Economics and Organization of Logistics
5 (1), 2020, 55–64

DOI: 10.22630/EIOL.2020.5.1.5

Tomasz Rokicki[1] **, *Paulina Ziółkowska***[2]
[1]Warsaw University of Life Sciences – SGGW
[2]MZ Sped Sp. z o.o.

Integrated IT systems in logistics company management

Zintegrowane systemy informatyczne w zarządzaniu przedsiębiorstwem logistycznym

Abstract. The paper presents issues related to integrated IT systems, which are used in the management of many enterprises, including those dealing with logistics. The source of materials was a literature review. The study is a review. The evolution of the approach from MRP systems to integrated MRP II and from ERP to ERP II respectively is shown. The systems cooperating with ERP, such as CRM, SCM and WMS are also presented. Finally, important aspects related to the implementation of integrated ERP class IT systems are presented.

Key words: IT solutions, logistics, MRP, ERP

Synopsis. W artykule przedstawiono zagadnienia związane ze zintegrowanymi systemami informatycznymi, które są wykorzystywane w zarządzaniu różnymi rodzajami przedsiębiorstw, w tym logistycznymi. Źródłem materiałów był przegląd literatury. Badanie ma charakter przeglądowy. Pokazano ewolucję podejścia od systemów MRP do zintegrowanego MRP II i odpowiednio od ERP do ERP II. Przedstawiono również systemy współpracujące z ERP, takie jak CRM, SCM i WMS. Na koniec przedstawiono istotne aspekty związane ze wdrażaniem zintegrowanych systemów informatycznych klasy ERP.

Słowa kluczowe: rozwiązania IT, logistyka, MRP, ERP

Introduction

Today, one of the determinants of competitiveness is the ability to use information and effectiveness in managing the decision-making process. The information era has begun, in which communication by means of information technologies is becoming common [Kisielecki and Sroka 2005]. To use information resources effectively, a company needs an appropriate information system, which integrated with the management system will ensure control and development of all processes in the company. The functionality of such a system should be of great importance. Reliability is required in the transfer of current, comprehensive information to all levels of the organization. Only such an approach

affects the appropriate economic efficiency of operations. It allows for accurate and quick decision making by the authorities responsible for it and eliminates the possibility of creating an information gap. The information management system, supported by computer technology, is applicable to all operations carried out on information [Flakiewicz 2002].

Of course, the quality of the information used in the management process must always be kept in mind. Precision, reliability, completeness, timeliness and compatibility of information is important [Kiełtyka 2002]. The information should also be useful in a given situation, concise and immediately usable [Długosz 2009].

Integrated IT system of an enterprise means a modularly organized IT system, serving all levels of its activity, starting from marketing and planning and supply, through technical preparation of production and its control, distribution, sales, repair management to financial and accounting works and human resources management. The functional scope will be different in a production company and different in trade or services [Adamczewski 2001]. The components of an information system are usually human resources, information resources (databases, method bases, model bases, knowledge bases), procedural resources (algorithms, procedures, software), technical resources (hardware, telecommunications infrastructure, data carriers) [Dudka 2011]. The process of integration of the company's information systems used for logistics purposes is considered in the following dimensions: organizational and management, technical and technological and social. The organizational dimension is particularly important. It refers to the structure of the company management system, production processes and administrative works, behaviors of human teams and adaptation processes, information resources, material production factors [Nowicki 2006].

The emergence and growing popularity of integrated systems supporting business management is the result of the mutual complementarity of logistics, trade and computerization, which supports the sale of products and services. An extremely important reason for the development of integrated IT systems is the fact that most of the leading manufacturers of these systems offer the possibility of working with web browsers. The user then has access to the system's individual functions anywhere, even outside the company [Lech 2003, Zutshi and Sohal 2005].

Aim and methodology of the tests

The main aim of the study is to present the most important integrated IT systems used to support the logistics activities of the company. The specific objectives were: to show the functionality of the most important IT systems, to determine the conditions for implementing these solutions. The study is a review. The source of materials was a literature review.

Evolution of IT systems from MRP to MRP II

An important group of systems are MRP/MRP II (Material Requirements Planning). Their introduction to use took place in the 1970s. The system's operation consisted in combining the demand for individual products with the demand for materials in their

production and the use of a computer to make the necessary calculations. This made it possible to purchase the necessary materials at the earliest possible date, which significantly reduced the costs, while at the same time maintaining all the deadlines resulting from arrangements with the customer [Roberts and Barrar 1992].

The main objectives and functions of MRP systems include: determining the amount of production costs, precise determination of the time of delivery of raw materials and semi-finished products, reduction of stocks, optimization of the use of infrastructure resources (e.g. warehouses, production capacity), dynamic response to changes in the environment, control of production stages [D'Avino et al. 2014].

MRP systems have been very successful in business management. They covered more and more business areas. Therefore, companies decided to extend the use of computer techniques. The result of these activities was the creation of the MRP II (Manufacturing Resource Planning) system, i.e. the planning of production resources, in which all activities of a manufacturing company, including sales, purchases, maintenance, engineering, personnel, etc., were integrated with the MRP system. MRP II systems give the possibility to receive answers to the following questions, i.e. [Olszak and Sroki 2001]:

- can we deliver the products expected by our customers within a specified time and at the lowest cost?
- what and in time should be produced to meet current demand? what range?
- what and how long does it take to complete production?
- what resources does the company have at its disposal at any given time?
- what should be taken into account in planned purchases in order to carry out production?

The MRP II system covers the whole company and coordinates manufacturing, sales and financial activities. The system processes the demand for production resources into financial requirements. It shows the results of production activities in financial terms. The processing of production resources helps to calculate the company's capital capacity to implement the plan. The task of this function is to present the financial aspects of the production plan in the form of appropriate indicators [Turgay et al. 2007].

The "MRP II Standard System", the official description of MRP II, presents 16 groups of functions to be fulfilled [Majewski 2002]. The use of MRP II class systems has resulted in an increase in the overall dynamics of the business environment. The principles of their operation have also changed, including the economic efficiency of economic processes [Miclo et al. 2019].

It can be stated that MRP II applied the methodology of the so-called "rolling planning", which is based on the analysis of internal and external demand while maintaining model stock levels, minimizing costs while using the available machinery [Jakimowicz et al. 2015].

Transition from ERP to ERP II

The development of ERP systems results from changes in management logistics. At an early stage, the systems only supported management within the company. With the development of technology, and the consequent spread of computer systems, the need arose to connect business entities in the entire logistics chain. This resulted in the development of

ERP systems. The system was extended with additional functions that are applicable in the supply chain. They enabled companies to integrate and optimize logistics processes. The basic property of ERP systems is the optimization and arrangement of the whole range of processes occurring within a business entity, i.e. logistics, production, sales and financial management [Długosz 2009].

The scope of basic functions of integrated ERP systems includes: distribution, sales and marketing (customer relationship management – CRM subsystems), reports, service, personnel administration, finance (fixed assets and controlling subsystem), manufacturing, accounting and procurement (supply chain management systems – SCM and warehouse process management systems – WMS), electronic data transmission (EDI) subsystem, business intelligence (multidimensional data analysis processes – OLAP and data warehouses). From the above mentioned functions it can be concluded that ERP systems are able to function thanks to their detailed structure, which consists of many modules and covers individual departments of the company. The elements of the system may interact with other modules after appropriate integration, or operate separately. An indispensable condition for staying on the market is effective management of relations between the company and its business partners, i.e. external company processes. Specialists in innovative IT systems from Gartner Group were the first to create a definition of this transformation called ERP II (Enterprise Resource and Relationship Processing). ERP II is a set of industry-specific applications that generate value for customers and shareholders by making available and optimizing operational and financial processes, both within the company and between companies – partners [Stancu and Drăguţ 2018].

Among the main processes that support the ERP II system, the following are distinguished: accounting, purchasing, order registration, sales, cost estimation. Among the operational processes there should be those that give the possibility of cooperation with business partners. From the technical point of view, the construction of ERP II is based on a network and consists of components, while the ERP system consists of modules, thanks to its architecture ERP II integrates more easily with other systems and has an active and immediate participation in the chain of information exchange between business partners. ERP II systems operating in typical manufacturing companies connect with the systems of suppliers and sellers, with the systems of financial branches, and through network distribution channels, also directly with consumers. In the future, logistic concerns will compete for who will catch the demand, the demand for a good or a service to be delivered faster [Kanicki 2001].

Solutions that work with integrated systems

In a time of constant competition and struggle for the customer, companies must watch every step of the customer before, during and after the use of services or purchase. This is exactly what CRM (Customer Relationship Management) does. This approach has been used since the mid-1990s. Customer Relationship Management is a business strategy consisting of building relationships and managing customers to optimize long-term benefits. CRM requires the introduction of a customer-focused business philosophy and culture that ensures effective marketing, sales and service processes. CRM applications should give the possibility of effective Customer Relationship Management leading to

the primacy of this approach over the overall strategy and culture in the company [Zając 2007]. CRM systems allow to create a classification of customers with a division into key customers (generating a substantial profit) and less profitable and sometimes even unprofitable customers (generating too little profit or even losses) [Laskowska-Rutkowska 2006].

Another integrated IT system that needs to be characterized is SCM (Supply Chain Management), which is a supply chain management system. The dynamically changing concept of supply chain management among enterprises has led to a situation where the functionality of ERP-class integrated systems no longer fulfills its purpose. ERP is a proven and effective system that improves business processes, but it is designed for individual companies and does not provide the ability to manage information within the supply chain building network. Therefore, organizations started to look for systems that would provide appropriate processes going beyond the boundaries of the enterprise with the concept of comprehensive supply chain management. SCM enables the management of the entire logistics chain from the point of design and establishing the source of supply of appropriate materials, through demand planning and distribution of goods to the delivery of the finished product to the consumer [Ciesielski 2006]. Integrated SCM IT systems optimize internal and external logistics processes, both sourcing and as a starting point for optimizing own customer relations. Users of SCM systems are more efficient on the market because they flexibly influence customers and suppliers and include them in the supply chain at the very beginning of the planning process [Majczak 2007].

The last integrated IT system discussed is the WMS (Warehouse Management System), which is a warehouse management system. The diversity of the software used and its functionality must always result from the function and nature of a particular warehouse [Niemczyk 2008]. The WMS is an effective and functional tool supporting the management of operations carried out in the warehouse and all processes related to the distribution of goods in the warehouse. It also gives the possibility to manage any number of warehouses, divided into areas, classes and places. The most important functions of the WMS include management of the article database, management of packaging structures, defining the division of the warehouse (warehouse locations), handling of hazardous materials, receipt and storage of goods, management of the order list, order picking, goods storage, packing, co-packing (repacking) and preparation of sets, management of goods in the warehouse, inventory, dispatch of goods (release from the warehouse). WMS solutions are of great importance primarily for logistics operators (service providers), handling in their warehouses and terminals a large number of diverse shipments every day, coming from many senders and directed to more recipients. There should be an integrated structure of information transfer between the ERP and WMS systems, which allows for complete automation of product movement in warehouses [Kotowicz 2008].

Implementation of ERP class integrated systems

An optimally selected system and meticulously executed implementation of an integrated ERP system provides the company with many benefits, the ability to apply all functional capabilities of the system. If we want to get acquainted with the general benefits resulting from the implementation of an ERP system in logistics companies, we may

come across numerous encouraging benefits guaranteed by suppliers, such as [Dudka 2011]:

- compromise response to immediate customer needs, changes in the business plan and production risks,
- minimizing work in progress by about 30%,
- increase, even up to 50%, the adherence to deadlines,
- reduction of the average time of delivery (order execution),
- minimizing the shortage of parts for assembly from 75 to 90%,
- an increase in labor productivity of 10 to 20%,
- reducing stockpiles from 10 to 50%,
- improving the average stock turnover rate,
- sales increase from 15 to 25%,
- reducing the average number of employees in material supply services,
- reduction of purchase costs from 7 to 15%;
- increase the profit from the company's operations.

An important part of the corporate IT system is the integrated ERP system. Its proper implementation is very important. However, it should be remembered that ERP class systems are subject to constant changes in terms of technology used and functionality offered. The directions of development and improvement of ERP systems include [Soja 2001]:

- integration of new business planes by adding new modules (applications) to the system, or by developing newer versions of existing modules;
- taking into account industry-specific solutions so far supported only by specialized software (e.g. insurance, banks, financial services, construction);
- providing mechanisms to optimize production within the logistics chain and adapting the logistics chain to the needs of the individual company;
- change of package architecture to systems consisting of a core offering basic minimum functionality and sets of components that can be independently created or purchased from external manufacturers;
- outsourcing of ERP systems by offering the client only access to the system (via a web browser), while the database system and computers are located in a remote data center managed by the provider;
- the use of platforms and technologies enabling the realization of e-commerce using Internet access.

It should be noted that there are no rigid standards for this system as with MRP II, which clearly defines the functions available in the program. When ordering an ERP system, the manufacturer may modify the program according to the customer’s needs [Jakimowicz et al. 2015].

After the implementation of the ERP system, the company acquires the ability to quickly circulate and assimilate information and control the directions of economic processes in both external relations, e.g. contractors’ customers and internal, i.e. employees. When making a decision to purchase and implement an ERP management system, companies must make a thoughtful and reasonable choice from among the many software offered on the market. Attention should be paid to adapting selected ERP packages to the planned type of business activity and to the easy operation and reliability of the system.

From the very beginning, one has to reckon with the possibility of negative consequences of improper adjustment of the system, which may significantly worsen the process of implementation of ERP systems, as well as the current functionality of the company. The most common implementation problems of ERP class systems are [Kanicki 2011]:

- insufficient and unsystematic knowledge of the management about processes functioning in the organization;
- an incorrectly selected supplier with no relevant industry experience or an incorrectly selected system that does not meet the requirements of the economic sector concerned;
- imprecise or wrongly defined objectives and expectations for implementation;
- lack of sense of importance of the company and support at the highest management levels;
- system tests performed in an inaccurate and incomplete manner, resulting in undetected errors;
- failure to meet safety requirements and formal and legal regulations system;
- difficulties in identifying the person responsible for the project, resulting in incorrect management of changes, risks and project scope;
- the lack of responsibility and the lack of an implementation team on the part of the company in which the system is implemented;
- too many reported system modifications affecting the planned schedule and budget of the project;
- undefined business processes in the initial phase of implementation;
- incorrect calculation of implementation costs as a result of incorrectly agreed scope of implementation with the supplier.

Implementation is the most frequently described issue concerning integrated management information systems. In the case of implementation, the main focus was on the issue of preparing for implementation (e.g. ERP system) from the technical and organizational point of view and proceeding during the implementation project [Fogli and Provenza 2010, Yuesheng 2011, Salmeron and Lopez 2012]. However, apart from the implementa-

Table. Evaluation of ERP class solutions in the opinion of its users
Tabela. Ocena rozwiązań klasy ERP w opinii ich użytkowników

Kind of cloud ERP solutions	Number of ratings	General rating	Evaluation & Contracting	Integration & Deployment	Service & Support	Product Capabilities
CloudSuite	10	4.5	4.5	4.6	4.5	4.5
Workday	104	4.4	4.3	4.1	4.3	4.4
Intacct	52	4.4	4.3	4.2	4.4	4.5
Oracle ERP Cloud	51	4.4	4.3	4.4	4.3	4.4
Microsoft Dynamics 365	49	4.4	4.2	4.3	4.1	4.4
Oracle NetSuite ERP	12	4.3	4.2	4.2	4.5	4.6
Deltek Vision	40	4.2	4.3	4.3	4.4	4.2
ePROMIS ERP	18	4.2	4.4	4.3	4.5	4.3
SAP Business ByDesign	13	4.2	4.3	4.0	4.2	4.5

Source: [Gartner n.d.].

tion, it is also worthwhile to take an interest in the decision making, acquisition, use, maintenance and development phases, up to the final stage [Bernat and Cieśliński 2016].

Reviews for Service-Centric Cloud ERP Solutions Market were presented. Maximum given solution could receive five points. Table lists the available ERP class systems, the number of assessments made, the average of ratings received for the last 12 months (from July 2019 to June 2020) and average ratings in specific areas. The review was performed by representatives of large companies from around the world that used thises solutions. The differences between the solutions were not big. However, there were differences in the assessment of individual areas. Each enterprise can choose the solution best suited to the company's needs. There are many solutions on the market.

Summary and conclusions

1. The activity of logistics companies is determined by the ever-growing need to obtain up-to-date information, both from external and internal sources of the business environment. The development of integrated IT systems presented in the study allows us to state that at the beginning the basic integrated systems, e.g. MRP, served individual processes of the company's activity, such as production or warehousing. The evolution has transformed them into complex integrated systems covering all internal and external organization processes concerning relations with business partners.
2. The study collected and systematized basic knowledge about the most popular integrated MRP, ERP systems and their complementary packages, such as CRM, SCM and WMS. Overarching functions and benefits resulting from their application were presented. The aim of using the above mentioned IT systems is to gain a competitive advantage, which is created by precise control of business processes, improvement of the way the organization operates and better quality of information. On the basis of the literature review, it was concluded that the use of even the simplest IT systems significantly entitles enterprises to work. Depending on the needs, an MRP system or more extensive MRP II or ERP can be used.
3. The ERP system covers all the key areas of business operations. Additionally, it is possible to include additional areas. The system can be individually adapted to the customer's needs. Supporting the management process in an enterprise with integrated IT systems has become a standard and practice that determines competitiveness in a company.
4. The selection of methods and tools used to improve a particular organization must be adapted to the characteristics of the enterprise concerned, the problems it is facing. Each individual case, as well as the entire organization, should be considered on an individual basis, as there are no two identical companies. Implementation of system solutions based on information technologies always generates significant expenditures. Therefore, appropriate actions at the stage of system implementation are important. Only the application of an appropriate implementation of an IT system may result in an increase in productivity.

References

Adamczewski P., 2001: Informatyczne wspomaganie łańcucha logistycznego [IT support for the logistics chain], Wydawnictwo Akademii Ekonomicznej w Poznaniu, Poznań [in Polish].

Bernat P., Cieśliński W., 2016: Zastosowanie ICT i augmented reality w inteligentnym rozwoju przedsiębiorstw [The use of ICT and augmented reality in intelligent enterprise development], Zeszyty Naukowe Politechniki Śląskiej. Organizacja i Zarządzanie 93, 31–40 [in Polish].

Ciesielski M. (ed.), 2006: Instrumenty zarządzania logistycznego [Logistics management instruments], Polskie Wydawnictwo Ekonomiczne, Warsaw [in Polish].

D'Avino M., De Simone V., Schiraldi M.M., 2014: Revised MRP for reducing inventory level and smoothing order releases: a case in manufacturing industry, Production Planning & Control 25(10), 814–820.

Długosz J., 2009: Nowoczesne technologie w logistyce [Modern technologies in logistics], Wydawnictwo Naukowe PWN, Warsaw [in Polish].

Dudka A. (ed.), 2011: Systemy informatyczne zarządzania [IT management systems], Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław [in Polish].

Flakiewicz W., 2002: Systemy informacyjne w zarządzaniu [Information systems in management], C.H. Beck, Warsaw [in Polish].

Fogli D., Provenza L.P., 2010: From User Practice to ERP Customization – Reversing the 19 Process. Management of the Interconnected World, Springer-Verlag, Berlin Heidelberg.

Gartner, n.d.: Service-Centric Cloud ERP Solutions, [electronic source] https://www.gartner.com/reviews/market/service-centric-cloud-erp-solutions [access: 23.06.2020].

Jakimowicz M., 2015: Systemy informatyczne wspomagające produkcję i logistykę w przedsiębiorstwie [IT systems supporting production and logistics in the enterprise], Logistyka 2, 5–6 [in Polish].

Kanicki T., 2001: Główne problemy związane z wyborem i wdrożeniem systemu klasy ERP [The main problems related to the selection and implementation of an ERP class system], Logistyka 5, 7–8 [in Polish].

Kiełtyka L., 2002: Komunikacja w zarządzaniu [Communication in management], Placet, Warsaw [in Polish].

Kisielecki J., Sroka H., 2005: Systemy informacyjne biznesu [Business information systems], Agencja Wydawnicza Placet, Warsaw [in Polish].

Kotowicz D., 2008: Globalny system zarządzania magazynem na przykładzie systemu WMS w firmie Kuehne+Nagel [The global warehouse management – an example of WMS system in Kuehne + Nagel], Logistyka 4, 66–68 [in Polish].

Laskowska-Rutkowska A., 2006: Jak CRM może zwiększyć efektywność łańcucha dostaw [How Can CRM Increase Efficiency of Supply Chain], Gospodarka Materiałowa i Logistyka 1, 21–25 [in Polish].

Lech P., 2003: Zintegrowane systemy zarządzania ERP/ERP II. Wykorzystanie w biznesie, wdrażanie [Integrated ERP/ERP II management systems. Using in business, implementation], Difin, Warsaw [in Polish].

Majczak A., 2007: SCM nowej generacji [New generation SCM], Eurologistics 1, 4 [in Polish].

Majewski J., 2002: Informatyka dla logistyki [IT for logistics], Biblioteka Logistyka, Poznań [in Polish].

Miclo R., Lauras M., Fontanili F., Lamothe J., Melnyk S.A., 2019: Demand Driven MRP: assessment of a new approach to materials management, International Journal of Production Research 57(1), 166–181.

Niemczyk A., 2008: Zapasy i magazynowanie [Inventory and storage], Biblioteka Logistyka, Poznań [in Polish].

Nowicki A. (ed.), 2006: Systemy informacyjne logistyki [Logistics information systems], Wydawnictwo Akademii Ekonomicznej we Wrocławiu, Wrocław [in Polish].

Olszak C.M., Sroka, H. (eds), 2001: Zintegrowane systemy informatyczne w zarządzaniu [Integrated IT systems in management], Wydawnictwo Akademii Ekonomicznej w Katowicach, Katowice [in Polish].

Roberts H.J., Barrar P.R.N., 1992: MRPII implementation: key factors for success, Computer Integrated Manufacturing Systems 5(1), 31–38.

Salmeron J.L., Lopez C., 2012: Forecasting Risk Impact on ERP Maintenance with Augmented 27 Fuzzy Cognitive Maps, IEEE Transactions on software engineering 38(2), 439–452.

Soja P., 2001: Wdrożenie systemu zintegrowanego klasy MRP II [Implementation of an integrated MRP II class system], Zeszyty Naukowe Wydawnictwa Akademii Ekonomicznej w Krakowie 569, 85–95 [in Polish].

Stancu A.M.R., Drăguţ B.M., 2018: ERP systems – past, present and future. Knowledge Horizons, Economics 10(4), 33–44.

Turgay S., Kubat C., TaŞkin H., 2007: Modelling and simulation of MRP II activities in multi agent systems, Production Planning and Control 18(1), 25–34.

Yuesheng Z., 2011: Training the ERP Project Implementation Personnel Based on the Life Cycle Theory, [in] 2011 International Conference of Information Technology, Computer Engineering and Management Sciences, Nanjing, Jiangsu, 204–206.

Zając P., 2007: CRM zarządzanie relacjami z klientem w logistyce dystrybucji [CRM customer relationship management in distribution logistics], Wydawnictwo Politechniki Wrocławskiej, Wrocław [in Polish].

Zutshi A., Sohal A.S., 2005: Integrated management system: The experiences of three Australian organisations, Journal of Manufacturing Technology Management 16(2), 211–232.

Correspondence addresses:

Tomasz Rokicki, PhD, habil., Eng.
(https://orcid.org/0000-0003-3356-2643)
Warsaw University of Life Sciences in Warsaw – SGGW
Institute of Economics and Finance
Department of Logistics
Nowoursynowska St. 166, 02-787 Warsaw, Poland
tel.: (+48) 22 593 42 59
e-mail: tomasz_rokicki@sggw.edu.pl

Paulina Ziółkowska, MSc
(https://orcid.org/0000-0001-9140-8228)
MZ Sped Sp. z o.o.
Kazimierza Pułaskiego Sq 7/14, 10-514 Olsztyn, Poland
e-mail: paulina@mzsped.pl