Research Article

Crystal Journal of Applied Science

Business Information Systems for Small and Medium-sized Enterprises

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Cite: Prajová, V., & Škůrková, K. L. (2025). Business Information Systems for Small and Medium-sized Enterprises. Cryst J Appl Sci. 1(1), 01-05.

Received: August 20, 2025; **Accepted:** October 30, 2025; **Published:** November 10, 2025

Abstract

In today's rapidly changing business environment, information systems are a crucial part of effective organisational management. Their significance is increasing, especially in the context of small and medium-sized industrial enterprises, which face specific challenges. These enterprises encounter intense competition both domestically and internationally, experience pressure to continually innovate their products and services, and must adapt swiftly to ever-changing market conditions. This paper concentrates on analysing and designing an Enterprise Resource Planning (ERP) system for a small or medium-sized enterprise specialising in customised engineering production, which will form the foundation for a future digital ecosystem. The first part of the paper discusses the theoretical definitions of information systems, business processes, and the digital ecosystem within the context of small and medium-sized industrial enterprises. The subsequent section offers a detailed examination of business processes and data flow within an industrial enterprise. It includes a comprehensive analysis of the current state of business processes, involving the creation of process maps that detail individual processes, data flow, and existing software solutions. The implementation section presents the design and deployment of an ERP solution customised for the analysed enterprise. It proposes changes in the pre-production and production stages through the ERP system and the digital transformation management process.

Keywords

Enterprise Resource Planning, Digital Ecosystem, Data, Digitization, Data Flow, Business Processes, Industrial Enterprise

Introduction

The implementation of appropriate information systems is crucial for these companies. These systems enable managers and employees to efficiently process and analyse large amounts of data, leading to better decision-making at all levels of management. Through information systems, companies can optimise their production processes, including production planning, inventory management, quality control, and logistics. This reduces costs, minimises errors, and increases the overall efficiency of the company.

In addition to optimising internal processes, information systems also contribute to improving the quality of products and services. They enable companies to better understand customer needs and expectations by analysing feedback and market trends. This leads to the development of products that better meet market requirements and the provision of services with higher added value.

The effective use of available resources is another significant benefit of implementing information systems. These systems enable companies to monitor and manage the use of material, financial, and human resources in real time. This leads to more effective planning and distribution of resources, thereby increasing productivity and reducing operating expenses. Information systems also support better communication and collaboration between departments, contributing to the smoother functioning of the entire enterprise.

The European Commission (EC) defines an enterprise as an entity engaged in economic activity, regardless of its legal form or structure. The determining factor is economic activity, not legal form. For this reason, according to the EC, enterprises include self-employed persons and family businesses engaged in craft or other activities, as well as commercial companies, partnerships, or associations that regularly engage in economic activity. Small

and medium-sized enterprises, including micro-enterprises, are the main driving force behind the European economy, effectively supporting economic growth and ensuring social stability. In 2013, more than 21 million SMEs across the European Union (EU) provided 88.8 million jobs. Nine out of every 10 businesses were SMEs, and SMEs created two out of every three jobs. SMEs also promote entrepreneurship and innovation across the EU and are therefore crucial to fostering competitiveness and employment. Given their importance to the European economy, SMEs are at the heart of EU policy. The European Commission aims to support entrepreneurship and enhance the business environment for SMEs, enabling them to develop their potential in today's global economy fully [1-3].

Enterprise Resource Planning (ERP)

ERP systems form the foundation of modern enterprise information systems (EIS) in process-driven companies and organisations. They represent a specific type of enterprise IS through which it is possible to effectively utilise company resources to achieve the highest efficiency of primary and supporting processes within the organisation. Their main task is to help manage and utilise available business resources effectively. In this way, they enable optimisation of all activities, whether they are core production processes directly related to manufacturing or service provision, or support processes that ensure the organisation runs smoothly. ERP systems are therefore a tool for increasing a company's overall efficiency and improving the interconnection and coordination of individual processes within the entire organisational structure. It is a software system that helps organisations streamline their core business processes in finance, human resources, manufacturing, supply chain, sales, and procurement, providing a unified view of operations.

The pioneer in this field was the Japanese car manufacturer Toyota, which had been developing a production management system since 1948 aimed at eliminating unnecessary time losses, material waste, and storage capacity. This concept, later known as the Toyota Production System (TPS), also considered the key role of employees and effective human resource management, laying the foundations for a comprehensive approach to production optimisation. Joseph Orlicky, an economist of Czech origin who served as production director of the American agricultural machinery factory J. I. Case in the 1960s, recognised the potential of using computers for production management and, to create comprehensive information planning software, adopted the basic principles of the TPS above. The result of these efforts was the MRP (Material Resource Planning) system, which was later introduced in 1961. A year later, Orlicky joined the renowned IBM company, where he continued to develop MRP and convinced other companies of its benefits. Seven years later, approximately 700 companies were using MRP, and by 1981, that number had grown to nearly 8,000. The innovation introduced by Oliver Wright in 1983, which expanded the MRP system to include capacity planning, financial management, and business process management, laid the foundation for modern enterprise information systems. This type of information system, known as Manufacturing Resource Planning (MRP II), became the basis for modern ERP solutions. It was during the 1980s, when MRP II systems experienced tremendous growth, that today's world-renowned brands such as SAP and Oracle appeared on the market.

The Importance of ERP Systems Today and their Purpose

The main aim of an ERP system is to centralise data, enabling managers to make informed decisions based on a complete view of the business. For example, if the sales department plans to launch a new marketing campaign, it can use the ERP system to access up-to-date information on inventory levels, production capacity, and budget options. This coordination reduces the risk of errors and unnecessary costs that could arise from using incomplete or inaccurate information. Besides centralising data, ERP systems focus on enhancing efficiency by automating routine processes. Just as the software used by an F1 team automatically analyses times and performance, ERP systems automate tasks such as accounting, payroll, and production planning. This allows employees to dedicate more time to strategic activities and less to administrative duties. An additional key feature is the scalability and flexibility of ERP systems, which enable entrepreneurs to adapt to market changes and new requirements. Just as F1 teams adjust their strategies based on track conditions, businesses can use ERP to customise their processes to suit current needs. ERP systems are valuable tools for organisations aiming to improve process integration, boost efficiency, and support strategic decision-making.

Who Benefits from ERP Systems?

ERP systems serve a wide range of organisations and user groups seeking tools to manage their processes, resources, and data efficiently. Their goal is to unify different parts of an organisation into a single, centralised system that promotes smooth information exchange and activity coordination. The following sections describe the types of organisations that most commonly use ERP systems and the user groups within these organisations.

1. Large corporations – the need for comprehensive solutions

- Extensive organisational structures, multiple departments, and global operations characterise large corporations. For these organisations, it is vital to have a robust and comprehensive ERP system that supports diverse functions and integrates data from various departments. Large ERP systems, such as SAP or Oracle, are often customised to the specific needs of corporations and are capable of integrating processes across different geographical locations and legislative frameworks.

2. Small and mid-sized businesses — modular, custom-built ERP

- For SMEs, ERP systems are becoming increasingly accessible, mainly thanks to the rise of cloud-based solutions and modular platforms offered by various software vendors. These businesses need flexible and cost-effective systems that can be tailored to their specific requirements. Modularity enables companies to select only the functions they truly need.

3. Public sector

- ERP systems are also widely used in the public sector and nonprofit organizations. In this context, they are often applied to public finance management, resource planning, project administration, and compliance with regulatory standards. Public institutions frequently face pressure to maintain transparency and efficiency, and ERP systems help them meet these requirements. Nonprofit organizations, on the other hand, can leverage ERP systems to track donations, manage volunteers, and plan projects.

ERP Systems are used by Different Groups of Users Within a Company

4. Senior executives and managers at various levels of the company

- Managers at different levels of the organization use ERP systems for data analysis and to support strategic decision-making. ERP systems provide them with insights into key performance indicators (KPIs), enable resource planning, and support the setting of strategic objectives. For managers, the accuracy and timeliness of the data provided by the ERP system are essential in order to manage the organization effectively.

5. Operational employees from different departments — carrying out daily tasks

- Operational employees who handle day-to-day tasks—such as processing requests, managing accounting, creating orders, processing production technologies, overseeing manufacturing, and reporting—use ERP systems to streamline their work. These users need an intuitive interface and features that allow them to complete their tasks quickly and accurately. ERP systems automate many routine processes, leading to higher productivity and reduced error rates [4-7].

Materials and Methods

The goal of the analysis was to create a detailed overview of the current state of processes within the company, which would serve as a basis for the future comprehensive and functional setup of processes, as well as the creation of a digital, functional whole to meet the needs of an industrial enterprise. The analyzed industrial company set its main objective as designing a method for digitalizing and optimizing production and supporting processes in order to increase the efficiency of the entire order flow. For reasons of data confidentiality and the requirement to maintain anonymity, this specific company will be referred to in the following chapters simply as "the industrial enterprise," although it is in fact a real business operating in Slovakia.

The analysis of business processes and data flow mapping begins with a scheduled meeting with representatives of the analyzed company. At the outset, it is necessary to describe the company's processes in general from the perspective of a representative who has a comprehensive overview of the organization (for example, a managing director or a process engineer). After the initial consultation, a detailed analysis follows for each process area, conducted in a dedicated room, where the cooperation of employees competent to consult in the following areas is required:

- **General process description:** Process specialist, Managing Director
- **Sales department:** Representative/responsible person for company operations
- **Estimator/Costing specialist:** Representative/responsible person for company operations
- **Design/Engineering department:** Representative/responsible person for company operations
- **Technology/Process engineering department:** Representative/responsible person for company operations
- **Purchasing department:** Representative/responsible person for company operations
- **Warehousing and inventory management:** Representative/responsible person for company operations
- **Production planning and control, Quality assurance:** Representative/responsible person for company operations
- **Shipping and production completion:** Representative/responsible person for company operations
- **Finance/Accounting department:** Representative/responsible person for company operations.

After completing all consultations with the respective employees responsible for individual process areas, a tour of the production followed. During this tour, the entire order flow was reviewed directly within the industrial enterprise, across various departments and production facilities—from initial customer communication through the pre-production stages, up to actual manufacturing and the dispatch of the finished product. Based on this analysis, laboratory testing of solutions was carried out using the company's data at the TestBed 4.0 laboratory in Košice at TUKE University, where ERP solutions are simulated and validated to meet the needs of industrial enterprises.

Reporting and Assessment

At present, the company is able to define the estimated actual costs of an order/product as follows:

- Actual material cost based on received invoices
- Production labor cost taken from the ERP system database
- Subcontracting/outsourcing costs — currently based on received invoices.

In practice, such evaluations are not carried out, as they are neither accurate nor efficient.

The industrial enterprise does not yet have a centralized data collection system from production equipment (machines). However, this data would be highly valuable—particularly for understanding the actual utilization of production equipment, as well as for refining the inputs to the planning system (e.g., the ERP system).

Pre-production Stages – Opportunities for Improvement

- **Inconsistent and unreliable data:** Information is scattered across different systems and depends on manual retrieval by employees, which increases the risk of errors and undermines the reliability of decision-making processes.
- **Estimated production time without detailed data analysis:** The time required for production is only estimated, without precise use of in-depth data analytics.
- Duplicate work with documents.
- **Work-in-progress tracking online:** Needed for effective management of received orders.
- No fast/online and accurate actual product costing.
- **Lack of real-time inventory overview:** Without an online system, warehouse status, reservations, and order lists must be checked physically.
- **Unclear status of purchase orders:** The status of purchase orders can only be tracked manually through XLS files.

Production Stages – Opportunities for Improvement

- **Manual planning:** The production manager plans without support software, relying on expert estimates, which may lead to errors and reactive, short-term production planning.
- **Lack of feedback and records:** There is no real evidence of machine utilization, production times, or product quality.
- **Complicated product tracking:** Tracking products is difficult and depends on manual records.

- **Inefficient use of machines:** Machines are underutilized, and no tool is available to highlight this issue.
- **Maintenance:** Maintenance in production and logistics is not systematically recorded; it is carried out as needed, which may result in longer production downtimes.
- **Quality:** Quality control in terms of OK/NOK pieces is not electronically documented.
- **Stress and employee overload:** The pressure to meet deadlines, combined with the above operational issues, may lead to high workload and stress among employees, negatively affecting their performance and morale.

Based on the analysis carried out, the industrial enterprise gained a comprehensive overview of its business processes and the current way in which data flows within the company. This "helicopter view" allows management to look at the company as a whole—clearly seeing how departments collaborate, where information is transferred, and what bottlenecks or shortcomings may arise. Such a complete picture of operations is an essential foundation for making meaningful and effective decisions about process optimization and digitalization. Without this type of analysis, the company would face a high risk when implementing an ERP system, as the new technology might not cover its actual needs, potentially leading to further organizational and financial complications. On the other hand, with a detailed understanding of the current state, it is possible to prepare the ERP implementation in a way that reflects real conditions, reduces costs, and maximizes benefits for users and for the enterprise itself.

Discussion

The results of the analysis indicated that the key to effective management lies in the implementation of a centralized information system (ERP) and the development of a fully functional digital ecosystem for the enterprise. The main goals include integrating data into a single platform, enabling capacity planning for production based on real operational data, and improving communication between departments. These recommendations stem from findings that highlighted insufficient control over bills of materials and technological procedures, the inability to quickly and accurately determine the status of work-in-progress orders, and the lack of digital support for tracking project-specific costs.

The ERP system should be considered the foundation of the digital ecosystem, into which individual specialized solutions (whether existing or new) will be integrated. We propose considering the development of an "IT ecosystem" as follows:

Pre-production Stages – Proposed Changes

- Comprehensive recording of business cases and documentation within a single system = ERP as the primary working tool.
- Processing of business cases managed through predefined workflows (WF).
- Data updates handled directly in the ERP.
- Pricing generated from the ERP (with online availability of material stock levels, demand, cost, availability, and production capacities), transferring know-how into the digital ecosystem.
- Introduce a standardized and managed costing process.
- Gradually use actual costs to refine pricing and conduct customer analyses.
- Online tracking of work-in-progress (necessary for managing received orders).
- Delivery dates should be based on the actual available capacities and the current state of the enterprise.
- Recording of technological procedures, including operation times, in the ERP.
- Recording of material consumption through the ERP.
- Recording of subcontracting activities through the ERP.
- Use of data for clear identification of order and product costs.

Production Stages – Proposed Changes

- Implementation of a fully integrated warehouse management system in the ERP (POs, issues, receipts, returns, delivery notes, deadlines, reservations, and summary orders).
- Introduce regular inventory audits, at least once a year, within the ERP system.
- Generate documentation for Intrastat reports directly from the ERP system.
- Manage issued purchase orders comprehensively in the ERP, based on real-time status and needs.
- Enable online monitoring of warehouse stock and introduce material reservations.

Production planning and control managed through ERP, including:

- Capacity planning
- Support through visualizations
- Execution of work in production via job/production orders

Ability for Management to Prioritize Orders

- Ensure production is carried out according to the currently valid production documentation linked with production orders.
- Introduce recording of final quality control in the ERP system, including evaluation and costing of defective or non-conforming products.
- Collect production data using barcode scanning — enabling real-time feedback from the shop floor.
- Track the actual state of work-in-progress based on inputs from production.
- Record actual costs (materials, depreciation, subcontracting).
- Evaluate orders based on a comparison of planned vs. actual costs.

Recommended Stages of Implementation

We recommend starting the implementation gradually, focusing first on a selected process or application based on the priorities of the industrial enterprise [8-10].

Main Points for the Digitalization of Processes in an Industrial Enterprise

Implementation of comprehensive management and digitalization of an industrial enterprise through an ERP system:

We Propose the Following Implementation Scenario

1. **Stage 1:** Introduce comprehensive process digitalization by deploying the ERP system across the entire industrial enterprise within 6 to 9 months from the installation of the solution on the server.
2. **Stage 2:** In subsequent project stages, it will be possible to address specific requirements in greater detail as they emerge after the solution's implementation, as well as to further expand digitalization within the enterprise through additional optimization-focused digital solutions..

Conclusion

Small and medium-sized enterprises (SMEs) represent the backbone of the European economy, but they continue to face challenges related to competitiveness, innovation, and efficient resource management. The analysis carried out in this study demonstrates that a carefully implemented Enterprise Resource Planning (ERP) system provides a powerful foundation for overcoming these challenges.

The findings confirm that the absence of centralized, reliable, and real-time data management significantly undermines productivity and decision-making. Process mapping revealed fragmented communication between departments, inconsistent costing, and insufficient production tracking as the most pressing issues. By designing and implementing a tailored ERP solution, enterprises can unify data, streamline workflows, and establish a digital ecosystem that supports efficiency, transparency, and long-term competitiveness.

The proposed ERP implementation scenario, divided into gradual stages, ensures that digital transformation does not overwhelm the enterprise but instead aligns with its operational needs and strategic objectives. In doing so, ERP becomes more than just a software system—it evolves into a strategic tool for sustainable growth, enabling SMEs to improve their responsiveness to market dynamics while optimising resources and enhancing overall organisational performance.

Ultimately, the research highlights that digitalization, supported by ERP, is no longer optional for SMEs but rather a critical necessity. Enterprises that adopt such integrated systems will be better positioned to innovate, adapt, and succeed in the global economy.

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