METHODS OF FORMING AN EXPERT ASSESSMENT OF THE CRITERIA OF AN INFORMATION SYSTEM FOR MANAGING PROJECTS AND PROGRAMS

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Abstract: The article presents a method for determining and ranking significance of the criteria of an information system for managing projects and programs (hereinafter, PMIS) based on the concept of subjective probability with the help of expert assessments. The method of expert assessments is implemented by processing the opinions of experienced specialists on the possible values of losses and (or) the probability of their occurrence. It is also used in non-formalizable problem situations, when the lack of a sufficient array of information or its unreliability does not allow the use of purely formal mathematical methods. When analyzing the PMIS choice, expert assessments can be used, firstly, to form a subjective assessment of one or another PMIS with the subsequent use of this information in order to quantify it using statistical methods. Secondly, for a qualitative assessment of the PMIS choice in terms of determining their rank significance, priority in an ordered list of PMIS criteria.

As the main stages of the proposed methodology, the following are proposed:

1) development of a list of assessed PMIS criteria and formation of a list of experts;
2) conducting a survey of experts in order to obtain a set of individual expert assessments according to the PMIS criteria;
3) calculation of the average assessment criteria of the PMIS;
4) checking the consistency of expert opinions on the rank significance of the assessed PMIS criteria based on the Kendall coefficient of concordance;
5) summing up the results of expert assessment of the PMIS criteria.

The practical aspects of the expert assessment are considered: calculation tables, the method of filling them, processing and analyzing the results. The method of expert assessment of the PMIS criteria was further developed, thanks to which a set of effective and functional criteria was determined, which will be taken into account when developing technical requirements for this system.

Keywords: project and program management information system, expert assessment method, project-driven organization, coefficient of competence.

1. Introduction

PMIS is the uncertainty about the achievement of the goals of the project-driven organization as a result of the influence of factors related to the process of managing projects and programs. It can manifest itself in the form of financial (and other) losses, or in the possibility of obtaining additional benefits (income) as a result of positive deviations. First of all, in order to take adequate measures for choosing PMIS, when creating a corporate project and program management system (hereinafter referred to as CPPMS), it is of interest to select and assess PMIS criteria with negative consequences.

Problems of assessing the PMIS choice in modern project management literature are poorly developed; in practical work, project managers also do not pay enough attention to this problem. Neglect of the assessment of the PMIS choice in the creation and implementation of CPPMS can be accompanied by significant losses.

2. Methods

The method of expert assessments is implemented by processing the opinions of experienced specialists about the possible values of losses and (or) the probability of their occurrence and is used in non-formalized problem situations when the lack of a sufficient array of information or its unreliability does not allow the use of formal mathematical methods in pure form. This method is based on the use of intuition, past experience, analogy and logic. The procedures of the method of expert assessments are based on the use of a person to obtain quantitative assessment of qualitative judgments that can't be directly measured. At the same time, experts conduct an intuitive-logical analysis of the situation under study with quantitative or ordinal assessments of processes or phenomena, after which a formal processing of the results is performed.

This study presents a methodology for determining and ranking the significance of the PMIS criteria based on the concept of subjective probability using expert assessments.

Stage 1. PMIS is a tool that supports corporate norms and rules for managing projects and programs. It, as a rule, should include, at a minimum, support for such processes as:

– calendar, network and resource planning of the project, including performance reporting;
– project content management (changes);
– management of risks;
– cost management;
– management of interaction (communications), including problem management and support for group work with project documents and reporting materials.

PMIS as a complex systemic phenomenon is classified according to many criteria. As criteria for assessing the PMIS, the following can be established:

– support up to 100 projects and up to 100 users;
– calendar and network planning, Gantt chart;
– subproject (multiproject, program), project portfolio management;
– management of resources, interaction and risks;
– ability to customize;
– personalization and configuration of the interface;
– functionality for the project manager and resource manager;
– reference books and dictionaries, their extensibility;
– corporate knowledge base;
– technical support in Russian;
– Russian user interface;
– integration with MS Project (export and import).

This assessment can be carried out both in person and in correspondence. Assessment will be in the ranking of the proposed PMIS criteria.

Selection of experts is the most important stage of the proposed methodology, on which the information base depends on the implementation of subsequent analytical procedures for assessing the PMIS criteria, and, consequently, the results of the assessment. The circle of experts may include project managers, financial managers, project administrators whose job responsibilities directly affect the implementation of projects and programs. External assessment can be obtained based on a survey of consultants in the field of project management. When selecting experts, the following characteristics are taken into account: competence in project management, high level of communication, collective perception. Most of these characteristics are rated qualitatively, not quantitatively. The coefficient of competence in the field of project management is the value that characterizes the level of competence of an expert in the field of project management based on the opinions of other experts. Changes from 0 to 1. The closer the value of the

coefficient of competence in the field of project management to 1, the higher the level of competence of this expert is based on the opinion of other experts.

The method of assessing the coefficient of competence in project management is to interview experts about other research participants, their knowledge, professional thinking, experience, and so on. Each of the experts should conclude that the opinion of one or another participant is included in the analysis of the research results. If the opinion should be taken into account, then the value 1 is put down for this expert. If the opinion of this expert is not important, a score of 0 is set. As a result of a survey of all potential experts, a matrix of mutual assessments r_{eh} is formed with values in cells

$$r_{eh} = \begin{cases} 1, \text{ if the e-th expert includes} \\ \text{h-th expert in circle of experts,} \\ 0, \text{ if the e-th expert doesn't include} \\ \text{h-th expert in circle of experts.} \end{cases} \quad (1)$$

The coefficient of competence in the field of project management is calculated based on the assessments obtained using the formula:

$$k_e = \frac{\sum_{e=1}^{m} r_{eh}}{m}, e = 1 \ldots m, \quad (2)$$

where k_e – the coefficient of competence in the field of project management of the e-th expert. Thus, the coefficient of competence in the field of project management shows how many experts considered the opinion of the e-expert to be important and considers it necessary to include it in the circle of experts participating in the study.

Stage 2. This stage involves obtaining individual expert assessments of the PMIS criteria by filling in experts with individual questionnaires with a list of assessed PMIS criteria.

Assessment of criteria for PMIS can be formed, for example, according to the following rating system: "1" is not at all important; "2" is not very important; "3" is quite important; "4" is very important; "5" is extremely important.

Stage 3. At the next stage, the obtained assessments are averaged by the arithmetic mean value method:

$$\bar{K} = \sum_{e=1}^{m} K_e / m, \quad (3)$$

where $\bar{K}$ – the average score of PMIS criterion; K_e – the level of significance of the PMIS criterion for assessing the e-th expert; m – the number of experts.

Stage 4. An important characteristic of the quality of the results of expert assessment is the consistency of expert opinions. Consistency is recommended to assess the value of the Kendall concordance coefficient (W):

$$W = \frac{12 \cdot S}{m^2 \cdot (n^3 - n)}, \quad (4)$$

where S – the sum of the squares of deviations of all grades of ranks of each object of expertise (each PMIS criterion) from the arithmetic mean of ranks; m – the number of experts; n – the number of objects of examination.

The concordance coefficient can take values from 0 to 1. A value of 0 means inconsistency of expert opinions; if the coefficient value exceeds 0.40–0.50, the quality of the assessment is considered satisfactory; if the value exceeds 0.70–0.80, the quality of the assessment is considered high.

Stage 5. The final stage of expert assessment of the PMIS criteria is summarization and drawing conclusions. The main conclusions are made on the composition of the circle of experts selected for the study and on the obtained significance of the PMIS criteria.

3. Results

Stage 1. *Development of a list of assessed PMIS criteria and formation of a list of experts.* The list of assessed criteria for PMIS is presented above. At this stage of the study, a circle of experts is created who fill out the questionnaire for assessing the competence of research participants.

According to the results of the survey, a matrix of mutual assessments is compiled, which is presented in **Table 1**.

Table 1

Matrix of mutual assessments of study participants

Participants	Participant 1	Participant 2	Participant 3	…	Participant m
Participant 1	–	o_{12}	o_{13}	…	o_{1m}
Participant 2	o_{21}	–	o_{23}	…	o_{2m}
Participant 3	o_{31}	o_{32}	–	…	o_{3m}
……	…	…	…	–	…
Participant m	o_{m1}	o_{m2}	o_{m3}	…	–

Based on the obtained data for each expert (participant) the coefficient of competence should be calculated by the formula (2). For inclusion in the circle of experts set the threshold value of the coefficient of competence. An example is a value of 0.5 (at least half of the respondents consider it necessary to include this participant in the circle of experts). An example is shown in **Table 2**.

Table 2

Coefficients of participants' competence

	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7	…	Participant *m*
Coefficient of competence	0,6	0,6	0,7	0,2	0,9	0,8	0,7	0,1	0,1

As can be seen from the **Table 2** in the circle of experts for further research there are $m_e = 6$ participants, since their value of the coefficient of competence exceeds the threshold value of 0.5.

Stage 2. *Conducting a survey of experts in order to obtain a set of individual expert assessments according to the PMIS criteria***.** This stage involves obtaining individual expert assessments of the PMIS criteria by filling in experts with individual questionnaires with a list of the assessed PMIS criteria. The set of criteria for assessment depends on the scope of the project-driven organization, the characteristics of projects and programs. It is formed by management together with consultants in the field of project management.

The results of the survey are shown in **Table 3**

Table 3
The significance level of the PMIS criterion

Criterion / Experts	K 1	K 2	K 3	K 4	K 5
Expert 1	a_{11}	a_{12}	a_{13}	a_{14}	a_{15}
Expert 2	a_{21}	a_{22}	a_{23}	a_{24}	a_{25}
Expert 3	a_{31}	a_{32}	a_{33}	a_{34}	a_{35}
Expert 4	a_{41}	a_{42}	a_{43}	a_{44}	a_{45}
Expert 5	a_{51}	a_{52}	a_{53}	a_{54}	a_{55}
Expert 6	a_{61}	a_{62}	a_{63}	a_{64}	a_{65}

Stage 3. At the next stage, the obtained assessments are averaged by the method of the arithmetic mean value using the formula 3. For inclusion in a further study, a threshold value of the average value of the PMIS criteria is established. For example, the value is 2. The results of the average significance level of the PMIS criteria are presented in **Table 4.**

According to the resulting assessments of the average significance level of the PMIS criteria, it is concluded that criterion 3 should be excluded from further research.

Table 4
Results of the average significance level of the PMIS criteria

	K 1	K 2	K 3	K 4	K 5
$\bar{K}$	4	3	1	4	4

Stage 4. *Check the consistency of expert opinions on the rank significance of the assessed PMIS criteria based on the Kendall coefficient of concordance.* To characterize the quality of the results of expert assessments, it is also necessary to assess the consistency of expert opinions. For this, by the formula (4) the coefficient of concordance W is calculated.

Stage 5. *Summing up the results of expert assessment of the PMIS criteria.* The results of the application of the approved methodology allow to determine the average level of significance of the PMIS criteria, which makes it possible to determine a set of effective and functional criteria that will be taken into account when developing the technical requirements for the PMIS. Expert assessment can be considered successful and effective if all research participants have a high level of competence in the field of project management.

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