Management of process control in innovative projects

Chapter 3
Evaluation of the effectiveness of the innovation project. Basic modern approaches

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Lecture content

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01

Life cycle of an innovation project

The concept of the life cycle of an innovative project is one of the most important for DM, because it is the definition of the current stage of project implementation that forms the tasks and activities of the project manager, methods and tools to be used.

Definition 1. The life cycle of an innovation project is a certain period between the beginning of the project and its completion.

The beginning of the project can be considered the moment of origin of the idea or the moment of the beginning of its realization. For example, in a start-up project, the beginning of the project is the origin of the idea, the formation of a development team, the division of responsibilities and more.

The end of the project can be defined in different ways, namely:

- achievement of the declared results by the project;
- termination of funding for project needs;
- liquidation of the project.

The life cycle consists of phases characterized by the achievement of one or more goals.

Definition 2. Result is a product of work that can be measured; detailed project or working prototype.

The results, and hence the phases of the project, are elements of a consistent logic designed to correctly determine the product of the project.

To implement the various functions of innovation project management requires certain actions, called project management processes.

To ensure the best controllability, each phase is divided into separate works. Most of these works are related to the main product of the phase and the name of the phase corresponds to the name of its main product.

Most phases of the project life cycle have similar characteristics:

1. the cost and number of participants at the start are small, but increase at the end and decrease sharply until the end of the project;
2. the probability of successful completion of the project at the start is the lowest, but increases as the project is implemented;
3. the ability of the customer to influence the results and cost of the project is highest at the start, and decreases during the project, because in the end the cost of making changes and correcting errors increases significantly.

There is no universal approach to the division of the project, let alone an innovative project, into phases. DM projects break the life cycle into different stages. The most traditional is the allocation of four general phases of the project life cycle in the project: initiation, planning, implementation and control, completion.

More often there are two - the planning phase,
the implementation phase.

The World Bank takes a more thorough approach to detailing the project life cycle and distinguishes the following stages:

1. creation of an idea, concept;
2. definition of tasks;
3. development;
4. working design;
5. expertise;
6. negotiations;
7. making a decision on granting a loan;
8. project implementation;
9. implementation control;
10. analysis and evaluation of results;
11. completion of the project.

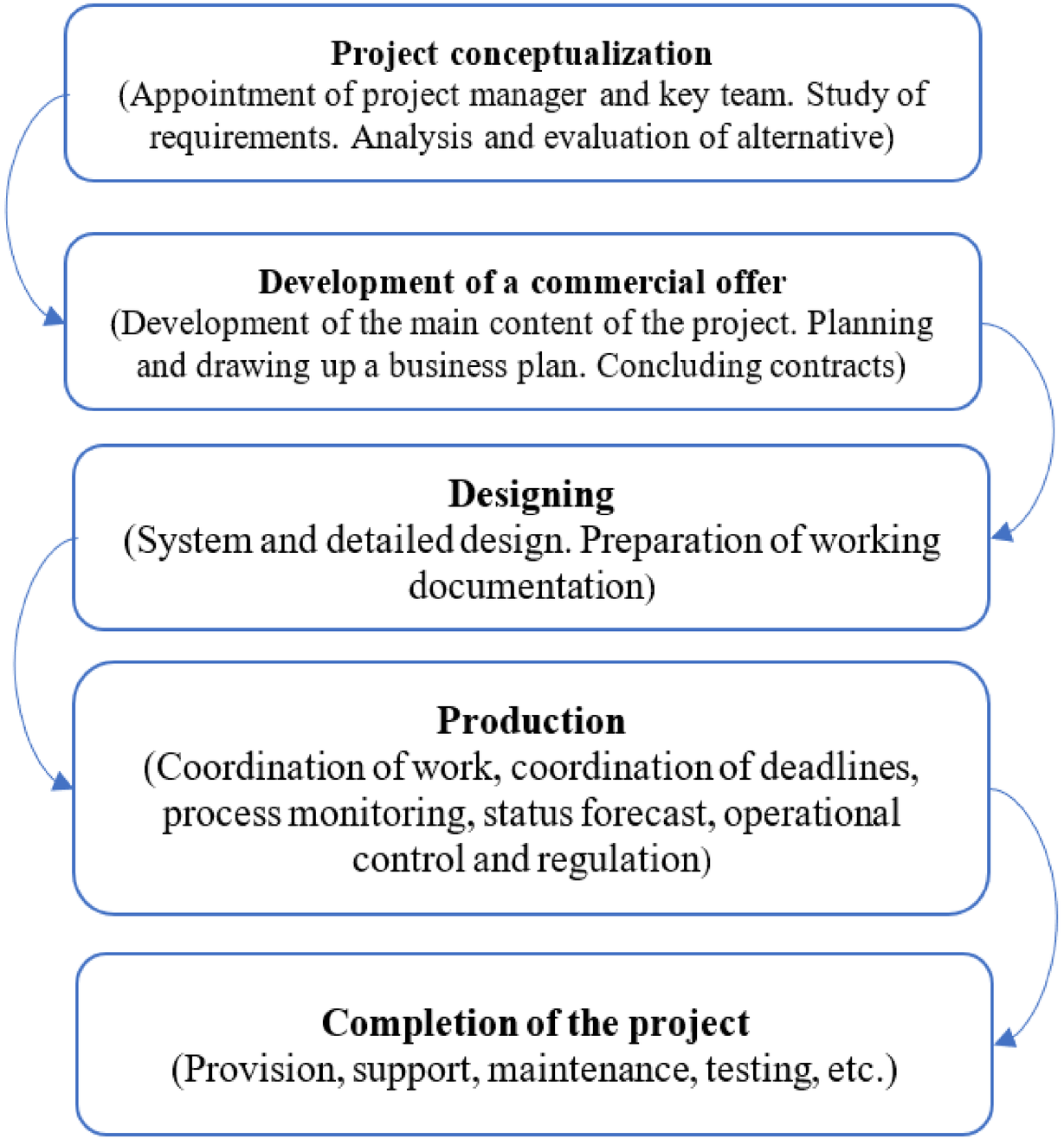
According to the UNIDO classification, there are three phases of the project life cycle: pre-investment, investment and operational, which, in turn, branch out at the stage:

1. Pre-investment phase: analysis of investment opportunities, preliminary feasibility study.
2. The investment phase includes negotiation and conclusion of contracts, design, construction, marketing, training.
3. The operational phase includes acceptance and launch, equipment replacement, expansion and innovation.

According to the proposal of the institute of creation and management of projects it is accepted to allocate 5 basic phases:

1. concept formation;
2. development of a commercial proposal;
3. design;
4. manufacturing;
5. delivery of the object of development and completion of the project.

Here is a diagram of the project life cycle.


Project conceptualization
(Appointment of project manager and key team. Study of requirements. Analysis and evaluation of alternative)
Development of a commercial offer
(Development of the main content of the project. Planning and drawing up a business plan. Concluding contracts)
Designing
(System and detailed design. Preparation of working documentation)
Production
(Coordination of work, coordination of deadlines, process monitoring, status forecast, operational control and regulation)
Completion of the project
(Provision, support, maintenance, testing, etc.)

In production practice, the first two phases are often combined into one "Initial phase of the project".

Formally, the project phases include stages. The stages of the project consist of stages. Stages of the project include certain types of work (works).

Full phase-by-stage structuring is not required. Everything is determined by the specifics of the project. The main thing is to ensure the best controllability.

1. Initial phase or concept.

The main content of the work is the development of the project concept, which includes the collection of initial data and analysis of the current situation, preliminary research.

Identifying needs for project changes, defining the project, which is divided into goals, objectives, results, basic requirements, restrictive conditions, criteria, level of risk, project environment, potential participants, required time, resources, funds, etc.

Definition and comparative characteristics of alternatives. Submission of proposals, their testing, and examination, approval of the concept, and obtaining approval for the next phase of development.

2. Development phase - development of the main components of the innovation project and preparation for its implementation.

General content of works:

- appointment of the project manager and formation of the project team;
- establishing business contacts, establishing the requirements of the customer and the project owner, key participants;
- concept development and main content of the project: final results, quality standards, project structure, main works, necessary resources, structural planning, including project decomposition, calendar plans, increased schedules, budget and project budget, resource requirements, distribution lawsuits. Organization of implementation of basic projects and research and development work on the project, project submission,

obtaining a decision to continue the work.

3. Project implementation phase - implementation of the main works to achieve the main objectives of the project.

The main works of this phase:

1) organization of tenders and conclusion of contracts;
2) commissioning of the project management system;
3) organization of works;
4) introduction of means and methods of communication of project participants;
5) introduction of a system of motivation and stimulation of the project team;
6) detailed design and technical specification;
7) operational planning of works;
8) establishment of a system of information control over the progress of work;
9) organization and management of material and technical support of works;
10) performance of works envisaged by the project;
11) management, coordination of works, coordination of rates, monitoring of progress, forecast of a condition, operative control, regulation of the basic indicators of the project;
12) solving problems and problems.

4. Project Completion Phase - In this phase, the ultimate goals of the project, summarizing the results of conflict resolution and closing the project are achieved.

The main content of works in this phase:

1) planning the completion process;
2) operational testing of the product or provision of services;
3) training for the operation of the facility or service;
4) preparation of documentation;
5) transfer of developments to the customer;
6) evaluation of project results and summing up;
7) preparation of final documents;
8) closure of works and projects;
9) accumulation of factual and research data for further projects.

The second and partly the third phase is called the "system design phase", and the last two (sometimes also include the design phase) - the "implementation phase". In the initial phases of project implementation, it is necessary to apply non-traditional methods and tools of project management, first of all, management of the system design process (phases of commercial proposal development and design). Traditional project management methods can be used in the project implementation phases.

02

Economic approaches to evaluating the effectiveness of an innovative project

The effectiveness of the project is characterized by a system of indicators that express the ratio of benefits and costs of the innovation project from the prism of its participants. At the moment, the following indicators of efficiency of the innovative project are distinguished:

1. indicators of commercial efficiency, which take into account the financial consequences of the project for its direct participants;
2. indicators of economic efficiency, taking into account the areas of economic benefits and costs of the project, taking into account the assessment of environmental and social consequences, with the assessment of the monetary dimension;
3. indicators of budget efficiency, which reflect the financial consequences of the project for state and local budgets.

The same can be used to calculate these indicators formulas, but the values of the initial indicators for the calculations are significant will be different.

Depending on the length of the project cycle, the evaluation of performance indicators may be different. Indicators of commercial efficiency can pay not only for the entire project cycle but also for a certain period of time: month, year.

2 groups of methods are used for the economic evaluation of project efficiency:

- **formal** (involve the use of mathematical apparatus for calculating indicators);
- **informal** (heuristic approaches) - rating, level of abilities management staff before the project implementation, the level of infrastructure development that ensures the implementation of the project.

Consider the assessment of the economic effect. The assessment of this effect takes into account the need to invest in an innovative project and therefore is based on investment components. The economic effect is determined by the excess of the value of the results of innovation activities over the value of the associated costs.

Depending on the basic principles of project effectiveness assessment, uses a number of methods, which are divided into three groups:

1 - methods based on discounting cash flows;

2 - methods that do not use discounting;

3 - methods that take into account the probabilistic characteristics of innovation.

The discount rate depends on three factors:

- risk - consists of various risks, such as country, industry, and the project itself. Risks are determined by expert approaches;
- lost profits - is the interest rate on alternative deposits (average market return) excluding inflation;
- inflation - determined by statistical authorities.

The discount rate is assumed to be equal to the weighted average cost Capital (WACC), instead of:

1. If the innovation project will be financed differently than the existing funding structure, then it is advisable to transfer the cost of capital, taking into account these changes;
2. If the project is characterized by a higher risk than the current one the activities of the entity implementing the project, then it is advisable to make an allowance for the risk determined by experts;
3. Sometimes all projects are simplified at one discount rate, and other criteria (including risk) are additionally taken into account in the final decision on project selection.

Definition 3. The weighted average cost of capital is the income from which the investor refuses, investing money in a particular project and not in a bank or securities.

The most common formula for determining the size of the weighted average the cost of capital is:

$$\mathrm{WACC}=\frac{E}{V}R_E+\frac{D}{V}R_D, \quad (1)$$

Where E is the cost of equity; V - total cost of capital; RE - the rate of return; D - the cost of borrowed capital; RD - is the average interest rate on bank loans.

The value of equity and borrowed capital is determined according to the financial statements. The total cost of capital is defined as the sum of equity and borrowed capital. The average interest rate on bank loans is calculated by the respective central bank separately in each country of the world. The rate of return can be calculated by several formulas, for example:

$$R_E = \frac{P_T}{E}, \quad (2)$$

where RT is net profit.

The size of the weighted average cost of capital is directly dependent on the rate of return, ie an increase in the latter leads to an increase in the weighted average cost of capital, and inverse dependence on the average interest rate on bank loans.

Consider the most modern methods of assessing the effectiveness of the project, based on discounting cash flows.

1. The net present value of the project (NPV) will be calculated by the formula.

$$NPV = \sum_{k=1}^{n} \frac{CF_k}{(1+r)^k} - CF_0 ; \quad (3)$$

where CF_0 – initial investment; CFk – flow of payments on the k-th step, or in the k-th period; r – discount rate, which reflects the rate of change in the value of money over time; n – is defined as the average of the simple payback period of the considered investment projects. The result of calculating this formula will be the monetary value of the project. In this formula, the initial investment is expressed as equity. In our case, we must take into account the investment in the investment (we can also include here the interest accrued on the investment).

If NPV> 0 - the project can be accepted; NPV = 0 - the project will not cause any profits or losses; NPV <0 - the project is unprofitable and should be rejected.

It allows you to get the absolute value of the effect of the project.

The disadvantages of this method are:

1. Answers only the question of whether the analyzed investment option contributes to the growth of the value of the firm or the wealth of the investor in general, but does not indicate the relative extent of such growth.
2. The difficulty of determining the discount rate on which the valuation results significantly depend.
3. The invariance of the discount rate when calculating the NPV is a fairly large assumption.
4. Does not allow to assess the degree (reserve) of sustainability of the project.

2. Profitability Index (RI) - a variant that provides a one-time investment and a long period of benefits:

$$PI = \frac{\sum_{t=1}^{T} \frac{CF_t}{(1+i)^t}}{I_0}. \quad (4)$$

The project is rejected if PI <1; accepted if PI> 1; and in the case of PI = 1, the project is neither profitable nor unprofitable. RI is closely related to NPV. If NPV is positive, then PI> 1, and vice versa. If PI> 1, the project is effective, if PI <1 - ineffective. Allows you to get the relative magnitude of the effect of the implementation.

Problems of calculating the profitability index - the investment in installments over several periods, rather than a single amount at once. In this case, the use of RI as a criterion for ranking projects is not correct enough, as the principle of calculating this indicator and different investment schemes for projects violate
the conditions of identical comparison.

3. Indicator of the internal rate of return (IRR)

IRR = r, at which NPV = f(r) = 0.

$$\sum_{t=0}^{n} \frac{CF_t}{(1+k)^t} - \sum_{t=0}^{n} \frac{I_t}{(1+k)^t} = 0 \quad (5)$$

$$\text{IRR} = \text{A} + \frac{a(B-A)}{(a-b)} \quad (6)$$

where A is the value of the discount rate at which the NPV is positive; B is the value of the discount rate at which the NPV is negative; a is the value of the positive NPV, with the value of the discount rate A; b is the value of NPV, with the value of the discount rate B.

The company can make any investment decisions, the level of profitability of which (IRR) is not lower than the current cost of capital (CC - Cost Capital). If IRR <CC, then such a project is rejected, if IRR> CC, then the innovation project is accepted. In case of limited investment resources, choose a project with a higher IRR. Shows the upper limit of the allowable level of the discount rate, exceeding which makes the project unprofitable.

03

Scoring approaches to evaluating an innovative project

1. Cost method

A method that estimates the real financial cost of creating a similar innovation project and is calculated based on:

- current market value of project developers;
- costs of various official and legal formalities;
- assets available in the project;
- costs of repurchase of shares from investors of the previous stage of financing;
- costs of third party services (marketing research).

This method allows you to assess the efficiency of spending money by the team of an innovative project, which is its advantage.

The disadvantages of this method are that it does not take into account the value of intellectual property, the assessment of personal initiative of developers of innovative projects, and so on.

2. Bercus method

It was first published in 2001 in the book "Winning Angels by Harvard's Amis and Stevenson". The idea of the method is to account for the potential of an innovative project using some empirical coefficients to the cost method.

The coefficients are as follows:

- allowance for an attractive idea - 20% - 40%;
- allowance for competent and professional project management - 20% - 80%;
- professional board of directors, highly qualified project mentor - 10% - 40%;
- surcharge for the uniqueness of the market position (participation of government agencies, a large strategic partner, a high threshold of entry into the market of competitors, etc.) - 10% - 20%;
- implemented prototype - 20% - 40%;
- CashFlow - 20% - 40%.

The coefficients and their percentage, the author based on his own experience has repeatedly improved. Like any empirical assessment, the method suffers from bias and attempts to adjust to the current market moment.

3. Profit rate method (venture capital method) through Forwarding value

Calculation of the forward value of the planned investment according to the formula:

$$FV = PV (1 + r) N, \quad (7)$$

where FV - forward value, future value of investments;

PV - present value, the cost of investment at the moment;

r is the target rate of return (IRR);

N - the period during which the investor's money works in the project (the number of years before the investor leaves the start-up).

4. Method of estimating the potential audience at the cost of the client

This method can be used to assess the future value of an innovative project, the success of which is closely linked to the gained audience of customers.

It is important that the "price" of an individual client does not have much difference between companies operating in this business sector. This method of evaluation is similar to the method of analogies, but has more objective results, because with the right approach you can average overestimated and underestimated projects.

5. Method of estimating the potential audience for the profitability of the client

This method is probably the most accurate economic method of calculating the future cost of the project. It is based on the standard method of estimating business by income. Based on:

- current profitability of one client, averaged over the business area of the start-up;
- expert assessment, or forecasting the number of customers at a certain stage of project development, you can calculate its future value.

6. Calculation method according to the Ave Maria model

Model Ave Maria (short for Acquisition, Value, Engagement, Monetization, Retention, Intellectual Property). The author of the model is Maxim Kraynov (Kraynov Investments).

- Acquisition (Getting new customers or users). What is the audience of the project, what is its size, how can it be described and characterized? What channels and partners can be used to attract the described audience, how many people can be involved as users (customers) as a result?
- Value (value - the author admits that the term is unfortunate, it would be more correct Cost - costs). How much does a visitor cost, how much does a user (client) cost? What is the cost of attracting a user (client) in different channels?

- Engagement. Description of desired actions for active and passive users, as well as secondary, side effects. This also includes the interaction of users (customers) with each other.
- Monetization (Monetization of the project). How will the number and activity of users be converted into project revenue? Additionally, you can describe different ways of monetizing for different segments of users. At what point will the user pay for himself?
- Retention. Description of how to force a client to return, turn him into a regular user, convince him to pay for membership (status)? All this relates to the topic of customer retention. How will the budget be divided between attracting new customers and retaining old ones?

- Intellectual Property. How does a company protect itself from the machinations of competitors and from the fact that a dissatisfied employee goes and opens a competing company? How can a company protect itself from copying the implementation of a working idea?

This method does not provide evaluative characteristics of the project, but it is convenient to compare different projects, when choosing the priority direction of investment.

7. Scorecard Method

Author - investment "angel" Bill Payne. The method is also known as the Bill Payne Method or Benchmark Method.

This method compares the acquired company with other typical ones and adjusts the average score of recently funded innovation projects in the region to obtain an estimate of the innovation project before the first income is received. Such comparisons can only be made for companies in the same stage of development, e.t.c before the start of income. The methodology is similar to the Brooks method but is tied to specific local conditions.

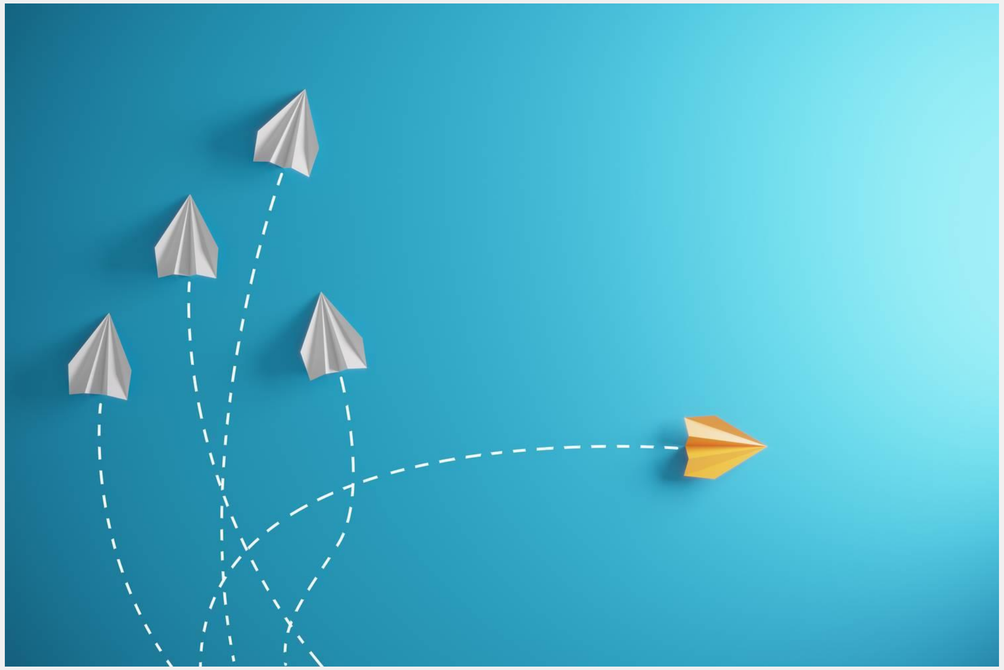
1. The first step in using the method should determine the average rating of the company in this region and in this sector of the economy. The average score may vary from region to region depending on the state of the economy and the competitive environment for startups. In most regions, this assessment does not change significantly depending on the sector of the economy (data are not widely available, but nevertheless, they are already collected and analyzed).

2. The second step in determining a startup valuation before earning revenue is to use the scoring method to compare the acquired company with your data on similar transactions, considering the following factors and coefficients that affect the valuation value:
   - the presence of a strong management team: 0-30%;
   - market size: 0-25%;
   - novelty of the product and technology: 0-15%;
   - competitive environment: 0-10%;
   - marketing, sales channels, partnership: 0-10%;
   - need for additional investments: 0-5%;
   - other factors: 0-5%.

Subjective ranking of factors is typical for investor evaluation of innovative projects. Some may be surprised that the importance of product and technology is lower than the importance of management team and market size. In building a business, the quality of the team is the key to success. A good team will be able to identify product flaws at an early stage and correct them, and opportunities to increase sales and business scalability are important for the investor's future income. Good product and intellectual property are important, but team quality is key.

04

Fuzzy approach to evaluating an innovation project



Suppose you set a set of innovative projects S = {S_1, S_2, …, S_n }, which must be evaluated by many indicators (criteria) and organized according to a certain rule.

We offer a general set of criteria for evaluating innovative projects and classify them into five groups of criteria: $\boldsymbol{G_1}$ - the essence of the idea; $\boldsymbol{G_2}$- the authors of the idea; $\boldsymbol{G_3}$- comparative characteristics of the idea; $\boldsymbol{G_4}$- commercial significance of the idea; $\boldsymbol{G_5}$- expected results.

For example, the group of criteria G1 - "essence of the idea" includes the following indicators: K1 - type of product; K2 - field of application; K3 - social significance; K4 - the power of the idea.

According to each criterion, the expert chooses one of the answer options, which is assigned the appropriate score. Define a convolution of scores, for example, as the sum of the score points of the gradation scale for the group of criteria G_1, which is denoted by g_1. Thus, we obtain a set of numerical variables $g = \{g_1, g_2, g_3, g_4, g_5\}$ for a group of evaluation criteria, respectively $G = \{G_1, G_2, G_3, G_4, G_5\}$, which take values on a certain numerical interval.

We will consider each of these numerical variables as a set-carrier of the linguistic variable U, consisting of the following terms: U_{i1} - "the estimate of the group of criteria G_i is much lower relative to the" desired value ""; U_{i2} - "the evaluation of the group of criteria G_i is lower relative to the" desired value ""; U_{i3} - "evaluation of the group of criteria $G_i$is close to the" desired value ""; U_{i4} - "evaluation of the group of criteria G_i is slightly better relative to the" desired value ""; U_{i5} - "evaluation of the group of criteria G_i is much better relative to the" desired value "".

«Desired valuesis» a conditional convolution of points that satisfies the decision maker in considering, evaluating and selecting innovative projects.

Gradation scales and convolutions of points on other considered groups of criteria are similarly defined.

Since the input data are presented in the form of a questionnaire, which is used to score points that are subjective, at the first level it is necessary to reveal the uncertainty of the input data of the groups of criteria. At the second level, the set of "desired values" is projected onto the set-carrier of linguistic variables U.

Since the obtained numerical variables $\{g_1, g_2, g_3, g_4, g_5\}$ take different numerical values, it is necessary to have normalized values to compare them. To do this, we construct an s-shaped membership function in the following form:

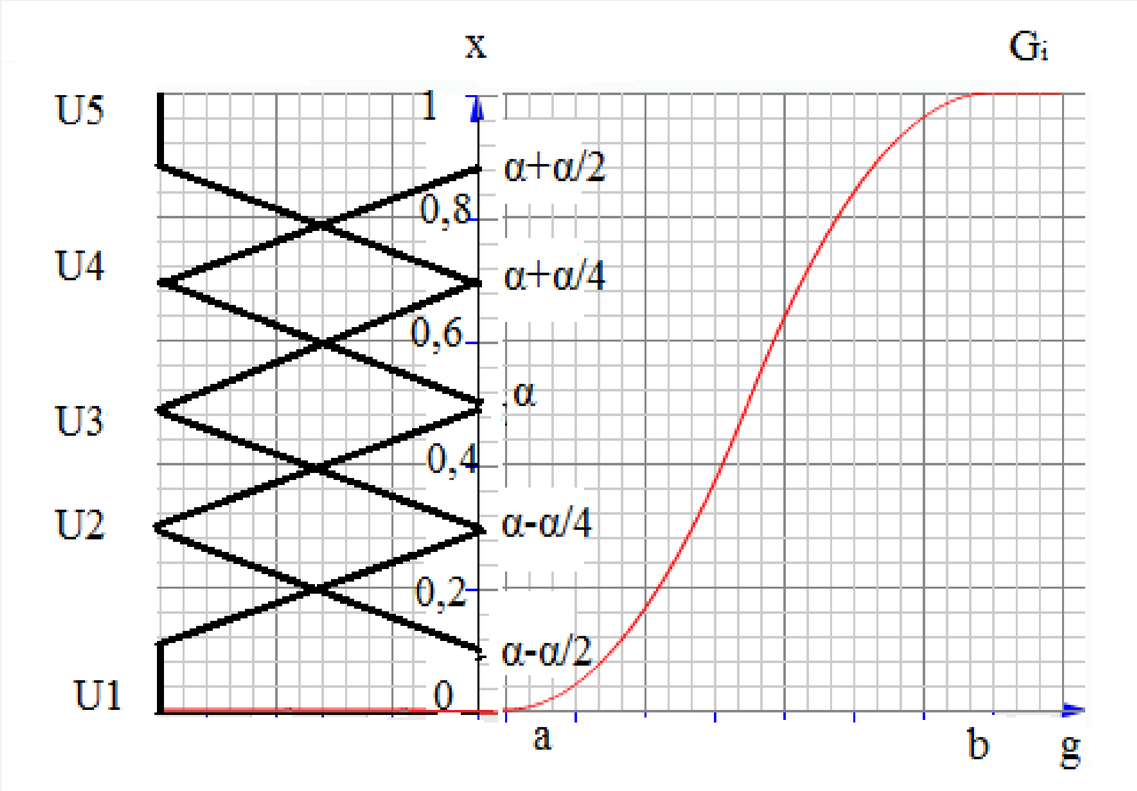
$$\mu_{G_i}(g_i, a, b) = \begin{cases} 0, & g_i \le a; \\ 2\left(\frac{g_i - a}{b - a}\right)^2, & a < g_i \le \frac{a+b}{2}; \\ 1 - 2\left(\frac{b - g_i}{b - a}\right)^2, & \frac{a+b}{2} < g_i < b; \\ 1, & g_i \ge b. \end{cases} \quad (7)$$

Here a – is a convolution of the sum of the minimum points, b is a convolution of the sum of the maximum points of the grading scale according to the criteria in the group G_i, g_i is a convolution of the sum of points on the gradation scale for the considered innovative projects. Thus, the obtained input data will be normalized and comparative.

Let us denote $x_i = \mu_{G_i}(g_i)$ – the value of the membership function of the considered innovative projects by groups of criteria $G_i, (i = \overline{1,5})$. Then, calculating the convolution of points for each group of criteria G_i and finding their membership functions by formula (7), we proceed to the next step.

For each group of criteria, the decision maker (DM) has his own considerations, which should be the "desired values", ie the sum of points, respectively, for each group of criteria. We denote them by the vector $T = (t_1, t_2, \ldots, t_5)$, respectively, by groups of criteria $G_i, (i = \overline{1,5})$, and for each value we calculate the membership function by formula (7). The vector of membership function "desired values" is denoted by $\alpha = (\alpha_1, \alpha_2, \ldots, \alpha_5)$, where $\alpha_i = \mu_{G_i}(t_i), (i = \overline{1,5})$.

At the second level of the model, relative to the "desired values" and the results obtained for each group of criteria G_i, we project the value of the membership function on the set of carriers of the linguistic variable U. This will reveal the essence of the "idea" in relation to the "desired values".



For each term U we construct membership functions for example.

$$\mu_{U1}\left(x;\alpha-\frac{\alpha}{2};\alpha-\frac{\alpha}{4}\right)=\begin{cases}1, & x\le\alpha-\frac{\alpha}{2};\\ \frac{3\alpha-4x}{\alpha}, & \alpha-\frac{\alpha}{2}<x\le\alpha-\frac{\alpha}{4}.\end{cases} \quad (8)$$

Depending on the interval in which x falls, for each group of criteria G_i, we choose one or another membership function μ_{Uij} relative to the "desired value" α. We calculate the membership function for the terms $U_{ij},(i,j=\overline{1,5})$ for the considered innovative projects. As a result, for each group of criteria G_i we get the linguistic value and assessment of the reliability of the innovative projects.

That is the reliability of the fact that the evaluation of a group of criteria belongs to one or another term. This will provide an opportunity to get an interpretation of the scores, revealing their subjectivity and understanding of what the innovative projects is.

The next step examines the estimates that return to the received and desired dates using the following functions (9):

$$\mu(O_i) = max\{\mu(A_i); \mu(B_i)\}, \quad (9)$$

$$\mu(A_i) = \begin{cases} \mu_{Uij}, & U_{ij} = U_{ij}^*, \\ 0, & U_{ij} \neq U_{ij}^*. \end{cases} \quad \mu(B_i) = \begin{cases} \frac{\mu_{Uij}}{2}, & U_{i(j\pm1)} = U_{ij}^*, \\ 0, & U_{i(j\pm1)} \neq U_{ij}^*. \end{cases} \quad (i = \overline{1,5}).$$

The obtained membership function shows how much the considered innovative projects satisfies the wishes of DM for each group of criteria.

Given the called functions, abilities have transformations so that we obtain either one or two terms for the group criteria and correspond to such several validities for them. Therefore, if we can make two estimates according to a group of criteria, it causes the functionality of correspondence (9) for the next stage, which chooses most of them.

Let DM know or can assign weights to each group of efficiency criteria {p1, p2, …, p5} from the interval [1; 10]. Then you can determine the normalized weights for each group of criteria:

$$w_i = \frac{p_i}{\sum_{i=1}^{5} p_i}, i = \overline{1,5}; w_i \in [0,1]; \qquad (10)$$

Consider one of the convolutions for constructing an aggregate estimate:

$$m = \sum_{i=1}^{5} w_i \cdot \mu(O_i), i = \overline{1,5}. \qquad (11)$$

We introduce the linguistic variable M(m)=«evaluation of the idea». The universal set for the variable M(m) is the segment [0; 1], and the set of values of the variable m – term-set $M = \{m_1, m_2, m_3, m_4, m_5\}$„ where: m_1 = "evaluation of the idea is very low"; m_2 = "evaluation of the idea is low"; m_3 = "evaluation of the idea is average"; m_4 = "evaluation of the idea above average"; m_5 = "evaluation of the idea is high".

The rating scale can be defined as follows: $m \in (0{,}67;\ 1]$ – m_5; $m \in (0{,}47;\ 0{,}67]$ – m_4; $m \in (0{,}36;\ 0{,}47]$ – m_3; $m \in (0{,}21;\ 0{,}36]$ – m_2; $m \in [0;\ 0{,}21]$ – m_1.

Conclusions

The life cycle of an innovative project is a certain period between the beginning of the project and its completion. The real research task of obtaining a quantitative estimation of innovative projects is to increase the safety of their funding. The model applied has helped develop the quantitative estimating innovative projects at the stage of product output to the market, in the conditions of uncertainty with the use of the apparatus of fuzzy mathematics.

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Thank you!