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ENGINEERING PROJECTS FOR CONSTRUCTION OR RECONSTRUCTION OF INDUSTRIAL ENTERPRISES

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ABSTRACT

One of the important tasks of industrial design is the creation of engineering projects for the construction of new or reconstruction of existing industrial production processes and enterprises. The developed projects must meet certain conditions and a number of engineering and technical requirements in order to ensure high technical and economic indicators of the industrial enterprises. The aim of this paper is to specify some of the important characteristics of engineering projects for the industrial design of production processes and to propose a model for the technological design process, as this will systematize the steps and sequence in the process, as well as significantly facilitate any practitioner in this field. To achieve the goal, the comparative analysis method was used, comparing the types of possible engineering projects, on the basis of which the author developed the model proposed in the paper. The limitations in the study are reduced to the fact that the author himself sets the boundaries of his research and chooses only engineering projects, since project management is a vast scientific territory, and the volume of a scientific paper is too short. The topic is well known and still relevant because engineering project management is a daily activity for management specialists, but unfortunately there is still much to add and improve in the knowledge, skills and competencies of managers. Overall, the author believes that this is a topic that would help to achieve higher goals and results, and to improve the existing management practice..

1. INTRODUCTION

The innovative business idea predetermines the success of every engineering project that an industrial enterprise implements in its striving to develop, gain customer satisfaction, expand its market share and guarantee good final financial results for the benefit of its owners and associates who perform all functional activities.

An activity is perceived and defined as a project when its object is not the main production activity of the industrial enterprise, but a constructive or technological change, introduction of a new product and/or new technology, or installation of new facilities and technological equipment.

The choice of projects that an industrial enterprise intends to implement depends entirely on the strategy and policy of the enterprise's top management. The placement of projects in a certain sequence in time also depends on their priorities.

Each project has its own specific goal, which is subordinated to the general strategy and policy of the industrial enterprise. By definition, it follows that the project will lead to a necessary, desired and possible result for the enterprise. The result should be presented through specific parameters for value, for the duration of its achievement, for the difference between the old and the new situation, and others [1, 2].

In this way, the project materializes as an element of the overall target management of the industrial enterprise within the framework of two main parameters - time and value. From here it can be summarized that the project is a unique one-time activity, limited to a certain period of time, to achieve a specific goal, quantitatively measured in value by its price.

The project goal is necessarily divided into activities with predictable parameters – time, cost, resources, performers (Fig. 1). The complexity of the project depends on how many logical levels its goal will be decomposed into. On this basis, the value of the activities is determined; their sequence; the schedule for their implementation; the performers responsible for each activity; a group of specialists is formed; conflicts are also resolved when necessary; various contracts are concluded; the actual research, design and production activities are carried out; their implementation is controlled; it is assessed whether the implementation is going as planned; it is assessed whether the project goal has been correctly chosen.

To achieve the goal in this study, the comparative analysis method was used, comparing the types of possible engineering projects, on the basis of which the author developed the model proposed in the paper. This method makes it possible to compare the results of the activities carried out within the framework of the engineering project

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based on the main economic indicators and to reveal the relevant patterns against the background of the dynamic business environment.

The comparisons in this study are made according to several criteria. First of all, comparisons according to the scope of the engineering project and the levels of management should be placed. They are grouped in several directions, as follows:

• horizontal comparisons, when comparing economic indicators (labor productivity, gross domestic product, value added, employment, etc.).

• vertical comparisons, when comparing similar economic indicators for production processes within the industrial enterprise.

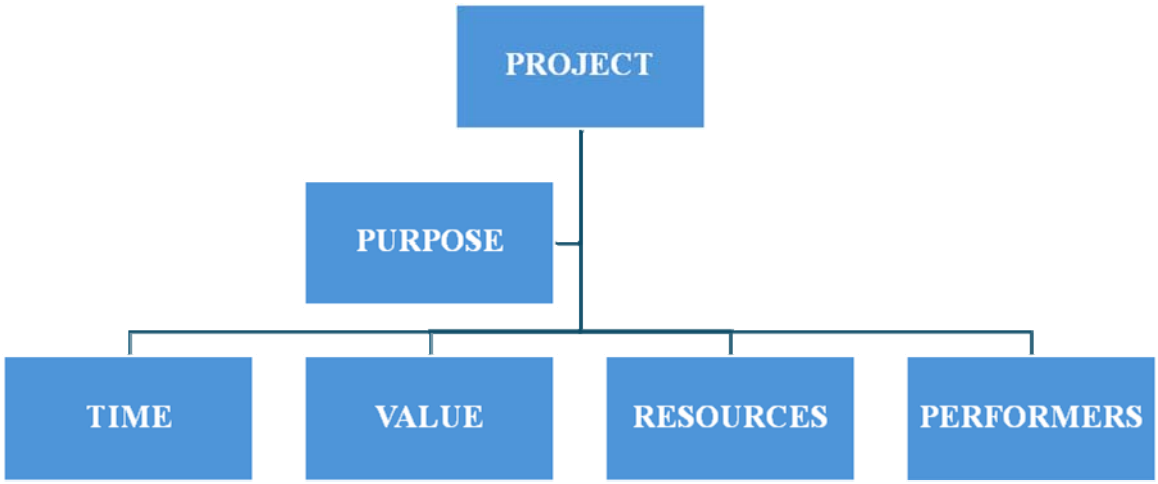

Fig. 1. Decomposition of a project and its purpose (Source: Author)

The second criterion is related to the baseline used in calculating the indicators. They can be:

• comparisons between indicators for the implementation of various production processes in the industrial enterprise and with the implementation of activities within the engineering project.

• comparisons of indicators calculated sequentially compared to the previous year.

The third criterion refers to the content of the study. Comparisons are made to establish compliance between the result indicators with the goals and objectives that the engineering project aims to achieve.

In addition to the comparative method, the present study also uses the method of detailing or dissection. It can be rightly considered as a complement to the comparative method, because it allows for the simultaneous analysis of the general indicators for certain production processes and the elements that form the engineering projects.

The limitations in the study are reduced mainly to two points. The first one is connected to the fact that the author himself sets the boundaries of his research and chooses only engineering projects, since project management is a vast scientific territory, and the volume of a scientific paper is too short. The second one is similar to the first, but it specifies the selected for this research from the author engineering projects for construction or reconstruction of industrial enterprises as a variety of all other various types of engineering projects at all.

2. EXPOSITION

One of the important tasks of industrial design is the creation of engineering projects for the construction of new or reconstruction of existing industrial production processes and enterprises. The developed projects must meet certain conditions and a number of engineering and technical requirements in order to ensure (Fig. 2):

• high technical and economic indicators of the industrial enterprise;

• the highest possible level of equipment, technology and organization of production;

• low cost of manufactured products;

• low cost of construction or reconstruction.

Design work can be considered in five typical variants, which differ from each other in the nature of the tasks set, the volume of work, labor intensity, methods and freedom of decision-making [3].

Typical variant “A” is associated with the design of a new industrial enterprise. This is the classic (ideal) case in design, oriented towards the creation of production, having the following characteristic features:

• a long and large-scale preparatory period;

• consolidated forecasts for the production program and future development;

• selection of an optimal location, including a number of requirements for the elements of the infrastructure;

• development of a general development plan;

• selection of an optimal variant of the project.

Type B is associated with the change and renovation of an existing industrial enterprise or production complex (reengineering). This option is characterized by the following features:

• the design objective is the rationalization and modernization of existing production;

• there are opportunities to compile a relatively accurate forecast of the production program under the influence of the market or innovations in production processes and equipment in order to reduce costs.

Type C is associated with the expansion of existing industrial enterprises or production complexes. This design is typical in cases where there is an increase in production capacity and the goal is to modernize or reconstruct existing production. The characteristic features of this type are:

• the expansion requires more intensive use of the areas and premises within the available territory;

• as a rule, there is an opportunity to compile a relatively accurate forecast and assessment of the production program and the terms for its implementation;

• expansion may involve the selection of new construction sites to increase production capacity (type A), as well as the development of a master plan for the construction;

• in some cases, expansion may require a change in the location of the enterprise.

Type variant "D" is associated with the reduction of the size of the industrial enterprise. The essential point in this design is the adaptation, in accordance with the new conditions of the production capacities and structure, of both the main production and the auxiliary production. Distinctive features:

• renewal of the structure of the production program;

• change of parameters (reduction of production capacities);

• design of new parameters for production and production-supporting equipment (reduction of the size of the system);

• restructuring (change of production capacities);

• renewal of the structural configuration and organization of production.

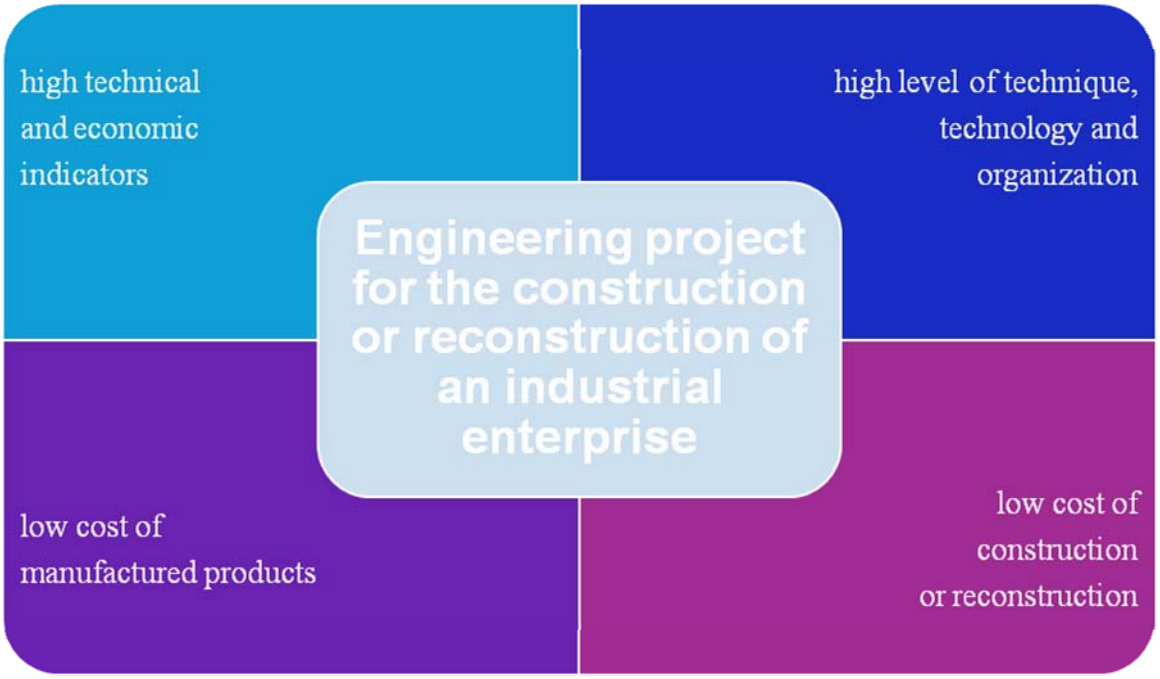

Fig. 2. Conditions and requirements for engineering projects (Source: Author)

Type variant "D" is associated with the revitalization (revitalization) of industrial enterprises. Revitalization is called such a process of transformation of enterprises that are essentially in the process of renovation. The characteristic features of this type of process are:

• use of the territory of the enterprise for new purposes (reprofiling);

• demolition or renovation of the production site and premises;

• aggregated or detailed forecasts of relative production programs;

• restructuring or reconfiguration of production complexes and facilities;

• adoption of optimal solutions with a high degree of freedom in design.

The design of an industrial enterprise is a complex problem, including a large number of correlated tasks in the field of economics, technology and production organization [4, 5].

The main economic issues addressed in engineering design are:

• a realistic and justified production program;

• a suitable geographical location;

• conditions for the most appropriate supply of raw materials, materials and energy;

• suitable connections with subcontractors;

• suitable transport connections for export;

• the necessary working capital;

• the possibility of obtaining the necessary workforce;

• the cost of production.

The design objectives can be grouped into the following main groups:

1. Ensuring high economic efficiency of the industrial enterprise.

2. The production cycle must be organized in a way that ensures optimal time, inventory and the required quality of the manufactured product, as well as ensuring effective use of equipment, areas, premises and personnel.

3. Ensuring high flexibility and variability of use of the industrial enterprise.

4. The company's equipment, production processes and the structure of production areas must be adapted to flexible regulation in response to market fluctuations.

5. Ensuring high attractiveness:

• favorable working conditions that motivate employees;

• compliance with environmental requirements;

• use of industrial architecture that meets modern aesthetic requirements.

The economic efficiency of an engineering project is determined to a significant extent by the level of technical solutions embedded in it [6, 7]. There are many problems that need to be solved. First of all, this is the design of technological processes for the production of products

embedded in the production program. Based on this, the following are determined:

• the type and number of main and auxiliary machines and equipment;

• design of their location in space;

• determination of the number and composition of the workforce;

• the type and quantity of raw materials, materials and energy;

• solving problems with transport, power supply, heating, ventilation, lighting, water supply, sewage;

• selection and development of the building structure.

Solving the technical problems of the engineering project is directly dependent on the method of organizing the production process. It includes solving issues regarding:

• the form of organization of production;

• the organizational and production structure of the enterprise.

These two things include the issues of:

• labor organization;

• workplace organization;

• organization of production management;

• organization of overall management.

The presented problems are solved in detail in the individual parts of the project:

• general plan;

• transport management;

• technological part;

• energy management;

• production organization;

• architectural and construction part, etc.

To solve them, it is necessary to use a wide range of specialists in individual fields.

Technological design

The main part of a project is its technological setting.

The main tasks that are solved through technological design of an engineering process are:

• technological development of the production process to a degree and scope sufficient to obtain information necessary to solve the following related problems;

• selection and sizing of the main elements - machines, equipment, raw materials, materials, labor, areas, energy.

• design of the spatial arrangement of the individual components of the enterprise (workshops, sections, workplaces).

The technological design of new production units includes solving a larger range of issues than in the reconstruction of existing ones. However, the development of the engineering technological project is the basis for their solution. For it, it is also necessary to solve some organizational issues [8]. First of all, the type of production and its corresponding form of organization should be determined. This allows for the determination of the structure of the industrial enterprise – the basis for the spatial construction of the individual units.

The construction of industrial production or the reconstruction of existing industrial production is a logically connected process in which one can find usually repeating sequences of actions and activities [9]. Their goal is to create something completely new or to improve and perfect something that has already been created but is currently not effective enough.

As some of the important characteristics of engineering projects for the industrial design of production processes are already specified, the author is proposing a model for the technological design process, as this will systematize the steps and sequence in the process, as well as significantly facilitate any practitioner in this field (Fig. 3).

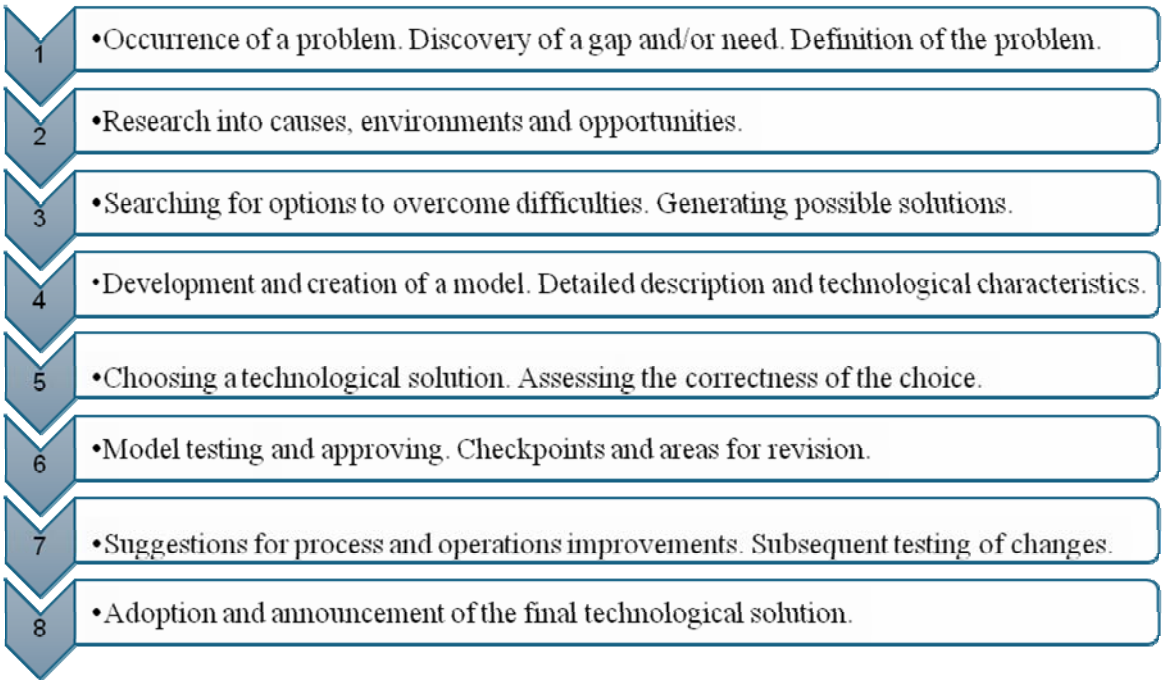

Fig. 3. Model of the technological design process (Source: Author)

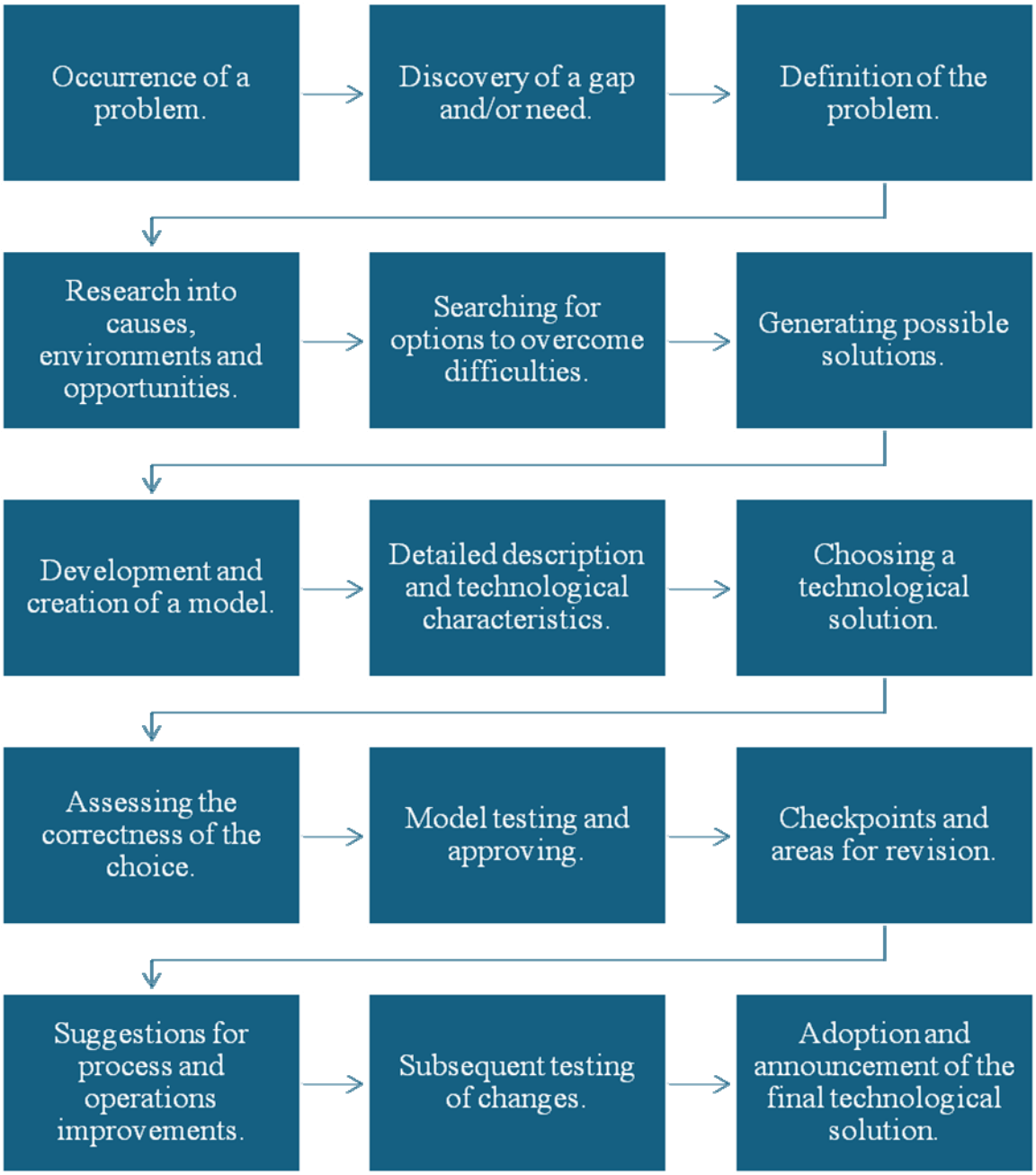

Fig. 4. Sequence of steps in engineering project design (Source: Author)

The technological design of industrial facilities, by its very nature, has serious similarities with the process of scientific research. For this reason, the author considers it appropriate to propose an algorithm for the technological design process, as this will systematize the steps and sequence in the process, as well as significantly facilitate any practitioner in this field (Fig. 4).

3. CONCLUSIONS

The topic is well known and still relevant because engineering project management is a daily activity for management specialists, but unfortunately there is still much to add and improve in the knowledge, skills and competencies of managers [10, 11]. Overall, the author believes that this is a topic that would help to achieve higher goals and results, and to improve the existing management practice.

The concept of engineering project management, which the author presented in this paper, is based on the unity, consisting of the necessary conditions and the technology of transforming the management system to changes and new challenges. The necessary conditions are reduced to the integration of three basic components, which can also be defined as prerequisites for successful business:

- Business processes.
- Organizational support systems.
- Information systems.

For the implementation of engineering projects in industrial enterprises and the performance of activities in production processes, managers and specialists with a new way of thinking and new skills for action in the conditions

of an active, rapidly changing aggressive business environment are needed. The inevitable and constructive change is associated with the improvement of processes and the creation of prerequisites for the development of human potential.

The path to successful management of engineering projects passes through entrepreneurship and innovation, which form the new attitude towards unconventional thinking and rational action in conditions of high risk and inability to predict the final results of the functioning of industrial enterprises.

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