20. METHOD FOR FORMALIZING THE CUSTOMER'S ATTITUDE TO POSSIBLE CHANGES TO THE BASIC PROJECT PARAMETERS IN THE PHASE OF ITS IMPLEMENTATION

Rach V.A., Borulko N.A.

A distinctive feature of the work of project managers is a significantly large number of decision-making situations in the face of uncertainty and dynamic changes in the environment. One of the main sources of uncertainty is the project customer. At the stage of project development, he concentrates on putting forward requirements for the parameters of the project and the project product from the standpoint of his subjective idea of the success of the project. At the same time, his reaction to deviations from planned indicators remains unformalized. This makes it difficult for project managers to make current management decisions that are adequate for understanding the admissibility of deviations for the customer. The article describes the conceptual and mathematical models of the proposed method of collecting information from the customer about his attitude to possible risk situations in the project, which are associated with the deviation of the basic indicators "time-quality-value". The method is based on the transformation of a well-known 2D template into a 3D template while maintaining the structure and relationships between the components of the model. This allowed us to introduce quantitatively measured parameters of the customer's attitude both to the risk situation as a whole and to possible deviations of each basic indicator of the project individually.

Introduction

As it was noted in 2018 at a conference of the European Academy of Management, the current stage in the development of project, program and portfolio management is characterized by a transition from the perspective of classical project management to the perspective of rethinking project management. This conclusion was made in a report by Lars Kristian Hansen and Per Svejvig from Aarhus University (Denmark) based on a comparative analysis of the most cited publications of all years and the most cited publications over the past five years [1]. The main characteristics of the first perspective include aspects of instrumentality and controllability. In the second perspective, against the background of much less dominance of the characteristics of the first, new steadily growing tendencies are appearing: an increase in increased attention to project stakeholders; wider recognition of intuitive alternative solutions that differ from those with a rational explanation; increased attention to adaptation in the implementation of projects, programs and portfolios to a rapidly changing world [1]. This allows us to argue that such trends will determine the direction of future world and European studies, primarily related to project management. It should be noted that the new described perspective fully fits into the framework of the triadic project management paradigm [2]. It was formed within the framework of the scientific school to which the authors of this article belong and assumes a system-integral presentation of the project, in which both the components of the project-system and the relationships between them are analyzed.

One of the complex tasks in which the focus of the above three trends, is the task of selecting a team of project management objectives of the implementation of the project in situations of deviations from the planned option. Planned variation can be attributed to the category "the selected alternative that has a rational explanation" (classic project management). And unplanned deviations, which avoid even theoretically impossible, require you to select one of the fairly intuitive alternative solutions (rethinking project management). In this case, you need at least a fuzzy criterion. Given that the main stakeholder of the project is the customer, it is desirable that this criterion took into account its estimated vision. This mechanism is used in the soft control methodologies in the implementation of small projects and their individual increments [3]. However, in practice, for very large and complex projects, the availability of the customer is limited. Therefore, management decisions on the project taken by the team management projects are often based on information that reflects poorly formalizable relation to the customer and other stakeholders to deviations from the planned values of the basic parameters of the project (time, quality, cost). Weak formalization of information and the prior lack of coordination between stakeholders are one of the main sources of potential risks in the implementation phase of the project. Therefore, it is important to develop a method of formalizing the relationship of the customer to possible changes in the basic parameters of the project in the phase of implementation. The urgency of development enhanced by the General trend emerging in the project management - the offset in the implementation of projects focus of project control at agility project [4].

Conceptual model of the method

In the framework of a scientific school, we widely use the template for representing system models developed in it [5]. It involves placing the system components in a flat two-dimensional space at the vertices of a square so that the connections between the components are four sides and two diagonals of the square. The total number of bonds is six with four components of the system. Figure 1 presents a template for such a system model [6] taking into account the recommendations [7] on the openness of one of the components of the external environment. This allows considering as an open component planned or risk situations at the same time as part of the external environment (supersystem) and system.

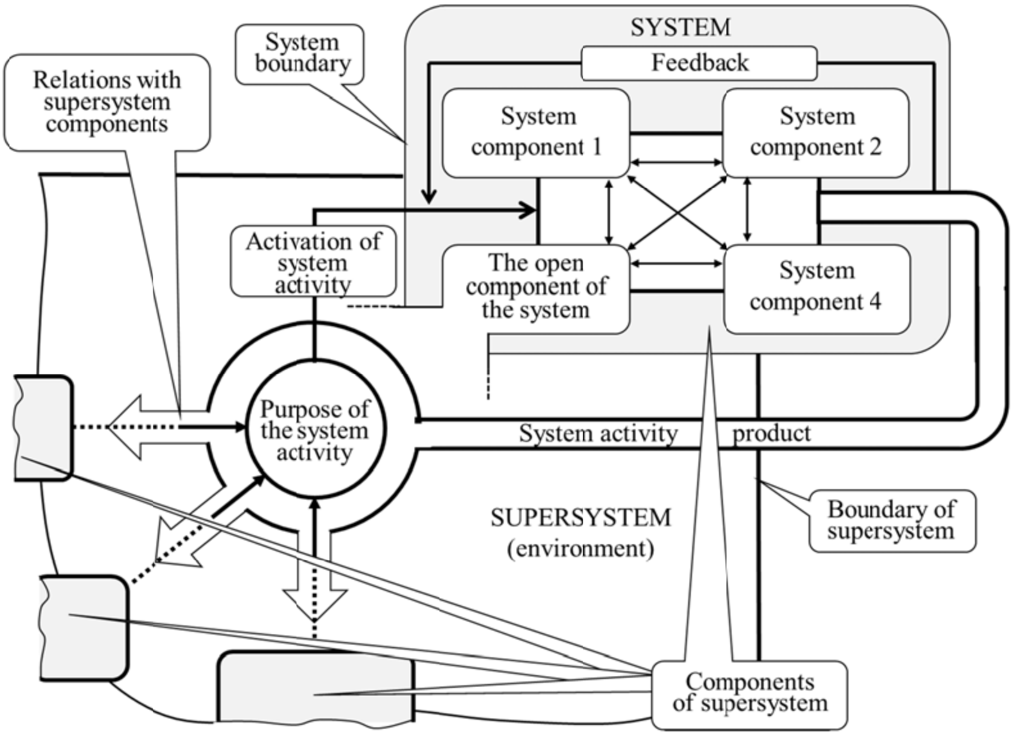


Fig. 1. 2-D template of a system model as a component of a supersystem [5-7].

However, an attempt to use a 2-D template to develop a system of measurable indicators to identify customer reactions to possible deviations of the basic parameters of the project during its implementation was unsuccessful. Therefore, the transformation of the 2D template into a 3D template was carried out while maintaining the structure and relationships between the components of the model. As a result, a model in the form of a tetrahedron was obtained (Fig. 2). To simplify further calculations, the edge of the tetrahedron is taken equal to unity. With this transformation, the previous number of components of the 2D template is saved, namely four (vertices of the tetrahedron), and the same number of bonds (six) which are the edges of the regular tetrahedron.

We define the state of the project in the form of four components (vertices of the tetrahedron): a planned or risk situation (vertex V_0), and three basic parameters of the project - time, quality, cost (vertices V_1, V_2, V_3). For the project state that corresponds to the planned one, points are placed on the edges of a regular unit tetrahedron, which divide the edges in half. The midpoints thus obtained on the edges correspond to the ratio of the segments 0.5: 0.5 (Fig. 2). Connecting the points on the edges, we get five volumetric figures: the “vertex” planar tetrahedral with edges of 0.5 each and the inner figure is the octahedron.

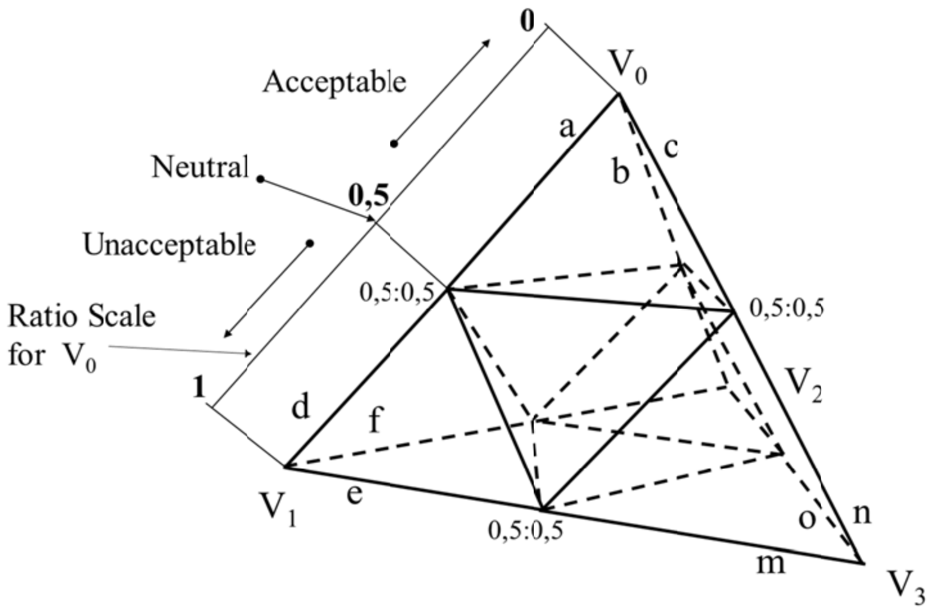


Fig. 2. 3D model of the presentation of the basic parameters of the project at the planning stage

Given that the vertices of the tetrahedron in the 3D model of representing the basic parameters of the project have a different essence, let us dwell on the consideration of the vertex V_0 “Situation”. We represent each edge emanating from this vertex in the form of a ratio scale (Fig. 2). Such a scale is necessary to fix the customer’s response to risk situations, which can lead to a deviation of the basic parameters of the project from the planned.

Denote the value of the scale equal to 0.5 as “neutral attitude to the risk situation”. Then a part of the scale from 0.5 to 0 is used to fix the degree of acceptable attitude to the situation, and from 0.5 to 1 to fix the unacceptable attitude. To indicate the degree of acceptability/unacceptability, it is proposed to use the four-element linguistic set “low – medium – high – very high”. Then a very high degree of acceptability will be in the region of the scale “0”, and a very high degree of unacceptability in the region “1”.

In the process of removing information from the customer about the degree of acceptability/unacceptability of the risk situation in question, he is invited to put a dot on each edge. Then the current will divide the unit scale into two segments (for example, d and a Fig. 2). Each rib will reflect not just the attitude of the customer to the situation, but the attitude to a possible change in a specific basic parameter of the project. Trial tests of this method of collecting information showed the occurrence of difficulties in putting a point in a particular location of the rib. This difficulty was removed when the customer was asked to put down two points between which there was a zone of a fuzzy border for choosing the degree of relation to the risk situation, for example, points p_{010} and p_{011} on the edge V_0 - V_1 (Fig. 3).

The mathematical model of the method

It is proposed to use volumes of vertex tetrahedrons as initial information for calculating the integral indicators of the customer's response to risk situations.

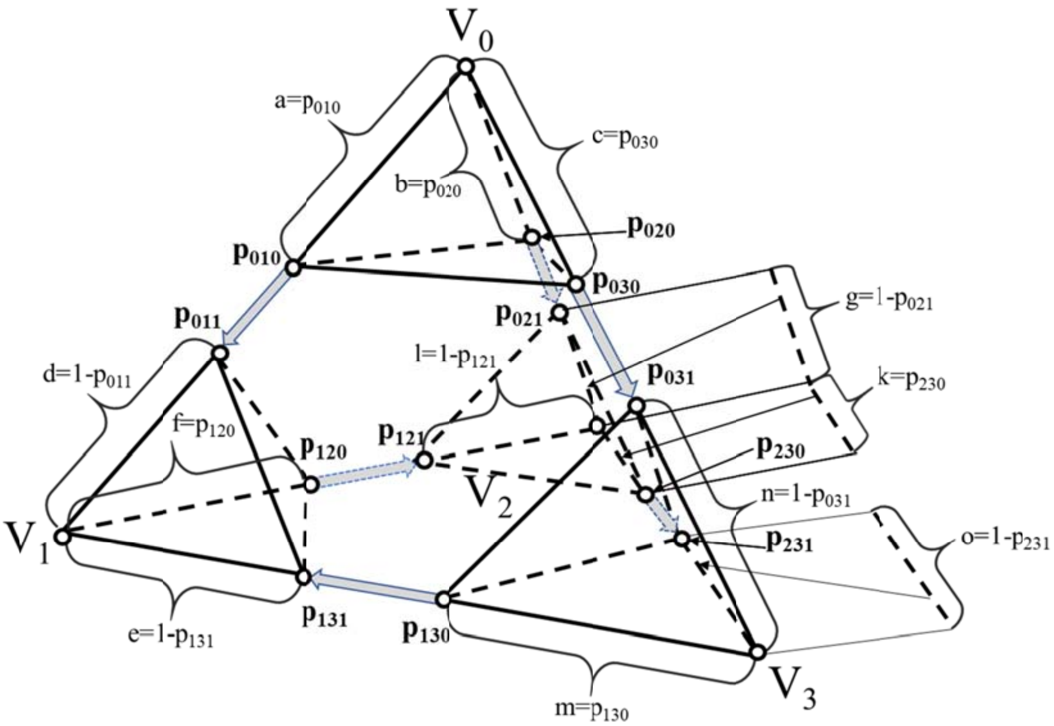


Fig. 3. 3D model of representing the customer's attitude to the risk situation and deviation of the basic parameters of the project from those planned in this situation

These volumes, the volume of the internal octahedron, as well as the ratio of the volumes of the octahedron and the base tetrahedron to the sum of the volumes of the vertex tetrahedra, are calculated by the following formulas:

$$V_0 = \frac{\sqrt{2}}{12} abc , V_1 = \frac{\sqrt{2}}{12} dfe , V_2 = \frac{\sqrt{2}}{12} glk , V_3 = \frac{\sqrt{2}}{12} mno , \tag{1}$$

$$V_{oct} = V - \frac{\sqrt{2}}{12}\left(abc + dfe + glk + mno\right), \tag{2}$$

$$\frac{V_{oct}}{V_0 + V_1 + V_2 + V_3} = \frac{12V}{\sqrt{2}\left(abc + dfe + glk + mno\right)} - 1 , \tag{3}$$

$$\frac{V}{V_0 + V_1 + V_2 + V_3} = \frac{12V}{\sqrt{2}\left(abc + dfe + glk + mno\right)} , \tag{4}$$

where V_0, V_1, V_2, V_3 – volumes of vertex tetrahedra,

V_{oct} – volume of the obtained octahedron,

$V \approx 0{,}11785113$ – base unit tetrahedron volume.

If the relations between the ith and jth vertices of the tetrahedron are set in the form of the lower and upper boundaries of the ranges formed by the setpoints p_{ij0} and p_{ij1} on the edge of the tetrahedron, then the lengths of the segments a, b, c, d, e, f, g, l, k, m, n, o will take values:

$$a = p_{010},\ b = p_{020},\ c = p_{030},\ d = 1 - p_{011},\ f = p_{120},\ e = 1 - p_{131},\ g = 1 - p_{021},\ l = 1 - p_{121},$$

$$k = p_{230},\ m = p_{130},\ n = 1 - p_{031},\ o = 1 - p_{231}. \tag{5}$$

Then the volumes of vertex tetrahedra can be calculated using the formulas:

$$V_0 = \frac{\sqrt{2}}{12} p_{010} p_{020} p_{030}, \qquad V_1 = \frac{\sqrt{2}}{12}(1 - p_{011}) p_{120} (1 - p_{131}),$$

$$V_2 = \frac{\sqrt{2}}{12}(1 - p_{021})(1 - p_{121}) p_{230}, \quad V_3 = \frac{\sqrt{2}}{12} p_{130} (1 - p_{031})(1 - p_{231}). \tag{6}$$

The formula for calculating the octahedron will be as follows:

$$V_{oct} = V - \frac{\sqrt{2}}{12}\left(p_{010} p_{020} p_{030} + (1 - p_{011}) p_{120} (1 - p_{131}) + (1 - p_{021})(1 - p_{121}) p_{230} + p_{130} (1 - p_{031})(1 - p_{231}) \right), \tag{7}$$

and volume ratio formulas are calculated as

$$\frac{V_{oct}}{V_0 + V_1 + V_2 + V_3} = \\ = \frac{12V}{\sqrt{2}\left(p_{010} p_{020} p_{030} + (1 - p_{011}) p_{120} (1 - p_{131}) + (1 - p_{021})(1 - p_{121}) p_{230} + p_{130} (1 - p_{031})(1 - p_{231}) \right)} - 1, \tag{8}$$

$$\frac{V}{V_0 + V_1 + V_2 + V_3} = \\ = \frac{12V}{\sqrt{2}\left(p_{010} p_{020} p_{030} + (1 - p_{011}) p_{120} (1 - p_{131}) + (1 - p_{021})(1 - p_{121}) p_{230} + p_{130} (1 - p_{031})(1 - p_{231}) \right)}. \tag{9}$$

An analysis of formulas (3), (4) and (8), (9) shows that they differ from each other by the value of the constant-coefficient (-1). This property of the project model under consideration requires additional study from the position of harmony mathematics in which the tetrahedron is the simplest polyhedron among the five Platonic solids, which in the ancient world were considered the geometric expression of harmony of the Universe [8].

Based on the above-fixed assumption, the volume V_0 of the vertex tetrahedron will act as the initial information for calculating the integral indicator of the customer's response to the risk situation. Theoretically, the values *a, b, c* included in the formula for calculating it can have different values in the range 0-1 for tetrahedra with the same volume value. This makes it possible for given *a, b, c* to calculate the value of the segment a_0 for the regular vertex tetrahedron, i.e., a tetrahedron in which all faces are equal to each other

$$a_0 = \sqrt[3]{abc}\,. \tag{10}$$

Then, for each of the basic components of the project, the customer's attitude to the risk situation can be calculated as

$$\propto_T = \sqrt[3]{\frac{a^2}{bc}},\ \propto_Q = \sqrt[3]{\frac{b^2}{ac}},\ \propto_C = \sqrt[3]{\frac{c^2}{ab}}\,. \tag{11}$$

For the integral indicator of the customer's attitude to the risk situation as a whole, it is proposed to use the triple-peer operator $\bar{Q}^3_{h,g,a,r}$ for values *a, b, c* [9]. It provides for the implementation of three steps. At the first step, four power means are calculated (harmonic $\overline{a_h}$, geometric $\overline{a_g}$, arithmetic $\overline{a_a}$ and quadratic $\overline{a_r}$). At the second step, for the obtained power means, the calculation of the new four means is carried out. In the third step, the procedure is repeated with power averages calculated in the second stage. As a result of calculations, all averages are reduced to one value.

For an integral characteristic of the customer's attitude to the risk situation, an acceptability function has been introduced (Fig. 4).

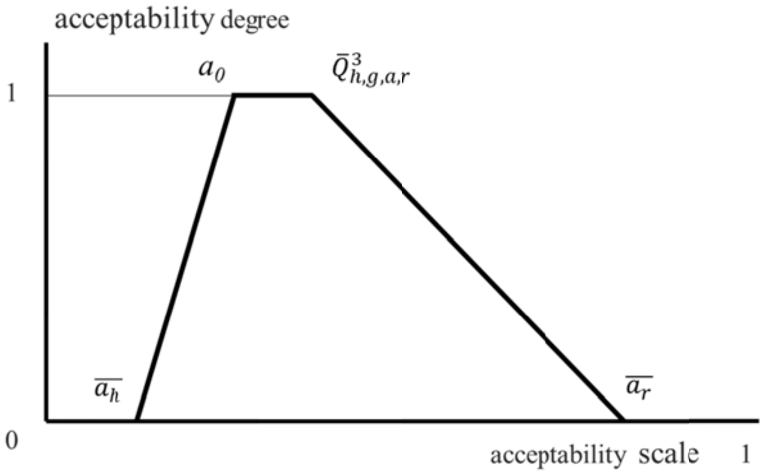


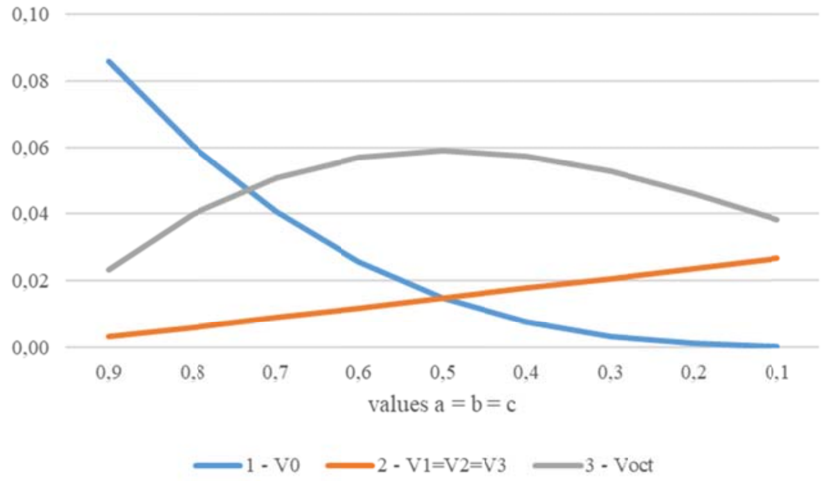
Fig. 4. Parameters of constructing the relationship function

It is built on the basis of four indicators on the principle of constructing trapezoidal membership functions. The horizontal axis is the ratio scale described above, which reflects the acceptability/unacceptability of the customer to the risk situation. The vertical axis is the acceptability scale. The carrier of the acceptability function is determined by the mean values of the harmonic $\overline{a_h}$ and quadratic $\overline{a_r}$, and the nucleus is determined by the length of the tetrahedron a_0 and the value of the makeup operator $\bar{Q}^3_{h,g,a,r}$.

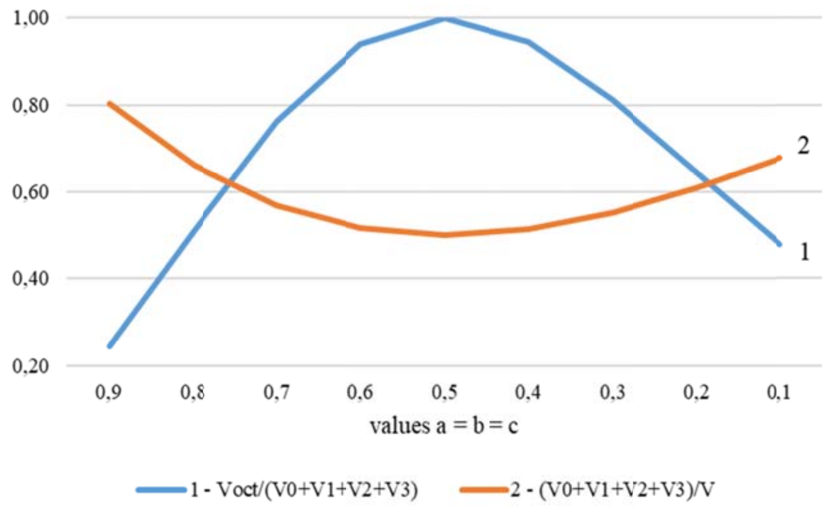
Test Calculation Results

Based on the constructed mathematical models, a computer program in the JAVA language was developed in the IntellijIDEA environment. The user interface of the program visualizes the 3-D model in the form of a basic regular unit tetrahedron and provides for the arrangement of points on the edges. After placing the points, the screen displays information about the scale values for each of the points, the volumes of the corresponding “vertex” tetrahedrons, the internal octahedron, the base tetrahedron, as well as the ratio of the internal octahedron to the sum of the vertex tetrahedrons, the base tetrahedron to the sum of the vertex tetrahedrons, their inverse relationships and the whole information regarding the integral indicator of customer response to a risk situation.

Test calculations made it possible to establish the nature of changes in the volumes of vertex tetrahedra (Fig. 5 a), their ratios to the volume of the base tetrahedron and octahedron (Fig. 5 b) depending on the size of the edges of the regular vertex tetrahedron V_0.



a)



b)

Fig. 5. Dependencies of changes in volume indicators that reflect the customer’s attitude to the risk situation in the project.

The dependence of the size change of the edge "c" of the tetrahedron V_0 was also established for different values of the edge "a" and "b" under the condition that the volumes are kept the same (for a = 0.4, the volume is 0.0075, a = 0.5 - 0.0147, a = 0.6 - 0.0255) (Fig. 6).

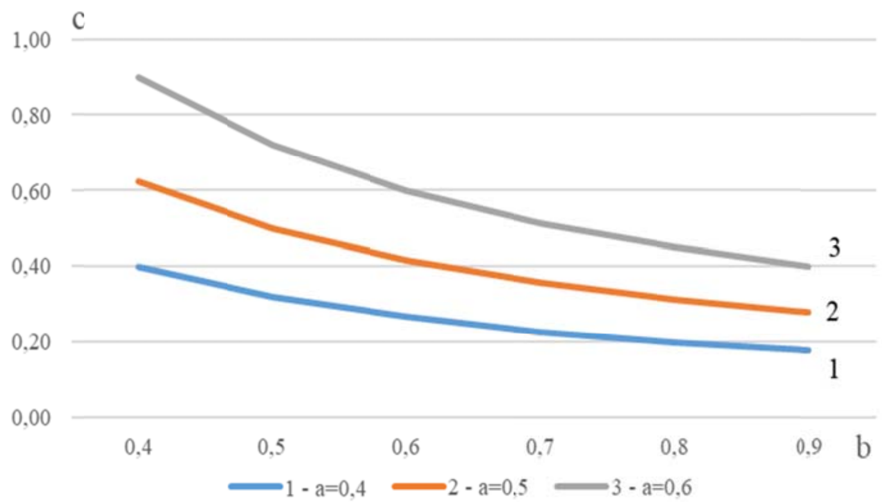


Fig. 6. Dependence of changes in the parameters of edges for fixed volumes of the vertex tetrahedron

The calculation of the acceptability function for a wide range of changes in the ratio between the edges of the vertex tetrahedron V_0 showed that as the difference between the sizes of the ribs decreases, the trapezoidal function degenerates into a triangular one, which becomes a vertically located segment (Fig. 7).

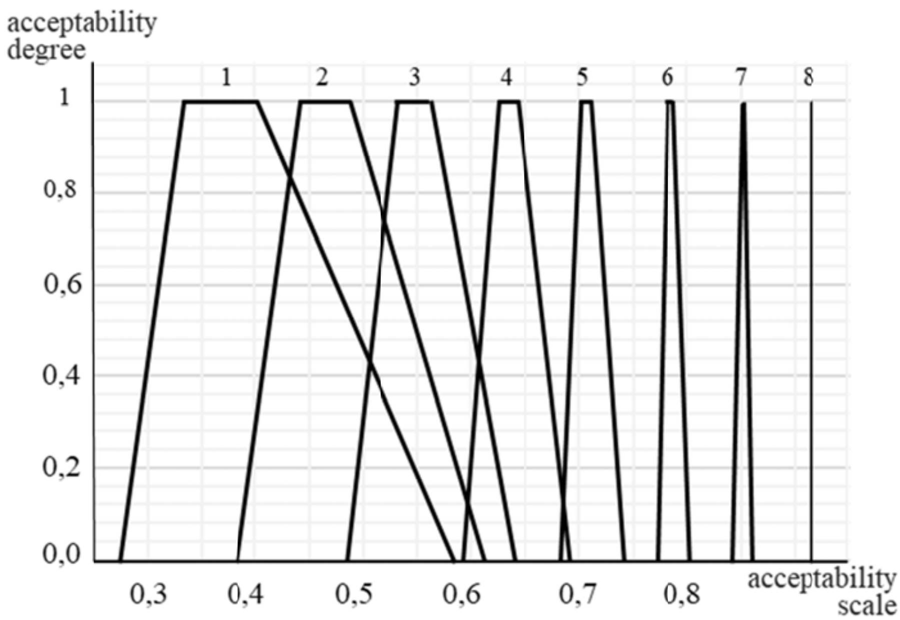


Fig. 7. Acceptance functions for a = 0.965 and the same values of b and c.

1 – b=c=0,2; 2 – 0,3; 3 – 0,4; 4 – 0,5; 5 – 0,6; 6 – 0,7; 7 – 0,8; 8 – 0,9.

Therefore, by the form of the acceptability function, one can judge not only the opinion of the customer on the acceptability/unacceptability of the risk situation but also the degree of certainty (reliability) of such a judgment.

Conclusions

The results of our study allow to draw some conclusions.

1. The current trend of shifting focus in the implementation of projects from control to project adaptability leads to the need to take into account new factors and adaptability conditions. These include the adaptability of the project management team to the subjective attitude of the customer about the acceptability/unacceptability of management decisions in specific diverse risk situations that are very common in the project. For this, it is necessary to have the appropriate tools for obtaining such information in a formalized form. Today, the existing tools do not satisfy, first of all, the temporary criteria for the operational continuous receipt of such information. Therefore, it is urgent to develop new methods that can be the basis for creating tools.

2. The conceptual basis of the developed method is a four-component system 2D template, which is transformed into a 3D template in the form of a tetrahedron. Using the edges of the tetrahedron as scales of the customer's attitude to the acceptability / unacceptability of deviation of the basic parameters of the "time-quality-cost" project allowed us to construct vertex tetrahedra, the sizes of which correlate with the customer's judgments on the acceptability / unacceptability of the alleged deviations in a particular risk situation.

3. The mathematical models of the method are deduced from considering the lengths of the segments formed by the points that the customer affords on the edges, the coordinates of these points and the features of the tetrahedron as the simplest polyhedron among the five Platonic solids.

4. It is proposed to use the ratio of the lengths of the edges of the vertex tetrahedron to the length of the edges of the correct vertex tetrahedron as indicators of the customer's attitude to changes in the basic categories of the project in a risk situation. And to display the integral attitude of the customer to the risk situation, a new acceptability function was introduced and a rule for its construction was developed.

5. The performed test calculations confirmed the efficiency of the proposed method and the possibility of using the developed software as a tool for collecting information from the customer about his attitude to deviations in risk situations of the planned values of the basic parameters of the project - "time-quality-value".

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