UDC 338

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MODELING THE COORDINATION PROCESS IN THE ENTERPRISE PROJECT MANAGEMENT SYSTEM

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Projects are aimed at obtaining certain results – in other words, they are aimed at achieving goals. It is these goals that are the driving force behind the project, and all efforts to plan and implement it are undertaken to ensure that these goals are achieved. Any project in the process of its implementation passes through various stages, called in aggregate the life cycle of the project. To implement various project management functions, which are referred to as project management processes. At this stage of economic development, enterprises need to make the right management decisions to achieve their goals and maximize profits. So, as there is competition in the market, the entrepreneur has a risk of losing all his investments and becoming bankrupt. To successfully build your business, you need to plan each step correctly. Simulation of the coordination processes will help the entrepreneur in making managerial decisions. The article is devoted to solving this problem.

Keywords: coordination, management, planning, activation, organization, control.

Formulation of the problem

A modern organization is able to exist and successfully compete in the market only under the condition of constant development and adaptation in the changing conditions of doing business. This means that the company's management, planning and achieving certain goals, constantly faces with the appropriate management problems: how to plan the distribution of work in time to meet the deadlines; how to allocate resources, how many they are needed, to whom and when; how to achieve the achievement of the required quality; how to organize timely and objective control over the progress of work, etc. These tasks all the time are becoming more complicated, because new problems constantly arise, related both to the development of technologies in general, and to the appearance of new opportunities to increase the flexibility of control systems. Therefore, effective project management requires the transition of organizations to more progressive management structures: self-managed teams, self-regulating organizational structures [5]. At the same time, the role of coordination in project management sharply increases, which is designed to ensure the consistency of the work of such autonomous subdivisions. Consider the essence of modern project management processes, their features and methods.

Project management is the art of leadership and coordination of human and material resources throughout the life cycle of a project to achieve the projected results in terms of composition and scope of work, cost, time, quality and satisfaction of project participants [1]. Successful implementation of the project is determined by the fulfillment of a number of established criteria: the completion date of the project, the cost and budget of the project, the quality of the work performed and the specification of the requirements to the results, the degree of customer satisfaction, which may also depend on the degree of preservation without disturbing the current work of the organization, its production culture and values.

Such authors as Levitsky S.I., Rudensky R.A., Kravchenko V.N., Lysenko Yu.G., Mesarovic M., Takahara Ya., Sivitskaya I.G., Stasyuk V.P., Golenco-Ginzburg D., Gonik A., Slyeptsov A., Tyshchuk T. worked on this issue.

Statement of the main material

Work on project management includes a number of relatively independent processes. Several groups of project management processes can be distinguished [1]:

– initiation processes (concept development, feasibility study, project approval);

– planning processes (definition of goals and success criteria, development of working schemes, plans, algorithms, etc.);

– implementation processes (organization and implementation of the implementation of the project plan, the conclusion of contracts, the development of team projects, etc.);

– control and analysis processes (determining the degree to which the current results of the project meet the planned standards);

– completion processes (formal acceptance of the completed project, closing of contracts, etc.).

Some authors separately identify management processes, which are understood as the processes of change management that are initiated during the implementation of the analysis processes. They include the processes of resource management, goals, quality, risks, contracts. At the same time, these authors consider the processes of implementation to be only those that occur in accordance with the planned plan. Obviously, such a division is very conditional and difficult to implement in a functional aspect. Therefore, from the functional point of view, it is convenient to understand management processes as processes of organization and implementation of the project, as well as the processes of its coordination and change management.

Implementation of any part of the project requires the implementation of certain control functions. There are basic and integrating functions [1]. The basic functions include:

1. Management of the project's subject area, or substantive entity. It is carried out through the processes of defining goals and consists in developing a concept, planning, accounting, controlling the implementation of the project.

2. Quality management. It covers the entire life cycle of the project and includes an evaluation of the results of the work of all project participants, beginning with the quality of management decisions and ending with the quality and conformity of the final project output to the existing standards.

3. Management of temporary resources – determining the timing of the beginning and completion of the project and its parts, optimizing the use of the time budget. Here, methods of scheduling, monitoring work schedules, and temporary analysis of the project are used.

4. Cost management – «cost estimation», cost budgeting, identification of sources of financing and monitoring of financial and material budget compliance.

Integration functions include [1]:

1. Personnel management of the project – selection, recruitment and training (retraining) of specialists.

2. Management of communications (interactions and information links). It is necessary to organize monitoring and control over the progress of the project, interpretation of the information received and forecasting.

3. Contract management – determining the composition of the entities involved in the contract, selecting counterparties and suppliers, signing contracts and monitoring the progress of their implementation.

4. Risk management. It consists in forecasting uncertainty, preventing negative impacts of disturbing events (insurance, diversification, hedging), as well as assessing the damage and eliminating the consequences of their occurrence.

To successfully implement these functions, a number of generally accepted methods are used in project management.

Effective management is possible when any of the management functions is based on five relatively independent activities: planning, organization, coordination, activation and control [26].

Planning – the definition of the optimal work program of subsystems of the subordinate level to achieve a certain result. Planning is carried out within the existing limitations on cost, timing, quality of products, etc. As a result of planning, it is determined who, what, how much and in what terms should do it.

Organization – the definition of ways, methods, ways to implement the plan. As a result of the organizational arrangements, determined how to bring the plan into effect, after which the actual implementation of the planned decision is carried out.

Coordination – coordination of activities of various project participants, prevention and resolution of imbalances and conflicts at the lower levels, maintaining the main quality criteria for the work performed (on terms, cost, product quality, etc.) in order to increase the efficiency of the implementation of the planned decision.

Activation is the process of stimulating project participants to work effectively. The result of the activations is the development and application of motivational measures (incentives, penalties) that interest the project executors to work with maximum efficiency.

Control – systematic observation of all project implementation processes, identification of deviations from the planned work on a number of criteria, forecasting the consequences of the situation. Control realizes feedback from the level of direct executors to the highest levels of management and allows timely use of coordination and activation mechanisms to prevent negative consequences of observed deviations.

The most important and complex processes are planning and coordination.

Planning is of great importance, since the full result of the project depends on its quality. The development of a quality plan (that is, real time, resources, product quality standards, implementation methods, etc.) is also complicated by the uniqueness of the conditions for the implementation of the project and the content in it of what has not previously taken place in practice.

Planning involves the following processes:

– planning and decomposition of goals;

– planning of the subject area (the composition of the work and their interrelationship);

– planning the resource fund (employees, equipment, materials) available for the implementation of the entire project;

– planning the duration and resource intensity of certain types of work;

– transaction value of certain types of work;

– allocation of resources between works;

– development of calendar plans,

– development of criteria for evaluating the effectiveness of project implementation, including the quality criteria of the project's products;

– identification and risk assessment, etc.

However, even the most careful planning can not guarantee successful implementation of the project, as the project implementation conditions are in constant change. This is also confirmed by the world experience in project management, which shows that only a very small percentage of all projects are completed on time with the implementation of resource constraints.

The most commonly cited reasons for project implementation failures:

– unrealistic deadlines;

– mistakes in the formulation of goals;

– disunity of the project team;

– insufficiently detailed planning;

– inefficient interaction within the project;

– change of objectives during the project;

– conflicts between the objectives of the project and the interests of the organizational units.

Almost all of the above reasons effectively solve the coordination processes, including the redistribution of resources, the adjustment of the objectives of the project participants (executors), the coordination of objectives between different levels of management, the definition and adjustment of the relationships between individual executors of the project (in accordance with the chosen principle of coordination).

Thus, coordination tasks in the project management system are of great importance, and their solution is one of the most important factors determining its effectiveness.

The degree of coordination of the project management system strongly depends on the chosen organizational structure of project management [7].

To determine the effective structure of project management, it is important to define the principle of decomposition of the project itself (the project team). The number of decomposition levels depends on the complexity of the project and the degree of detail required for the researcher. It is necessary to clearly distinguish the principle of decomposition of the upper levels of the project, at the lower level, regardless of the chosen decomposition principle, the same set of single works should be obtained, which together represents the whole project. The following principles of decomposition are distinguished:

– subjective feature (object-constructive), which defines special types of works and is oriented to the components of project production;

– a functional feature that determines the individual functional parts of the project: design, planning, supply, etc.;

– a territorial feature defining the parts of the planning object, located in different regions for extended and spatially-distributed projects;

– decomposition in phases of the life cycle of the project – is used in the early stages of the project, when the detailed plan for its implementation is not yet known.

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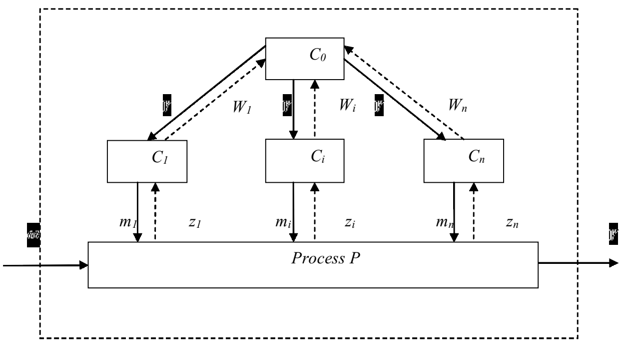
The choice of this or that decomposition principle is determined by the researcher's interest, however, for effective implementation of the coordination processes, the most convenient is the decomposition according to the object sign, when the project can be presented as separate subprojects, the result of each of which is a certain type of product (a component of the product of the whole project).

Projects are complex by their very essence, since they involve the implementation of numerous interrelated processes and operations. In some cases, these relationships are obvious, in other cases – these are stochastic, ambiguous and weakly structured interactions. For example, some intermediate tasks can not be implemented until other tasks are completed, others can be carried out in parallel and so on. Violation of the synchronization of the execution of different tasks, that is, coordination, can jeopardize the implementation of the entire project. In this case, the system's co-ordination becomes the decisive factor in ensuring the viability of the system, since it underlies system adaptability and manageability. Let us consider some classical approaches and concepts of the theory of coordination. Before turning to the coordination problem itself, we will become acquainted with the model of the classical two-level hierarchical system (Figure) proposed by Mesarovic [5, pp.109-112]:



Two-level hierarchical management system

Here we use the following notations: C_0 – higher management system (coordinator);

$C_1,...,C_n$ – low-level control systems (local); $\omega\in\Omega$ – influence on the process of the external environment, which obviously includes not only disturbing actions, but also resource flows, as well as everything else that enters the system from the outside (since there are no other inputs to the system); $y\in\Gamma$ – coordinating signal, $y=(y_1,...,y_n)$; w_i – information signals from local control systems, $w=(w_1,...w_n)$, $w\in W$; $m_i\in M_i$ – control signals of the i-th local control system $M=M_1\cdot...\cdot M_n$; $z_i\in Z_i$ – information signals coming from the process, $Z=Z_1\cdot...\cdot Z_n$; $y\in Y$ – output of the process P.

Each subsystem performs certain functions:

– coordinator function:

C_0: $W\rightarrow\Gamma$ – function that serves to coordinate the operation of subsystems of lower levels;

– functions of local control systems:

C_i: $\Gamma\cdot Z_i\rightarrow M_i$ – control function; f_0: $Z\cdot\Gamma\cdot M\rightarrow W$ – function of result evaluation;

– process functions:

P: $M\cdot\Omega\rightarrow Y$ – production function;

F_1: $M\cdot\Omega\cdot Y\rightarrow Z_i$ – reporting function.

It is obvious that this model of the hierarchical system is extremely simplistic and only schematically reflects the essence of the system's work [5]. We note the essential shortcomings of this model, which require specification, additions and development of the model.

1. The external environment acts on the system through the process, which, in this way, makes the system completely nonadaptive: while higher-level control systems learn about the perturbation that has arisen (via feedback signals) and make the appropriate decision, the work of the process will be destabilized. More precisely, only after destabilizing the operation of the system, control systems of different levels can take steps to solve the problem (regulation by deviation), which, of course, is unacceptable for economic systems. Obviously, in a real situation, perturbing environmental influences act simultaneously on all functional subsystems, with priority given to adaptive control of the system or, in extreme cases, regulation by disturbances. For adaptive management, the most diverse components of the adaptation potential are not provided in this model: the possibility of predicting disturbing impacts, planning for possible changes in the environment, passive and active adaptation elements, memory blocks responsible for self-learning of the system, etc.

2. The influence of the external Medium is represented by only one action of щ. Obviously, it would be desirable to structure it: tallocate flows of material resources (used in production), information resources, actual perturbations (deviations from expected impacts).

3. The coordinator's function has been greatly simplified. Note that the initial start-up of the operation of such a system (when there are no wi signals) would be impossible, since there is no directive function of the coordinator $\Omega\rightarrow\Gamma$ (the function of the initial planning).

Taking into account the above remarks, we will try to improve the model of the hierarchical control system. In doing so, we will use the principles of adaptive management in the economic system, and we will also proceed from the assumption that making a decision at a higher level of governance is associated with greater uncertainty and requires the presence of more complex structures.

Define the main provisions and notation. We will consider a multi-level hierarchical system having k control levels [5].

1. We start the numbering of levels from zero, then at the zero level there is the coordinator, from

1 to k–2 – the levels of the higher control systems, k–1 – level of downstream control systems. We will assume that the controlled process is at the proposed k-th level (which is not a control level).

2. We will assume that each member of the hierarchy can manage several sub-subsystems, but he himself is the control object for only one system (standing higher) than a tree-like control structure is provided. Then the signal coming from the higher-level system is a vector, each l-th component of which is intended to control the l-th (in this branch of the hierarchy) subordinate subsystem. So, for example, the coordinating signal y_{ij} coming from the i-th control system of the j-th level can be represented in the form: $y_{ij}\left(y^{l}_{i-l+1,j+1},\ldots,y^{l}_{i,j+1},\ldots,y^{l+1}_{i+1,j+1},\ldots\right)$. Likewise, the signal that enters the higher-level system is a vector that is composed of l-th components of the signals of the children (in this branch of the hierarchy).

For example, the feedback signal w_{ij} entering the ith control system of the j-th level can be represented in the form: $w_{ij}\left(w^{l}_{i-l+1,j+1},\ldots,w^{l}_{i,j+1},\ldots,w^{l+1}_{i+1,j+1},\ldots\right)$. The number of such components depends on how many children are managed by this system (how many of them are in a given branch of the hierarchy).

The primary reason for the interaction between local control systems C_i is the process P, which realizes the global goal of the functioning of the system (mission). It also calls for the introduction of higher-level management systems and a coordinator. The process is a set of operational elements (subprocesses) P_i, interconnected by a certain structure Each subprocess P_i will be considered atomic (elementary) and indivisible within the framework of this level of consideration. Each operational element is the control object for the corresponding downstream control system C_i.

Each subprocess performs two functions:

– production function:

$$P_i:\ X{\cdot}M_i^{l}{\cdot}\Omega\rightarrow Y_i,$$

it should be noted that the intermediate product Y_i is actually a resource for the (i+1) subprocess, that is, $Y_i=X_{i+1}$, and then the production function for the subprocess can be represented in the form:

$$P_i:\ X{\cdot}M_i^{l}{\cdot}\Omega\rightarrow X{\cdot}Y;$$

– reporting function:

$$f_{li}:\ M_i^{l}{\cdot}W{\cdot}Y_i\rightarrow Z_{li},$$

where X – a lot of resources involved in production, Ω – set of perturbing influences of the environment, $i=\overline{1,n_k}$ – sequence number of the subprocess, n_k – number of subprocesses.

The remaining notations coincide with those introduced earlier.

There are k levels of control systems. At the first level is the coordinator C_0. Next comes the (k–2) level of the higher-level local control systems C_{ij}, which coordinate the work of the children. The last level is the downstream control systems C_i that make direct contact with the process and manage it.

Consider what the control elements of C_i are. Like all control systems, the lower-level control elements consist of the decisive element r_i and the implementer c_i. The decisive element performs the solution of the local task facing the system C_i, in accordance with the operating conditions of the entire control system; the implementer realizes the r_i solution developed $d_i\in D_i$, that is, develops such management signals that the resulting management decision brings to life. In other words, the decisive element answers the question «what to do?», and the implementor on the question «how to do?» or «how to do it better?». Together, these two elements constitute a subsystem, which we call the decision making subsystem. Such a subsystem takes place in all control systems [3].

Subordinate control systems are tools for active adaptation, since only they make direct contact with the process and are best aware of the progress of its work. In this case, the development of corrective actions should be carried out both by deviations (in the work of the process) and by disturbances (coming from the external environment), thus preventing its negative effect. As a rule, such an adjustment is an operational control and does not require additional tools (for example, a memory block that can recognize familiar situations).

Low-level control systems perform two functions:

– control function (in conditions of the environment):

$$C_i:\ \Omega{\cdot}\Gamma^{l}_{i,k-1}{\cdot}Z_i\rightarrow M_i;$$

– output evaluation function:

$$f_{0i}:\ \Omega{\cdot}Z_i{\cdot}\Gamma^{l}_{i,k-1}{\cdot}M_i\rightarrow W^{l}_{i,k-1};$$

where $i=\overline{1,n_{k-1}}$, – the sequence number of the downstream control systems (located at k-1 level), n_{k-1} – the number.

Now consider the higher control systems C_{ij} (one of the levels). let us formulate the essential distinctive features of the upper-level control systems from the downstream control systems.

The task of higher systems is to coordinate the operation of lower level systems, therefore, the result of the operation of C_{ij} is the development of a coordinating r (and not a control signal m) signal. Influence on the process is mediated (through systems of lower levels).

The control system of upper levels, as a rule, participate in the synthesis and implementation of the development plan of the entire system and thus determine the level of passive adaptation in the system. On the other hand, in the course of the poor performance of lower levels (due to disturbances) system C_{ij} can participate in the active adaptation of the system. Thus, upstream control systems are members of both passive and active adaptations in the control system.

There are common features of superordinate control systems and subordinate; e.g., subsystem of decision-making in C_{ij} also consists of two elements: a decisive r_{ij}, which finds the optimal solution of the problem of this control system $d_{ij} \in D_{ij}$, and sellers of c_{ij}.

The upper level control systems perform the following functions:

– the function of identifying familiar situations:

$$f^a_{ij}:\ \Omega \cdot W_{ij} \cdot \Gamma^l_{ij} \rightarrow A_{ij} = D_{ij} \cdot \Gamma_{ij};$$

– coordination function (in conditions of the environment, using information from the memory block):

$$C_i:\ \Omega \cdot A_{ij} \cdot \Gamma^l_{ij} \cdot W_{ij} \rightarrow \Gamma_{ij};$$

– coordination result evaluation function:

$$f_{0ij}:\ \Omega \cdot W_{ij+1} \cdot \Gamma^l_{ij} \cdot \Gamma_{ij} \rightarrow W^l_{ij},$$

where $j = \overline{1, k-2}$ – the level number is parent driven system, $i = \overline{1, n_j}$ is the ordinal of the subsystem in the j-th level, n_j –their quantitative higher level managed system.

Now consider the coordinator system C_0, the highest control system at the head of the entire hierarchy. It is distinguished as a special control system, which is distinguished from other (local) control systems by the following properties.

1. Control (coordinating) signals are generated only on the basis of information coming from the lower levels and the external environment, and there are no restrictions that could be set by the higher coordinator (due to the lack thereof).

2. The coordinator can perform a policy function, develop managerial influences only on the basis of information from the external environment (for example, at the initial stage of the operation of the ES, when feedback signals from the lower levels are not yet available).

3. The coordinator must coordinate the work of the whole system so that the global task of the operation of the ES is solved; local control systems only care about solving their scale problems.

4. The coordinator takes a direct part in the synthesis and implementation of the development plan for the entire system, and the level of passive adaptation in the system depends on it in the overwhelming majority of cases. The role of the coordinator in active adaptation is somewhat less, since most perturbations are localized at lower levels of control.

5. In view of the fact that the coordinator is responsible for developing the development plan for the entire system, it is his responsibility to predict the disturbing impacts on the planning period. Therefore, the coordinator's subsystem should have some «intellectual» prediction block that, based on information from the external environment $t \in I$ (including weak signals), currently acting perturbations of щ and, possibly, information from the memory block (in which, in addition to Parameters of the system operation for various kinds of perturbations, information on the prerequisites for the appearance of this disturbance is stored) forms the predicted value of the action $\omega = \omega_{pr}$.

On the basis of the obtained ω_{pr} the coordinator develops a plan for the development of the system, laying in it the necessary potential for passive adaptation (volumes of reserves, stocks of raw materials and finished products, etc.). The memory block includes two components:

– contains information on the parameters of the system operation on the basis of the perturbations acting ω and the internal states

$$\omega_0:\ f^a_{10}(\omega, \omega_0) \rightarrow a_{10} = (d_0, y_0);\ a_{10} \in A_{10};$$

– contains information on the prerequisites for the occurrence of a perturbation:

$$f^a_{20}:\ (t, \omega) \rightarrow a_{20} = (\omega_{pr}, \Delta\omega);\ a_{20} \in A_{20},$$

where ω_{pr} is the predicted value of the disturbance determined in the past based on the one acting at that moment щ and information i; $\Delta\omega$ is the deviation of the perturbing effect, which actually took place in the system, from its predicted value. Again, the vectors a_{10} and a_{20} will be zero if the situation corresponding to the given current parameters w and i in the system has not previously occurred, and, therefore, the necessary information is absent.

Thus, a model of a multilevel hierarchical system possessing adaptive properties, described in terms of the set-theoretical approach, was obtained [5].

Structural analysis of the multi-level management system shows that one of the essential characteristics of such an organization is specialization. Obviously, for the effective operation of such a complex system, it is necessary that specialized operations performed in various «functional nodes» of the system be coordinated and coordinated. In addition, subordinate management elements act to achieve their own goals, which often leads to conflicts between them, and the global goal is most likely not achieved. The actions of the coordinator are aimed at preventing or reducing the consequences of such a conflict.

Conclusions

Coordination carried out by the project manager is related to the forecasting or evaluation of subproject interactions; Sub-project managers – with the forecasting or assessment of interactions of individual parts of the project and work packages. The leaders of the project parts correspond to the downstream control systems in the ISM and implement the function of managing the individual operations of the work complexes, the relationship of which is determined by the superior control system using the chosen coordination method. As the market develops constantly, more thorough research is required to maintain competitiveness and increase demand.

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МОДЕЛЮВАННЯ ПРОЦЕСУ КООРДИНАЦІЇ В СИСТЕМІ УПРАВЛІННЯ ПРОЕКТАМИ ПІДПРИЄМСТВА

Гайдар І.В., Дубницький В.І.

Проекти спрямовані на отримання певних результатів – іншими словами, вони спрямовані на досягнення цілей. Саме ці цілі є рушійною силою проекту, і всі зусилля, спрямовані на його планування та здійснення, здійснюються для забезпечення досягнення цих цілей. Будь-який проект у процесі його реалізації проходить через різні етапи, що сукупно називають життєвий цикл проекту. Впровадити різні функції управління проектами, які називаються процесами управління проектами. На цьому етапі економічного розвитку підприємства повинні приймати правильні управлінські рішення для досягнення своїх цілей та максимізації прибутку. Тому, оскільки існує конкуренція на ринку, підприємець ризикує втратити всі свої інвестиції та стати банкрутом. Щоб успішно побудувати свій бізнес, потрібно планувати кожний крок правильно. Моделювання процесів координації допоможе підприємцеві в прийнятті управлінських рішень. Стаття присвячена вирішенню цієї проблеми.

Ключові слова: координація, управління, планування, активізація, організація, контроль.

МОДЕЛИРОВАНИЕ ПРОЦЕССА КООРДИНАЦИИ В СИСТЕМЕ УПРАВЛЕНИЯ ПРОЕКТАМИ ПРЕДПРИЯТИЯ

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Проекты нацелены на получение определенных результатов – другими словами, они направлены на достижение целей. Именно эти цели являются движущей силой проекта, и все усилия по его планированию и осуществлению направлены на достижение этих целей. Любой проект в процессе его реализации проходит через различные этапы, называемые в совокупности жизненным циклом проекта. Для реализации различных функций управления проектами, которые называются процессами управления проектами. На этом этапе экономического развития предприятия должны принимать правильные управленческие решения для достижения своих целей и максимизации прибыли. Таким образом, поскольку на рынке существует конкуренция, предприниматель рискует потерять все свои инвестиции и стать банкротом. Чтобы успешно создать свой бизнес, вам необходимо правильно спланировать каждый шаг. Моделирование процессов координации поможет предпринимателю принимать управленческие решения. Статья посвящена решению этой проблемы.

Ключевые слова: координация, управление, планирование, активизация, организация, контроль.