

## Modelling Information Systems for Personnel Management: Navigating Economic Security in the Transition to Industry 5.0



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### ABSTRACT

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Within the backdrop of rapidly advancing technology, the transition from Industry 4.0 to Industry 5.0 is underway, with each socio-economic system endeavoring to adapt to these transformative changes. Industry 5.0 signifies a shift from conventional technologies, advocating for enhanced digital interaction between humans and machines. This change significantly influences economic security - a socio-economic paradigm that safeguards the economic interests of personnel. The primary objective of this study is to explore the development of personnel management information systems during the economic security transition within the context of Industry 5.0. This involves the modelling of a personnel management information system, which constitutes the main scientific task of the research. The scope of the study extends to the broader personnel management system and the economic security of a unified information system. To accomplish the theoretical and scientific objectives, we employed contemporary methodological approaches for modelling and graphical representation. The results of the study, presented visually, provide a model for information systems for personnel management during the transition of economic security to Industry 5.0. Evidently, the novelty of this study lies in its proposed methodological approach and the delineation of specific processes that facilitate the organization of a personnel management information system amidst the transition of economic security within the context of Industry 5.0. This study's findings contribute to the body of knowledge by providing a comprehensive model for navigating these transitions in the era of Industry 5.0.

## 1. INTRODUCTION

### 1.1 Research context

The contemporary transformation of managerial functions necessitates an exploration into the information and analytical support systems that underpin enterprise activities. These systems not only encapsulate economic phenomena and processes but also furnish analytical insights into their essence and influence on managerial decision-making efficacy.

Information systems represent an intricate amalgamation of concepts, methods, technologies, and technical and software tools, collectively employed to automate the procedures of collecting, processing, storing, and disseminating information to consumers to accomplish specified objectives. Tailored to the domain of enterprise activity, these systems play a pivotal role in organizational operations.

A prevalent challenge within corporate information systems is the absence of an effective system model. This lack has led to a focus on business processes rather than the system's state. Adopting a systematic approach could potentially recalibrate this focus, incorporating all factors that could impact the system's state, even those outside of the business process.

Models based on business processes currently allow management at an intuitive level only.

In the era of market globalization, planning the management of any enterprise revolves around ensuring optimal personnel performance. The heightened competition compels leaders of engineering companies to explore novel approaches to improving personnel service quality. Effective management of personnel work quality has emerged as a critical determinant of an engineering enterprise's success, with competitive advantages in both foreign and domestic markets being contingent on an integrated approach based on implementing international standards for work quality.

Human resource management is increasingly acknowledged as a vital area of enterprise function, capable of elevating management efficiency and productivity, and enhancing economic security during the transition to Industry 5.0 standards. Current economic conditions necessitate innovative approaches to personnel management, recognizing that a significant organizational reserve is the employees who guarantee product quality and competitiveness and augment economic security during the transition to Industry 5.0. The ever-evolving market environment necessitates continuous refinement and updating of the principles underlying modern

personnel management systems. The endeavor to establish an optimal personnel management system involves navigating complex economic and socio-political issues, necessitating a radical shift in management style and an enhancement in economic security during the transition to Industry 5.0.

### 1.2 Research aim and focus

The main purpose of the article is to determine the ways of forming information systems for personnel management during the transition of economic security in the context of Industry 5.0. For this, the main scientific task will be to model the personnel management information system during the transition of economic security in the context of Industry 5.0. At the same time, the object of study is the personnel management system and economic security of a unified information system.

## 2. LITERATURE REVIEW

### 2.1 Synthesis of literature

The scientific literature often underscores the significance of personnel management planning in ensuring the economic security of an enterprise [1]. Within the paradigm of personnel management planning systems, employees are likened to fixed capital — the incurred costs are viewed as long-term investments, personnel planning is intimately tied to production processes, and employees become the focus of corporate strategy.

The strategic role of information technology in today's world is to bolster management, respond aptly to market fluctuations, and sustain or deepen competitive advantages to maximize benefits [2]. The deployment of information systems can dramatically shift the management style and significantly enhance company performance.

Kryshchanovych et al. [3] and Thakre et al. [4] argue that the adoption of information systems is aimed at augmenting the efficiency of a company's production and economic activities. This is achieved not only through routine information processing and storage and the automation of accounting and clerical tasks, but also through the introduction of novel

management methods predicated on modeling the actions of the firm's specialists. These include methods of artificial intelligence, expert systems, and the use of modern telecommunications means like email and teleconferences, and global and local computer networks.

Literature often emphasizes that personnel management planning is characterized by its systematic and comprehensive nature, addressing the problems of workforce reproduction holistically [5, 6]. The personnel management planning system, in the context of securing the economic safety of engineering enterprises, is viewed as a confluence of applied science and practical activities. This includes the development and implementation of organizational, economic, administrative, managerial, legal, and personal factors, methods, and means to influence personnel for improved management of socio-economic systems [7-9].

Numerous sources [10-12] highlight the imperfections, inefficiencies, and outdatedness of management planning systems in many engineering service providers. The consequences of these shortcomings include low labor productivity, high staff turnover, and a poor psychological climate within teams. A well-coordinated engineering enterprise seems implausible without an optimal management structure, a robust social protection system, and effective employee motivation.

Gradually, the focus of scientific literature is shifting towards Industry 5.0 [13-15], acknowledging the importance of this transition in research.

### 2.2 Identified gaps in literature

The prevailing gap in the current literature is the preponderance of research centered around Industry 4.0. This could be a temporary research gap, indicating the need for contributions in the context of Industry 5.0. Regrettably, there is a dearth of literature that adequately addresses the issues of personnel management information systems during the economic security transition to Industry 5.0. Therefore, it seems expedient to undertake modeling to actualize Industry 5.0. A significant portion of the pressing issues in enterprises concerning personnel management information systems pertains to forming a planning system in the context of ensuring enterprise economic security.

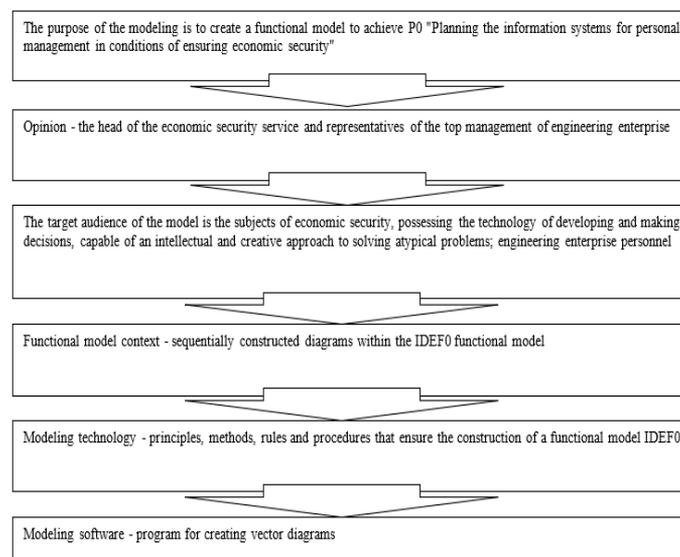


Figure 1. The basic conditions for the development of a functional model in the framework of our study (Formed by the authors)

### 3. METHODOLOGY

#### 3.1 Characteristics of the chosen method

For the study, one should choose a functional modeling method. Functional modeling is an essential element of conceptual analysis, which is carried out every time to improve engineering activities. The development and analysis of a functional model of engineering activity allow you to dive deep enough into the subject industry, identify and evaluate the business processes that occur in the engineering enterprise, determine information flows, and localize bottlenecks in the organization's activities, which significantly reduces the likelihood of possible negative consequences. For a complete analysis, you need to know how the organization works as a whole, how it interacts with external enterprises, firms, and suppliers, and also how organized activities are at each workplace.

The IDEF0 graphical language is quite simple and harmonious. The functional block is graphically depicted as a rectangle and represents some specific function within the considered system [13, 14].

The second concept of the IDEF0 method is the interface arc (Arrow). Interface arcs are often referred to as flows or arrows. An interface arc represents a system element that is processed by a function block or that affects the function displayed by this function block.

The third basic concept of the IDEF0 standard is decomposition. The decomposition operation is used to break down a complex process into its functions. In this case, the level of detail of the process is determined specifically by the developer of the model.

The IDEF0 model always begins with the representation of the system as a whole - one functional block with interface arcs that go beyond the considered area. Such a diagram with one functional block is called a context diagram and is denoted by the identifier P0.

#### 3.2 The basic conditions for the development of a functional model in the framework of our study

The basic conditions for the development of a functional model in the framework of our study are presented in Figure 1.

The visibility of the IDEF0 graphic language makes the model fully readable for people who did not participate in the project of its creation, as well as effective for demonstrations and presentations. In the future, taking into account the constructed model, new projects can be organized aimed at making changes to the engineering enterprise (in the planning system).

This method was actively used to form the development of enterprise security. For example, Kryshchanovych et al. [3] ensure the security potential or Sylkin et al. [16] ensure the effectiveness of anti-crisis management within the framework of financial security. Thus, both for safety and for the control system, scientists see expediency in it.

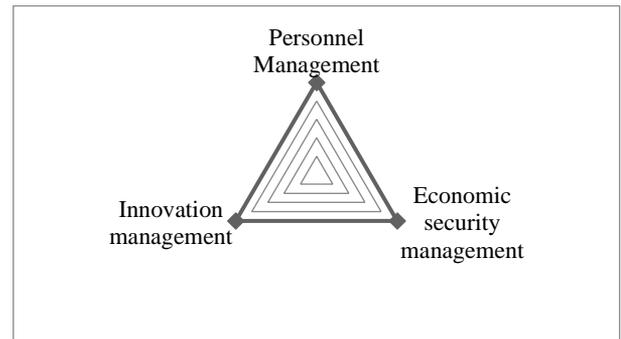
One of these methods of functional modeling is the DFD method, however, its use does not imply the identification of key paths in such a way that the so-called feedback can be established. Thanks to the IDEF0 method, we can do this in such a way that each of the presented stages showed feedback.

### 4. RESULTS OF RESEARCH

It should be noted that the engineering sector occupies a

significant share in the international arena. Every year, the engineering sector is only expanding and the number of enterprises providing engineering services is only growing. In general, as a result of the analysis, we found that the three priority areas of management in engineering enterprises are: management of economic security; personnel management; innovation management (Figure 2).

Thus, the goal set by us in the form of P0 "Planning for personal management in conditions of ensuring economic security" is relevant for enterprise engineering. Its achievement involves the implementation of the following stages, presented in Figure 3.



**Figure 2.** The triangle of priority areas of engineering enterprise management (Formed by the authors)

Let us characterize in detail all the elements of the context diagram of achievement P0 "Planning the information systems for personal management in conditions of ensuring economic security":

C1. Legislative acts and normative documents. Restrictive and guiding information. Legislative and by-laws; Documentary support of the economic security system in the context of the transition to Industry 5.0.

C2. Information from interested organizations and individuals. Control information. Comments, recommendations, and requests received from other business entities and consumers, public authorities, aimed at ensuring personnel management at a sufficient level.

I1. Financial and material resources. Restrictive and descriptive information. Means of production and means are necessary to ensure the functioning at a sufficient level. It is clear that if the system is insufficiently provided with appropriate resources for the functioning of the system, it may not fulfill the tasks assigned to it in full.

I2. Security information content. Descriptive information. Information characterizes the state of the subject itself, whose economic security must be ensured, and the external environment of its functioning. Such information is the result of a separate process carried out simultaneously or in parallel with the provision of the functioning of personnel management.

M1. Organizational and technical means. A set of ways and means of influencing personnel, as well as personal computers, software, and general-purpose stationery.

M2. Decision makers. Plant engineering manager or employee(s) responsible for ensuring safety and maintaining it at an appropriate level during the transition to Industry 5.0 standards.

O1. Information about the level of economic security. Descriptive information. Information that is the result of ensuring the functioning of management, on the basis of which it is possible to assess the state of economic security of

engineering enterprise during the transition to Industry 5.0 standards.

O2. Proposals for the implementation of protective measures. Descriptive information. Proposals are based on a specific strategy and tactics for ensuring economic security, and engineering enterprise in the transition to Industry 5.0 standards (Figure 4).

Thus, we will consider in detail the proposed processes for achieving P0 "Planning the information systems for personnel management in conditions of ensuring economic security":

P1. Planning the operation of personnel management. Covers the determination of the level of security based on an assessment of the effectiveness of the implementation of protective measures against certain key risks and threats, followed by monitoring the results of personnel management. During this stage, the employee (employees) responsible for ensuring economic security and maintaining it at an appropriate level generates information about the level of personnel management engineering enterprise, the head of the enterprise, taking into account feedback from other subprocesses, develops directives for managing them. The effectiveness of the organization at this stage, information, and resource support determines the results of the entire process.

P2. Analyze the characteristics of personnel management. The employee (employees), responsible for ensuring the functioning and maintaining its proper level, collects and accumulates information about the features of personnel management engineering of the enterprise, analyzes the dynamics of the main indicators of its activity, an attempt is made to identify long-term trends in the development of the enterprise, namely its: financial condition, personnel, investment, and innovation policy. The information obtained about the functioning of a business entity and the dynamics of the main indicators of its activity and the forecast of their changes in the future allows us to determine the fullest possible set of internal threats to economic security. The result of work at this stage is generalized information that characterizes the environment for the functioning of the engineering enterprise, which, in turn, allows for determining the degree of influence of the elements of Industry 5.0 on economic security.

P3. Study changes during the transition to Industry 5.0. The head of the engineering enterprise, together with the employee (employees) responsible for ensuring economic security and maintaining its appropriate level, assesses the development trends of the national economy in terms of the activities of this engineering enterprise, as well as regional aspects of the development of this business and determines the nature and level of interaction of the studied subject with the subjects of the external environment during the transition to Industry 5.0.

In other words, at this stage, information about the aspects of Industry 5.0 is collected and accumulated, and the place and role of the studied subject of engineering activity among other enterprises of the industry and objects of higher order are determined. The information obtained about the impact of Industry 5.0 on the functioning of the subject of engineering activity on its economic security becomes the basis for obtaining a list of external threats.

The result of the work at this stage is generalized information about the impact of Industry 5.0 on the process under study, which, in turn, allows, if necessary, to determine the degree of their impact on the management system.

P4. Establish planned benchmarks. Based on the data obtained at the previous stages, the head of the engineering enterprise determines the goal and plans to set tasks, then the employee (employees) responsible for ensuring economic security and maintaining its appropriate level during the transition to Industry 5.0 standards develops a methodology for evaluating and criteria for evaluating the effectiveness of the actions of subjects of economic security are formed. During this stage, the company's engineering workers develop indicators, the achievement of which should indicate the required level. Established planning targets should, if possible, be more clearly defined to make it easier to talk about the extent to which they have been achieved.

P5. Formation of the foundations of the functioning of personnel management. The formation of the foundations for the functioning of personnel management covers the justification by the employee (employees), which is responsible for ensuring economic security and maintaining it at the proper level, and consumers, representatives of other business entities, and public authorities whose activities include economic crimes and the security of the owner's subjects, functions and the principles of the system, the definition of objects and subjects of security, the development of a mechanism for achieving the necessary goals and the coordination of the process of ensuring security with the engineering of activities. During this stage, the head of an engineering enterprise evaluates the adequacy of such proposals according to the proposed strategy and tactics. It should be noted that when forming plans to ensure the functioning of personnel management, the head of the engineering enterprise can put forward new proposals that have not been considered before. That is, the combination of the experience of the head of the enterprise and the proposals of employees and consumers, representatives of other economic entities, and public authorities makes it possible to most fully take into account all aspects of the problem that needs to be solved (Figure 5).

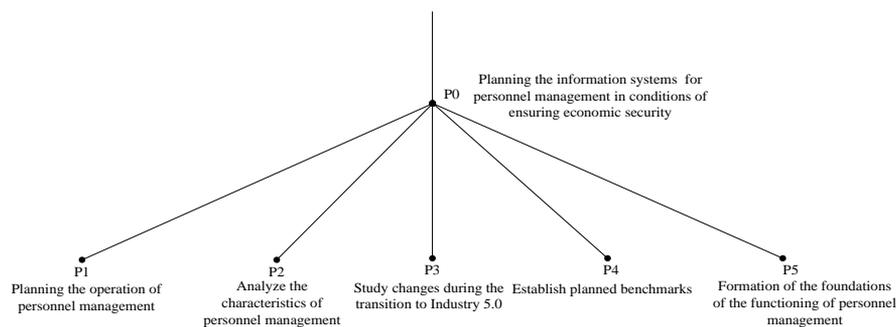
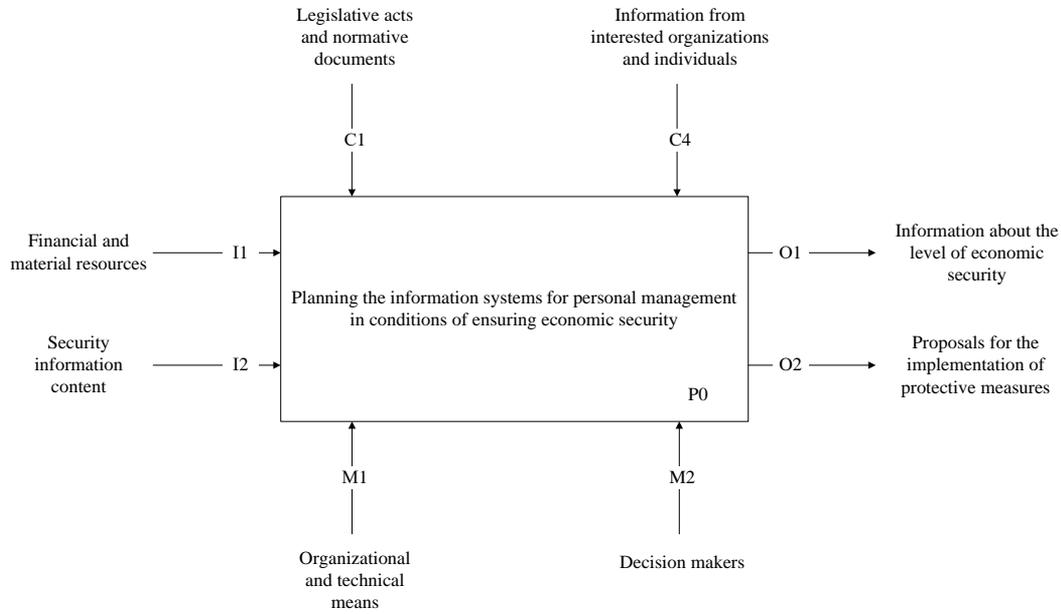
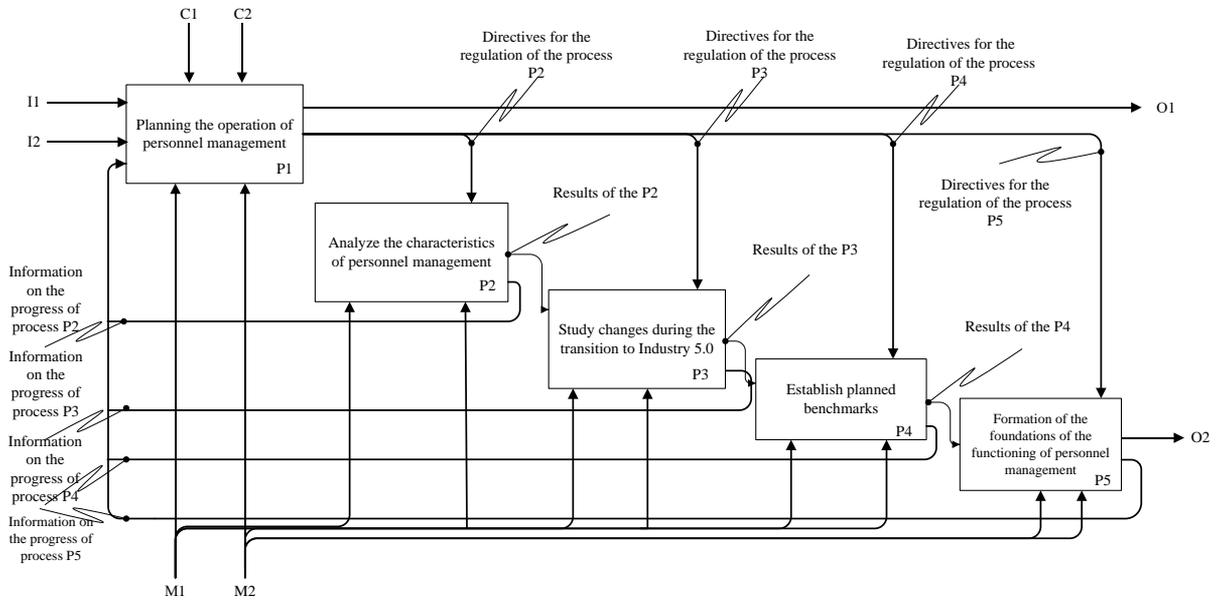


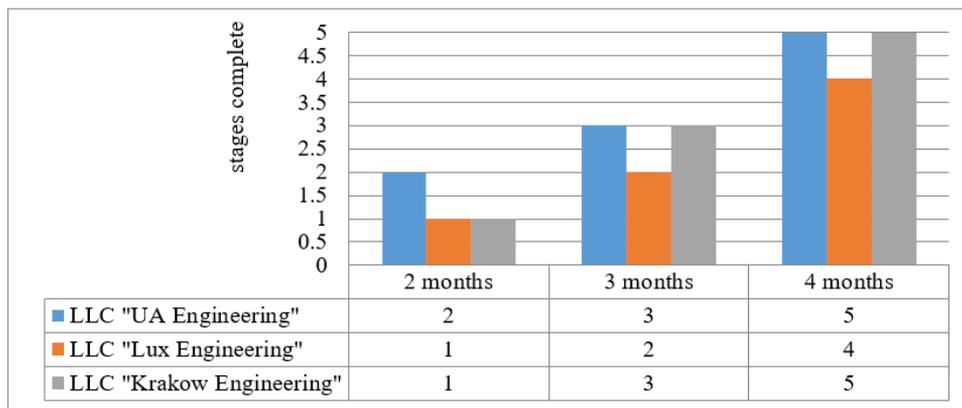
Figure 3. The triangle of priority areas of engineering enterprise management (Formed by the authors)



**Figure 4.** The context diagram of achievement P0 "Planning the information systems for personal management in conditions of ensuring economic security" (Formed by the authors)



**Figure 5.** Decomposition of modeling results (Formed by the authors)



**Figure 6.** Dynamics of completed stages according to the proposed model (Formed by the authors)

Our model was applied in the practice of three enterprises providing engineering services: LLC "UA Engineering"; LLC "Lux Engineering"; LLC "Krakow Engineering" (Figure 6).

The application took place in several stages: to begin acquaintance with the model of managers; presentation of all its aspects; proof of the model for the staff and the implementation of each of the stages.

In the 4-month observation period, the selected engineering enterprises demonstrated that it is possible to complete almost all stages of the proposed model.

## 5. DISCUSSIONS

Discussing the results of the study, you should compare them with similar and previous ones. Kohnová et al. [17] and Nwaiwu et al. [18] have shown that an equally important factor in successful engineering activities is the structure and quality of the personnel directly creating products, repairing equipment, and ensuring the conditions for a normal production process. Personnel qualification characterizes the complexity of labor and its quality and is a set of relevant knowledge and practical skills that determine the degree of readiness of the worker to perform professional functions of the appropriate complexity.

Al Azzam [19] and Iskajyan et al. [20], concluded that special attention in the process of personnel management is paid to the recruitment process, which includes the study of the professional and psychological qualities of employees to establish suitability for the performance of duties in a particular position or workplace, taking into account the correspondence of the specialty, qualifications, personal qualities and abilities to the interests of the socio-economic system.

Also, in the course of the study [21], some scientists found that in most engineering enterprises there is no system of measures to improve professional competencies and staff qualifications in the context of using information systems. Passing refresher courses in the organization is the prerogative of the employees themselves. This is explained by the lack of financial opportunities for such measures, although the responsibility for financing vocational training also lies with the employer.

The degree of professional development of personnel is a determining factor in the effective functioning of the organization. To ensure competitive advantages in the market in today's conditions of rapid aging of knowledge, and practical skills, organizations need to provide continuous professional development of staff. Therefore, the management of professional development of personnel becomes relevant for engineering enterprises [22].

However, in discussing our research results, attention should be paid to the fact that we went the other way and presented the entire process of personnel management planning in the economic security system in the form of functional process modeling, taking into account the aspects of the transition to Industry 5.0 and modern informational systems. The novelty lies in the proposed methodological approach and certain processes that allow us to determine the ways of forming the information systems for personnel management during the transition of economic security to Industry 5.0.

## 6. CONCLUSIONS

In the last century, there has been a significant and profound transformation of the concepts of personnel management information systems, the successive change of which led to the transition to the real Industry 5.0. The emergence of management planning paradigms is closely related to the realities and requirements of life in a given period, taking into account the developments of different trends, schools, and directions. The vector of movement of the personnel management information systems paradigm from technocratic to humanistic is traced, the fundamental difference between which is the assessment of the role of a person in the organization and understanding of the nature of the socio-economic system. The transformation and development of paradigms and concepts of personnel management information systems take place taking into account the experience gained, modernized under the influence of scientific and technological progress. In conclusion, today human capital management planning is considered as an independent area of enterprise management that provides engineering services. Summing up, we note that in accordance with the existing developments in the field of enterprise management planning, a number of aspects have not yet been disclosed, especially when it comes to modeling.

Some stages presented in the model are in the nature of a humanistic paradigm and this should be taken into account, in our opinion, always in personnel management. An engineering enterprise is a socio-economic system that cannot survive on a technocratic system alone.

The personnel management information systems that have developed in most engineering enterprises are imperfect, ineffective, outdated, and do not meet the requirements of the time, requiring large-scale modeling and reforms. As a result, there is low labor productivity, significant staff turnover, and an unhealthy psychological climate in teams. A significant part of the urgent problems of engineering enterprises related to personnel management planning that needs to be addressed relates precisely to the formation of a system of economic security.

As a result of the study, a model of information systems of personnel management planning was presented in graphical form during the transition of the economic security of an organization providing engineering services to the conditions of Industry 5.0. The article has its limitations; in the process of research, the methodological approach was used exclusively for information systems and the information basis of the personnel management process. In the future, our research will be directed to a greater variety of processes in the activity of the socio-economic system during the transition of economic security to Industry 5.0.

Also, it should be noted that limitations were used and exploited in the research methods. The fact is that we were dealing with the definition of transformation paths, and not the database. In this case, not all modeling methods were suitable. As for specific actions, in our opinion, enterprises should integrate the proposed model into their own personnel management system, which will allow information support.

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