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# Personnel Management in the System of Ensuring Safety and Security of the Engineering Enterprise in the Conditions of Industry 4.0

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**ABSTRACT**

The main purpose of the article is to study the key aspects of ensuring economic safety and security through the modernization of personnel management. At the same time, in order to achieve the goals set, the main scientific task is to model the processes of ensuring economic safety and security through the modernization of personnel management. The object of the study is the enterprises of the engineering sector of the economy. The research methodology involves the use of modern modeling methods with appropriate graphical displays. Research questions are in the disclosure of safety and security within the scope of engineering enterprises. The key method is to use graphic language technologies. The specific result is the multi-model nature of the proposed measures within the framework of safety and security engineering enterprise. According to the results of the study, the main processes of ensuring economic safety and security through the modernization of personnel management and engineering enterprise were presented in detail. The scientific novelty of the study should be considered in the presented methodological approach to ensuring economic safety and security through the modernization of personnel management. The study is limited by taking into account only the personnel management system. Prospects for further research should be devoted to ensuring the safety and security of engineering enterprises through other control systems than personnel.

## 1. INTRODUCTION

In the introductory part, it should be noted and emphasized that the strengthening of the negative impact of the market environment, the deterioration of the economic situation, the instability of the political situation, the ineffectiveness of the regulatory framework, the variability of the external and internal environment, the aggravation of competition in the sales markets affected the financial performance of engineering enterprises, satisfaction the needs of consumers both in the domestic and foreign markets, which affected the volume of engineering services provided, the expenditure of funds, and the use of labor resources. A prerequisite for the formation of competitive advantages in engineering enterprises, the growth of performance, production volumes, and the services provided by engineering, strengthening positions in the world market, and meeting the needs of consumers is to increase the effective use and management of personnel of engineering enterprises. Therefore, for any engineering enterprise, the problem of rational use of personnel is of particular importance, which should guarantee stable development, improvement in performance, and prosperity in the future. Along with the organization of the use of personnel in engineering enterprises, it is advisable to manage them to ensure safety and security.

Personnel management and engineering enterprises are powerful tools for adjusting the activities of employees, organizing their work, promoting the achievement of established goals, and increasing competitiveness and economic development while making effective managerial, personnel, and administrative decisions. Under such circumstances, one of the main tasks of the management of engineering enterprises is the formation of an effective system, a mechanism for managing the efficiency of personnel use as a prerequisite for planning, organizing, regulating, adjusting the work of employees, increasing labor productivity, overcoming problems in personnel management, rational use of labor resources, establishing functioning and development of engineering enterprises.

Also, in engineering enterprises, there is a need to introduce the latest approaches to managing the efficiency of personnel use, the experience of competitors, and developed countries. However, the vast majority of engineering enterprises use outdated motivation methods and approaches to assessing the effectiveness of personnel use, there are no methodological approaches to analyzing the rationality of personnel

management, and there is a need to improve the personnel management process to restore their functioning.

A prerequisite for the formation of competitive advantages in engineering enterprises, improving their safety, the quality of engineering services provided, increasing revenues, and meeting the needs of consumers both in the domestic and foreign markets is to solve the problem of effective use and management of personnel and personnel. In addition, an urgent problem for any engineering enterprise is to ensure stable development, operation, improvement of performance indicators, and personnel play an important role in solving this problem. Rational management and efficient use of labor resources will contribute to the growth of labor productivity and, as a result, the expected financial results, cost reduction, and improvement of performance. The most rational use of personnel and their management is a significant factor determining the level of competitiveness, and economic development of an engineering enterprise. Particularly significant, with the deterioration of the performance of engineering enterprises, the loss of competitive positions, the lack of support from public authorities, the improvement of the management process, and the use of personnel. Consequently, economic growth, development, neutralization of the effect of environmental factors is possible on the basis of the rational use of labor resources to ensure safety and security.

Today, the key challenge for the engineering sector is the problem of ensuring one's own safety and security. It is the personnel who perform the tasks involved in ensuring safety and security. It is up to people what level of security can be expected in a highly changing operating environment. Today there is a lack of new approaches to safety and security in the engineering sector.

The main purpose of the article is to study the key aspects of ensuring economic safety and security through the modernization of personnel management. At the same time, in order to achieve the goals set, the main scientific task is to model the processes of ensuring economic safety and security through the modernization of personnel management. Research questions are in the disclosure of safety and security within the scope of engineering enterprises.

## 2. LITERATURE REVIEW

In the scientific and practical literature [1, 2], it is often believed that personnel management and the efficiency of personnel use are interconnected concepts. The use of personnel in the engineering enterprise is aimed at creating the necessary conditions for developing the potential of employees and achieving the main goals through the use of certain measures. At the same time, the use of personnel should be aimed at: performing various tasks by an employee at one workplace; distribution of working time; ensuring a change in the type of work performed; compliance of the qualification level of employees with the work performed. Commenting on the author's research, it is worth emphasizing that increasing the productivity of the use of personnel; the rationality of the distribution of responsibilities will improve personnel management in engineering enterprises. It's hard to disagree with this.

Other authors [3, 4] publish in the literature the conclusion that personnel management is carried out within organizational structures, and is based on the use of principles, and methods, which ensures effective personnel management. The main purpose of personnel management is the search, selection, and acceptance of qualified employees. It should be noted that personnel management for engineering enterprises should be aimed at the formation of new knowledge, the use of the skills of employees, the restoration of coherence in the team, and the rational use of labor resources, which will increase the competitiveness and profitability of the activity.

It is correctly noted in the literature [5, 6] that the modern realities of the functioning of engineering enterprises confirm the expediency of the effective use of personnel, and the rational distribution of available financial resources. It should be noted that in the definition of the concept of "management of the effectiveness of the use of personnel in an enterprise", attention is focused on the importance of the effective use of labor resources, assessing the effectiveness of the work of personnel, disseminating and accessing information, studying the socio-economic situation of employees, studying the level of qualifications, staff composition, introducing new methods of management, attracting investment resources, the feasibility of managing not only the staff but also the results of their activities, labor productivity, bonus systems for employees with the variability of external and internal environment factors.

Factors of the market environment, affect both personnel management and the formation, use, and development of personnel. Analysis and study of factors of influence is the main source of information for assessing the activities of personnel, and existing problems in the engineering enterprise for its use. Therefore, taking into account factors, factors in the activity of engineering enterprises have a positive value, which is manifested in the following: improve personnel management; develop a personnel management strategy; define basic principles and methods; assess the effectiveness of management and make adjustments to the organization of management; predict the change in the influence of factors; perform a forecast of the effectiveness of personnel management [7, 8].

In the works of scientists [9-11], the need for effective use of personnel is substantiated, the application of the system and mechanism of personnel management is considered, the essence of the concept of personnel use, methods of motivating employees, theoretical and methodological approaches to assessing the rational use of personnel are disclosed.

The scientific literature describes a significant amount of the specifics of personnel management and its features within the engineering sector. Analyzing the literature, it should be noted that the key gaps are manifested in the fact that there is no clear approach to how to effectively ensure security and security in general. However, a number of aspects of ensuring safety and security engineering enterprises through improving the efficiency of personnel management are still relevant. It is these problems that determined the choice of the topic and the relevance of the chosen areas of research.

## 3. METHODOLOGY

The main modeling method involves the IDEF method. Methodologies for building visual models of the IDEF (Integrated Computer-Aided Manufacturing) family are widely used in CASE tools for modeling management process (including personnel management, and enterprise engineering for security and safety). The most famous and popular

methodologies of the IDEF family are IDEF0 – functional modeling methodology; DFD - data flow diagram methodology; IDEF3 is a process modeling methodology. All of the above methodologies use the principle of the hierarchical grouping of models: the top-level diagram contains a general description of the system, and then it is detailed in decomposition diagrams.

For the same complex object or process, a large number of different variants of IDEF models can be built (including personnel management and enterprise engineering to ensure safety and security). The choice of one or another option is determined by the subjective opinion of the model developer. Therefore, it is useful to introduce objective criteria that would allow us to compare different options for building models, which will allow us to settle on the best option.

IDEF notation uses the simplest set of symbols: process rectangles and arrows representing inputs, outputs, controls, and mechanisms. This notation features a built-in numbering system for business process steps that allows you to track the relationship between parent and child activities. As a rule, modeling by means of IDEF0 is the first stage of studying the system (including personnel management and enterprise engineering for safety and security).

The diagram in IDEF0 allows you to visually structure the processes of the organization and graphically reflect the interaction between these processes. It is especially important that in the IDEF0 notation, with the help of special arrows, it is possible to show managerial actions that make it possible to describe the personnel management system of enterprise engineering to ensure safety and security.

Despite this, it should be noted that the application of the proposed methodical approach is possible when using the actual engineering of an enterprise. We chose the European engineering enterprise "Metallit Engineering".

The chosen method is best suited to the framework of our study through the effective practice of forming a model precisely in a graphical language, which, through the appropriate arrows and blocks, allows us to demonstrate exactly how to achieve safety and security.

The choice of "Metallit Engineering" is not accidental, most of the authors of the article work there, and know the control system and the security system well.

## 4. RESULTS OF RESEARCH

Thus, the results of the study in our case will consist in the presented models, which will contribute to ensuring the safety and security of the engineering enterprise "Metallit Engineering" chosen by us as an example. For each simulation, you need to set a task. In our case, having agreed with the management of the selected engineering enterprise, we set it as T0 "Ensuring safety and security through improved personnel management" (Figure 1).

"Metallit Engineering" is characterized by several main problems that we tried to solve in our study. The list of these problems is presented in Figure 2.

Thus, it is also necessary to present an information model of the main elements of modeling and the desired results, which have been agreed with the management of the selected engineering enterprise (Figure 3).

To achieve T0 "Ensuring safety and security through improved personnel management" the following processes should be completed:

T1. Development of a program to improve the mechanism for managing the efficiency of the use of personnel in engineering enterprises. The next stage is the development of a program to improve the mechanism for managing the efficiency of the use of personnel in engineering enterprises, i.e. elements, expected effects, and period of operation. Also, the sequence of actions to improve the mechanism and the development of the enterprise when using it is determined.

T2. Determination of the tasks of the mechanism for managing the effectiveness of the use of personnel. As for the tasks of the mechanism, the following should be highlighted for the engineering enterprise: improving performance; reduction of terms of performance of work by personnel; automation of workplaces; improving the efficiency of employees; creation of safe working conditions; introduction of new equipment; reduction of production costs; establishing the process of work in individual departments; interest of employees in the results of work; growth in revenue from product sales; proper control over the work of personnel; rational distribution and use of labor resources; availability and dissemination of information among management on the results of the work of employees.

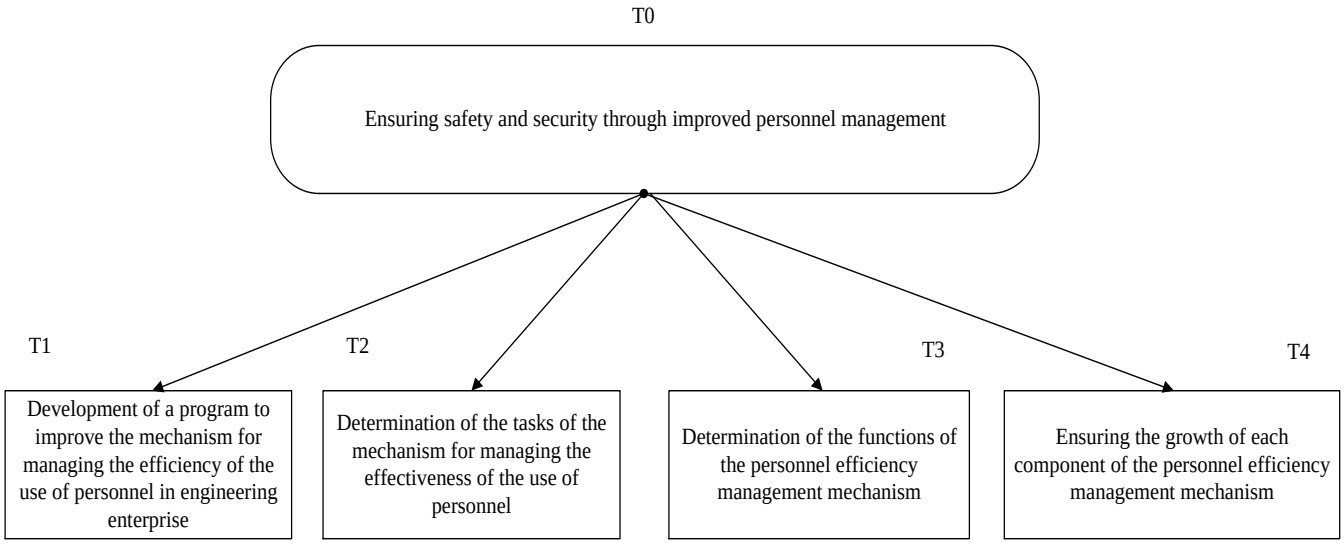


**Figure 1.** The task of modeling and the processes of its achievement (Development by authors)

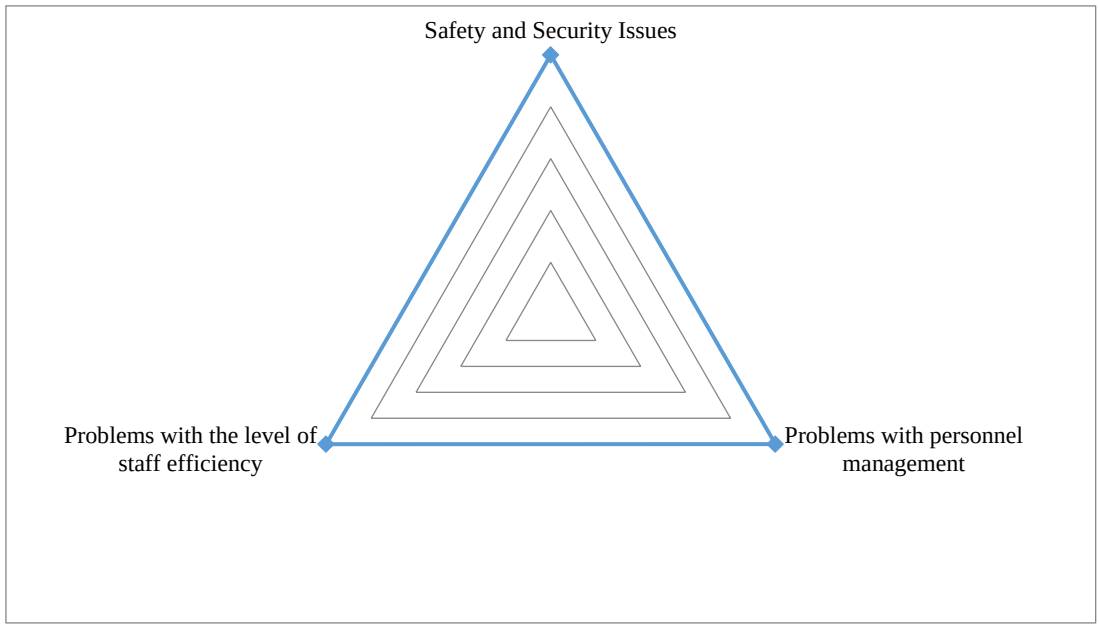


**Figure 2.** Problems in the activities of the selected engineering enterprise, which will be solved by the proposed models (Development by authors)

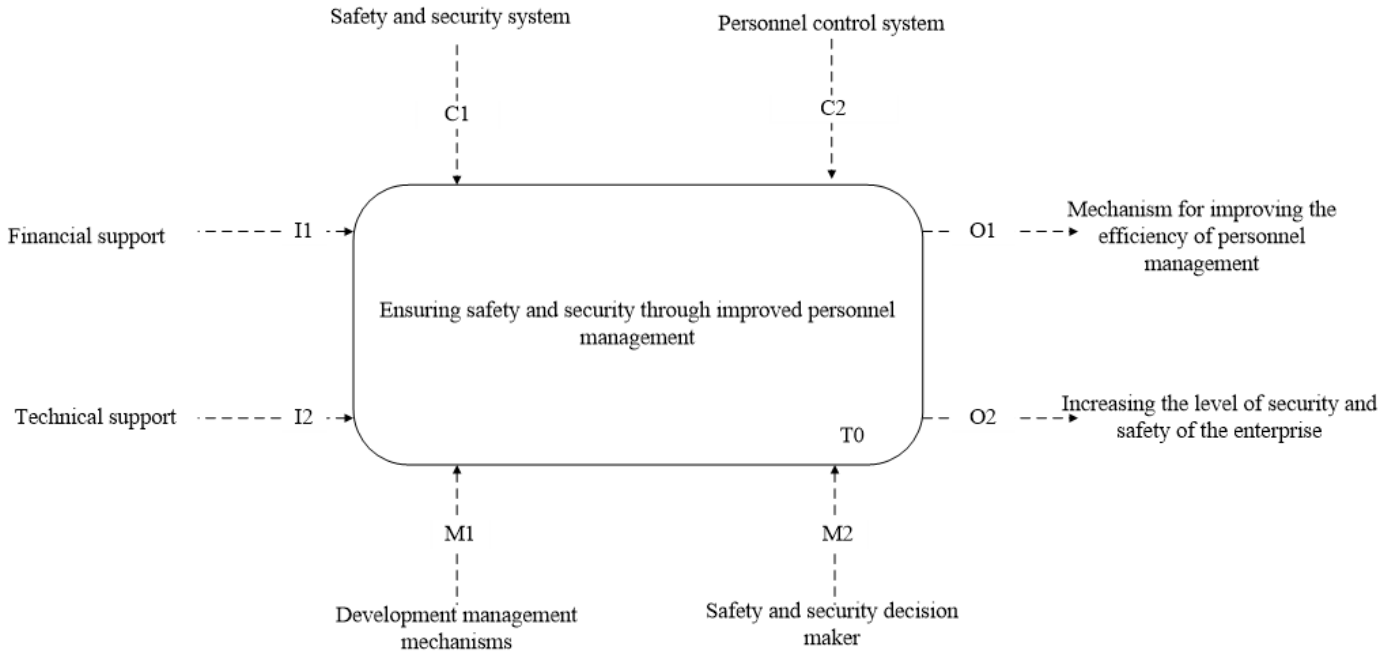


**Figure 3.** Desired modeling results (Development by authors)

T3. Determination of the functions of the personnel efficiency management mechanism. The main functions of the mechanism included: personnel planning; planning the number of personnel; selection of employees and assessment of their abilities; introduction of modern personnel management tools; use of personnel; creation of safe working conditions; establishing a favorable climate in the team; development of a personnel efficiency management system; enforcement of legal regulations; staff development; staff development; use of motivation methods; information support of management on personnel matters and management of the effectiveness of the use of personnel; analysis of personnel needs and monitoring of the personnel management process; control over the achievement of the desired results and the fulfilment of tasks by employees, compliance with regulatory requirements. The use of these functions will create an effective management mechanism that will function successfully to ensure safety and security.

T4. Ensuring the growth of each component of the personnel efficiency management mechanism. The mechanism for managing the efficiency of the use of personnel in engineering enterprise should take into account the following components: social (wage level, social climate in the team, compliance with the terms of the employment contract, the introduction of material and non-material methods of motivation); innovative (the use of modern means of production, the level of implementation of technologies, the latest equipment, equipping workplaces with equipment, the use of the latest management methods); technological (depreciation level of equipment, the share of new equipment, product renewal, increasing the level of knowledge of personnel to use new equipment); economic (methods of

personnel management, the level of remuneration, satisfaction of employees with wages); financial (the amount of costs for the development of personnel, its use, the implementation of employee management, analysis of cost coverage by the expected economic effect from the use of the mechanism); informational (analysis of the provision of the mechanism with information data, data exchange within the enterprise, the availability of information for making important decisions on managing the efficiency of personnel use). The use of these components will ensure and analyse the effectiveness of the mechanism and determine further areas of operation (Figure 4).

However, in our opinion, it is T1 "Development of a program to improve the mechanism for managing the efficiency of the use of personnel in engineering enterprise" that is one of the most important stages that should be detailed:

T11. Definition of safety and security tools. The main tools are: planning (determining goals, objectives, actions necessary to achieve the goal of the mechanism, distribution of responsibilities between structural elements, planning time to achieve goals, assessing the quality of management work); organizational (improvement of working conditions, personnel management, organization of work and functioning of the mechanism, implementation of measures to achieve the tasks set); stimulation (according to the results of the analysis of the effectiveness of the use of personnel, measures are being introduced to stimulate them and improve management); regulatory support (control over compliance with the requirements of the current legislation and regulatory legal acts by management, employees, as well as product quality requirements, its compliance with established standards, use of the mechanism in accordance with established rules); forecasting (determining the results from using the mechanism, comparing them with planned indicators, making appropriate decisions); adjustment and control (carried out to make adjustments to the operation of the elements of the mechanism, eliminate contradictions and shortcomings, control the use of the mechanism and the fulfilment of the tasks set); personnel (hiring of employees, selection of personnel, advanced training, analysis of problems of management and use of personnel, assessment of the effectiveness of the use of employees, creation of conditions for the creative activity of personnel, proper work with personnel, assessment of the work of employees, balance of interests of management and employees, reduction in the number of layoffs, accounting workers' rights and freedoms).

T12. Establishing the responsibility of the management of the engineering enterprise and structural divisions for the fulfilment of the goals set. Next, the stage of establishing the responsibility of the management of the enterprise and structural divisions for the fulfilment of the goals, objectives, achievement of the desired result, the timeliness of decision-making, problem-solving, and compliance with norms, rules, and recommendations are carried out. At the same time, the responsibility of the management of structural divisions for the implementation of the management mechanism, the implementation of each of its stages in the direction of applying the methods and methods of effective management of the use of personnel is determined. In case of non-fulfilment of the formed tasks, various types of liability are provided: material; administrative; disciplinary.

T13. Analysis of the activities of structural units and the level of development engineering enterprise. The stage of analysis of the activities of structural divisions and the level of development of engineering enterprise covers operations to assess the efficiency of production activities, the level of solvency, competitiveness of products, sales volumes, the presence of debt, the dynamics of wage increases, profits earned over several periods, the frequency of introduction of new equipment, working conditions for employees, availability of financial resources, the use of motivation methods

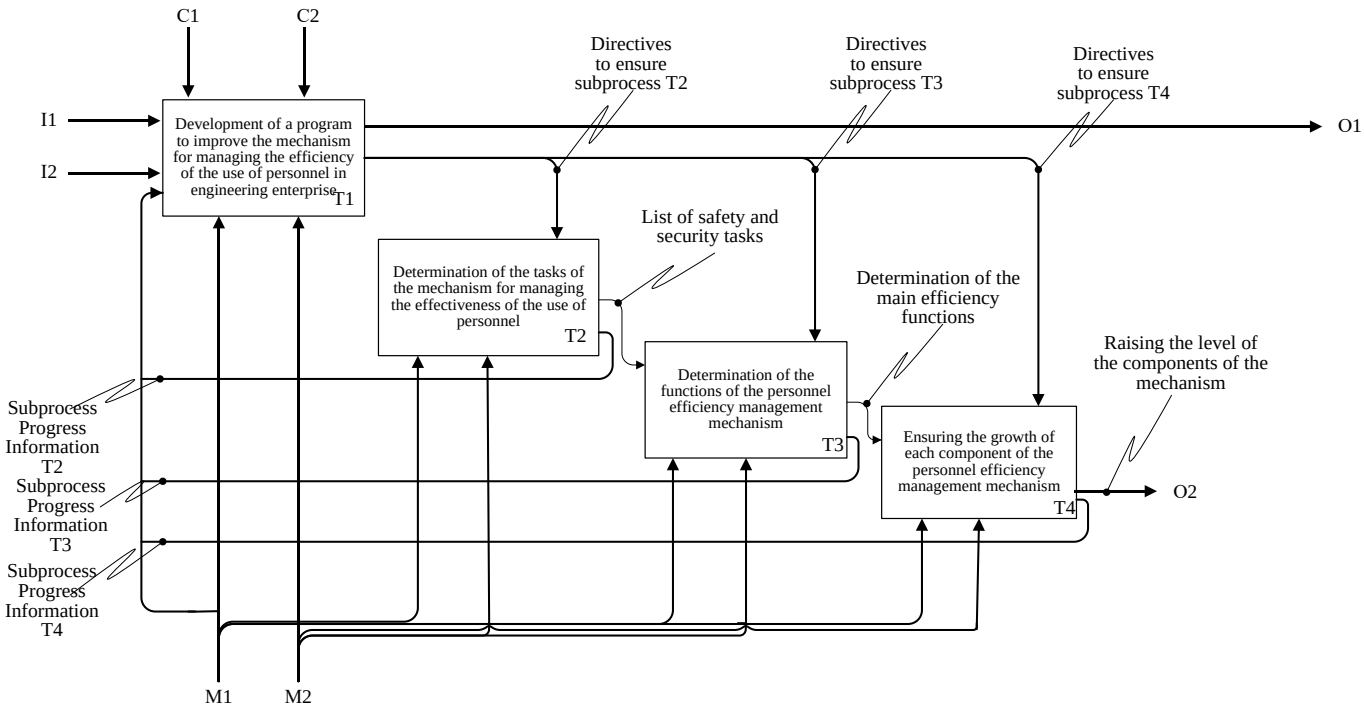


**Figure 4.** Results of T0 "Ensuring safety and security through improved personnel management" process modeling results (Development by authors)

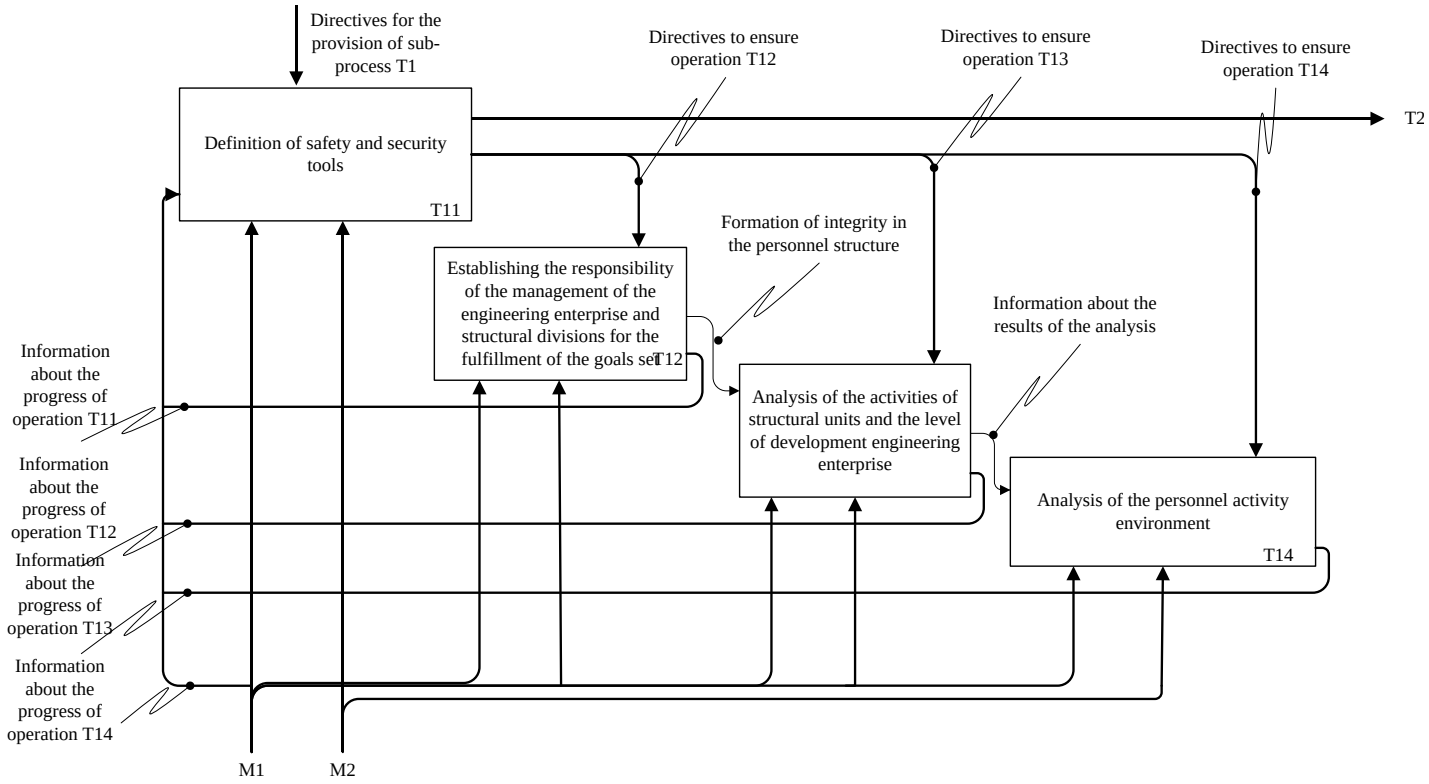


**Figure 5.** Results of T1 "Development of a program to improve the mechanism for managing the efficiency of the use of personnel in engineering enterprise" process modeling results (Development by authors)

T14. Analysis of the personnel activity environment. The next stage is the analysis of the personnel activity environment. This stage involves the analysis of the conditions of personnel activity, the safety of working conditions, compliance with the mode of operation, the level of achievement of the needs of employees, the availability of information for workers, and unused personnel potential. Based on the results of the study, the problems of the enterprise in working with personnel, and the level of their dissatisfaction with working conditions are determined in order to make appropriate decisions on safety (Figure 5).

The management mechanism aims to increase the efficiency of personnel use, regulate their work, and improve the work of enterprise divisions by using appropriate principles, methods, tools, and components, which is also aimed at improving the management process itself. That is, based on the results of the preliminary stages of the mechanism, an improvement in the process of managing the efficiency of personnel use is organized.

It is supposed to study forecast data and establish the effectiveness of using the mechanism not only for the present but also in the future. It also determines the effectiveness of the mechanism for the long-term development of an engineering enterprise and evaluates the performance management indicators for the use of personnel in the future.

After 4 months of implementation of the processes and operations presented in the model, the management of the engineering enterprise reported an increase in the efficiency of personnel management and an increase in significant safety and security indicators. However, the management of the engineering enterprise demanded that this report not be published publicly.

The blocks T in the definition are presented in the figures thanks to the analysis and practice in the engineering sector. Their implementation should take place according to the proposed model under strict control and monitoring.

According to the management of the engineering enterprise, according to their data, the personnel perform the assigned tasks to ensure safety and security more efficiently, since the model is clear to them.

## 5. DISCUSSIONS

Discussing the results of our study, we should compare them with the previous ones. For example, as a result, some authors [12-14] found that in order to manage personnel, increase the productivity of employees, the coherence of the management process, the work of structural divisions, and improve production and economic activities, it is advisable to use the mechanism for managing the efficiency of the use of personnel in engineering enterprises. The use of this mechanism requires the coordinated work of its structural elements and allows you to improve the efficiency of personnel management, plan and organize the work of employees, increase the effectiveness of the work of personnel, increase the profitability of activities, and achieve economic benefits in the long term.

Other scientists [15-17], for example, in their studies have formed the process of managing the effectiveness of the use of personnel engineering enterprises, in which the factors of the external, general and specific internal environment are identified by studying the specifics of the use of personnel engineering enterprises, the features of personnel management, the functioning of engineering enterprises. Accounting for these factors in the work of engineering enterprises will allow timely identification of the negative impact of management factors and the use of personnel, improve the work of employees, develop their abilities, achieve established goals, and determine areas for improving the work of engineering

enterprises in a changing market environment.

A separate group of scientists [18-20] also offers a certain methodological approach. The methodological approach made it possible to calculate the predicted value of the integral indicator of the personnel, social, innovative, technological, economic, and financial effect and the forecast of the level of effectiveness of managing the efficiency of personnel use from conducting a correlation-regression analysis, building an economic and mathematical model. This approach makes it possible to use it in engineering enterprises, it is easy to use and transparent; allows you to develop measures to improve the use of personnel, decide on the further use of personnel, determine development prospects for the future, and establish the functioning of engineering enterprises.

At the same time, when discussing our research results, it should be noted the uniqueness of our methodological approach through the modeling of safety and security engineering enterprises by improving the efficiency of personnel management using Industry 4.0 technologies. The scientific novelty of the study should be considered in the presented methodological approach to ensuring economic safety and security through the modernization of personnel management.

Our research differs in the very approach to security and safety. Our approach is based on showing how personnel management should be carried out and how it is convenient to explain it at the enterprise. The presented results of our study may have predictions. Such forecasts can be made, up to the point that we do not expect problems in the implementation of certain blocks of T.

Discussing the consequences of the study, it should be noted that they revealed an impact on the development of the safety and security engineering sector.

## 6. CONCLUSIONS

Summing up, it should be noted that due to the deterioration in the functioning of engineering enterprises, which occurs under the negative influence of external and internal environmental factors, the lack of effective tools for establishing their development, support from local and state authorities, there is an urgent need to introduce ways to restore safety and security engineering enterprise. Another reason for the unstable position of engineering enterprises is the inefficiency of the process of using personnel, and employee management, which directly affects the provision of engineering services, the amount of profit received, the level of competitiveness, and the satisfaction of consumer needs of engineering enterprises. Therefore, for the successful functioning of engineering enterprises, improving their production and economic activities, strengthening their positions in the market and covering new sales markets, maximizing profits and minimizing costs, it is advisable to use modern methods, models, approaches, mechanisms for managing the efficiency of personnel use. The process of personnel management affects the performance of employees through the creation of working conditions, the formation of labor potential, the use of the abilities of employees, the promotion of their development, and the consideration of the needs of personnel in the process of work and requires certain mechanisms or systems for its implementation in engineering enterprises. The introduction of a personnel efficiency management model is necessary in engineering enterprises in order to organize, adjust and implement rational management, use of employees, make administrative, managerial, and personnel decisions, achieve the goals of the enterprise, collect and transmit information about personnel activities, improve motivation, meet the needs of employees. Implementation of the work of managerial personnel and an important tool for the successful functioning of the management system.

According to the results of the study, the main processes of ensuring economic safety and security through the modernization of personnel management and engineering enterprise were presented in detail. The study is limited by taking into account only the personnel management system. Prospects for further research should be devoted to ensuring the safety and security of engineering enterprises through other control systems than personnel. It should be noted that in addition to the personnel management system, such systems as resource management, information, and innovation also have a significant impact on ensuring the safety and security of engineering enterprises. They should be explored in future studies.

As a result, we have the following: proof of the importance of the problem and the topic of the article; setting the task in the formation of models; representation of the models themselves. The results obtained have an impact on the engineering sector since it was the engineering enterprise that was chosen for the work and the model.

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