ISSN 1507-3858
e-ISSN 2450-0003

Tomasz Turek
Czestochowa University of Technology
e-mail: tomasz.turek@wz.pcz.pl
ORCID: 0000-0002-6946-6998

Damian Dziembek
Czestochowa University of Technology
e-mail: damian.dziembek@wz.pcz.pl
ORCID: 0000-0003-0006-703X

THE ERP PROCESS SYSTEM AS A DIRECTION OF THE EVOLUTION OF INTEGRATED MANAGEMENT INFORMATION SYSTEMS

PROCESOWY SYSTEM ERP JAKO KIERUNEK EWOLUCJI ZINTEGROWANYCH SYSTEMÓW INFORMATYCZNYCH ZARZĄDZANIA

DOI: 10.15611/ie.2018.3.10
JEL Classification: M1, M15

Summary: The article attempts to indicate the direction of ERP class information systems development. From the beginning, these systems have been changing and evolving. Along with the development of requirements and changes on the market, solutions known as ERP II and ERP III were created. Currently, these systems use a process approach. Three basic types of systems can be distinguished: ERP systems supporting processes, process-oriented ERP systems and process ERP systems. The considerations in the article are based on the Macrologic Merit ERP system, which not only supports processes, has a built-in modeler but also allows full service of processes in the system. The applied approach allows for the effective process management, analysis and improvement.

Keywords: ERP, process oriented ERP, management information systems.

Streszczenie: W artykule podjęto próbę wskazania kierunku rozwoju zintegrowanych systemów informatycznych zarządzania klasy ERP. Systemy ERP są rozwijane i doskonalone od wielu lat, w efekcie czego powstawały m.in. takie rozwiązania, jak ERP II i ERP III. Jednym z kierunków ewolucji systemów klasy ERP jest coraz większe uwzględnianie w jego strukturze i zasadach funkcjonowania podejścia procesowego. Ze względu na wsparcie podejścia procesowego w przedsiębiorstwach systemy ERP można podzielić na: systemy ERP wspierające procesy, systemy ERP zorientowane na porcesy i procesowe systemy ERP. Główną cechą procesowych systemów ERP jest możliwość tworzenia, modelowania i optymalizacji procesów bezpośrednio w systemie ERP bez konieczności stosowania zewnętrznych aplikacji

typu BPMS. W artykule zaprezentowano system ERP Macrologic Merit, który oprócz wspomagania procesów ma wbudowany modeler procesów oraz pozwala na pełną obsługę ogółu procesów realizowanych w organizacji. Zastosowanie podejścia procesowego w systemach klasy ERP umożliwia efektywne zarządzanie, analizę i doskonalenie procesów realizowanych w organizacjach.

Słowa kluczowe: ERP, procesowe systemy ERP, systemy informatyczne zarządzania.

1. Introduction

Modern enterprises, regardless of their size and industry, are increasingly using different types of IT systems. The progressing computerization results mainly from the role and significance of information necessary to make the right decisions in management and constant search by management for tools and methods that automate, integrate and improve business processes in enterprises. The integrated ERP IT systems play a significant role in supporting enterprises. Suppliers of ERP systems who want to stand out on the market are constantly developing their products taking into account different management methods and concepts.

One of the directions of the evolution of ERP systems is the increasing attention to the paradigm of the process approach in its structure and principles. In recent years, a new model of integrated information management systems appeared, referred to as a process ERP system. The aim of the article is to characterize and present the most important features of the ERP process system. In addition, the goal of the paper is to present an example of the ERP process system offered by a Polish supplier. In order to achieve the set goals, the process of evolution of ERP systems was approximated.

The research method used in the article is the analysis of the functioning of selected ERP systems. The paper focuses on the practical implementation of business processes in the information system. In the first example the ERP system does not have a built-in tool for modeling business processes. For this reason, modelling (if necessary) takes place in an external application. In the second case, modelling takes place directly in the ERP system. As a result, process models directly determine the way they are implemented by users.

2. Evolution of ERP systems

The complexity, unpredictability and dynamics of the modern business environment and the pursuit of the automation of business processes and the improvement of internal and external flows of information resources determine the use of various IT solutions in enterprises. One of the most important IT tools affecting the improvement of management processes and the improvement of the company's results are integrated ERP systems. This class of information systems has the ability to support and integrate almost all areas of company activity (e.g. trade, logistics, production,

personnel and payroll, accounting and finance, customer service, etc.) and significant support of management at various levels of management in reporting, monitoring and analysis of business processes. Various built-in or predefined reports in ERP systems provide the management with the necessary information describing the current state of company and making it easier to make rational decisions.

Generally, the ERP systems are understood as a modular (or component) organized IT system with a significant level of substantive and technological advancement, serving most or all spheres of economic activity, whose main task is to support the organization management processes (see: [Addo-Tenkorang, Helo 2011; Maditinos et al. 2011]).

The module-component construction of integrated management information systems enables the implementation of these domains, which are necessary due to the nature of the enterprise and the specificity of its operations, in stages (see also: [Matende, Ogao 2013]). ERP class systems have a separate, central database, which is the main component ensuring the proper functioning (up-todate and reliable data) and interoperability of individual modules creating an integrated IT system. In general, ERP class systems, through the aggregation and processing of information resources through a variety of analytical methods − enable proper planning and control of business operations of enterprises (see more: [Dziembek 2014b]).

Initially, ERP class systems were dedicated to large enterprises conducting production activity. The first applications constituting the starting point for the development of ERP systems were IC (Inventory Control) programs. IC applications were created in the sixties of the last century with the introduction of computers for business applications, and their main task was to support decisions in the area of warehouse management of enterprises. Essentially, the development of ERP systems took place from MRP (Material Requirement Planning) systems, through MRP II (Manufacturing Resources Planning) production planning and distribution, to ERP (Enterprise Resource Planning) resource planning and its subsequent versions, i.e. ERP II and ERP III (concept) [Caserio, Trucco 2018, pp. 14-17]. The evolution of ERP class systems is shown in Figure 1. Initially, the goal of the MRP concept was to solve the problems of material preparation of production. Integrated business information systems created on the basis of the MRP idea planned the size of material stocks in order to ensure the optimal level of production in business organizations. At the same time, this system analysed the stocks of material stocks and determined their amount at such a level that the time of their storage was the shortest, while maintaining the continuity of production.

The next step was Closed Loop MRP, considering the planning of stocks and material deliveries in the closed loop of the production process. At a further stage of development, a standard referred to as MRP II was created. It was extended in relation to the original MRP by planning and controlling other factors of production (human, machine and monetary resources). As a result, the MRP II standard also included modules for production planning, business planning, inventory and supply

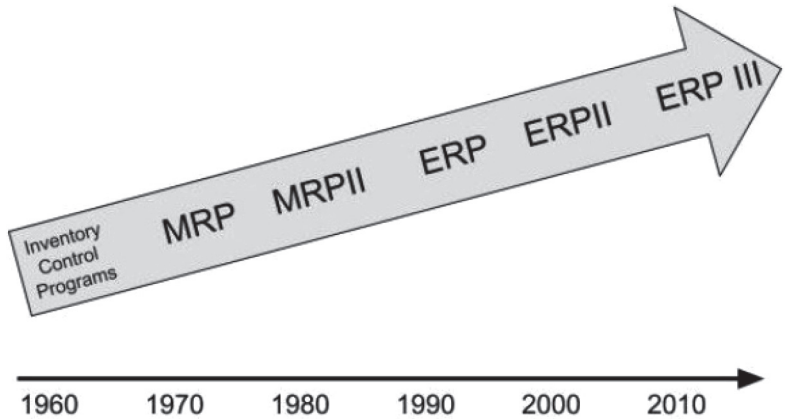

Fig. 1. Evolution of ERP class information systems

Source: own study.

management, demand management and sales. A precise description (and at the same time determination and consolidation) of MRP and MRP II standards was made by the American APICS association.

The following stage in the development of integrated business information systems was the ERP standard, which included the functionality of earlier standards, and in which virtually all areas of the company's operations were integrated, including supply, production and distribution processes, and areas such as accounting, finance, controlling, human resources management, quality management, document flow management, project management along with strategic management tools [Samara 2015, pp.10-12]. As a result, information flows have been streamlined and the ability to efficiently coordinate processes and quickly respond to opportunities and threats from within the company and its environment occurred. Currently, ERP systems have significantly extended functionality including, for example, Customer Relationship Management (CRM), project management, analytical tools (Business Intelligence), Supply Chain Management, and they can be implemented in enterprises with different business profiles.

A further development path resulted in the creation of another concept for this class of systems, i.e. systems referred to as ERP II [Albarakati 2015]. In this class of systems, it was particularly important to support the processes taking place between cooperating business entities, thanks to which it is possible to cooperate efficiently and fully (including inside and outside the organization) as well as integrate and optimize business processes using online technologies. Thus, the ERP II system penetrates beyond the boundaries of the enterprise, creating support for the exchange of data and information amongst cooperating parties interested in joint design, production and distribution of products.

The latest concept of the development of integrated business information systems launched since 2010 is ERP III. It assumes the extension of the existing ERP and ERP II to the actual as well as the potential client, who obtains the possibility of active participation in the implementation of the company's business processes. In addition, in the ERP III concept, the main role is played by mobile technologies that take into account the needs of today's users and employees of the enterprise as well as openness and construction consistent with SOA (Service Oriented Architecture) architecture, where the main pressure in creating IT solutions is put on defining services that they meet, even the most sophisticated user demands. The system compliant with the ERP II concept also uses the Internet technologies (e.g. analytical search engines), social media and various on-line communication tools, which together make it a solution enabling the functioning of the enterprise according to the virtual model. Through collaboration, direct contact, social media, and ERP III integrate marketplace. ERP and ERPII organizations [Clegg, Wan 2013]. ERP III is assumed to use Grid and Cloud Computing technologies. (e.g. ERP as a Service), which enable sharing databases and storing them on multiple servers, which in effect allows to achieve better application performance for users. At present, IT systems suppliers do not yet have in their offer information systems referred to as ERP III, defining their products as ERP II systems with additional capabilities – Figure 2.

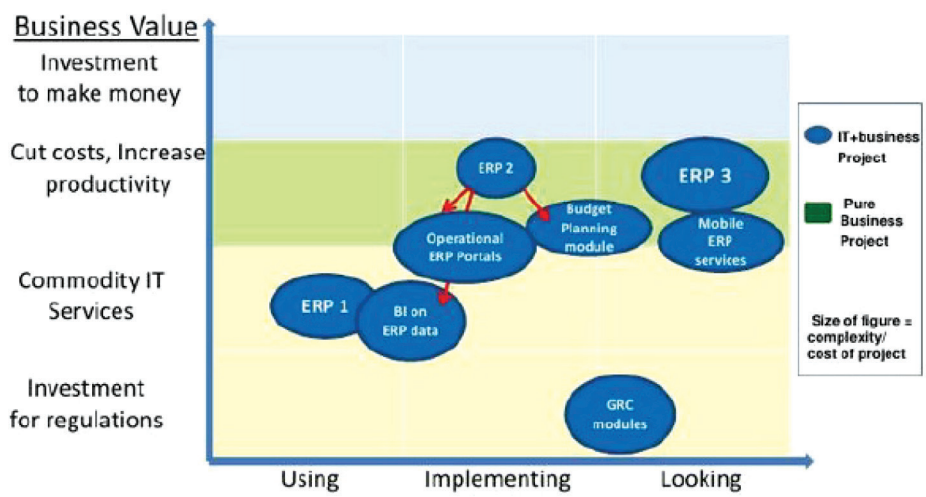

Fig. 2. ERP maturity model

Source: [Shimoni 2010].

In recent years, the ERP system model in the Open Source formula has been developing, where the software is available for free or for a small fee, while implementation services and support are paid. In this case, ERP systems are offered

in a similar way as server operating systems or web servers. Another option is to provide an ERP system in exchange for allowing ads to appear in it.

A popular trend is the use of ERP in the cloud computing model, especially for those users who value high flexibility and availability of data and services. In general, ERP systems can be offered in the form of services within the SaaS model or as standard licensed ERP systems used in the cloud. This second solution enables the use of ERP software without the need to have its own IT infrastructure and gives the opportunity to work remotely, while the software licenses are bought by the customer, not rented for a fixed period (as in the case of SaaS) (see also: [Dziembek 2014a]). ERP systems in the cloud are much easier to access for small and medium enterprises for financial reasons. Moreover, they are easier to implement and manage.

An important direction of development of ERP systems will be their integration with technologies such as Big Data, Internet of Thing and the solutions based on artificial intelligence or the mentioned mobile technologies − which will allow to collect, process and analyze data from both, internal and external sources and, consequently, facilitate decisions making processes in the company. These cloud computing-integrated technologies integrated with ERP systems will change the rules of communication and cooperation with clients, partners and suppliers, supporting the digital transformation of enterprises. However, it should be emphasized that a critical role in adapting to changes should be supported by enterprises that stand out from the competition, which are integral to properly selected and implemented IT technologies such as the ERP class system.

In ERP systems, the ability to support various types of processes has been playing a very significant role for years. Actions to improve ERP systems include both, improvement of decision-making processes, and better support of business processes. By dynamically planning, implementing and modifying processes in ERP systems, it is possible to improve operations and to react faster to emerging market changes. A strong focus on the processes implemented in the enterprise made it possible to create in ERP systems a standardized map of processes dedicated to particular industries and dedicated applications such as Workflow or BPMS (Business Process Management Systems). These applications enable the creation of organization process maps and modelling (graphical mapping) of processes. Most BPMS systems have simulation functions, thanks to which it is possible to predict future behaviour of the processes, after being implemented in the organization. Workflow or BPMS systems support the management of business processes in the company, facilitating their subsequent implementation in ERP systems. The dynamic creation and mapping of processes in a fixed notation (e.g. BPMN) in integrated management information systems creates an interesting direction of changes and the emergence of process ERP systems (see more: [Albanese 2017]).

3. Features of ERP process systems

The adoption of process orientation results from dynamic changes in the environment (e.g. globalization, increased competition, progress in IT), requiring the application of changed organizational and business management rules. Process orientation emphasizes the need for a comprehensive look at the processes implemented in an enterprise. In the process approach, it is necessary to undertake systematic actions for defining, modeling and improving the business processes. IT tools play an important role in supporting business process management, among which ERP occupies a special place.

Generally, due to the support of the process approach in enterprises, ERP systems can be divided into:

1. ERP systems supporting processes.
2. Process-oriented ERP systems.
3. Process ERP systems.

ERP systems supporting processes include integrated IT management systems in which there is a possibility of mapping processes in the form of related documents and data. This group of ERP systems usually operates on a shared dedicated database, which results in the fact that data and documents once entered can be visible and used by other system users (depending on the assigned rights). The entered data and generated documents reflecting the course of the business process cannot be freely modified and deleted in the ERP system. This results not only from the need to maintain the continuity of the business process but also from the risk of losing the integrity of database. In this group of ERP systems, processes can occur independently of modeled (or not modeled) organization of process maps and process models (no close relationship between the process model and its mapping in the ERP system). Maps and process models are usually created in other external applications not integrated with the ERP system (no data exchange module supporting communication between applications). Moreover, in this group of ERP systems, it is not possible to graphically reflect the process and conduct its in-depth analysis.

Process-oriented ERP systems extend the functionality of the previously distinguished group of systems by the ability to read modeled processes from external BPMS or workflow applications [Ziemba, Obłąk 2012]. Process-oriented ERP systems do not have the ability to analyze and optimize business processes. All activities in the field of graphic design, modeling and simulation are implemented in external applications (e.g. Aris Toolset for SAP, TM Workflow Comarch ERP XL).

Process ERP systems is a group of ERP systems that have been closely integrated with the process modeling tools. Process modeling takes place directly in the ERP system or in one of its modules. It should be emphasized that the modeled process, at the same time, determines the manner and form of its implementation in the ERP system. Therefore, there is no possibility that created maps and processes would

not be used in such an ERP system. What is more, the change in the process is automatically reflected in its course and implementation in the ERP system. The ERP process systems also go away from the rigid division into modules and functions. The most important features of strictly-process systems have the following properties:

- one application instead of modules,
- only these functions visible that result from the role of the user in the system,
- the ability to start processes, not functions,
- personalized (including the mobile available) desktop,
- visible tasks to be carried out,
- the possibility of modeling new processes adapted to the needs of the enterprise,
- sets of indicators for process analysis,
- graphical process analysis tools,
- possible analysis of process time,
- the ability to modify the already existing processes,
- tools for continuous improvement of processes,
- work in a transparent and ergonomic interface.

A synthetic approach to the differences between the ERP process systems and process-oriented systems is presented in Table 1.

Table 1. Differences between the ERP process systems and process-oriented systems

ERP systems	
Process support or process-oriented ERP systems	**ERP process systems**
Modules	processes
Starting functions	starting processes
Modeling processes using additional tools	direct modeling of processes in the ERP system
Analysis of processes in the ERP system is difficult	full and immediate ability to analyze processes
Indirect improvement of processes in the ERP system	the ability to directly improve processes in the ERP system
Process improvement in the ERP system is often based on intuition	process improvement based on quantitative indicators
Users of ERP systems may have problems with identifying their role in the organization and process	users know their role in the organization and process

Source: own study.

Process ERP systems allow managers to react dynamically to any changes that appear in the interior or the company's environment. A full insight into the organization and course of processes allows to organize and improve processes, which, in effect, should improve the proficiency, effectiveness and efficiency of the

company. The rapid change of business processes in the ERP system is particularly important in a situation of dynamic development or the need to restructure an enterprise. Analysis and ongoing control of processes in this group of ERP systems allow to determine the reasons for failures: too long execution time or stopping the process. Authorized users of the ERP process system (e.g. managers) gain the possibility of current implementation of necessary changes eliminating the emerging problems in the process. The analysis of processes in the ERP system is the basis for the automation of activities, and, as a consequence, it allows to optimize processes implemented in the enterprise and in cooperation with partners and recipients.

ERP process systems usually have a built-in group of predefined processes, characteristic for particular types of industries. On the basis of predefined processes, the company can take advantage of the supplier's knowledge and introduce some improvement, or can build an own set of processes. These types of systems have significant possibilities of adapting them to the needs of users (e.g. they can see their tasks to be carried out as part of the process, or get acquainted with the overall course of a given process and other people involved in its implementation), with a clear and user-friendly interface. A properly selected and implemented ERP process system should provide all the benefits associated with the application of the process approach in the company. In particular, the effect of using an ERP process system can be: the improvement of the quality of customer service, the speed and efficiency of the company's operation, the increase in the company's competitiveness in a dynamically developing market and the reduction of the costs of introducing organizational changes. The limitation of the ERP process systems can be an expensive and time-consuming workload to prepare a map of processes, designing a whole process reflecting the specificity of the enterprise and their optimization. Another problem may be a complicated service of the ERP process system (too many options available) and the necessity of constant improvement of processes.

4. An example of the operation of ERP process systems

An example of a process information system of the ERP class is Macrologic Merit [https://www.macrologic.pl/erp/procesowy-erp/erp]. Based on its previous ERP product, Macrologic Xpertis, Macrologic decided to develop software towards a process approach. In the new system there is no traditional division into modules (Finase and Accounting, Human Resources and Payroll, Logistics, Production, etc.). Instead of modules, there are processes that map most of the business tasks and processes in the enterprise. These differences are presented in Figure 3.

On the left Figure 3 shows the Macrologic Xpertis system. In this solution, the classic approach to ERP systems was used − the division into applications, referring to individual functional areas of the enterprise. The right part of the drawing is a fragment of the user's desktop of the new Merit system. In this system, the processes are started.

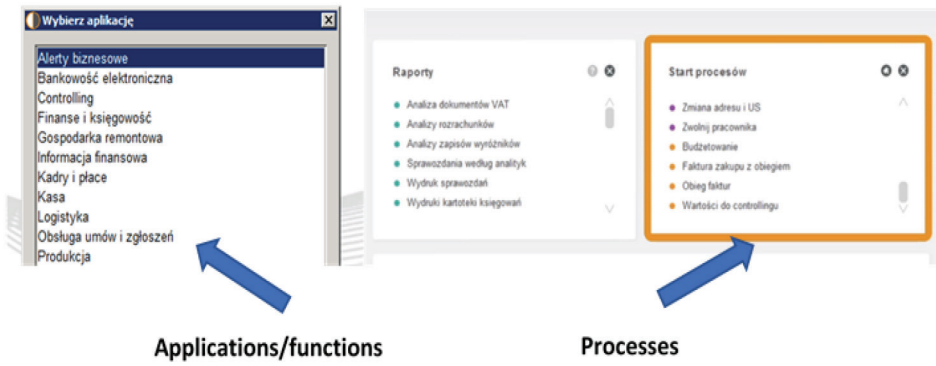

Fig. 3. Evolution of the ERP system from classical to process approach

Source: authors' own study based on Merit system.

The Merit system has approximately 300 predefined processes. They are mapping the most frequent business processes in an organization. Enterprises can use ready-made process models, modify them or create their own, tailored to the needs and specificity of operations and management models.

The Merit system can be offered to recipients in the Cloud Computing model and is generally not intended to be used in specific industries. Wide possibilities in the scope of customizing the system and the ability to freely define the way the software works, basing on the embedded business process modelling tool, can indicate the universality of the system. If it is necessary to modify processes or if the company decides to create a new process in the system, it is necessary to use the process modeller. In Macrologic Merit it is a tool that uses BPMN (Business Process Model and Notation) methodology. New process models are immediately reflected in the ERP system. Managers can quickly adapt the processes currently implemented in the company to the Macrologic Merit system, because the modeller allows the creation of very diverse processes tailored to the individual needs of a given company. A fragment of the process modeller is presented in Figure 4.

Process modeller allows to quickly and easily create new processes in the system. It consists of workspace, a preview of the process diagram, a palette of BPMN elements and navigational tools. After creating a diagram, giving it a name, permissions and assigning users, the process immediately appears in the list (example in Figure 2) and is ready to run.

In case of ERP class process systems, all processes are run from the manager's desktop. Depending on the functions and positions assigned, each employee can see their own desktop, containing information and controls related only to their tasks. Figure 5 presents an example of the user's desktop. It shows that an employee has 5 own tasks and 10 free tasks to carry out for execution.

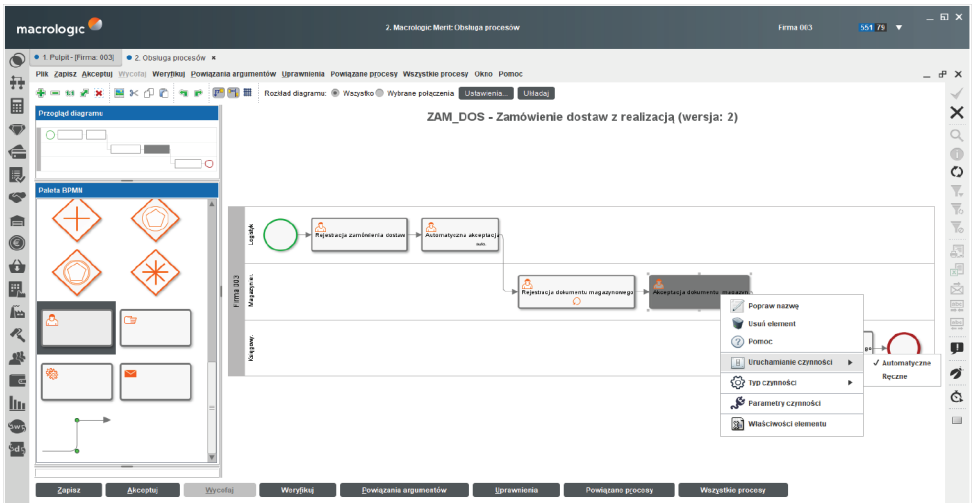

Fig. 4. Process modeller in Macrologic Merit

Source: authors' own study based on Merit system.

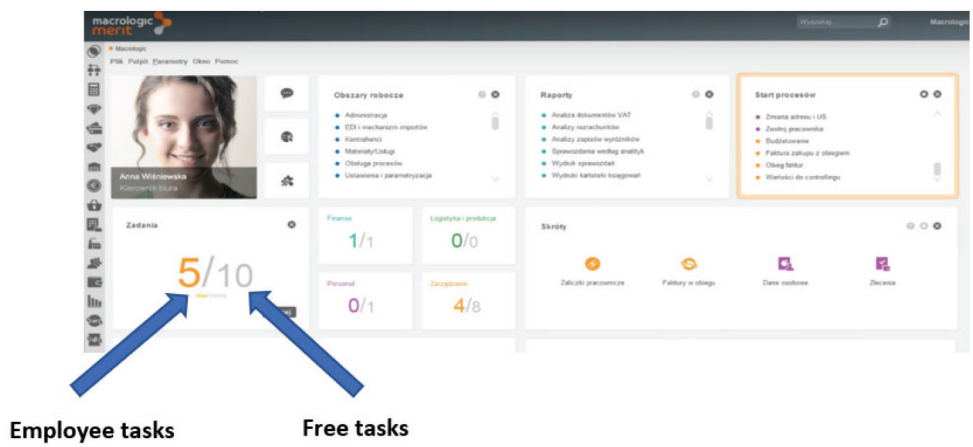

Fig. 5. A fragment of the Macrologic Merit user desktop

Source: authors' own study based on Merit system.

Tasks to be performed in the system result from the process model. Each element of the process is assigned to the user (Figure 6). Thanks to this approach, every employee knows their role in the process and the organization. Additionally, every employee working with the Macrologic Merit solution always knows what to do, and managers using the graphical gauges and process analysis tools embedded in the system can monitor the current course of business processes, track the effectiveness

of work and implement improvements. As a result, every employee is fully focused on the business and results of business processes, not on the use of programs. This results in a greater awareness of the employee as to their role in the company.

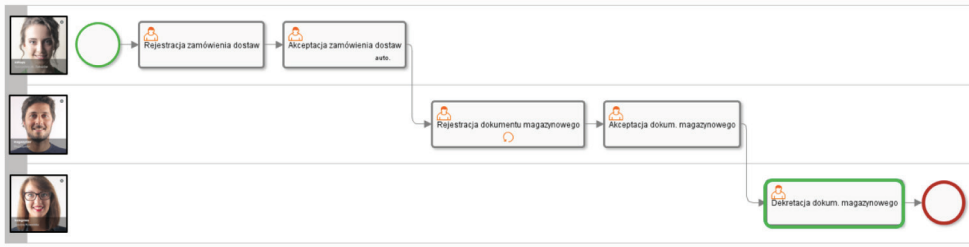

Fig. 6. Rules for assigning roles in Macrologic Merit processes

Source: authors' own study based on Merit system.

As mentioned above, events and tasks in the system are implemented by starting processes. The processes take place in accordance with the previously defined model, and the users see the tasks assigned to them in the process on the main system desktop. An organized ERP process system has one more significant advantage. Processes can be fully monitored and analyzed. Each launch of the process leaves a trace in the system. Thanks to this, it is possible to analyze each instance of the process. In the case of errors in the process model, it is possible to quickly detect mistakes and react accordingly. An exemplary process in the Merit system is presented in Figure 7.

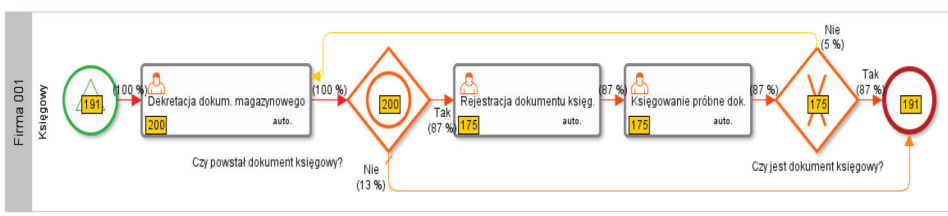

Fig. 7. The process of depositing a warehouse document in the Macrologic Merit system

Source: authors' own study based on Merit system.

The example in Figure 7 shows that the process was started by an accountant 191 times. The first task "Document's Deposition" was done 200 times, which means that 9 times it was called for a different reason than to start the process. Conditional gate "or" sent 87% of calls to "register an accounting document" and 13% to complete the process. The analysis of processes makes it possible to locate the so-called bottlenecks in the organization, or processes that last for the longest time. Thanks to this they can be constantly optimized which will shorten the duration of individual activities.

5. Conclusions

The changes that occur in ERP systems are on the one hand the result of changes in the environment and, on the other hand, are caused by the evolution of the management concept (including those consisting in moving away from classical organizational forms towards process organizations). An important direction of evolution in integrated management information systems is the emergence of a process ERP system. The main feature of process ERP systems is the ability to create, model and optimize processes directly in the ERP system without the need for external BPMS applications. Processes mapped in the process modeller are immediately mapped in the ERP system and a user can use a set of predefined processes or create and improve their own and individualized business processes.

The key activity in the ERP process system is defining, describing and modelling all business processes running through the enterprise, including taking into account the processes carried out jointly with the cooperating and the recipients. However, it should be remembered that the once-arranged process does not remain unchanged. Business processes should be monitored, streamlined and optimized. They have to be adapted to the dynamically changing market and to the internal changes in the organization, related to, for example, rotation of the team, a new competence or age structure.

An example of a process ERP system is, for example, the Macrologic Merit system. The application of this system can improve the efficiency and effectiveness of the company and increase its competitiveness. Some limitations of the ERP process system may be long-term and timeconsuming design and improvement of business processes as well as its complicated service for users working on other types of ERP systems. The growing concentration of enterprises on processes should increase the popularity of ERP process systems implemented in modern and growth-oriented enterprises.

References

Addo-Tenkorang R., Helo P., 2011, *Enterprise Resource Planning (ERP): A review literature report*, Proceedings of the World Congress on Engineering and Computer Science (WCECS), vol. II, October 19-21, San Francisco.

Albanese M., 2017, *Improving the ERP Literature review methodology: A multidimensional approach*, [in:] Dameri R.P., Spinelli R. (eds.), ECISM 2017, 11th European Conference on Information Systems Management, University of Genoa, Genoa.

Albarakati A.J., 2015, *Next generation Enterprise Resource Planning: ERP II*, International Journal of Applied Information Systems (IJAIS), Foundation of Computer Science FCS, vol. 8, no. 6.

Caserio C., Trucco S., 2018, *Enterprise Resource Planning and Business Intelligence Systems for Information Quality*, Springer, Rome.

Clegg B., Wan Y., 2013, *Managing enterprises and ERP systems: A contingency model for the enterprization of operations*, International Journal of Operations & Production Management, 33(11/12), pp. 1458-1489.

Dziembek D., 2014a, *System ERP w modelu SaaS w działalności przedsiębiorstw*, [in:] Knosala R. (ed.), *Innowacje w zarządzaniu i inżynierii produkcji*, vol. 2, Oficyna Wydawnicza (PTZP), Opole.

Dziembek D., 2014b, *Systemy informatyczne klasy ERP w modelu SaaS wspierające procesy produkcyjne w małych i średnich przedsiębiorstwach*, [in:] Nowicki A., Jelonek D. (eds.), *Technologie informacyjne w kreowaniu przedsiębiorczości*, Sekcja Wydawnictw Wydziału Zarządzania Politechniki Częstochowskiej, Częstochowa.

https://www.macrologic.pl/erp/procesowy-erp/erp (22.12.2018).

Maditinos D., Chatzoudes D., Tsairidis Ch., 2011, *Factors affecting ERP system implementation effectiveness*, Journal of Enterprise Information Management, vol. 25, http://dx.doi.org/10.1108/17410391211192161.

Matende S., Ogao P., 2013, *Enterprise Resource Planning (ERP) system implementation: A case for user participation*, Procedia Technology, vol. 9, https://doi.org/10.1016/j.protcy.2013.12.058.

Samara T., 2015, *ERP and Information Systems. Integration or Disintegration*, ISTE Ltd., John Wiley & Sons, Hoboken, London.

Shimoni E., 2010, *Enterprise Applications*, *BI & KM Trends*, STKI Summit 2010 − Enterprise Applications presentation, https://www.slideshare.net/Einats/2010- enterprise-applications-bi-km-trends.

Ziemba E., Obłąk I., 2012, *Process oriented information systems*, Informatyka Ekonomiczna. Business Informatics, no. 4(26).