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PROJECT IMPLEMENTATION OF CORPORATE INFORMATION SYSTEMS (ERP AND MES) AS A GUARANTEE FOR INCREASING THE OPERATIONAL EFFICIENCY OF THE ENTERPRISE

Statement of the problem. A modern company, whose priority is to maintain a competitive position, should have an effective system of automated management. A key component of such a system is corporate information systems (ERP and MES), which ensure the integrity, accuracy, and speed of data exchange between all company departments. In complex conditions of modern production, the implementation of ERP (Enterprise Resource Planning) and MES (Manufacturing Execution System) guarantees an increase in the company's operational efficiency.

ERP, as a modern integrated enterprise management system, includes management of finance, personnel, logistics, production, and other functional areas. MES is used for production planning and control. The systems interact with each other and with other enterprise systems, automating important business processes, simplifying management, and ensuring high data accuracy. First and foremost, the implementation of ERP and MES allows for data and information unity across different departments of the company. This means that all levels of management have access to the same information about the company's activities, making decision-making processes faster and more effective. In addition, ERP and MES provide automation of many company processes, reducing the amount of manual work and errors. As international and domestic experience shows, the implementation of IT projects for enterprise resource planning (MES and ERP systems) is a guarantee of successful digital transformation of modern business.

Therefore, for the further revival of the Ukrainian industrial complex as a driver of the post-war national economy, the issue of finding opportunities for implementing cost-effective production and operational efficiency projects, digital transformation programs, and resource planning, namely MES and ERP systems, becomes relevant even in complex wartime conditions.

Analysis of the latest researches and publications. Attention has been given to the issue of implementing corporate information systems, including MES and ERP levels, in the works of foreign experts, among whom Bill Baumann [1; 2], Jutta B.-Schrötgens, Angelika Reich, Bill Schaninger, Kartik Sharma [3], Tim Heston [6], as well as domestic scientists, including V. Yevdokimova [7], N. Orlova [8], L. Riznichenko [9], Rybalko [10], and others [11-12]. Experts indicate the need to implement corporate information systems as a tool to ensure competitiveness and efficiency of enterprises. Information systems, by performing functions such as grouping, systematization, processing, and analysis of data, help to successfully implement corporate management functions in enterprises and control information flows [11], which is a necessary condition for making timely informed strategic decisions.

The relevance of implementing ERP systems is driven by the advantages that the enterprise obtains by increasing operational efficiency and transforming business processes. However, in times of war, the urgent problem is the financing of projects and programs for implementing corporate information systems (ERP and MES), as well as difficulties associated with personnel training.

The goal of this article is to investigate the conditions and advantages of implementing corporate information systems (ERP and MES) to ensure operational efficiency of Ukrainian industrial enterprises.

Main results of the research. The ERP system consists of integrated business modules, which are oriented towards a specific business area, but all of them interact with each other, working using the same data to satisfy the company's needs. The ERP system usually includes modules for managing all processes throughout the entire material flow chain, from the procurement of necessary resources to the realization of finished

products, as well as for financial management based on accounting and managerial accounting, HR management, fixed and current assets of the enterprise. Companies can choose the modules they need during implementation, add additional ones through extensions for applications, which can easily be integrated into the selected package [1-3].

Thanks to the implementation of IT resource planning projects, enterprises can optimize and automate basic business processes, helping every company employee increase productivity and achieve greater results with fewer resource costs; conditions are created for a more complete understanding of the situation and maneuverability through the organization of a single source of reliable information and the ability to respond quickly to changes, new prospects, and risks; information processing and report creation processes are accelerated based on accurate analytical data in real-time; and conditions are created to increase the transparency and reliability of the business, as well as forecasting and preventing risks [1-3].

Modern flexible ERP systems support a wide range of business functions, but they require interaction and synchronization with other applications and data sources, as well as timely system verification [1]. IT industry representatives [2] emphasize that "implementing and verifying an ERP system is not the only way to prevent ERP failures, but it is one of the most important" [2].

Analysis of scientific literature, research, and recommendations from foreign experts in the IT field [2-4] indicates the importance of monitoring the implementation of ERP systems. When an enterprise tries to implement a new ERP system, it is important to ensure that the system meets the specific requirements and demands of the enterprise and its specific business processes, meets the needs, and automates (can automate) the already optimally configured business processes.

On the path to digital transformation, a successful experience of foreign companies in implementing ERP systems will be of interest to Ukrainian businesses. Generalization of works [2-4] allows for the following algorithm of actions for the implementation of ERP systems:

1. Identify the problems of the enterprise, establish requirements for improvement and optimization of business processes through their reengineering, requirements for improving productivity and business efficiency through the implementation of ERP systems.

2. Provide experts in ERP system implementation with all necessary data on (existing) business processes for their timely processing, consideration, and feedback provision, as well as for interaction between experts and responsible employees.

3. Ensure a thorough process of selecting a reliable supplier of ERP system software, other digital technologies, and artificial intelligence, with a demand to ask questions, seek help in servicing (at least at the initial stages), and make adjustments due to the rethinking of enterprise processes and new challenges (if the enterprise engages outside experts).

4. Optimize and automate business processes with ERP, implement appropriate security measures, such as encryption and secure data storage.

5. Ensure training for employees.

In the ERP systems market, the following 10 flagships can now be distinguished (Fig. 1):

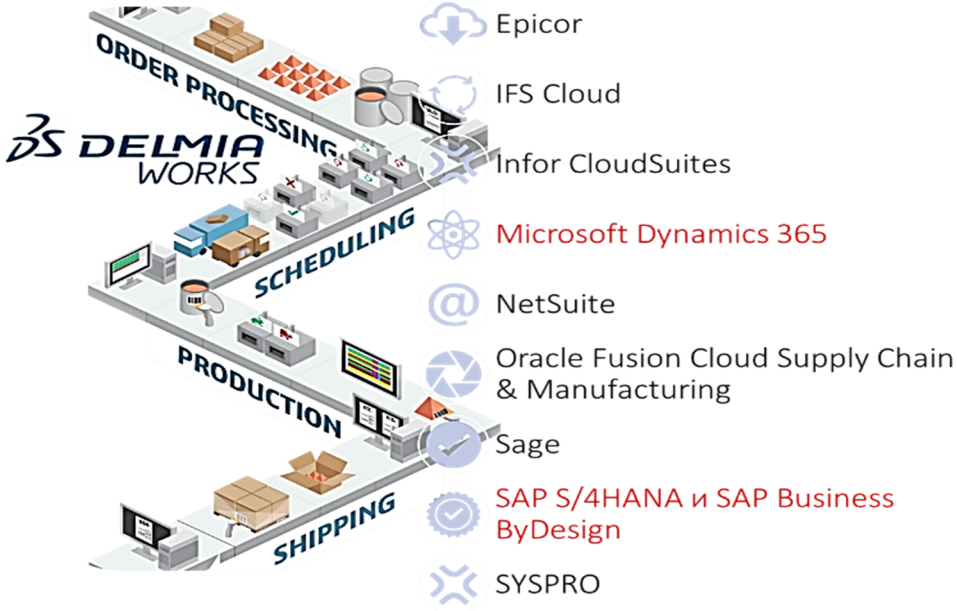

Fig. 1. Top 10 ERP systems in the world as of 2022-2023

Source: according to "Panorama-Consulting Group" company, URL: https://www.panorama-consulting.com/top-10-erp-software/.

From the popular ERP systems presented in the figure, it is worth highlighting the product DELMIAWorks, which is a "comprehensive production ERP system and manufacturing execution system (MES) designed for medium-sized manufacturers, oriented towards both discrete and batch production processes" [5].

Microsoft Dynamics 365 and SAP have a significant presence among the listed ERP systems in the Ukrainian market. In Ukraine, SAP is usually presented in the SAP ECC version (a local system), and the SAP company is interested in migrating all clients to SAP S/4HANA (cloud system). It is worth noting that the choice of MES and ERP systems (besides functional advantages) depends on the cost and complexity of the systems (in terms of configuration to fit the company's business processes and user adoption). The cost of the systems is influenced, at least, by the company's scale, business process structure, number of users, and the need for additional customization of the basic software version.

Usually, the implementation of MES requires more financial resources because it is associated with the procurement of related technical equipment for equipment management, diagnostics, etc. However, there are many advantages to such an implementation (Fig. 2).

Fig. 2. Advantages of implementing MES [12]

If the implementation of MES allows a company to efficiently manage its current production activities, reducing production costs and increasing labor productivity, then ERP systems are primarily focused on solving financial, economic, and management tasks [12]. In addition, MES serves as a link between the ACS TP (automated control systems for technological processes) and the ERP system (Figure 3).

Fig. 3. "ERP-MES-SCADA" Chain ACS TP

Source: constructed by the authors.

Analysis of scientific papers and analytical materials [2-4 and others] allows us to state that from the perspective of effective business process management and project management, the implementation of an ERP system may involve the following stages:

1. Defining the functional requirements of the ERP system that are needed by the business.

2. Defining the functional characteristics of the requirements. This stage is associated with a higher level of detail in the functional specification of system expectations.

3. Conducting a gap analysis between what the ERP system is needed for and what it is capable of doing. This gap analysis documents and identifies organizational risk priorities based on system deficiencies. For all gaps with high risk in the enterprise, plans and procedures must be in place to mitigate these vulnerabilities and optimize team productivity.

4. Determine and agree on the protocol for the installation of the ERP system, which describes the staff's algorithm of actions and includes equipment characteristics, installation instructions, software verification documentation, and so on.

5. Create a report on the installation of the ERP system for possible internal review (testing).

6. Define a protocol for testing software components, which should include, for example, special testing procedures, datasets for different testing procedures, objectives and expected results, and evaluation criteria for accepting the results. Based on such a protocol, a test report is prepared that answers questions such as: how well did the team adhere to the testing procedures? Are the results acceptable? Were there any irregular or unexpected results?

7. Determine the date and procedure for launching (putting into industrial operation) the ERP system, ensure training of users, data input and processing, their authorization, documenting changes, and establishing a procedure for their approval before implementation.

8. Maintain the functionality of the ERP system by establishing standard operational procedures for processing system changes and updates.

9. Conduct an external audit of the ERP system if necessary to ensure its reliable compliance with business needs.

When conducting an internal audit of an ERP system according to the recommendations of foreign experts [2], it is necessary to provide answers to the following main questions:

1. Is the ERP system configured for successful execution of processes documented by the company and regulated by the industry?

2. Is the ERP system functioning properly?

3. Are there procedural controls to ensure the accuracy and compliance of the ERP system with requirements?

4. Have all employees been trained to use the system?

Despite the difficult process of implementing an ERP system, according to research data [1], the enterprise receives significant benefits associated with improving operational efficiency and transforming business processes (Figure 4): from increasing productivity to ensuring simplicity, transparency, flexibility of processes, reducing risks, improving document management, and other advantages.

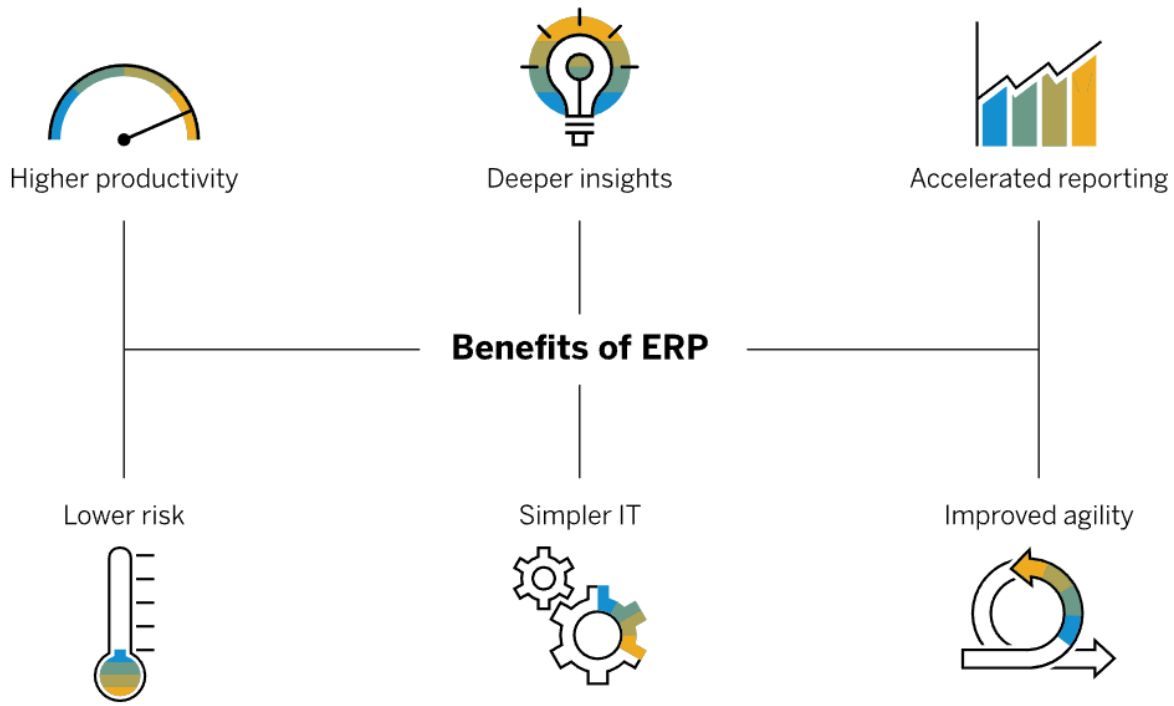

Fig. 4. Benefits of implementing ERP system projects [1]

Addressing the final question requires additional motivation for personnel, because quality work of an employee who participates in a particular business process with the system is possible with a conceptual understanding of the need for ERP system implementation and the significance of the results it provides.

According to the conclusions of foreign experts [3], many companies are currently facing a serious shortage of personnel skills development. Interestingly, the most prioritized skills for companies are leadership and management, critical thinking and decision making, as well as project management. The authors of the study [3] emphasize that companies need to prepare their employees for the future, where new skills that are constantly evolving are a necessity, and continuous learning is the key to competitiveness in the job market.

All of this is related to the rapid changes in the automation processes of production, and the global digitization of all business processes.

According to the General Director of "The MPI Group" in Cleveland, USA, rapid changes are currently being observed in all areas of business, especially in manufacturing, which have not been seen for decades. Over the next 10 years, we can expect to see the emergence of a digital disruption in manufacturing. There will be those who invest now and move forward, and there will be those who do not and will be left behind [6]. Priorities have changed, and now to improve operational efficiency, it is necessary not only to learn more about the company's processes and connect the dots to improve and move these processes in new directions, but also to have the necessary information at the right time [6], which is possible with the effective implementation of systems such as MES and ERP.

Indeed, the process of implementing MES and ERP systems is labor-intensive and expensive, requiring clear regulation, deep rethinking of business processes, and quality personnel training. However, the enterprise undoubtedly benefits from the significant advantages associated with improving operational efficiency and transforming business processes since ERP and MES can be used to manage all aspects of business, including production, logistics, sales, and finance. ERP and MES, as key components of corporate information systems (CIS), help enterprises automate processes and ensure high data accuracy, which contributes to the increased efficiency of their operations.

Conclusions and prospects of further researches. Therefore, corporate information systems (CIS) play an important role in the successful functioning of enterprises, as they provide convenient resource management, reduce costs for production and management processes, improve product quality, and increase overall operational efficiency. The advantages of implementing CIS systems in enterprises are due to the fact that these systems (ERP and MES) meet all the requirements of effective management, as ERP allows managing business processes in one centralized system, provides the company's management with data necessary for making strategic decisions, and reduces management costs by minimizing manual work and error correction, while MES provides information support for production processes. With the help of the MES system, it is possible to automatically control various stages of production, from raw material input to finished product shipment. This reduces the number of errors and increases the speed of task execution.

ERP and MES help enterprises ensure data and information unity between different departments. This means that all management levels have access to the same information about the enterprise's activities, making the decision-making process fast and efficient. For example, with ERP, it is possible to collect data on finances, personnel, logistics, and production in one system, simplifying the planning and decision-making process.

In addition, ERP and MES provide enterprises with the ability to prioritize tasks and control their execution. For example, with the help of the MES system, it is possible to determine the time required to complete a particular task and distribute it among workers according to their skills and abilities.

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Шевченко Н. Ю., Мойсеєнко К. Є., Латишева О. В. Проєктне впровадження корпоративних інформаційних систем (ERP та MES) як гарантія підвищення операційної ефективності підприємства

У статті досліджено особливості проєктного впровадження корпоративних інформаційних систем, таких як ERP (Enterprise Resource Planning) та MES (Manufacturing execution system). Встановлено, що впровадження корпоративних інформаційних систем (ERP та MES) є гарантією підвищення операційної ефективності підприємства, оскільки дозволяє автоматизувати багато процесів на підприємстві. З'ясовано, що система MES дозволяє контролювати різні етапи виробництва, починаючи від входу сировини і закінчуючи відвантаженням готової продукції, що знижує кількість помилок та підвищує швидкість виконання завдань. Встановлено, що ERP та MES допомагають забезпечити єдність даних та інформації між різними департаментами, що дозволяє всім рівням управління мати доступ до однакової інформації про діяльність підприємства, тим самим роблячи процес прийняття рішень швидким та ефективним. Визначено, що ERP дозволяє збирати дані про фінанси, кадри, логістику та виробництво в одній системі, що спрощує процес планування та прийняття рішень. Сформульовано, що за допомогою системи MES можна визначити час, необхідний для виконання певного завдання та розподілити його між робітниками відповідно до їхніх навичок та здібностей. Доведено, що ERP та MES дозволяють підприємствам визначати пріоритетність завдань та контролювати їх виконання, допомагають підприємствам автоматизувати процеси, покращувати якість та швидкість виконання завдань, забезпечувати єдність даних та інформації між різними департаментами, та контролювати виконання завдань.

Ключові слова: проєкт, операційна ефективність, корпоративні інформаційні системи, ERP (Enterprise Resource Planning), MES (Manufacturing execution system).

Shevchenko N., Moiseienko K., Latysheva O. Project Implementation of Corporate Information Systems (ERP and MES) as a Guarantee for Increasing the Operational Efficiency of the Enterprise

This article delves into the intricacies of implementing corporate information systems, such as Enterprise Resource Planning (ERP) and Manufacturing Execution System (MES). It has been established that the implementation of ERP and MES ensures increased operational efficiency of the enterprise by automating various processes. Additionally, the MES system controls multiple production stages, from raw material input to finished product shipment, thereby reducing errors and increasing task execution speed. ERP and MES also facilitate data and information consistency between different departments, providing all levels of management access to the same company information, streamlining the decision-making process. Furthermore, ERP allows for the collection of data on finance, personnel, logistics, and production in one system, making the planning and decision-making process simpler. The MES system can be used to determine task execution time and distribute it among workers based on their skills and abilities. Lastly, ERP and MES enable companies to prioritize tasks, control their execution, automate processes, improve task execution quality and speed, and ensure data and information consistency between different departments. The article discusses the importance of corporate information systems (CIS) in modern companies with a priority of maintaining a competitive position. The key components of such a system are enterprise resource planning (ERP) and manufacturing execution systems (MES), which ensure the integrity, accuracy, and speed of data exchange between all company units. Implementing ERP and MES is a guarantee of increasing the company's operational efficiency in complex production conditions. CIS help companies ensure data and information unity between different departments, enabling quick and efficient decision-making processes.

Keywords: project, operational efficiency, corporate information systems, Enterprise Resource Planning (ERP), Manufacturing Execution System (MES).

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