

ERP SYSTEMS IN CROATIAN ENTERPRISES AND INDUSTRY 4.0

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Abstract: Resource planning in manufacturing companies is crucial in the context of Industry 4.0. Enterprise Resource Planning (ERP) systems that enable vertical and horizontal integration between different operational and management levels are essential for monitoring process execution through real-time data access and for making decisions according to these data.

The implementation of the ERP system is one of the key indicators highlighted by the European Commission (more than 100 indicators) in the Digital Agenda for Europe (A Europe 2020 Initiative), which sets the goals for the growth of the European Union by 2020. It is important to make an analysis of the state of implementation of the ERP systems in the Republic of Croatia. We researched within the metalworking industry in Croatia. Purpose of the research conducted is to determine the state of implementation of ERP systems in metalworking companies and on the compliance of ERP systems with Industry 4.0 and to investigate the opinions of ERP system users on the extent to which the ERP system they use meets the requirements of Industry 4.0.

The main objective of our paper is twofold: to present the features of modern ERP systems in the Industry 4.0 framework and to present the results of our research.

Keywords: ERP SYSTEMS, INDUSTRY 4.0, CROATIAN ENTERPRISES

1. Introduction

New innovative information-communication technologies and advanced production technologies such as Cloud Computing, Big Data Analytics, Internet of Things, Internet of Services, Internet of People, Additive Manufacturing, Cyber-Physical Systems, Wireless Sensor Networks, mobile Internet, Artificial Intelligence, Simulation and Modeling, Automation and Industrial Robotics, Augmented Reality, Cybersecurity, Blockchain, etc. are the basis of the fourth industrial revolution called Industry 4.0 [1].

In the context of Industry 4.0, all manufacturing resources are connected and exchanged data and information with each other. The innovative technologies that Industry 4.0 is based on enabling the connection of smart products, machines, processes, and humans within the manufacturing system and through the value chain. This connectivity facilitates real-time information sharing and adaptation to changes in the manufacturing system. The planning of resources in manufacturing is critical for the quality of process performance and monitoring, and quality decision making based on real-time information. There must be information flow, from the shop floor to the level of management of the enterprise and vice versa, with the purpose to make better manufacturing performance. Business partners through the value chain also need to exchange information to achieve common goals with greater effectiveness [2]. ERP systems are used to collect, analyze and interpret business process data, and it is extremely important in the context of Industry 4.0 that this takes place in real-time. ERP systems facilitate the full integration of the enterprise and also the value chain, therefore ERP systems are the information backbone of Industry 4.0 [3].

2. Literature review

Our literature review covered ERP publications on ERP systems in general and in the context of Industry 4.0 and content analysis of the literature.

2.1 Enterprise Resource Planning

Enterprise resource planning (ERP) is a concept of integrated management of enterprise resources and all business processes in real-time, with the support of software and technology, so we can say that ERP is both a concept and software. The term "enterprise resource planning" (ERP) first appeared in 1992 and was coined by Gartner. The first paper that mentions ERP indexed in the database Web of Science Core Collections (WoSCC) was published in 1994.

ERP systems were first applied in manufacturing and later in other areas. The beginnings of development were in the 1960s with the first software control packages, through MRP and MRP II, and

then ERP systems were developed. The latest trend in development is intelligent ERP systems. The steps of the ERP system evolution are shown in Figure 1.

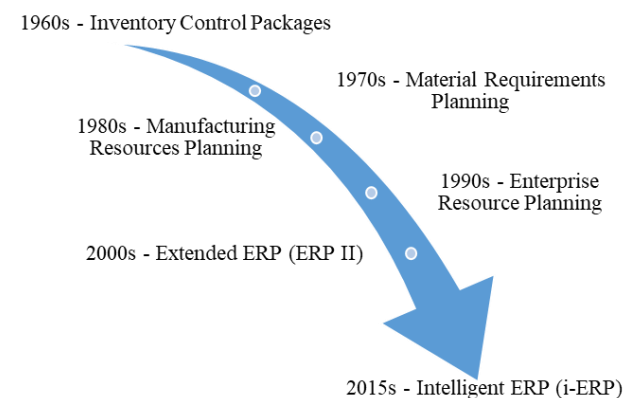


Fig. 1 Share of enterprises with implemented ERP system

2.2 ERP systems in the context of Industry 4.0

The new generation of ERP systems are intelligent ERP systems. The basic features are: the use of in-memory technology, which can be used to simulate the impact of change on production in real-time; a service-oriented architecture that enables direct communication of ERP systems with smart resources; take advantage of cloud computing; integration with MES and PLC (vertical integration), enabling cost-effective production of product variants; horizontal integration; role-based personalized intuitive interfaces; application of innovative mobile applications; in addition to a central database, decentralized data storage (e.g. on a smart product) is also possible; access data at any time and from anywhere using mobile devices (such as tablets and smartphones).

Integration is significant for Industry 4.0: vertical, horizontal and end-to-end integration. Modern ERP systems are key integrating factors in the context of Industry 4.0. Modern Enterprise Resource Planning (ERP) systems have to facilitate vertical integration between different operational and management levels, horizontal integration with business partners (suppliers and customers) within value chain through real-time information flow, and end-to-end integration, for monitoring products through their lifecycle.

The authors of [4] researched the readiness of ERP systems for Industry 4.0, and the result of the study showed that modern ERP systems are ready. An example of a modern ERP system for Industry 4.0 is SAP S/4 HANA, which has high computational

The surveyed enterprises have implemented systems of global and local suppliers such as SAP, Oracle, Microsoft Dynamics, Infor, Epicor, Insight, ININ, etc.

Survey results show that 90% of surveyed enterprises use an on-premise ERP system (Figure 5). Only 10% of enterprises use cloud ERP. That is in line with the research [10] that has revealed Cloud ERP systems not significantly represented in Croatian enterprises, and traditional on-premise solutions are still prevalent.

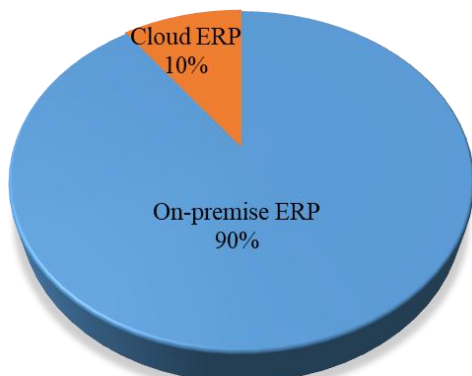


Fig. 5 Share of enterprises with implemented ERP system by deployment

With ERP, 30% of surveyed enterprises use Business Intelligence Systems and 10% of enterprises use Customer / Supplier Relationship Management Systems.

According to survey results software (ERP systems), that enterprises use, technologically outdated considered 20 % of respondents.

It is evident from the survey results that enterprises with ERP systems often have installed modules that do not use, or a lot of modules do not have installed at all (Figure 6).

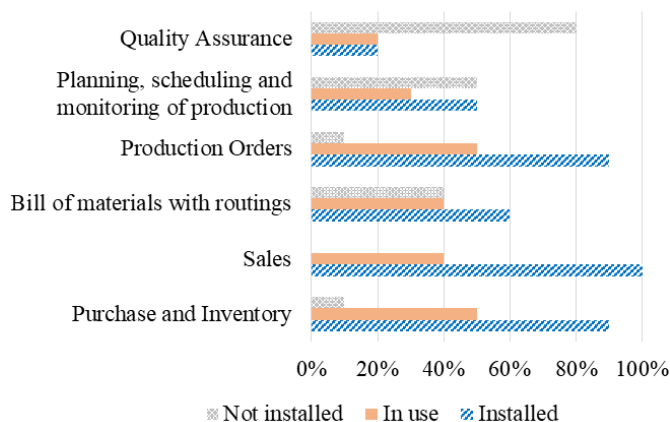


Fig. 6 Modules of ERP systems in the surveyed enterprises

For example, Purchase and Inventory, Sales, Production Order modules are installed in almost all surveyed enterprises, however, not all enterprises use them. Only about half of the surveyed enterprises possessed and use those modules. The module Planning, scheduling, and monitoring of production is installed in 50% of surveyed enterprises, but it is used only by 30% of surveyed enterprises (some enterprises have that module but do not use it).

The level of agreement of respondents with the statement that their ERP system hinders or even prevents the growth of business and market expansion is shown in Figure 7.

Figure 8 illustrates to which extent the surveyed companies agree with the claim that the ERP system they are currently using is incomplete and inadequate.

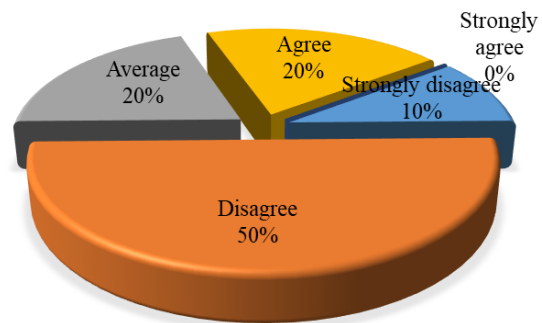


Fig. 7 The level of agreement with the statement "Our ERP system hinders or even prevents the growth of business and market expansion"

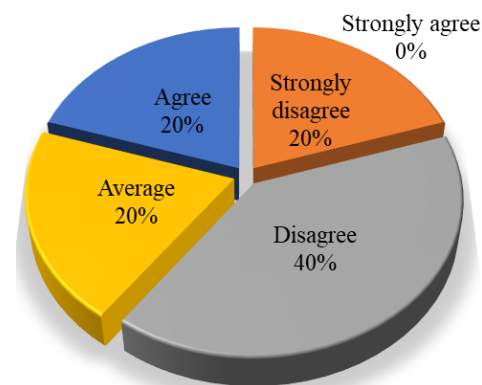


Fig. 8 The level of agreement with the statement that the ERP system they are currently using is incomplete and inadequate

To which extent the surveyed companies agree with the claim that the ERP system they are currently using is incomplete and inadequate illustrates Figure 9.

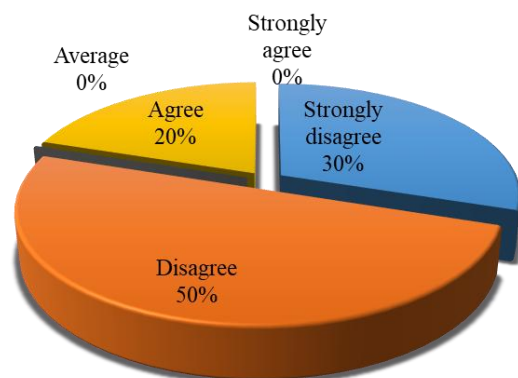


Fig. 9 The level of agreement with the statement that the ERP system they are currently using is technologically outdated software

A spreadsheet is used by 90% of the enterprises surveyed, in parallel with the ERP system. Some of the stated purposes of using a spreadsheet with an ERP system are: assistance in daily work, in design and sales, for various complex documents: offers, calculations, records, for control of ERP systems, for all analyzes, for additional work tasks not contained in the modules of the their ERP system, ad-hoc data analysis, in addition to most of the processes we follow and through ERP (delivery orders, production planning, ...), which is in line with the research findings in [11], that spreadsheets "is still dominating over the use of ERP" for planning.

The timeframe in which surveyed enterprises use the ERP system shows Figure 10.

Figure 11 shows the ownership license of ERP systems used by surveyed enterprises. Commercial proprietary licensing systems predominate over open source ERP systems, with 20% of enterprises using a combination of both.

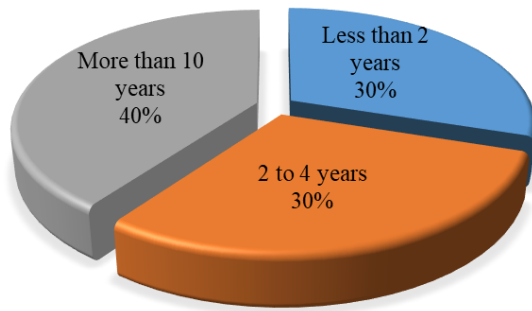


Fig. 10 Timeframe in which surveyed enterprises use the ERP system

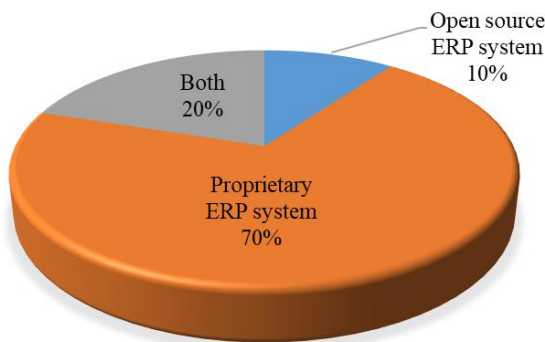


Fig. 11 Ownership license of ERP systems used by surveyed enterprises.

The number of enterprises that implement ERP systems is steadily increasing, but the number of surveyed enterprises that have not implemented the ERP system is still too high, even 63%. Also, according to the survey, 40% of surveyed enterprises are not familiar with the term Industry 4.0.

According to our research, 90% of enterprises do not have an ERP-compatible Manufacturing Execution System to achieve vertical integration. The ERP systems of the surveyed enterprises in 60% of cases do not allow mobility of the ERP system (access to the system from different locations and devices (smartphones, tablets)). ERP systems do not allow the sharing of data with external partners (suppliers and customers), who thus participate in business processes. In 70% of cases, ERP systems do not allow personalization of the user interface within the Role-based interface (they do not have modern functionalities that support the work according to the individual needs of users).

ERP systems in 40% of enterprises do not allow the transition to cloud business. Automatic object identification methods not integrated with ERP systems in 30% of enterprises, in 50% of enterprises only bar code used, in 10% of enterprises the combination of bar code and RFID methods of automatic identification and tracking of objects applied, and the biometric method (fingerprint) is used in 10% of enterprises.

4. Conclusions

Industry 4.0 enables businesses to become flexible and competitive, using ERP systems as the backbone of horizontal, vertical and end-to-end integration. Modern ERP systems based on innovative emerging technologies meet the requirements of Industry 4.0.

But there is a noticeable problem in surveyed Croatian enterprises. Even 40% of businesses are not familiar with the Industry 4.0 concept. This is a particularly important issue because Industry 4.0 is the key to increasing the competitiveness of Croatian enterprises, given that Croatia's competitiveness is very low. Croatia ranks 68th out of 140 countries according to the World Economic Forum 2018 data. Regarding the readiness of ERP systems in

Croatian surveyed enterprises for Industry 4.0, it can be concluded that the ERP systems are to a large extent incompatible with the requirements of Industry 4.0.

Given that surveyed enterprises point out the high costs of implementing an ERP system as a reason for not implementing an ERP system, it is possible to use alternative open source ERP systems. There is also a need to increase awareness of the importance and benefits of Industry 4.0.

The limitation of the research is the low response rate to the survey so results cannot be generalized.

5. Literature

[1] Ghobakhloo, M. (2018). The future of manufacturing industry: a strategic roadmap toward Industry 4.0. *Journal of Manufacturing Technology Management*, 29(6), 910–936.

[2] Sandengen O Ch, Estensen L A, Rodseth H, Schjolberg P: High Performance Manufacturing: An Innovative Contribution towards Industry 4.0. Proceedings of the 6th International Workshop of Advanced Manufacturing and Automation. November 10-11, 2016, Manchester, England

[3] Barth, C., & Koch, S. (2019). Critical success factors in ERP upgrade projects. *Industrial Management & Data Systems*. doi:10.1108/imds-01-2018-0016

[4] Haddara, M., & Elragal, A. (2015). The Readiness of ERP Systems for the Factory of the Future. *Procedia Computer Science*, 64, 721–728.

[5] Cocca, P., Marciano, F., Rossi, D., & Alberti, M. (2018). Business Software Offer for Industry 4.0: the SAP case. *IFAC-PapersOnLine*, 51(11), 1200–1205.

[6] Ghobakhloo, M. (2018). The future of manufacturing industry: a strategic roadmap toward Industry 4.0. *Journal of Manufacturing Technology Management*, 29(6), 910–936.

[7] Demirova S., Industrial Information Technology - A Revolutionary. Factor In Logistics, *Acta Technica Corviniensis - Bulletin of Engineering*, Tome X, 2017, Fascicule 4 (Oktober-December), pp.25-28, ISSN 2067-3809, 2017

[8] Telukdarie, A., Sishi, M. N. (2018) Enterprise Definition for Industry 4.0. Proceedings of the 2018 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), Bangkok, Thailand, 16-19 Dec. 2018, 849-853

[9] Sivo, S. A., Saunders, C., Chang, Q. et al, (2006). How low should you go? Low response rates and the validity of inference in IS questionnaire research, *Journal of the Association for Information Systems*, 7(6), 351-414.

[10] Picek, R., Mijac, M., & Androcec, D. (2017). Acceptance of Cloud ERP Systems in Croatian Companies: Analysis of Key Drivers and Barriers. 20th International Scientific Conference "Economic and Social Development", Prague, 27-28 April 2017

[11] De Man, J. C., & Strandhagen, J. O. (2018). Spreadsheet Application still dominates Enterprise Resource Planning and Advanced Planning Systems. *IFAC-PapersOnLine*, 51(11), 1224–1229.