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VISUALIZATION TECHNOLOGIES FOR INNOVATIVE
PROCESSES OF AGRICULTURAL PRODUCTION INDUSTRIES

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Abstract

Modern development of any industry is impossible without introduction and application of innovations and innovative technological solutions, since the level of activation of the latter determines the overall level of competitiveness. Innovative behavior is the prerequisite for the implementation of various market strategies by business entities aimed at achieving advantages due to the compulsory anticipation of competitors in the subject, technological, organizational and / or management areas and achieved through the implementation of creative entrepreneurial decisions. Enterprises with an innovative type of behavior implement a whole range of scientific, technical, technological, organizational, financial and commercial activities, which together lead to the emergence of various types of innovations. The implementation of digital technologies is multidimensional. One of the priorities is network planning, which is a set of graphical and computational methods, organizational measures and control techniques that provide modeling, analysis, and dynamic restructuring of the plan for the implementation of work packages and developments. Network graphics allow creating a project that has visibility, the ability to identify technological links between operations, graphical representation of critical paths, the definition of overall deadlines for the work and their optimization. The article examines the use of the network planning and management system in the agro-industrial complex as one of the ways to visualize innovative processes, describes modern software products designed to solve project management tasks, develops a system of project objectives for introducing innovative type of competitive behavior in an agro-industrial complex (AIC).

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Keywords: Agriculture, digital technologies, innovation, network chart, project, visualization.



1. Introduction

Many researchers have confirmed that competitiveness of products is a fundamental factor that provides the necessary level of competitiveness of an enterprise. Of course, it is the central, but not the only activator of achieving competitive advantages. The world practice of the development of branches of the agro-industrial complex shows that innovative behavior of economic entities of the agro-industrial complex contributes to the organizational, technological, technical and economic renewal of agricultural production and increase its competitiveness (Getmanchuk, 2011). Innovative type of competitive behavior is the focused nature of action of a business entity based on the application of various innovations, both on technical, production, economic, organizational, managerial, informational and social levels (Yurina & Grishakina, 2015). Innovative processes in agriculture have their own specific features. They are distinguished by a variety of regional, sectoral, functional, technological and organizational features. Today, there are quite a few approaches for classifying innovations (Golova, 2015; Golova & Sukhovey, 2018; Dankevich, 2012; Ivanov, 2012; Kuptsov, 2007; Qingrui et al., 2007). The opinions of scientists regarding the classification of innovations in the field of agriculture are also of great interest. So, some authors highlight:

- material and technical innovations that are aimed at the technical improvement of the production of agricultural products;
- technological innovations that contribute to the updating and improvement of engineering, agronomic, computer, resource-saving and high-tech production technologies, storage and processing of products;
- innovation in breeding - the creation, updating and improvement of the composition of seeds;
- organizational and information - managerial, based on changing and improving the organizational structure, technics and methods of planning and managing production activities, information and infrastructure support of the agricultural sector;
- marketing, representing changes and improvements in the management and regulation of sales activities;
- socio-economic and environmental innovations that are focused on the transformation and improvement of working conditions in production, social security of the team, development of a system of training and advanced training of personnel, preservation of the ecology in agro-industrial production, as well as the production of environmentally friendly products.

2. Problem Statement

The implementation of a certain type or the set of innovations should be carried out in accordance with an innovative project. The project will be the sequence of work pursuing a deterministic goal, performed at a specified time, by specially appointed employees within the framework of the established estimate. An innovative project is considered to be a set of documents that define a system of scientifically grounded goals and measures to solve a problem, the organization of innovation processes in space and time (Minnikhanov, Alekseev, Faizrakhmanov, & Sagdiev, 2003).

An innovative project is developed considering the planned innovative behavior and goals that a business entity determines according by an innovative strategy - improving the quality of the goods produced; price reduction without changing product's characteristics; reducing the cost of goods produced by the development of new technologies, methods of organization of production, labor and management; an increase in the production of goods (sales) for the same market without changing other parameters; development of a new market for an old or new product.

3. Research Questions

1. What is an innovative project?
2. How is an innovative project being implemented through visualization technologies, in particular, through the network chart?
3. What are the objectives of the project of introducing an innovative type of competitive behavior in an enterprise in the AIC sector?

4. Purpose of the Study

The purpose of the study is to describe the structure of network planning and modern software products, i.e. visualization tools designed to solve project management tasks, and develop a system of project objectives for introducing innovative types of competitive behavior in an agro-industrial complex enterprise.

5. Research Methods

The authors used the following methods: monographic, comparative and system analysis, as well as logical approach.

6. Findings

In our opinion, the optimal project that takes into account the production and technological, scientific and technical, financial and economic and personnel innovation potential of the enterprise is a project consisting of four main stages (Figure 01).

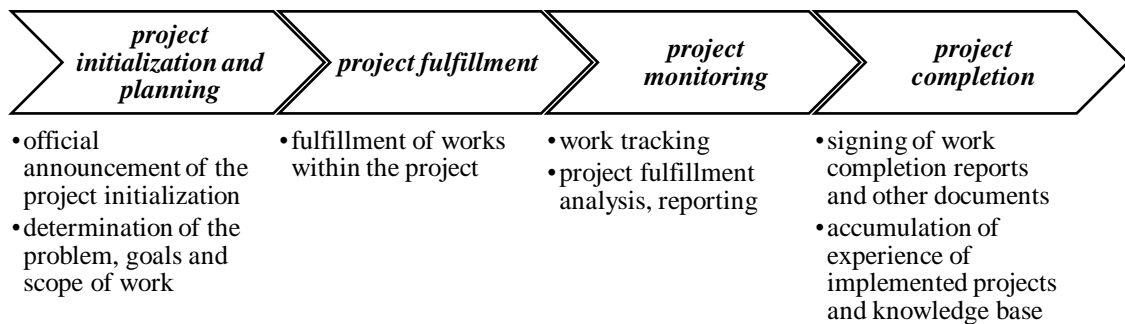


Figure 01. Project management processes

Project planning can be viewed as a procedure that takes place in a few steps.

1. Identification of goals and objectives, definition of restrictions on the project.

2. Fragmentation of the total volume of the project into smaller tasks, their differentiation. A task is a technological operation, event, type of activity or a combination of them, characterized by time spent on execution, the need for resources and the conditions under which they can be performed.

3. Network plan development, where the duration of the tasks and their interrelationships are established, the schedule is debugged using the critical path method, the project time is calculated.

4. Forming a list of required resources, their volume and period of use. Resources should be divided into non-stored and stored in an innovative project. The first ones are released upon completion of the work and are suitable for their subsequent use (for example, employees of the enterprise (specialists), technical equipment, computers and software, etc.). The second group includes resources that are fully spent in the process of the project. These are all kinds of materials: fertilizer, fuel, seeds, etc. Resources manager distributes the described resources between tasks (according to the goals).

5. Preparation of estimates containing value for all types of costs (Chekaldin, 2017; Shimanovskaya, 2014).

In the current business environment it is necessary to develop a model that is understandable, dynamic and, at the same time, powerful enough to allow analysis of influencing factors in order to effectively implement an innovative project, control and complete it. Its existence will make it possible to determine the minimum possible project implementation time under specified conditions and, finding a critical path (chain of related works completed in time), indicate a subset of critical works (processes forming a critical path), even the smallest delay of which will lead to a delay in the end of the project. Thanks to this, the project manager can prevent interruptions by concentrating resources on the most critical areas.

The dynamic model of the project, which presents the technical possibility of visualizing the processes within the project and reflects the technological dependence and sequence of the work package, linking their completion in time, considering the cost of resources and cost of work while highlighting the critical places is the network chart. Network charts are used to plan all kinds of long-term processes; coordinating the actions of project managers and implementers; calculation of the required production, including material and labor resources and their rational exploitation. The developer should consider the following rules in the network chart (Figure 02):

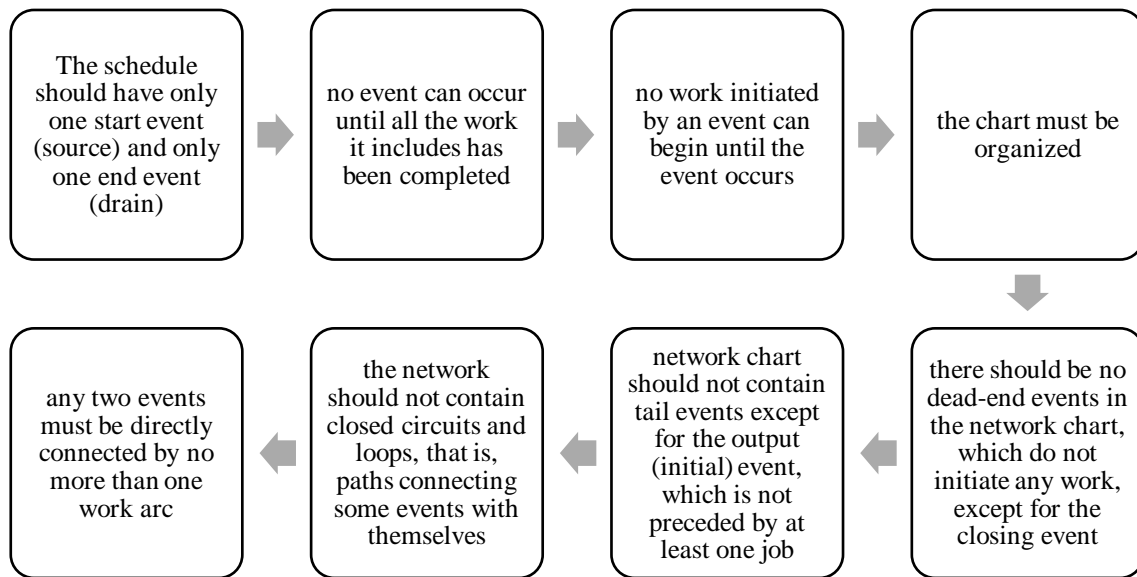


Figure 02. Network chart development rules

The network chart structure is shown in Figure 03.

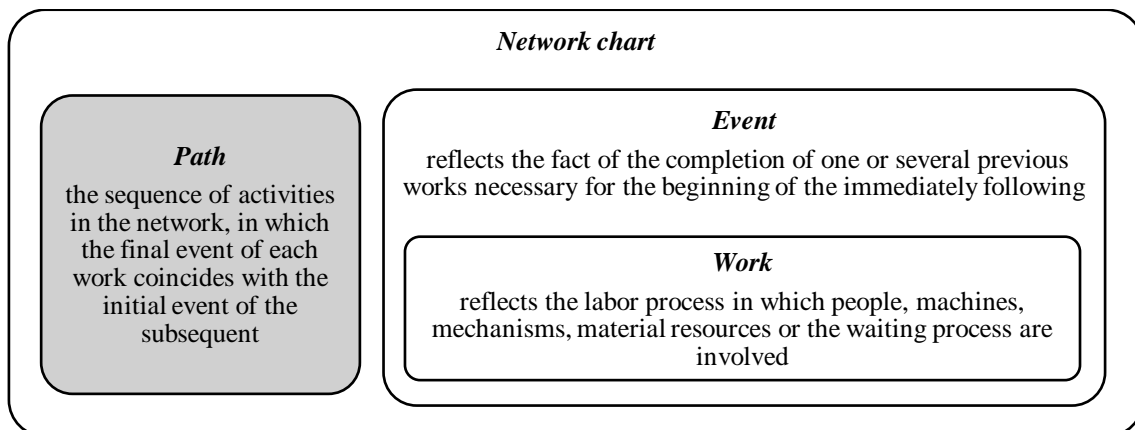


Figure 03. The project network chart structure

Production processes reflected with the help of chart-schedules was first used by G. Rentier in American firms (Belyaev, 2011).

Competent network planning in the conditions of modern business and production activities helps to achieve more efficient implementation of research and development, contributes to the modernization and repair of technological equipment, allows getting the maximum possible effect from experimental development, launching mass production, etc. (Belyaev, 2011; Romanova, 2017).

During the implementation of network planning, the operational and strategic objectives presented in the table 01 can be achieved.

Table 01. Levels of network planning tasks

Tasks	Levels	
	Operational	Strategic
	Efficient allocation and rational use of limited resources that are available in the enterprise;	Competent and clear setting of tasks for all departments and services of the enterprise, based on their relationship with a single strategic goal in the planning period;
	Adjusting the work schedules, considering changes in the external environment, internal environment and other market conditions;	Reasonable choice of development goals for each individual unit of the enterprise, considering existing market requirements and planned outcomes;
	Use for processing large arrays of reference and regulatory information, implementation of current calculations and construction of network models of modern computer equipment;	Forecasting the implementation of the main stages of work focused on the critical path, timely adoption of the necessary managerial and planning decisions on the timing of the adjustment;
	Involvement of future direct implementers of the main stages of the upcoming work, who are highly qualified and have relevant experience, in the creation of plans and projects;	Carrying out a multivariate economic analysis of various kinds of technological methods and successive ways to accomplish the tasks and analysis of allocation of resources to achieve the desired results;
	Prompt receipt of the necessary planning data on the actual status of the work, costs and production results;	Ensuring interaction in the process of planning and managing work in a long-term overall strategy with short-term specific objectives of the enterprise.

A lot of methods of planning and management are developed based on network models. The most famous among them is the so-called critical path method (CPM – Critical Path Method), as well as a system for planning and managing development programs (PERT – Program Evaluation and Review Technique).

The modern Russian market of information technologies (IT) is represented by a large number of software products using PERT technology, designed to solve project management tasks. All of these software products can be divided into two groups, namely, programs designed to automate services such as ARTA Software (ARTA Synergy), Epicor Software, IFS Applications, Microsoft Project Professional, Oracle E-Business Suite, PeopleSoft Project Management, Primavera, SAP Professional Services Automation), and software products aimed at managing tasks and projects. The latter include software products such as: Bontq, Cerebro, Easy Projects. NET, eGroupWare, GanttProject, Kommandcore, OpenProj, OnePoint Project, PayDox, Project Kaiser, ProjectMate, Redmine, TeamLab, TrackStudio Enterprise, Trac, Web2Project. The authors consider the most famous project management systems (Nureev & Simakovsky, 2017).

Microsoft Project. Manufacturer - Microsoft Corp. (USA). This software is the most common project management system (the number of registered users of this software is approaching 8,000,000). The program can create schedules for the critical path based on the resources used. The chain can be visualized in a Gantt chart.

Open Plan. Manufacturer - Welcom Corp. (USA). It is a system for planning and controlling of large projects and programs. The features of this software product are powerful and flexible means of

resource and cost planning, a clear and effective organization of multi-user work with the ability to create an open and scalable solution for the whole enterprise. The software comes in Professional and Desktop versions, each of which is designed to meet the different needs of any project participants.

Primavera Project Planner. Manufacturer - Primavera Systems, Inc. (USA). This software product is used by medium and large enterprises in various fields for scheduling and management, considering the needs of labor, material and financial resources. The program is mostly widespread in management of engineering and construction projects.

SureTrak Project Manager. Manufacturer - Primavera Systems, Inc. (USA). This software is completely Russified and focused on monitoring the implementation of small-scale projects and/or fragments of large projects. It can function as a standalone product, or in conjunction with the Primavera Project Planner in a corporate project management system.

Spider Project. The Russian product Spider Project has powerful algorithms for the allocation of limited resources, as well as a large number of additional functions. The program was created considering the needs, characteristics and priorities of the Russian market. Spider Project comes in two versions – Professional и Desktop.

Project Expert. Manufacturer - Pro-Invest Consulting (Russia). The software provides resources for creating a financial model of an enterprise, preparing a business plan, developing a strategic development plan, and analyzing the financial efficiency of business projects. This system is recommended for use by federal and regional government agencies as a standard tool for developing enterprise development plans.

1C-Rarus: Project Management. Manufacturer - 1C-Rarus (Russia). This software product is a Russian development on the platform of the accounting system "1C: Enterprise" version 8.0 and is designed for planning, organizing, coordinating and controlling design work and resources.

These programs, which can implement a network plan and monitor the project, constitute the core of the PERT technology software. However, it should be noted that none of them can fully protect the project from failure by analyzing all the negative factors that may arise in its path. Therefore, it is required to use software not only for managing projects (for example, Microsoft Project), but also database management programs (DBMS), mathematical modeling, text and tabular processors, presentations and others for effective computer support of this technology (Volgina, 2017; Polyanskaya & Naidanova, 2015).

In our opinion, the optimal project that considers production and technology, scientific and technical, financial and economic, personnel innovation potential of an enterprise in the agricultural sector is a project consisting of four main stages, including the initiation and development of a project plan; its approbation; monitoring progress of implementation and completion.

This project can be described by a combination of the following activities and a system of tasks (Figure 04).

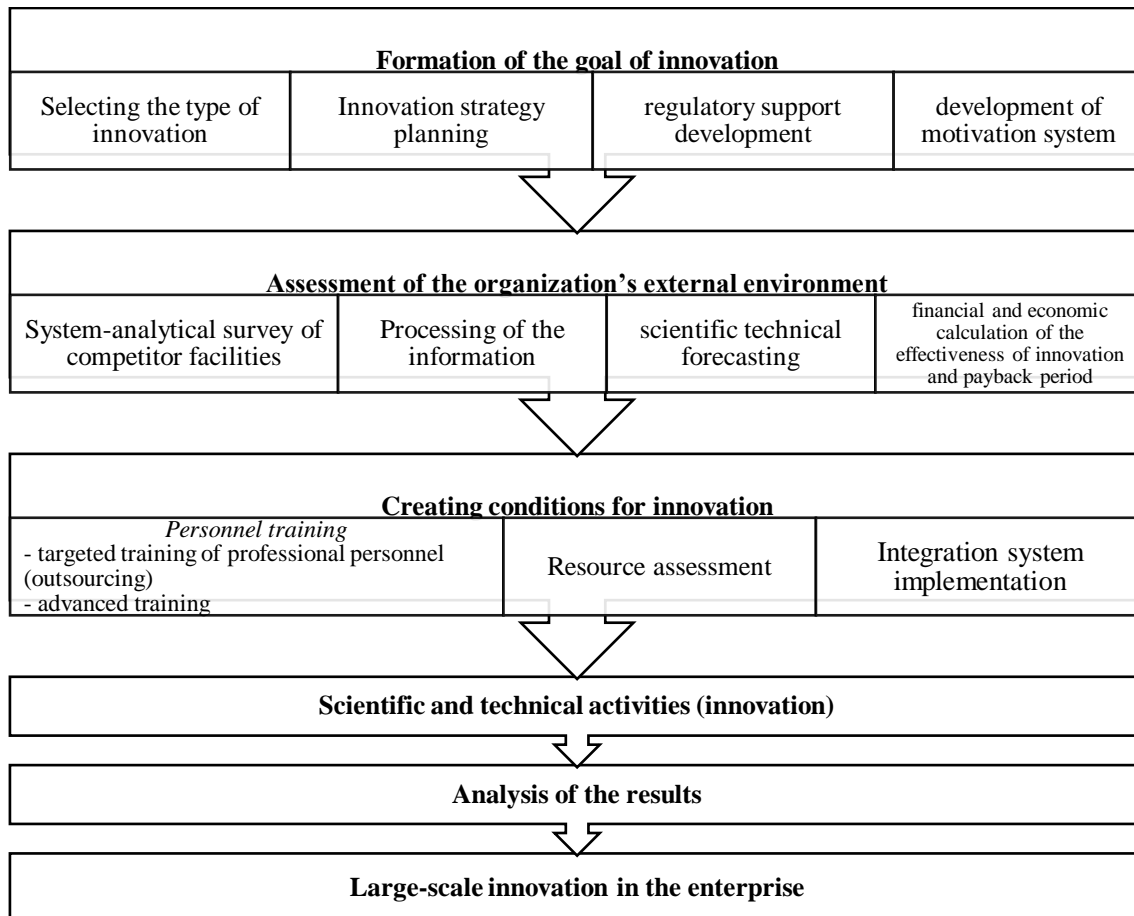


Figure 04. The system of tasks of the project of introducing an innovative type of competitive behavior in the AIC enterprise

It is necessary to review the project as a whole, that is, identify goals and objectives, argue the expected results at the planning stage. Then the main tasks are split into smaller ones - components. The set of all tasks should form the total volume of the project. It is necessary to create a project schedule to make the task list workable, in other words, to designate the duration of each individual task and their relationship with each other. It is also necessary to determine the amount and period for the required resources further at this stage. After the project is split into separate tasks, it is necessary to determine the amount of equipment, skills and materials needed to perform a specific task. These resources are related to the tasks. After the completion of the above preparation processes, it is necessary to calculate the project execution time and its final cost. If the data obtained exceeds the budget allocated to the project, then it is necessary to adjust it.

7. Conclusion

Innovative behavior is an internal factor in the competitiveness of enterprises in the field of agriculture, because it allows fighting for more favorable conditions for the production and marketing of products with the possibility of obtaining maximum profit. The combination of such actions, accompanied by innovative activity, allows achieving competitive advantages by reducing production costs, reclaiming new market sectors, creating more efficient business organization.

The practice of innovative behavior also lies in the implementation of innovative projects. Innovative project belongs to one of the types of projects and is a more general, broader concept, since they additionally contain their specific features in addition to all the tasks of a regular project. Global experience in the form of network planning technologies can ensure the effective management of innovative projects.

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