



PROCESS MANAGEMENT IN ENGINEERING PROJECT PLANNING

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ARTICLE INFO

Article history:

Received 3 May 2025

Accepted 30 May 2025

Keywords:

engineering projects, planning processes, industrial engineering, industrial enterprise

<http://doi.org/10.62853/JYCD1949>

ABSTRACT

The planning process group consists of those processes performed to establish the overall scope of the activity, define and refine objectives, and develop an action plan necessary to achieve those objectives. The planning processes build the engineering project management plan and documentation that will be used to implement it. The purpose of this report is to systematize and summarize the groups of processes necessary for the successful implementation of engineering projects, in order to make their implementation and adaptation easier in practice, which will significantly support the work of specialists in the planning and organization of engineering activities in industrial enterprises. The author makes no claims to exhaustiveness, as well as to the mandatory and literal application of the topic discussed in the practice of industrial processes. To achieve the goal, the methodology of system-structural analysis was used, which creates the opportunity to consider related processes and phenomena as a structured system that functions at the level of the industrial enterprise. One of the serious limitations that the author finds is that there is almost no research and there is a serious lack of scientific literature on the problems and issues related to project planning processes, and in particular, on planning engineering projects in industrial enterprises.

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1. INTRODUCTION

The multifaceted nature of engineering project management creates recurring feedback loops for further analysis. As more information or characteristics about the project are collected and clarified, this usually leads to the need for continuous and additional planning. Significant changes that occur during the life cycle of an engineering project cause the need to regularly review one or more of the planning processes and possibly some of the processes that have already been started. This gradual detailing of the engineering project management plan is often called "phased planning", indicating that planning and documentation are repetitive and ongoing processes [1]. The engineering project planning process group in an industrial enterprise consists of those processes performed to establish the overall scope of the activity, define and refine objectives, and develop an action plan necessary to achieve those objectives. The planning processes build the engineering project management plan and documentation that will be used to implement it.

The aim of this report is to group, summarize and systematize the groups of processes for planning engineering activities of industrial enterprises, regardless of whether they are primary or auxiliary. This systematization is particularly useful for planning activities and assists specialists in the field of engineering project planning.

To achieve the goal, the methodology of system-structural analysis was used, which creates the opportunity

to consider related processes and phenomena as a structured system that functions at the level of the industrial enterprise, such as:

- through this method, the set of connections and dependencies between the main groups of processes in industrial technologies can be studied as a system.

- through system-structural analysis, conditions are created for differentiating the characteristics of groups of processes in different industrial productions.

The purpose of using system-structural analysis is to obtain the most complete possible view of the state of the monitored object (in this case, the planning process in engineering projects) and to provide reliable and trustworthy information for the analysis. Therefore, the procedures used in the collection and processing of information in terms of content and sequence are important.

System-structural analysis is used not only to register facts and processes, but also to study the cause-effect relationships and dependencies between them. To achieve quality results from system-structural analysis, it is essential to define the methodological principles that are the starting point for building the logic of the toolkit itself. For example, in this case, it is necessary to consider the following:

- to define clearly and precisely the group of processes that will be used in planning activities in the engineering project.

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- to ensure dialectical unity between the goals of planning and the selected technological processes in industrial production.

- to use a common methodology and ensure comparability of the results.

The main limitations that the author anticipated when starting work on the topic and consider to be more significant are related to the subject and object of the present topic. Since the planning process is a rather complex and labor-intensive activity as part of the management of an industrial enterprise, it uses a huge base of resources, both informational and human. The planning process of an industrial enterprise is characterized by a serious scope and volume of activities that begin with the strategic planning of industrial production and end with daily current and operational tasks from the production process to the provision of the finished product to the final customer. Since this is a really complicated task and will exceed extremely the volume of this paper, the author has limited himself to:

1. Organizing the planning processes in engineering projects and systematizing them into groups.

2. Selection of industrial enterprises as an object of observation and development.

The next limitation that the author considers is that in scientific literature and research there are an extremely large number of materials and studies related to project management in general. But in particular, it is almost not found, and the author notes a serious lack of research on the problems and issues related to project planning processes, and in concrete terms on the planning of engineering projects in industrial enterprises.

2. EXPOSITION

The engineering project management plan and project documentation created as a result of the planning process group will examine all aspects of scope, time, cost, quality, communications, risk, and delivery. Updates resulting from approved changes during the engineering project can significantly impact portions of the project management plan and project documentation. Updating these documents provides greater precision in terms of schedules, costs, and financial resources required to complete the defined project scope [2, 3].

The project team should encourage the participation of all relevant stakeholders in the planning of the engineering project, the development of the project management plan, and the documentation. Because feedback and the improvement process cannot continue indefinitely, procedures selected by the management of the industrial enterprise determine the completion of the initial planning activities. These procedures will be affected by the nature of the engineering project, its established boundaries, the appropriate monitoring and control of the activities, and the environment in which the project will be performed [4].

Other interactions between processes within the planning process group depend on the nature of the engineering project. For example, for some projects, there will be little or no risk present after significant planning has been done. At this time, the team may realize that the cost and schedule targets are too aggressive, which creates a much greater risk than previously thought. The results of the iterations are documented as updates to the engineering project management plan and project documentation [5].

The process is a set of interconnected and influencing actions and/or operations in the functioning of the relevant resources, aimed at achieving a predetermined goal - product, service, result.

The engineering project and its management represent a set of processes carried out during its life cycle. These processes can be grouped depending on their nature, the knowledge and skills required for their implementation, the techniques and methods for their management, as well as in terms of the initial conditions and data required for their initiation or the results achieved after their implementation. On the other hand, many processes can be decomposed into sub-processes, depending on the specific need and/or requirements of the customers, the characteristics of the project product, etc [6].

These groups of processes, although they generally follow the logic of the development of the engineering project life cycle, should not be confused with its phases. The main differences between them are as follows:

- While the life cycle describes what happens during the implementation of the engineering project, the processes are those due to which this happens. With their help, the project management itself is also carried out.

- The phases of the engineering project life cycle are most often sequential in time, while a certain process (group of processes) can continue in more than one phase.

The engineering project manager and his team must carefully and thoroughly consider each process that should be implemented during the life cycle, its input data, resources, etc., as well as the results that are intended to be achieved with its implementation.

Project processes are carried out by the engineering project team and are divided into two main categories:

- Engineering project management processes, which are common to most projects - during the project life cycle they are carried out with one common end goal - the proper functioning and management of the project. They interact with each other in a complex way and their simplified presentation is not always possible.

- Engineering project product creation processes, which are specific to each specific project, depending on its object, scope, etc.

The two categories of processes are in continuous interaction with each other throughout the entire life cycle of the engineering project and thus give it a unique and unrepeatable appearance.

The main groups of processes in project management are five and are universal, without being influenced by the scope of the product or the industry [7, 8]:

- Processes for initiating and defining the project.
- Processes for planning the project.
- Processes for implementing the project.
- Processes for monitoring and controlling the project.
- Processes for completing the project.

The group of process initiation and definition (Fig. 1) includes the processes that provide formal authorization for the start of the engineering project or a specific phase of it. These processes are often carried out "externally" to the scope of control of the project itself by the industrial enterprise, which often "diffuses" the starting point of the entire project - for example, before any work on initiating the project is started, the business need or problem itself, the solution of which the project is to be dedicated to, is already available and documented. However, a preliminary study may be assigned, as a result of which the best

alternative for approaching the problem and developing a project for its solution, implementing the business idea, etc. is selected. Here, the purpose of initiating the project is clearly defined and its differentiation from other (routine) management tasks and its separation as a separate management object is made. A justification is made as to why exactly a given project is the best solution to satisfy the specified requirements.

The development of an engineering project management plan is a process of documenting the actions required to define, prepare, integrate, and coordinate all supporting plans. The project management plan becomes the primary source of information on how the project will be planned, executed, monitored, and controlled, and closed. In this group of processes, detailed plans are developed in the main areas of the engineering activity of the industrial enterprise: planning of activities, their sequence, and

duration; planning of resources, inventories, and supplies; planning of costs and budgeting; planning of quality, communications, and risk; planning of human resources and productivity, etc (Fig. 2).

The Execution process group (Fig. 3) consists of those processes performed to complete the work defined in the engineering project management plan to meet the project specifications. This includes various activities that unite and manage all participants and resources in the production process of the industrial enterprise - from materials and warehouse stocks, from individual production operations and technological processes to financial resources and the most valuable capital of the engineering project - the specialists and collaborators who have a fundamental role, commitment and responsibility for achieving the goals and implementing the engineering project plan.

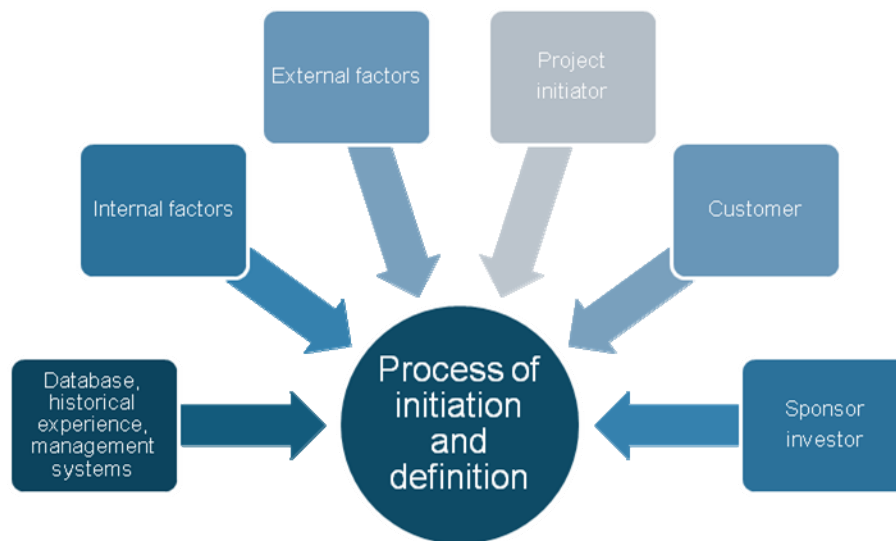


Fig. 1. Processes for initiating and defining the project (Source: Author)

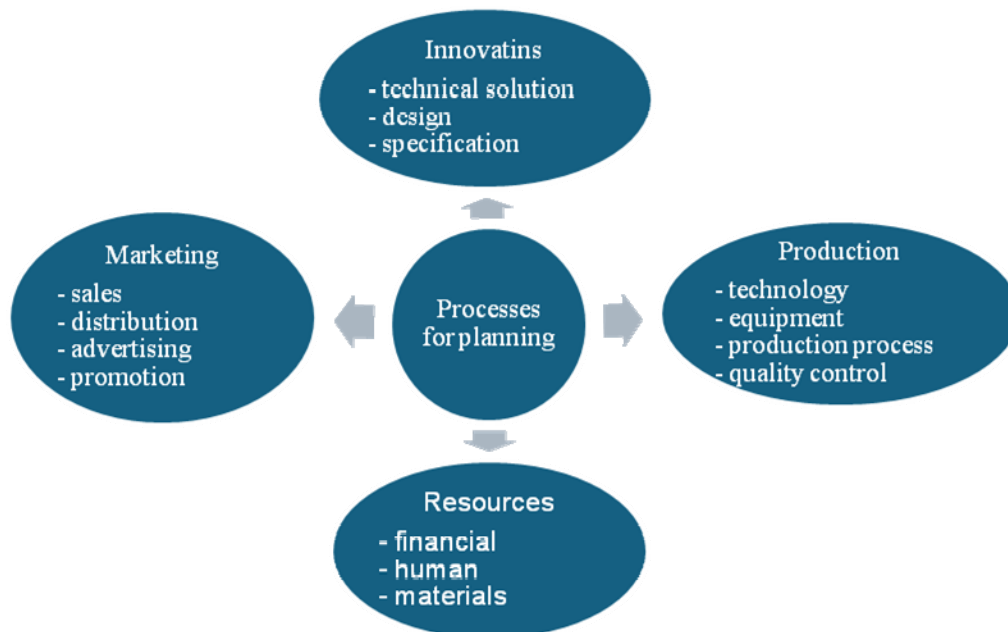


Fig. 2. Processes for planning (Source: Author)

During the execution of an engineering project, results may require updating the planning and revising the project baseline. This may include changes in the expected duration

of the activity, changes in productivity and resource availability, and unforeseen risks. These differences may affect the engineering project management plan or project

documentation and may require detailed analysis and development of appropriate project management responses. The results of the analysis may result in change requests, which, if approved, may change the project management

plan or other documents and possibly require the implementation of new project baselines. A large part of the budget will be allocated to the implementation of the processes from the implementation process group.

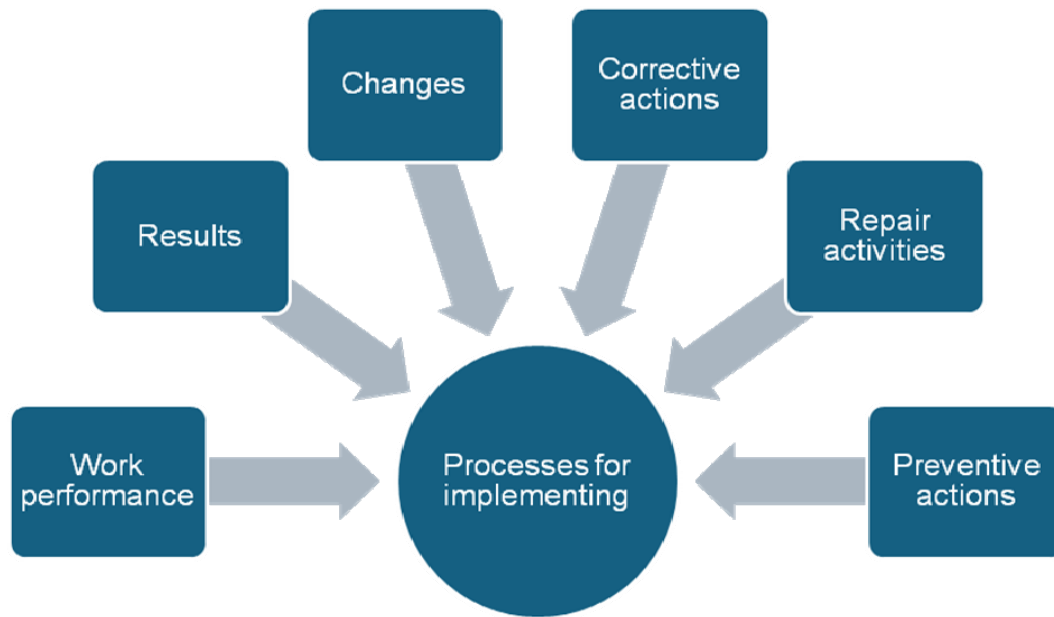


Fig. 3. Processes for implementing (Source: Author)

The Monitoring and Control process group (Fig. 4) consists of those processes required to track, verify, and regulate the progress and execution of the project; identify any areas where changes to the plan are needed; and initiate appropriate changes. The primary benefit of this process group is that project performance is monitored and measured regularly and consistently to identify deviations from the project management plan. The Monitoring and Control process group includes:

- Controlling change and recommending preventive measures in anticipation of potential problems.
- Monitoring ongoing project activities against the project management plan and the project performance measurement framework.
- Influencing factors that could bypass integrated change control so that only approved changes are implemented.

Continuous monitoring provides the project team with insight into the status of the project and identifies any areas that require additional attention. The Monitoring and Control process group not only monitors and controls the work being performed within the process group, but also monitors and controls the efforts across the entire project. In multi-phase projects, the monitoring and control process group coordinates the project phases to implement corrective or preventive actions to bring the project into compliance with the project management plan. This review may result in recommended and approved updates to the management plan. For example, missed completion dates may require adjustments to the current staffing plan, the use of overtime or compromises between budget and schedule.

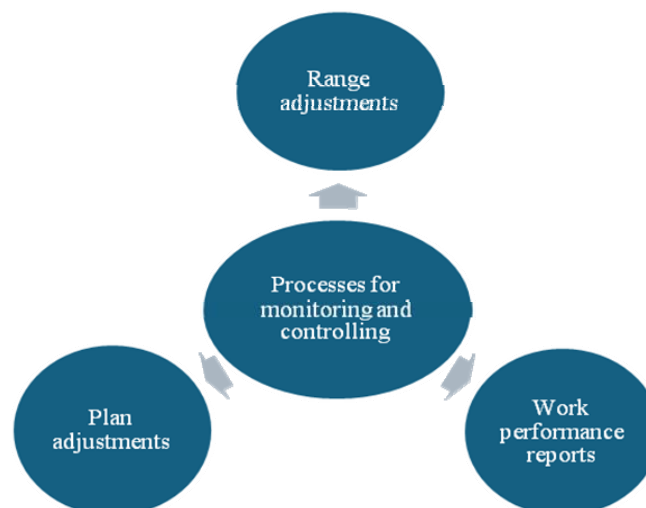


Fig. 4. Processes for monitoring and controlling (Source: Author)

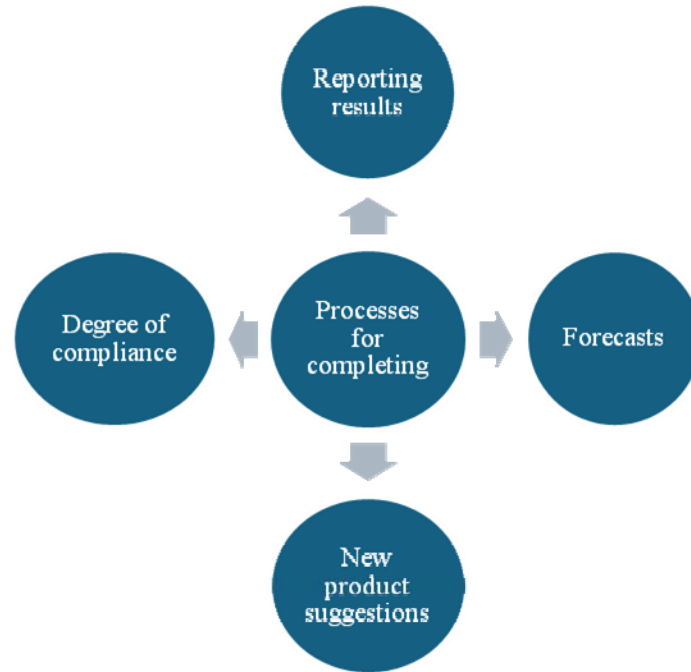


Fig. 5. Processes for completing (Source: Author)

The completing process group consists of those processes performed to finalize all activities in all engineering project management process groups to formally close a project, phase, or contractual obligations. At this stage, the engineering activities in the project are checked and evaluated, comparing the degree of compliance of the results with the planned values, the degree of implementation, and only then can the engineering project or its phase be considered completed. When a project or phase is closed, the following may occur:

- Acceptance by the customer or sponsor.
- Review the impact of adjustments to each process.
- Document the conclusions and recommendations made.
- Implement appropriate updates to organizational process assets.
- Archive all necessary project documents in the information system.
- Complete the deliverables.

Project Charter Development

This process is dedicated to authorizing the engineering project or its phase. With its help, the business need/problem is formalized and documented, as well as what the main result will ultimately be (product, service, other result that will satisfy this need or solve the problem). This definition shows how the project fits into the strategic goals of the industrial enterprise, how it contributes to their achievement, how it fits into the implementation of the strategic plan and as a consequence - clarifies the main connection of the engineering project to the current tasks and functioning of the industrial enterprise. Required input information:

- Project contract.
- General statement of the work to be done.
- Factors from the environment/ external environment of the industrial enterprise and/or the project that have an impact.
- Resources, processes, know-how and other assets owned by the industrial enterprise that would be included in the implementation of the project.

Developing a preliminary vision for the scope of the project

This process, using the engineering project charter, defines in broad terms the scope of activities that must be performed in order to "produce" the project result/product. The intermediate and final results, their characteristics and parameters, the requirements for them, as well as the project framework, the methods for establishing, qualifying/approving the achieved results and the ways of their acceptance are defined and documented.

When defining the scope of the engineering project, the way in which control over the implementation of the scope in its entirety will be exercised at the highest level must also be determined [9].

With the help of such a process, the scope of work in each phase of the project life cycle is also specified and approved.

3. CONCLUSIONS

The results are the most important "product" of any engineering project, so every industrial enterprise begins by predicting and specifying the results expected by it. They are always strictly individual, but surveys conducted in enterprises that have successfully implemented and executed engineering projects show that they reach a common conclusion - in almost all cases the results manifest themselves in five directions:

- improving customer service, increasing satisfaction and meeting specific requirements of product users.
- shortening the time for the process or production cycle, reducing and/or eliminating activities and operations that do not add value.
- reducing the number of employees; handling larger volumes of work more efficiently, increasing labor productivity.
- saving costs, increasing profitability and efficiency indicators.

In the five areas of analysis of the results, the way of prioritizing is striking - the greatest importance is given to improved customer service, and the least significant - to cost savings. Despite the challenges, robust infrastructure

and strategic planning enable long-term AI investments to yield substantial benefits, enhancing industry project management outcomes [10].

The comments can be very diverse, but the dominant opinion is that engineering projects are carried out primarily for the customer, so that he is satisfied and continues to seek the products and services of the industrial enterprise, without which it could not exist. Cost savings is a general indicator, the magnitude of which is formed both by the reduction (shortening) of the duration of the process, and by the reduction in the number of employees.

In conclusion, a very important recommendation can be made to specialists in the practice of engineering project management in industrial enterprises. Artificial intelligence in project management is said to be one of the trends of the future, with automation and human-machine collaboration [11]. In the interest of improving activities and processes and developing innovation policy in every modern industrial organization, it is necessary to introduce and more confidently use artificial intelligence in the planning of technological and production processes and the utilization of the necessary resources for their implementation.

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