freedom or order	3	3	2	2	2	3
8.	Understanding of requirements, adapting ability, initiative	3	4	2	3	2	3
9.	Probability of occurrence of managerial risks (inefficient planning, controlling, communication problems, etc.)	1	2	2	1	2	2
10.	Knowledge of applied tools and methods	3	4	1	4	4	3
11.	Means of communication	2	4	4	4	3	3
12.	Frequency of reporting to the Customer	3	2	2	2	1	2
13.	Understanding the scope of works	2	2	2	2	3	2
14.	Requirements to the project quality	2	2	2	2	3	4
15.	Probability of occurrence of technical, manufacturing or qualitative risks	3	2	3	2	1	2
16.	Probability of occurrence of external risks (disruption of work by contractors, unfavourable political situation, etc.)	1	1	1	1	1	1
17.	Probability of occurrence of organizational risks (disruption of funding, delivery of resources, inaccurate prioritizing, etc.)	1	1	1	1	3	1
18.	Requirements to the precise compliance with a deadline	1	1	1	2	2	3
19.	Ability to admit mistakes	4	4	4	4	3	4
20.	Learning ability	3	4	2	3	3	3
21.	Experience of cooperation	2	3	2	3	3	2
22.	Teams ability to clearly formulate and openly express ideas	3	4	3	3	4	3
23.	Customers experience of working with this project team	1	1	1	4	1	1

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5 RESULTS

The application of the above method for the projects P1–P6 had the following results.

Table 2 – The result of selection of methodology for the project P1

Methodology	Weighted Sum	TOPSIS	AVG
Scrum	**0.29**	**0.63**	**0.46**
SWEBOK Guide	0.26	0.43	0.34
PMBOK Guide	0.25	0.42	0.33
ISO21500	0.25	0.42	0.33
XP	0.22	0.45	0.33
Kanban	0.22	0.45	0.33
PRINCE2	0.24	0.4	0.32

For the project P1, Scrum was determined the best methodology (according to Step 13 of the above method, its score minus the arithmetic mean of scores = 0.111428571 > 0.1), which corresponded to the real situation in the project.

Table 3 – The result of selection of methodology for the project P2

Methodology	Weighted Sum	TOPSIS	AVG
Scrum	**0.32**	**0.67**	**0.49**
Kanban	0.25	0.54	0.39
SWEBOK Guide	0.24	0.43	0.34
XP	0.21	0.43	0.32
PMBOK Guide	0.22	0.41	0.32
ISO21500	0.22	0.41	0.32
PRINCE2	0.2	0.39	0.3

For the project P2, Scrum was also determined the best methodology (according to Step 13 of the above method, its score minus the arithmetic mean of scores = 0.135714286 > 0.1), which corresponded to the real situation in the project.

Table 4 – The result of selection of methodology for the project P3

Methodology	Weighted Sum	TOPSIS	AVG
SWEBOK Guide	**0.31**	**0.52**	**0.41**
Scrum	0.24	0.55	0.4
ISO21500	0.29	0.49	0.39
PMBOK Guide	0.29	0.49	0.39
PRINCE2	0.27	0.47	0.37
Kanban	0.19	0.49	0.34
XP	0.15	0.37	0.26

For the project P3, SWEBOK Guide was determined the best methodology, but according to Step 14 of the above method, its score minus the arithmetic mean of scores is 0.01<0.044285714<0.1, which requires to go back to the stage of initial determination of criteria and their weights (Step 3).

Table 5 – The result of selection of methodology for the project P4

Methodology	Weighted Sum	TOPSIS	AVG
Scrum	**0.3**	**0.63**	**0.46**
Kanban	0.24	0.52	0.38
SWEBOK Guide	0.27	0.44	0.35
PMBOK Guide	0.24	0.42	0.33
ISO21500	0.24	0.42	0.33
XP	0.21	0.41	0.31
PRINCE2	0.23	0.4	0.31

For the project P4, Scrum was determined the best methodology (according to Step 13 of the above method, its score minus the arithmetic mean of scores = 0.107142857 > 0.1), which corresponded to the real situation in the project.

Table 6 – The result of selection of methodology for the project P5

Methodology	Weighted Sum	TOPSIS	AVG
Scrum	**0.29**	**0.62**	**0.45**
Kanban	0.22	0.53	0.38
SWEBOK Guide	0.25	0.46	0.36
PMBOK Guide	0.23	0.43	0.33
ISO21500	0.23	0.43	0.33
PRINCE2	0.22	0.42	0.32
XP	0.16	0.38	0.27

For the project P5, Scrum was determined the best methodology (according to Step 13 of the above method, its score minus the arithmetic mean of scores = 0.101428571 > 0.1), which corresponded to the real situation in the project.

Table 7 – The result of selection of methodology for the project P6

Methodology	Weighted Sum	TOPSIS	AVG
Scrum	**0.3**	**0.65**	**0.48**
SWEBOK Guide	0.25	0.44	0.34
Kanban	0.21	0.47	0.34
XP	0.21	0.46	0.34
PMBOK Guide	0.23	0.41	0.32
ISO21500	0.23	0.41	0.32
PRINCE2	0.21	0.41	0.31

For the project P6, Scrum was also determined the best methodology (according to Step 13 of the above method, its score minus the arithmetic mean of scores = 0.13 > 0.1), which corresponded to the real situation in the project.

6 DISCUSSION

As can be seen from the results obtained, the use of the method for selecting the software development methodology, taking into account the characteristics of the project, allows determining the most suitable development methodology with a high degree of adequacy, since in five out of six cases, the application of the method resulted in the selection of methodology that corresponded to the methodology actually used in an actual project. In case of the project P3, the methodology chosen by the proposed method differed from the one that was actually used, but Step 13 of this method (Determination of the most suitable methodology) emphasizes that if the score of the best methodology minus the arithmetic mean of scores is >0.1, then this methodology is the most suitable and it is necessary to go to Step 14, if not, then it is necessary to check whether the score of the best methodology minus the arithmetic mean of scores is <0.1 but >0.01, if yes, then go to Step 3, if not, go back to Step 1. It is in the case of the project P3 that the proposed method recommends proceeding to the stage of initial determination of criteria and their weights (Step 3). It should also be noted that the Scrum methodology, which was actually used in this project, was the second of the most optimal methodologies for this project and received the score close to the best (Table 4), thus, changing the criteria weights may lead to the selection of this methodology when using the proposed method.

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CONCLUSIONS

This article describes the solution to the problem of adequate selection of the best software development methodology, taking into account the characteristics of the project. In the course of solving the problem, an analytical review of the most widespread approaches to the choice of software development methodology as of today was performed, which showed the existing shortcomings of such selection. The method was developed for selecting the best methodology for developing a software project, taking into account its characteristics. The method uses aggregated expert evaluation; it was decided to use the AHP to calculate the criteria weights. Based on the user-defined values of criteria, their weights and expert evaluation, the score for each methodology is calculated using the weighted sum and TOPSIS methods. The application of the developed method to the data of existing projects showed a match in 83% of cases (in five out of six cases, the use of the method resulted in the selection of methodology that corresponded to the methodology actually used in a real project). In case when the methodology chosen by the proposed method differed from the one actually used, the application of the proposed method recommends going to the stage of initial determination of criteria and their weights, which will allow selecting the methodology more adequately. The scientific novelty of the obtained results is that for the first time a generalized method for choosing the best software development methodology has been developed, taking into account the characteristics of the project, which implements the process of choosing a methodology using the methods of multi-criteria analysis AHP, TOPSIS and weighted sum and, unlike the existing ones, provides for gathering of expert evaluation taking into account the values of criteria set by a user independently, which allows reasonably determining the methodology that is most suitable for this project.

The practical value of the results of this work is that the application of this method will make it possible to reasonably choose the methodology for developing a software project, taking into account its characteristics, which will be especially useful for project managers with little experience, and will also allow reducing time spent on project management.

The prospects for further research are to verify the application of the developed method in software projects of various types and to expand the list of methodologies and project characteristics that will be taken into account when selecting the best development methodology.

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МЕТОД ВИБОРУ МЕТОДОЛОГІЇ РОЗРОБЛЕННЯ ПРОГРАМНОГО ЗАБЕЗПЕЧЕННЯ З УРАХУВАННЯМ ХАРАКТЕРИСТИК ПРОЕКТУ

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АНОТАЦІЯ

Актуальність. З розвитком програмної індустрії постійно зростає кількість застосовуваних методологій та гібридних підходів на їхній основі, тому вибір найбільш відповідної/оптимальної для даного проекту є актуальною проблемою програмної інженерії, оскільки процес вибору є слабко формалізованим, вимагає достатнього досвіду особи, яка буде приймати дане рішення та залежить від багатьох супутніх факторів.

Мета. Підтримка прийняття рішень в процесі вибору методології розроблення програмного проекту та підвищення ступеня адекватності вищезазначеного вибору

Метод. На основі попередньо розробленого автором алгоритму запропоновано узагальнений метод вибору оптимальної методології розробки програмного забезпечення, який складається з 14 кроків та враховує характеристики проекту базуючись на підходах багатокритеріального аналізу з урахуванням думок експертів для більш обгрунтованого вибору найбільш відповідної даному проекту методології. Метод використовує агреговані експертні оцінки, для обчислення ваг критеріїв вирішено використовувати AHP. Базуючись на встановлених значеннях критеріїв, їх ваг та експертних оцінках, обчислюється бал для кожної методології за допомогою методів Weighted Sum та TOPSIS.

Результати. Застосування розробленого методу на даних реальних проектів показало співпадіння у 83% випадків (в п’яти з шести випадків застосування методу дало вибір методології, яка відповідала тій, що насправді застосовувалась на реальному проекті). У випадку, коли вибрана запропонованим методом методологія відрізнялась від тієї, що була застосована насправді, застосування запропонованого методу рекомендує перейти до етапу початкового визначення критеріїв та їхніх ваг, що дасть змогу більш адекватно здійснити вибір методології.

Висновки. Запропонований метод може бути застосований в практичній діяльності керівниками програмних проектів для підтримки процесу прийняття рішень, а також дасть можливість скоротити часові затрати управління проектом.

КЛЮЧОВІ СЛОВА: програмне забезпечення; методології розробки програмного забезпечення; інженерія програмного забезпечення.

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