Management of process control in innovative projects

Chapter 7
Resource management in the implementation of innovative projects

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Lecture content

- Processes of cost management of an innovative project
- Resource planning of the innovation project
- Cost planning for an innovative project
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01

Processes of cost management of an innovative project

Definition 1. Project cost management will be understood as a combination of processes performed during planning, budgeting, fundraising, financing, management, and cost control, ensuring the implementation of the project within the approved budget.

Project cost management includes the following processes:

1. cost management planning is a process that establishes policies, procedures, and documentation for project planning, management, expenditure, and control;
2. cost estimation - the process of approximate estimation of monetary resources required to carry out project operations;
3. budgeting - the process of consolidating the estimated values of individual operations or packages of work to create an authorized baseline cost plan;
4. cost control - the process of monitoring the status of the project for updating the cost of the project and managing changes to the baseline plan value.

Project cost management should take into account the requirements for information on costs incurred by project stakeholders. Different project stakeholders can calculate the cost of a project in different ways and at different times.

For example, the price of an item to be purchased can be estimated at the time of the decision or confirmation of purchase, at the time of ordering, at the time of delivery, or its actual value is taken into account and recorded in the project costs.

Project cost management is primarily concerned with the cost of resources required to carry out project operations. In addition, project cost management should take into account how decisions affect subsequent recurring costs of operation, maintenance, and technical support of the product, service, or project result.

For example, limiting the number of design drawings may reduce the cost of the project, but it may increase the customer's operating costs.

02

Resource planning of the innovation project

Definition 2. Resources of an innovative project will understand what is needed to carry out project operations.

For example, resources: labor resources, machinery, equipment, materials, cash, energy resources, information resources, computers and office equipment, production space, knowledge, and funds.

Resources can be:

- Renewable (such as "capacity", simply called resources) are people, materials, and mechanisms that can be reused after an operation. They are restored, do not accumulate, and do not accumulate. If these resources are not used, then their functional capacity in this period of time can not be compensated in the future, can not be accumulated;

- Non-renewable (such as "energy", also called materials) - these are materials and equipment that are spent on operations. Such resources are not reproducible, accumulative, stored, which are spent completely, not allowing reuse. If such resources are not used in this period of time, they can be used later.

Workforce. Manpower consumes time (in hours or days) to complete tasks. They are characterized by the maximum number of units of resource, this is the amount of working time available for simultaneous use in the project.

For example, if one software developer is involved in a project, then the maximum number of resource units for the corresponding resource will be 100%, in the case of two - 200%, etc.

Material resources are various materials, components, and other consumer goods used to perform project tasks. Material resources are characterized by a unit measuring the amount of resources (Material Label).

Expenditure resources are a type of resource that describes the different ways of financing or spending financial resources of the project. This resource is often used to describe contractors or project investors. The amount of funding is indicated when allocating the resource to the project.

Cash resources are a financial dimension and can be allocated to project tasks.

The use of resources in project planning allows:

- track the amount of work performed by people and equipment, as well as the number of materials spent on tasks;
- guarantee a higher level of accounting and understanding of the innovation project plan;
- increase the accuracy of calculating the details of the project schedule.

One of the important issues in project management is a resource planning.

Definition 3. Resource planning - determining the number of resources that will be used in the project.

Resource planning is an iterative process. This process is closely related to the planning of operations, cost planning, and scheduling of the project, as a result of which the results of resource planning can be reviewed.

Resource planning involves the following steps:

1. assessment of resource needs;
2. compiling a table of resource needs for work and a table of resources;
3. drawing up a new plan in case of a pessimistic scenario;
4. smoothing of resource histograms by shifting works within the stock time;
5. re-planning of the calendar plan;
6. control and construction of new resource plans and histograms.

Resource planning also involves determining the suppliers of resources for the innovation project; taking into account the factors that affect the provision of the project with resources; formation of resource delivery schedules.

According In general, the project resource planning algorithm includes three main stages:

- definition of resources (description of the resource and determination of the maximum available amount of this resource);
- compliance of resources with tasks;
- analysis of the schedule of the innovative project and resolution of contradictions that have arisen between the required amount of resources and its available quantity.

Since the availability of resources to perform work in the project is the most important factor in project management, the manager can develop a realistic plan based on the described set of available resources.

The amount of resource requirements directly depends on the scale of the project, its innovative complexity. We must not forget that there will be a new task that has not been solved so far. As a rule, the main problem is the matching of labor and technology.

If the need for resources exceeds the possibilities, there are three ways to solve it:

- postpone (delay) work within the time reserve;
- adjust the deadlines according to limited resources (this is if resources are limited, limited in advance, the schedule should be changed);
- adjust the intensity of resource use within the set time (if the date can not be changed, then increase, for example, the length of the working day).

Estimation of the number of resources required directly depends on the amount of work to be expressed in labor intensity. The number of employees is determined by the formula:

$$K_p = \frac{T}{F}, \qquad (1)$$

where T is the complexity of work; F - useful time of one employee.

Resource conflict is a situation when the need for a resource exceeds its maximum consumption limit.

Use a variety of methods to balance resource conflict. Resource equalization eliminates peaks in resource use and sets the level of resource use within their availability. The choice of one or another method of resolving resource conflicts depends on the situation.

Definition 4. Resource equalization is the process of equalizing the load of contractors assigned to the project.

Equalization of resources, as a rule, leads to an increase in the duration of work and the total duration of the project. Alignment is a time-consuming operation and is usually performed using the software.

The result of resource planning is:

1. Allocation of resources for project operations. The main outcome of the resource planning process is a list of types and amounts of resources required to perform all elements of the WBS. These resources will be updated based on the results of the next stages of planning (scheduling and cost planning) and analysis of the plan.
2. Calendars of resources. The specification of the resources used in the project allows determining their calendars.

Definition 5. The process of resource allocation is the definition of the required resources for each work and their required amount.

Once the resources have been identified and coordinated with the schedule, they need to be compared with the available resources of the project executor.

The following should be taken into account:

- normal productivity (taking into account the level of training and qualifications);
- existing commitments for other projects (if labor is taken from one source);
- expected absenteeism (due to illness and other causes, which sometimes amount to about 25%);
- increase in resources, which is possible due to: additional hours; use of subcontractors; changes in the mode of work on the project, which will lead to changes in resource plans.

These paths require higher costs, which must be taken into account when evaluating them.

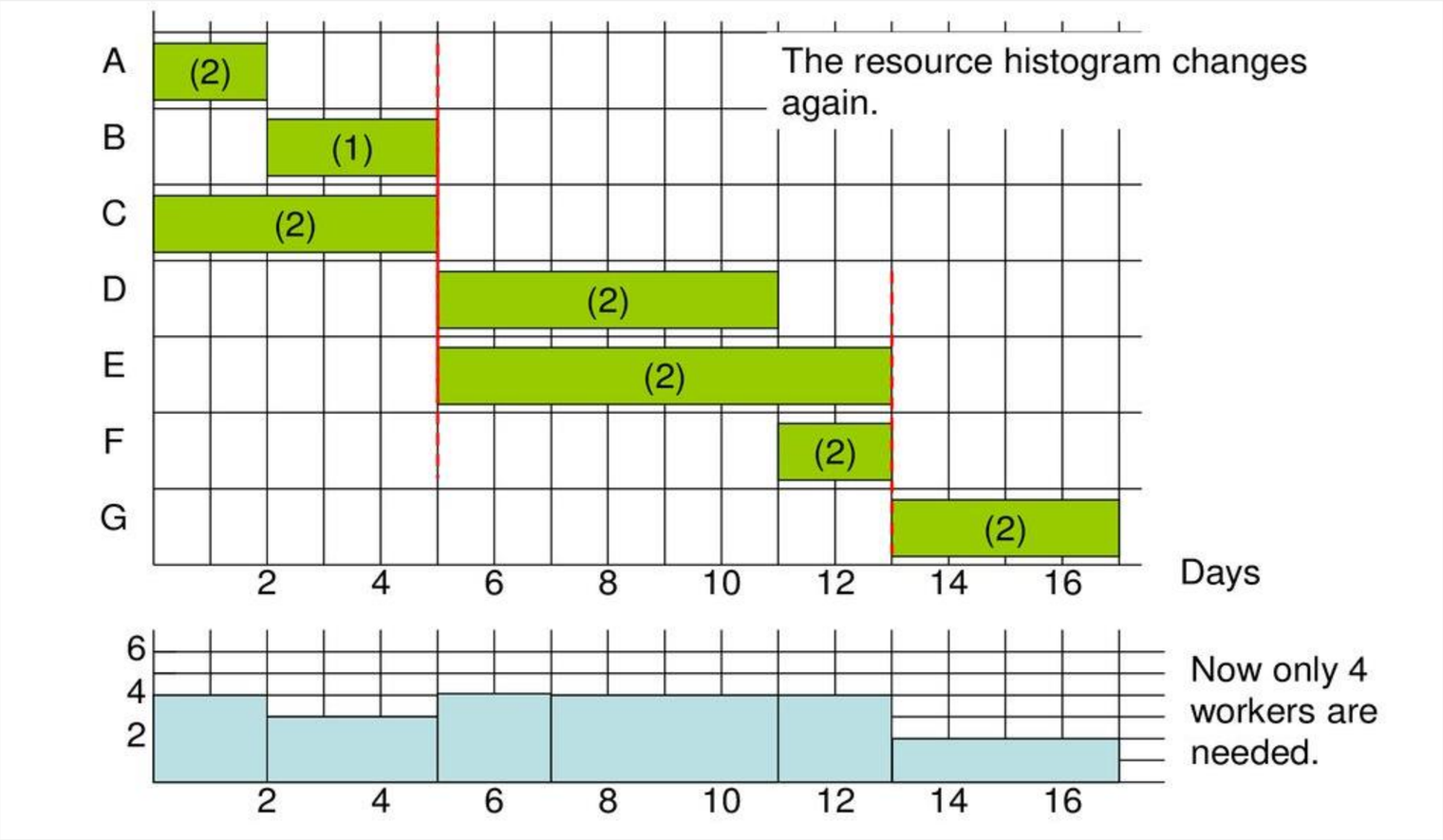
When we need workers for different jobs, then it is advisable to build a histogram of resource needs.

Definition 6. The histogram of resource requirements is similar to bar charts, where the horizontal axis indicates the calendar dates, and the vertical - the daily amount of resources needed to perform all work resources for each profession separately.

It is very widely used in the planning of any project because it is clear, is easy to understand and combine with other aspects of planning. To build it, you need:

- calendar schedule for early deadlines (we assume that we try to do all the work as early as possible);
- forecasts of resource needs in terms of work.

The histogram of resources is built based on the need for all additions. Further, on the basis of indicators of this table, the calendar schedule of need for a certain resource on all works is constructed:



Resource optimization involves:

- smoothing (optimization of resources within the time reserves of tasks);
- equalization of resources (leads to a change in the critical path).

Tools and methods for optimizing resources: transfer of work, downtime, stretching, changing the number of resources, changing availability.

- ✓ Resource optimization procedure iterative. May be repeated throughout the project.
- ✓ Each task must be provided with a resource or the cost required to purchase the resource must be determined.
- ✓ Prolonged overload of resources is not allowed.
- ✓ Resource calendars and resource availability for the project must be considered.
- ✓ When aligning resources, it is necessary to be guided by the matrix of project priorities.

Resource analysis requires a significant amount of mathematical calculations, so it is usually performed using the software.

There are three steps to follow:

Step 1: Determine where the information can be obtained (that is, where the resource information is located);

Step 2: Set priorities for resource allocation. Unambiguous about the "correct" or "optimal" allocation of resources, in the implementation of large projects, when it is impossible to solve these issues manually, also use a scale of priorities:

1st priority - early start (who has the earliest);

2nd priority - the least amount of time for work;

3rd priority - the longest duration of work;

4th priority - serial number.

When setting priorities, keep in mind:

1. When implementing large projects, it is unrealistic to draw up a very detailed calendar plan for many months to come, as changes will inevitably take place.
2. Time reserve implies the possibility of postponing the deadlines for work, so priority is given to work with the least amount of time, that is those that are almost critical.
3. Duration and budget characterize the amount of work, so resources are directed primarily to larger and more expensive work.
4. If it is impossible to meet the previous criteria, set priorities according to the serial number of the work;

Step 3: Allocate resources (after setting priorities).
Two basic methods are used in resource allocation:

The sequential method allocates resources between works according to the established priorities, each time considering one word after another.

The parallel method allocates resources to all work at the same time, but each time for one day, comparing the daily availability of resources, the need for them, and the duration of work. In this case, the manager must determine whether it is possible to interrupt the work and complete it after some time.

These actions require the following principles:

1. From the very beginning of the project the need for resources is compared with their availability, a calendar plan for the early start of work is developed.
2. If there is no resource to start work at an early date, it is shifted by one day (or week) within the time reserve and again compare the availability of resources with the need for them. This process will continue: the need for resources will correspond to their availability; all time will be used for work.

In the latter case, use one of two possible approaches:

1. Planning in conditions of limited resources.

If the resource is limited or cannot be increased, you must extend the life until the resource becomes available. Sometimes this increases the duration of critical work, then the implementation of the project as a whole is delayed. This is possible in the following situations: the work is performed in a limited space; limited capacity; a limited number of technologies.

2. Planning in a limited time.

This method is used if it is impossible to extend the project completion period.

In this case, the need for resources must be met (this is, the lack of resources must be renewed through additional acquisition).

Such situations are possible in the case of:

- the project has severe penalties for non-compliance in time;
- the project is part of another project with limited time (repair of the river pier to the summer recreation center).

As the terms of such projects cannot be postponed, resources are increased.

Once the analysis and allocation of resources have been completed, the initial network schedule needs to be reviewed, as some work on resource planning had to be postponed. You should also check the rest of the related documents: Gantt charts; budget; cost curves; cash flows; work plan; supply plan.

03

Cost planning for an innovative project

We propose to classify the costs of an innovative project according to the following criteria.

I. Project costs are divided into investment and current.

Investment costs include investments in fixed capital (construction of premises, purchase, or lease of technology and equipment), before production costs for working capital needs.

Current costs - the cost of production, which includes the cost of purchasing raw materials, basic and auxiliary materials, wages, factory, and overhead costs for the reporting period.

II. According to the place of work, the costs are divided into costs of the department, sector, laboratory, temporary creative team, expedition, service, or another administratively separate structural unit, etc.

III. By types of costs, classification is carried out by economic elements and cost items. Cost elements include a set of costs that are homogeneous in their economic content, and cost items include one or more elements.

IV. Depending on the selected object of cost accounting: costs for development, topics, design objects, stages, tasks, etc., approved in the prescribed manner, concluded contracts for the development and implementation of design work.

V. By methods of inclusion in the cost of project work (these are production costs of the project organization, directly related to the execution of custom organizations, enterprises, citizens at their own risk and own project work, income from which was recognized in the reporting period) and by nature participation in the production process costs are divided into direct and indirect.

Direct costs are costs that are directly related to the implementation of design work and are included in the production cost of design work of the relevant objects of accounting on a direct basis, in particular: direct material costs, direct labor costs; deductions for social activities, other direct costs.

Indirect (or overhead) costs are costs associated with the management and maintenance of production, organization of design work, and other costs that can not be attributed in an economically feasible way directly to a specific cost object.

VI. Depending on the change in the volume of project work, production costs are divided into fixed and variable.

Variable costs are costs, the value of which increases with the increasing volume of project work and decreases with their reduction. These costs include, for example, the cost of materials, wages, social security contributions, and so on.

Fixed costs are the value that remains unchanged when changing the amount of design work performed. These costs include, for example, costs associated with the management, organization, and maintenance of production.

VII. On the basis of the ratio to the cost of work, costs are divided into production costs and costs of the period.

Production is the costs of the design organization associated with the implementation of design and survey work. Production costs form the production cost of design work and are part of it.

Period costs are costs that are not included in production costs and are treated as costs of the period in which they are incurred. These are administrative costs, marketing costs, and other operating costs.

VIII. By calendar periods during which costs are included in the cost of project work: month, quarter, year, the operating cycle.

Cost planning

In order to coordinate the calendar deadlines with the available resources, in order to further control and make appropriate decisions, calendar planning of costs is also carried out, this is the distribution of costs by early and late deadlines.

Calendar planning includes not only determining the calendar deadlines for work, coordinating them with available resources, but also calendar planning of costs, or budget, in order to further control them and make appropriate decisions.

The project budgeting process is the distribution of the estimated cost over time according to the schedule.

The components of the calendar budget are as follows:

- cost calendar (includes payment dates);
- terms of payments;
- critical moments of the project implementation and means of reducing the risks associated with it.

Typical cost items for an innovation project are as follows:

Direct costs: labor, materials, equipment and other costs.

Direct costs are directly related to the work package. These costs are the actual cost of cash and must be paid as the project progresses. Direct costs are usually separated from overheads.

Overheads of the project.

Project overheads cannot be tied to any intermediate result, but to the project as a whole. For example, the costs of project management consultants, training, travel - these are overheads of the project.

General and administrative overheads are organizational costs not related to the project.

For example, the cost items in the budget of the cost of developing an innovative project may be as follows:

1. Salaries of the project development team.
2. Expenditures on equipment, materials, technologies.
3. The cost of renting premises and office equipment.
4. The cost of marketing, including marketing research.
5. Legal costs.
6. Travel expenses.
7. The cost of marketing.
8. The cost of the study.
9. Cost of feasibility study.
10. Cost of consulting services of external participants and various experts.
11. Payment for utilities.
12. Payment for the use of software and hosting.
13. Payment for educational services of the project implementation team.

When planning costs, it is not enough to know only the total amount of investment in the project, you also need to have data on the annual need for funding, and for the first year - its quarterly and monthly division.

Before planning costs, you need to do the following:

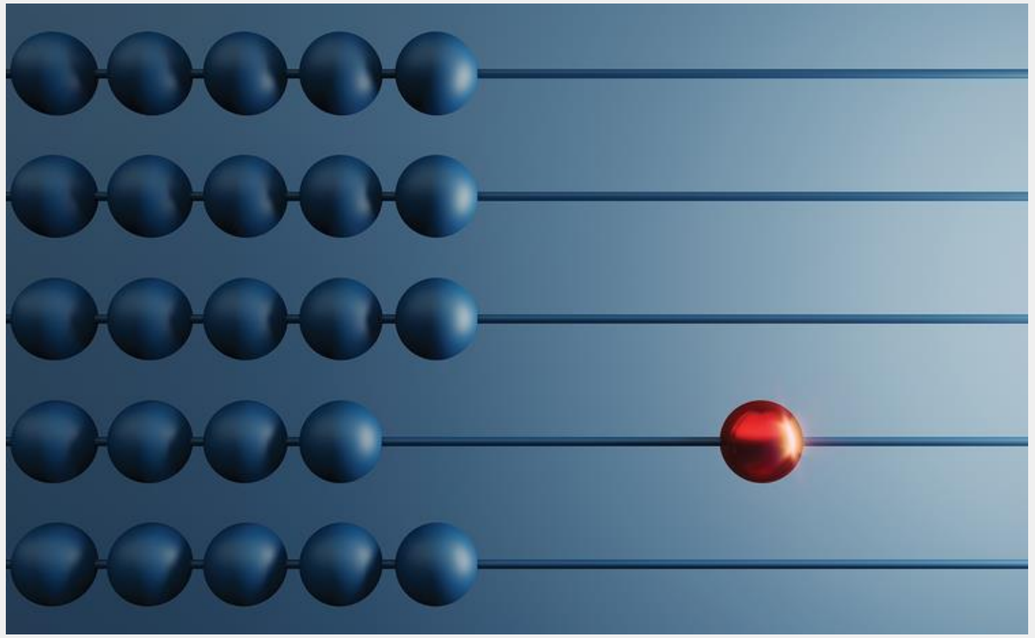
1. on the basis of the calendar plan to make the list of works which are necessary for performance in each period of time;
2. determine the cost of these works from the estimate documentation;
3. calculate the cost of work by cost items.

When drafting a project budget, costs are planned from general to specific.

In addition to the list of main costs, the budget of the innovation project should contain their comprehensive calendar, the degree of accuracy of which depends on the characteristics of the project, the amount of investment, as well as specific requirements proposed by creditor organizations.

04

Methods of calculating the cost of the project



Valuation of an innovative project is a process of developing an approximate estimate of the cost of resources required to carry out project operations; it is an estimate of the probable cost of the resources required to carry out the design work.

The input data for estimating the cost of an innovative project are considered to be the following:

1. Hierarchical structure of works (used to organize cost estimates, as well as to evaluate the entire development);
2. Requirements for resources (description of what types of resources and in what quantities are needed for each element of the hierarchical structure of work);
3. Resource norms (it is necessary to know the individual norms for each resource in order to calculate the project cost);
4. Estimation in terms of performance of works;
5. Accounting card (describes the code structure used by the executive organization to prepare various financial statements).

There is a well-known tool that provides a systematic approach to the cost planning of any project - the cost planning map (CPLM). CPLM formulates a sequence of steps that a development team should take to make decisions, develop basic definitions, terminology, and types of estimates, select valuation tools, and cost planning processes.

CPLM helps to build an organizational culture that is cost-conscious and proactive.

CPLM is most useful in organizations that carry out large projects or have a steady stream of small and medium-sized projects. In organizations that implement large, complex projects and consume a lot of resources, it is customary to involve specialists from various functional departments to work on the cost planning map.

The value of CPLM is that it gives clear and unambiguous instructions to the project team. Carefully formulating the action scenario and ensuring the coordinated implementation of planning tasks, the cost planning map clearly identifies the type of assessment and the type of baseline cost plan, as well as methods for obtaining them. This significantly reduces the risks of inadequate cost planning and misuse of the company's resources and makes it possible to understand the importance of cost.

The main advantage of CPLM is its linear structure, which allows you to clearly display the steps required to obtain a quality cost plan. Disadvantages - longer duration of map development and the need for significant experience.

There are many types of assessments, but in areas such as innovative software development or innovative production of technological products, three of them are most commonly used: estimation of the order of magnitude, budget estimation, and determinative estimation. They differ in many parameters, such as purpose, accuracy, cost of training, required information, and type of evaluation tool. Each of these estimates can be the basis for the development of the second element of the cost plan - the base cost plan or distributed overtime budget. Naturally, the characteristics of the basic cost plan developed in this way must correspond to the characteristics of the type of assessment on the basis on which this plan is based.

There are several common methods for calculating the cost of an innovative project:

1) **Top-down valuation method** - used to determine the cost in the early stages of project development, when information about the project is quite limited. Therefore, in fact, the cost of the whole project is estimated. The advantage of such an assessment is that it does not require much effort and time. The disadvantage is that the accuracy of such an assessment is much lower than in a more detailed consideration of the project.

2) **Bottom-up valuation method** - used to produce an agreed base price for the project or a final cost estimate for the project. Evaluation involves estimating the cost of each task at the level of the work group, followed by summarizing the results at the final levels. Adding estimates gives an overall estimate of the cost of the entire project. The accuracy and complexity of such an assessment is determined by the degree of detail of the project. The more detailed the project is divided into operations, the higher the complexity and accuracy of the assessment. The project team must find the optimal balance between complexity and accuracy.

3) **Evaluation by analogy** - is that the evaluation of the cost of the current project is based on the actual cost of similar previous projects. The basic principle is that the project on the basis of which the assessment is carried out is fully consistent with the current project. Only under this condition the assessment will be quite accurate. Estimation by analogy is less time consuming than other methods, but it is also less accurate. It can be relied on when not only previous projects were really similar, but also when the people who prepared the assessment have relevant experience.

4) **Parametric evaluation** - involves finding a parameter of the evaluated project, which varies in proportion to the cost of the project. Based on this parameter, a mathematical model is created.

Models can be simple (estimating the cost of housing per square meter) or complex using a large number of factors. After entering the parameter values into the model, the cost of the project is obtained as a result. The parameters used in the valuation should be easily measurable, which will increase the accuracy of parametric valuation.

5) **Expert assessment.** An expert survey can also provide a ready-made cost estimate. Experts can be any project participant, including a manager, and people who have experience working on similar projects. If certain project tasks are performed by third-party contractors, an effective method of estimating the cost may be a survey of suppliers, both planned for the project and other.

05

Determining the budget of the innovation project

Costs need to be planned so that they can meet the needs for financial resources throughout the project implementation period. To do this, make a project budget - a plan that reflects the quantified results of the adjusted calendar plan and project implementation strategy.

Definition 7. The project budget is an item-by-item list of the estimated costs required to complete the project's objectives.
The budget presents the estimated results of the adjusted calendar plan and project implementation strategy.

Definition 8. Budgeting is the process of combining the estimated values of individual operations or packages of work to develop an authorized baseline cost plan. This baseline plan includes all authorized budgets, except for management reserves.

Definition 9. Budget development - determining the baseline of the project cost, which shows the distribution in time and the cumulative cost of the project and serves to compare current results with planned; component of project budgeting, which means the definition of cost indicators within the project and the project as a whole, the process of forming a project budget, containing the established (approved) distribution of costs by type of work, cost items, time, cost centers or other structure.

Different types of budgets correspond to different stages of the project life cycle:

1. Preliminary (estimated) budget.
2. Approved (official) budget (cost baseline).
3. Current (adjusted) budget.
4. Actual budget.

The budget can be in the form of:

- Cost calendar.
- Cost allocation matrices.
- Bar chart costs.
- Cumulative cost diagrams.
- Line charts of cumulative costs distributed over time.
- Pie charts of cost structure.

Project budget calculation

To calculate the project budget, you need to have:

1. Project estimates.
2. Approved cost items.
3. Calendar plan of the project.

The project budget is calculated by summing by cost items and time periods. If the budget is displayed graphically, you get a typical project cost curve. This curve is also called the S-curve of the project.

There are the following problems of project budgeting:

1. Projects that take a long time to complete increase the inaccuracy of calculations.
2. Pre-determined implementation time can greatly affect the time and cost calculations.
3. The human factor can also be a source of error in calculations. The extent to which employees have the necessary qualifications to perform the task will affect the productivity and time they gain experience.
4. Sometimes the factor of staff turnover (it is clearly not reflected in the budget) can significantly affect the calculations.

Methods of project budget formation:

Top-down budgeting involves determining project costs at the top level. Typically, such costing is performed by management responsible for tangible assets or by a cost planning team that performs similar functions. The purpose of top-down budgeting is long-term planning. As a rule, top-down budgets do not take into account the details of projects and therefore cannot give an accurate definition of costs.

Bottom-up budgeting begins with planning the budgets of the individual components of the project at lower levels and then merging these budgets at a higher level. Such processes are usually performed by project managers or project schedulers, who usually spend a lot of time collecting and processing detailed information, but their results are more accurate.

A combination of top-down and bottom-up budgeting is used for more efficient cost planning.

Conclusions

In order to achieve the main goal of the innovation project, it is necessary to have knowledge of resource management. Project cost management is primarily concerned with the cost of resources required to carry out project operations. Resources of an innovative project can be labor, material, expendable, monetary. Resource planning also involves determining the suppliers of resources for the innovation project; taking into account the factors that affect the provision of the project with resources; formation of resource delivery schedules. An important issue in the planning of costs for an innovative project in the context of clear scheduling. In this lecture, we also considered the generally accepted methods of calculating the cost estimates of an innovative project. The issue of determining the budget of the innovation project was also superficially considered.

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Thank you!