The Direction of the Future Development of ERP and BPMS: Towards a Single Unified Class?

Marek Szelągowski[1], Justyna Berniak-Woźny[1], and Audrone Lupeikiene[2(✉)]

[1] Systems Research Institute, Polish Academy of Sciences, Warsaw, Poland
marek.szelagowski@dbpm.pl
[2] Institute of Data Science and Digital Technologies, Vilnius University, Vilnius, Lithuania
audrone.lupeikiene@mif.vu.lt

Abstract. Enterprise Resource Planning (ERP) systems and Business Process Management Suites (BPMS) are implemented in the organization to increase efficiency, reduce costs, and increase profits. In the case of the implementation of traditionally managed business processes, the scopes of operation of both classes of systems overlap. ERP systems allow for the standardization and improvement of the implementation of repetitive, standardized business processes, and BPMS enables the identification, redesigning, implementation, and monitoring of processes execution. But does the latter still have an application in Industry 4.0 and Industry 5.0, where processes are more complex and diverse? This discussion paper provides an overview of the current state and the direction of development of two classes of information systems (IS) crucial for the management of modern organizations – ERP and BPMS – and compares the critical success factors (CSFs) of both system classes. Based on this comparison, the direction of development of both classes of systems from the point of view of business requirements is determined.

Keywords: Enterprise Resource Planning system · Business Process Management System · Business Process Management Suite · Critical Success Factor · Industry 4.0 · Industry 5.0

1 Introduction

Enterprise Resource Planning (ERP) and Business Process Management Suites (BPMS) are the two classes of information systems (IS) crucial for the management of modern organizations. Both for vendors who create systems and for their users, it is extremely important how both IS classes will develop. The vast majority of organizations that already use ERP systems have to decide whether or not and to what extent BPMS should be implemented or whether their ERP system should be changed to a process-based one. ERP vendors are faced with even more fateful decisions. They have to decide whether to build "process" functionalities into the existing ERP system with a view to preparing integration mechanisms enabling on-demand addition of BPMS elements, including selected hyperautomation techniques, such as process mining, robotic process automation (RPA), or artificial intelligence (AI). For both groups, these are strategic decisions

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that are difficult to change, essential for the competitive ability of the organization, and involve long-term significant key human resources. As the literature review conducted by the authors has shown, there are no studies showing comparatively the development directions of both IS classes and containing practical recommendations. Thus, this study aims to answer the research question: "Which choice is better for the future: process ERP systems or the flexible, open integration of ERP and BPMS systems?" (In other words: Is the future a single unified class of "process" ERP systems or two separate classes of systems with standardized integration principles?).

The article begins with a discussion on the work methodology. Then, the authors present the results of the literature review relating to the current status and development trends of ERP and BPMS. Section 5 compares the requirements, goals and critical success factors (CSFs) of both system classes. The last part presents conclusions and practical recommendations resulting from the identified business requirements and comparative analysis.

2 Methodology

This discussion paper provides an overview of the current status and development trends of ERP and BPMS and compares the CSFs of both IS classes. The methodology used for the purposes of this paper is the theoretical review, which builds on existing conceptual and empirical research to provide context for identifying, describing, and transferring selected concepts, constructs, or relationships to a higher level (Pare et al. 2015). This type of literature review brings together different work streams (in this case academic and professional) in order to effectively organize previous research, analyze their interrelationships in depth, and identify patterns or similarities that will facilitate the development of new theories (Webster and Watson 2002). Thus, in the next two sections the evolution of the ERP and BPM systems will be presented. In Sect. 5, authors will compare the goals and CSFs for the implementation of ERP and BPMS. Based on that, future development scenarios for both systems will be defined.

3 Enterprise Resources Planning Systems

The use of IS in business began with simple programs or rather record-keeping databases. In a short time, it turned out that they can be successfully used to keep records of not only materials, but also other types of resources, e.g. money, devices, or people. The next step was to extend them with modules for recording operations specific to a given type of resource, e.g. receipts, issues, purchases, sales, employment, or dismissals. This allowed IS to support and monitor various areas of enterprise operation by independent, unrelated area programs, e.g. warehouse, human resources, payroll, or financial accounting programs. The next natural step was to extend the use of IS for material requirements planning (MRP), and then for material resources planning (MRPII) (Katuu 2020). Already at this stage, there was a need for the internal integration of various areas of IS operation, which became the basic distinguishing feature of the next generation

Table 1. ERP systems evolution timetable. Source: Authors own elaboration, based on Katuu 2020, and Rashid et al. 2002.

Date	Class of systems	Characteristics
1950+	Inventory software – databases	Unchanging database tailored to specific user needs. Usually dedicated to inventory
1960	Domain-specific software	Software dedicated to particular functional domains. Operational logic embedded in the software code
1970	Material Requirements Planning (MRP)	Software dedicated to material requirements planning for production purposes. Usually integrating the fields of production, supply, and warehouse management. Operational logic embedded in software code
1980	Material Resource Planning (MRPII)	Software dedicated to planning production and the resources required therefor. Usually integrating data from several functional areas. Limited possibilities of configuring the operational logic
1995	Enterprise Resource Planning (ERP)	Integrated systems supporting the management of the entire organization, consisting of multiple strictly interconnected modules. The possibility to configure the operational logic by way of configuring the system itself
2005	postmodern ERP (Enterprise Resource Planning II)	Integrated solutions supporting the management of the entire organization, consisting of multiple modules integrated within a main ERP system. The possibility to select modules from multiple vendors, configure their operational logic (e.g. by defining the business processes, the integration of activities among many entities) and the scope of the processed information. The possibility to select the principles of licensing and using a given model (e.g. the cloud, mobile devices)

of IS – Enterprise Resource Planning (ERP) systems – enabling consistent management not only of production resources, but also the resources of the entire organization (Table 1) (Gartner IT Glossary – ERP n.d.; Katuu 2020).

Initially, ERP systems, like their predecessors, were monolithic systems with integration mechanisms for elements of various areas rigidly built into the architecture and the IS database (Katuu 2020). In the 1990s and early 2000s, ERP software became the standard and the basis of the organization's systems architecture. But already in the mid-2000s, the weaknesses of this solution began to become increasingly more visible, such as the lack of flexibility, the user's dependence on one supplier, high purchase and use price of the solution, and difficulties in adapting to the user's business processes (Haddara et al. 2015). Business pressure and the emerging technological opportunities resulted in the evolution of ERP systems towards a modular structure with a clearly separated module responsible for consistent integration and data flow between individual modules (Lupeikiene et al. 2014). This opened the possibility of using modules provided by different vendors within one company, and at the same time reduced the dependence of users on one vendor. Recognizing this change, Gartner proposed the introduction of a new class of IS known as "postmodern ERP" (Gartner 2019a; Hardcastle 2014). Their feature is a departure from the monolithic structure of the system in favor of "loosely coupled decentralization" of the administrative and operational modules (Gartner IT Glossary – postmodern ERP n.d.). The goal of a postmodern ERP strategy is to use the best possible applications in each particular area, while ensuring that they adequately integrate with each other when necessary. This approach allowed users not only to choose the best among traditional ERP system modules such as finance, production, or human resources, but also to incorporate many of the hyperautomation technologies not offered by ERP system vendors into the solutions used. Integration with IoT, OCR of texts, reading QR codes, speech recognition, the use of software robots, or decision support by artificial intelligence provided by the best companies in this rapidly developing part of the IT industry are just some of the technologies that can be used as part of postmodern ERP (Gartner 2019b).

According to consulting companies following the development of the ERP systems market, the next step in the evolution of such systems will be the possibility of creating solutions from components integrated according to the needs, with the possibility of combining components provided by different suppliers in one solution (Gartner 2022). This will allow users to choose the best modules available on the market and to quickly expand or adapt their solutions in accordance with the needs of customers and new opportunities offered by vendors (Forrester 2020; Gartner 2021).

Conceptually, ERP systems include the integration of business processes in an organization (Nazemi et al. 2012). However, in practice, even postmodern ERPs remain transactional systems today, i.e. systems for recording and monitoring transactions (operations), and not systems meant to design and execute end-to-end business processes (Gartner 2019b). Recognizing the importance of this limitation, ERP system providers make attempts to integrate with business process management by adding an internal business process modeler (e.g. Dynamics AX – Microsoft or Xpetris – Asseco Business Solutions) or the ability to load and operationalize business process models using the opportunities offered by Business Process Model and Notation from version 2.0 (e.g. SAP).

4 Business Process Management Suites

In the 1990s, it was widely expected that workflow management systems would become the next step in supporting office work, after other tools such as database management systems, spreadsheets, and email systems (van der Aalst et al. 1994). This turned out to be true – workflow management (WFM) and document management (DM) systems work well in organizing people and documents and in automating specific stages of the process, especially in small and medium-sized companies. However, these systems focused on automating selected, fully repeatable workflows with little support for process analysis and optimization or end-to-end process management. The answer to the need for holistic management and greater flexibility of support for implemented processes were Business Process Management Suites (BPMS), which combined information technology and knowledge from management sciences and applied both to operational business processes (van der Aalst 2022; Gartner IT Glossary - BPMS n.d.). BPMS can be defined as an application infrastructure supporting BPM projects and programs. They support the entire execution and improvement life cycle process, from process identification, through modelling, design, implementation and analysis, to continuous improvement (Szelągowski 2019; Dumas et al. 2018).

Business Process Management Suits (BPMS) are being adopted in organizations to increase business process agility across a diverse application landscape (Koopman and Seymour 2020). Their main advantage is the visibility and transparency of the process and the simplified enforcement of organizational rules and principles. Another advantage of implementing BPMS is lower workload in the organization, because process coordination is automated. Countless IT systems are flexibly integrated with a view to supporting work in the organization (Dumas et al. 2018). According to Capgemini (2012), as many as 96% of enterprises that decided to implement business process optimization systems, achieved a significant return on investment, which in the case of 55% of them reached at least 200%. On the other hand, according to the BPTrends report (Harmon and Garcia 2020), 93% of companies are involved in many activities aimed at improving their processes, but only 52% of the companies using BPM software reported that they were satisfied with their specific tool.

BPMS has reached its limits, as it was unable to work with the growing volume of data or the complex decision-making process in real time. With the advent of Industry 4.0, traditional business processes, the management of which assumes the identification, design, implementation, and then implementation thereof in accordance with the optimal model, were systematically replaced by dynamic processes – partially structured (structured processes with ad hoc and unstructured exceptions with predefined fragments) and fully unstructured (where the exact steps to be taken to achieve the goal cannot be defined) (Szelągowski 2019; Kemsley 2011). Organizations must implement an extensive company strategy, coordinate interactions in departments throughout the organization (as well as in external systems), and integrate various platforms such as customer relationship management (CRM), enterprise content management (ECM), and other applications, with a view to facilitating management of different departments, processes, and people. This task is especially important in the era of digital transformation and Industry 4.0, when business processes run through many departments and systems or even organizations, which requires a new approach to their management. Business Process Management Systems, also known as Business Process Management Suites or Business Process Management Software, come in handy here. All these and other challenges have been resolved by the intelligent BPMS (iBPMS) (Gartner 2012).

The evolution of BPM support software systems began with two opposing assumptions:

- case management systems (CMS) – support for processes with an unpredictable flow and a not entirely known, but potentially high intensity of knowledge;

- traditional BPMS – support for processes of known and strictly repeated nature thanks to having all the knowledge necessary to perform the processes prior to execution. It strives to support all process groups, irrespective of their nature, unpredictability, and knowledge intensity (Di Ciccio et al. 2014).

The analysis of the main capabilities of iBPMS and dynamic CMS showed a trend towards a constantly increasing number of overlapping features. At the end of the considered period, both classes of systems enabled the dynamic execution of processes; their adaptation to the operational context; integration with rules processing; access to different sources of data to derive informed decisions in real time; and support of process redesign that emphasizes automation and digitization (Szelągowski and Lupeikiene 2020).

An iBPMS is a type of high-productivity (low-code/no-code) application development platform. An iBPMS enables dynamic changes in operating models and procedures, documented as models, directly driving the execution of business operations. In turn, business users make frequent (or ad hoc) process changes to their operations independently of IT-managed technical assets such as integration with external systems and security administration (Gartner 2015). iBPMS typically include advanced capabilities like enterprise document management, business rules, case management, advanced integration features on a Service-Oriented Architecture (SOA), cloud computing, as well as social collaboration features and responsive mobile user interface (Cheng 2012). Gartner defines the iBPMS market as the group of vendors offering an integrated set of technologies that coordinate people, machines, and things. An iBPMS allows “citizen developers” – most commonly business analysts, but also business end users – and professional developers to collaborate on the improvement and transformation of business processes. Products provide capabilities to optimize business outcomes in real time for a specific piece of work. They also allow new, emergent practices to quickly scale across a function or enterprise. The critical capabilities of the iBPMS platforms are based on six primary use cases (Gartner 2019c):

- composition of intelligent process-centered applications;
- continuous process improvement;
- business transformation;
- digitized processes;
- citizen developer application composition;
- adaptive case management.

BPMS is developing and will probably continue to develop in line with the changing requirements of the business environment. While intelligent business process management platforms take into account aspects of business transformation and digitization, technological improvements and the drive for digital transformation are pushing the evolution of BPM software further (Belev 2018). The aim of the changes is to provide a tool enabling the present effective competition and building a competitive position in the future. In practice, Industry 4.0 and emerging Industry 5.0 require close connection of BPM with the use of various ICT technologies implemented as stand-alone, point-based applications, but increasingly often as elements of comprehensive BPMS packages (van der Aalst et al. 2016). The differentiation of user requirements depending on the nature and context of business processes requires the flexibility of BPMS to integrate various technologies and devices in order to ensure the achievement of the organization's business goals.

5 Goals and CSFs for the Implementation of ERP and BPMS

Conceptually, ERP systems involve the integration of business processes within an organization, with improved order management and control, accurate information on inventory, improved workflow, supply chain management (SCM), and better standardization of business and best practices (Nazemi et al. 2012).

Organizations operating in Industry 4.0 and entering Industry 5.0 use both ERP and BPMS. As recently as 10–15 years ago, the purposes for using these two classes of systems were different. ERP was used to manage the organization's resources and BPMS (or before it, WFM) – to support the implementation of business processes. The requirements and the resulting drivers for the development and architecture of both classes of systems were also different.

Under the digital transformation, the measure of success of an organization is its ongoing efficiency and the development potential of its products and services, as well as the capability to use and develop its own intellectual capital (Nahavandi 2019). Just 10 years ago, the measure of success for implementing BPM according to Dabaghkashani et al. (2012, 727) simply pertained to the simplicity, quality, and flexibility of the business processes in the organization. Industry 5.0 has lessened the emphasis on technology and assumed that the true potential for development is rooted in the collaboration between humans and machines. This approach allows for usage of the rapidly expanding capabilities of machines in conjunction with better-trained experts to support efficient, sustainable and safe production. In the study on the CSFs of implementing ERP systems held by Leyh and Sander (2015), among the 320 respondents, 50% pointed to:

- top management support and involvement (202);
- project management (172);
- user training (167).

In the literature from the last 10 years, there exist multiple publications on the requirements of and CSFs for BPMS. All point to the fact that the success of implementing CSF or BPMS is dependent not on a single system, but on the synergy of several, or even several dozen CSFs (Rosemann and vom Brocke 2015, 110–112). Table 2 contains a comparison of CSFs for both classes of systems. In cases when CSFs with overlapping definitions received different names in particular publications, the "Critical Success Factors" column of Table 2 provides the most common name variant.

The strategic goals of implementing and using ERP and BPMS are unmistakably identical. However, the scopes of use and particular detailed goals, as well as the resulting requirements and CSFs, were different for both classes of systems in the 90's and 2000's. Another differentiating factor were technological limitations, such as the lack of flexibility with respect to internal system integration. The technological changes under

Table 2. Critical Success Factors for ERP and BPM systems.

Core element	Critical success factor	ERP system	BPMS
Strategic alignment	Strategic alignment	Zendehdel Nobari et al. 2022	Bosilj et al. 2018; Gabryelczyk and Roztocki 2018; Syed et al. 2018; Ubaid and Dweiri 2020; Castro et al. 2020; Koopman and Seymour 2020
	Business plan & vision	Gavali and Halder 2020	Kraljić and Kraljić 2017; Syed et al. 2018; Koopman and Seymour 2020
	Business process effectiveness	Hasan et al. 2019; Cieciora et al. 2020	Bosilj et al. 2018; Gabryelczyk and Roztocki 2018; Ubaid and Dweiri 2020
Governance	Top management support	Esteves et al. 2006; Ganesh et al. 2014; Kapur et al. 2014; Nagpal et al. 2017; Hasan et al. 2019; Gavali and Halder 2020; Vargas and Comuzzi 2020	Kraljić and Krallić 2017; Bosilj et al. 2018; Syed et al. 2018; Ubaid and Dweiri 2020; Castro et al. 2020
	Effective organizational change management	Ganesh et al. 2014; Kapur et al. 2014; Nagpal et al. 2017; Zendehdel Nobari et al. 2022; Vanani and Sohrabi 2020; Vargas and Comuzzi 2020	Kraljić and Kraljić 2017; Gabryelczyk and Roztocki 2018; Syed et al. 2018; Ubaid and Dweiri 2020
	Business process improvements implemented	Ganesh et al. 2014; Kapur et al. 2014; Nagpal et al. 2017; Zendehdel Nobari et al. 2022	Kraljić and Kraljić 2017; Brkic et al. 2020
	Continuous monitoring and improvement system	Hasan et al. 2019	Castro et al. 2020; Ubaid and Dweiri 2020

(*continued*)

Table 2. (*continued*)

Core element	Critical success factor	ERP system	BPMS
Methods	Awareness and understanding of BPM	Kapur et al. 2014; Nagpal et al. 2017; Gavali and Halder 2020; Vargas and Comuzzi 2020	Syed et al. 2018; Brkic et al. 2020
	Adequate implementation strategy	Esteves et al. 2006; Ganesh et al. 2014; Vargas and Comuzzi 2020;	
	Appropriate project management	Ganesh et al. 2014; Kapur et al. 2014; Nagpal et al. 2017; Hasan et al. 2019; Gavali and Halder 2020; Zendehdel Nobari et al. 2022; Vanani and Sohrabi 2020; Vargas and Comuzzi 2020	Kraljić and Kraljić 2017; Bosilj et al. 2018; Syed et al. 2018; Castro et al. 2020
Information technology	Realistic consideration of the capabilities and the limitations of the technology to be used	Ganesh et al. 2014; Zendehdel Nobari et al. 2022	Syed et al. 2018
	Architecture (especially flexibility and integration opportunities)	Kapur et al. 2014; Nagpal et al. 2017; Gavali and Halder 2020	Kraljić and Kraljić 2017; Koopman and Seymour 2020
	Data management (data analysis and conversion)	Ganesh et al. 2014; Kapur et al. 2014; Nagpal et al. 2017; Gavali and Halder 2020; Cieciora et al. 2020; Vargas and Comuzzi 2020	Kraljić and Kraljić 2017; Koopman and Seymour 2020
	Careful package/module selection	Ganesh et al. 2014; Kapur et al. 2014; Nagpal et al. 2017; Cieciora et al. 2020; Vargas and Comuzzi 2020	Kraljić and Kraljić 2017

(*continued*)

Table 2. (*continued*)

Core element	Critical success factor	ERP system	BPMS
People	Empowerment		Syed et al. 2018; Ubaid and Dweiri 2020;
	Professional level of employees (project team)	Ganesh et al. 2014; Vargas and Comuzzi 2020	Castro et al. 2020; Koopman and Seymour 2020
	User involvement and participation	Esteves et al. 2006; Ganesh et al. 2014; Vanani and Sohrabi 2020; Vargas and Comuzzi 2020	Syed et al. 2018; Ubaid and Dweiri 2020
Culture	Ogranization culture	Ganesh et al. 2014; Vargas and Comuzzi 2020	Bosilj et al. 2018; Gabryelczyk and Roztocki 2018; Ubaid and Dweiri 2020
	Interdepartmental (inter-parties) communication and collaboration (especially between business and IT)	Ganesh et al. 2014; Kapur et al. 2014; Nagpal et al. 2017; Hasan et al. 2019; Gavali and Halder 2020; Vargas and Comuzzi 2020	Kraljić and Kraljić 2017; Gabryelczyk and Roztocki 2018; Syed et al. 2018; Koopman and Seymour 2020

the digital transformation and, first and foremost, changes to the nature of the business processes creating value for the client, including the growing significance of processes requiring dynamic management, have led to changes in the requirements to and CSFs of the use of both classes of systems. From the perspective of management, the implementation of an ERP system will be considered successful, provided that it reduces the workload, costs, and time, as well as raises quality and the flexibility of executing business processes which create value for the client. At the same time, managers expect implementations of BPMS and its included hyperautomation technologies to ensure the fluidity and flexibility of information exchange and the execution of production-oriented or service-oriented processes, the reduction of the workload, in part thanks to robotization and automation, as well as thanks to providing detailed reporting data analytical information within a set time-frame (Karimi et al. 2007). The difference that is imperceptible to the user in the way of using hyperautomation elements in both classes of systems is that in iBPMS they are a native part of the system, and in postmodernERP they still require integration as an external solution. But from a business point of view, it can be said that the requirements for both classes of systems are the same and probably no one would notice if we changed the names of the functional descriptions of both classes of systems! Therefore, their artificial division and development as systems of two different classes is becoming increasingly meaningless.

The analysis of the CSFs for each of the 6 core elements in Table 2 leads to similar conclusions. In literature from the last 10 years, requirements for both classes of systems are described with the use of the exact same CSFs. Perhaps because of the theoretical approach of BPM, the CSF "Strategic alignment" is more often found in literature devoted to BPMS. And perhaps because of the traditional engineering roots of ERP systems, the CSF "Appropriate project management" is more often mentioned in the context of ERP/postmodern ERP. However, from the perspective of virtually all of the core elements, both classes of systems are described by a single, shared group of CSFs.

6 Conclusions

IS are widely used in the management of organizations to increase their efficiency, speed up operations, and enable simultaneous operations in many places (Katuu 2020). Current user requirements and solutions implemented by IS vendors are fully subordinated to these goals. CSFs allow for detailed analysis and measurement of the degree of completion of these goals. This discussion paper aimed to provide an overview of the current state and the direction of the development of two classes of IS crucial for the management of modern organizations – ERP and BPMS – and to compare from a business point of view the critical success factors of both classes of systems.

As shown, business sets exactly the same goals for both IS classes and their completion is measured by the same CSFs. Until now, the choice of an ERP or BPMS was mainly determined by the size of the organization. But regardless of their size, companies are still in the process of transformation (including digital transformation) and, consequently, require change management, risk management, knowledge management, etc. and they have to manage increasingly dynamic business processes (Szelągowski 2019). As a result of digital transformation, this choice is dictated rather by the nature of business processes and the opportunities offered by information technologies. For this reason, a full answer to the posed study question requires further in-depth research from us to research the possibilities of combining the functionalities of ERP with holistic and dynamic business process management supported by ICT solutions. The overlapping nature of the goals and CSFs of both classes of systems points rather to the emergence of a single class of systems combining in line with the requirements of business as part of the composite architecture the transaction capabilities of ERP systems with the flexibility of iBPMS.

A limitation of this study rests in its theoretical nature and the fact that it focuses only on the requirements of business users. In the course of further studies, the authors intend to broaden their research with an analysis of the architecture of both classes of systems, as well as interviews with the key vendors of both classes of solutions. This will enable them to formulate the final answer to the question on the future of ERP and BPMS.

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