

Impact of enterprise resource planning software implementation on companies' efficiency

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Abstract. This article is devoted to the description of the results of the research of the impact of the introduction of ERP-systems on the economic and financial performance of the company. To conduct an empirical study, 50 Russian companies of petrochemical production were selected. The purpose of the research was to quantify the results of the ERP systems implementation. Performance evaluation is of the interest to company executives and the board of directors, since the process of implementing an ERP system requires impressive financial investments and labor costs. However, at present, there are difficulties with scientifically based methods for evaluating the results of the ERP systems implementation. Software vendors announce attractive numbers about the effectiveness of the ERP systems implementation, but can they be trusted, since they are interested in sales. Therefore, we proposed the Monte Carlo method to assess the impact of the introduction of ERP systems on the efficiency of the company. The company's costs and savings characterize variables, increase in net profit and NPV were selected as result variables. As a result of the study, obtained data show both the probability distribution in relation to the indicated variables, and the average values of the implementation effects in such areas as stocks and production, working capital, efficiency, labor costs and reporting. According to the results of the analysis of the selected population, the greatest effects from the introduction of ERP-systems were obtained in the formation of management reporting and logistics, which is due to the greatest attention of managers and IT companies to these issues.

1 Introduction

ERP systems emerged when the improvement of processes and the accuracy of information became the most important strategic issues for business development. Almost all modern companies now need a reliable system for managing various assets. Without effective tools, it is difficult to control production and sales, and other business processes. As the business grows, the company needs to increase the efficiency of obtaining management reporting. In addition, the company needs to streamline operations as it expands its business activities.

The emphasis on supply chain management and the development of information technology has necessitated the integration of processes throughout the company. Over the

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past few years, ERP has become a necessary system for almost every company. Today, more than 80% of medium and large companies have installed or are planning to install a comprehensive ERP system.

Nowadays, enterprise resource planning (ERP) is no longer the exclusive prerogative of multinational corporations. Fig. 1 shows the percentage distribution based on the size of companies that implement ERP and CRM systems.

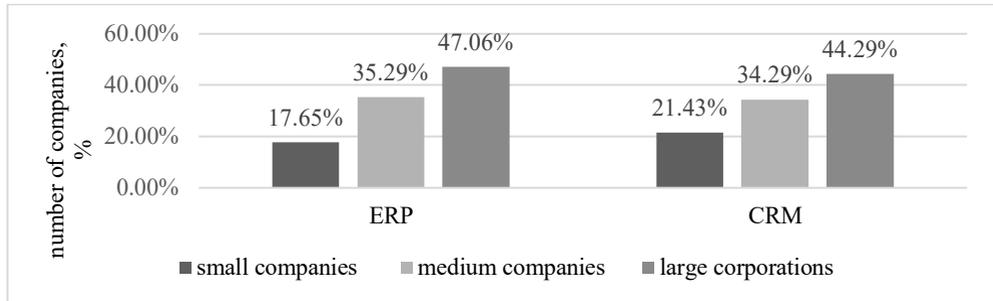


Fig. 1. Enterprises implementing e-business applications by size class, EC-27, 2019 [1]

According to surveys of companies that have implemented ERP systems [1-10], their impact on management practices has a number of benefits, which, in particular, include: increased flexibility in creating information, improved quality of reports, increased integration of accounting applications and improved solutions based on timely and reliable accounting information.

Various studies [2,7,11-17] indicate that companies expect ERP systems to improve company performance. However, to evaluate the impact of ERP-systems on the performance of the company is a rather difficult issue. It is not easy to determine what effect the implementation of an ERP system will have for two different companies, but there are common points.

As a rule, a positive effect can be achieved through the following: reducing the duration of the production cycle and optimizing the volume of work in progress; acceleration of capital turnover; reduction of inventory in the warehouse, optimizing the size of purchases and regulating the balance of goods, respectively, increasing savings on storage of stocks up to 40%; ensuring constant access to up-to-date information and the availability of tools for its qualitative analysis; optimization of the product ordering system, thereby improving the quality of customer service; high-quality and objective reporting; reducing the duration of the process of closing reporting periods.

According to published research by Panorama Consulting Solutions: the share of projects that received economic benefits as a result of implementation does not exceed 0.61; the share of projects implemented within the planned time does not exceed 0.53; the share of organizations satisfied with the implementation of the ERP system was 0.53.

Thus, the problems of substantiating the need to launch ERP systems and evaluating the effectiveness of their results remain relevant at the operational level of management [9,14]. The complexity of the process of assessing the return on investment in the ERP system, in the absence of a unified approach, exacerbates the problem. In the traditional view, the decision to implement an ERP system is methodologically based either on project and investment analysis, or on the approaches of project management and process analysis. At the same time, each of these methods is suitable for analyzing only certain aspects of assessing the feasibility of implementation [3]. Thus, project analysis methods are based on investment indicators that are difficult to assess before the start of the implementation process: almost any assessment included in the model for calculation, initially based on

empirical assessments of implementation risks, will ultimately differ greatly from reality and cannot provide an accurate return forecast from investments in the ERP system.

The aim of this study is to develop theoretical and methodological provisions focused on financial justification and support for making a decision on the implementation of an ERP system in a company, allowing to determine the most productive structure of its functional elements, taking into account the compliance of the capabilities of the considered ERP systems with current and strategic goals.

2 Materials and Methods

The object of the study was 50 petrochemical companies of the Russian Federation - producers of polypropylene. The largest petrochemical companies are presented in Fig. 2.

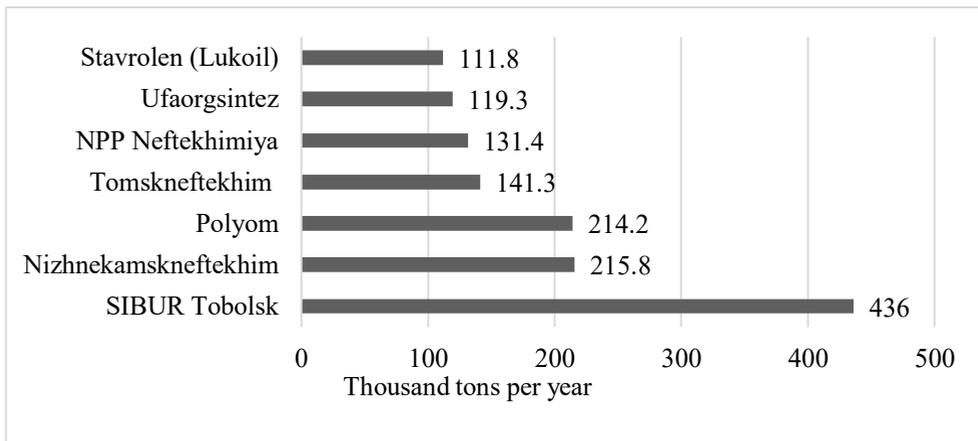


Fig. 2. The largest petrochemical companies - producers of polypropylene in the Russian Federation

The choice of the object is due to the high level of implementation of ERP systems in petrochemical companies and the need to ensure industry identity. It is believed that company resource planning (ERP) is able to maintain the efficiency of the business process of goods or services through the reliable flow of information and the rapid exchange of data between various functional departments of a company or several business units. Many managers are aware of this benefit, but they still hesitate when deciding to implement an ERP system [4,8,9]. Doubts are due to large budgets for implementation and the risk of not getting the expected effects. Calculating the effectiveness of implementing an ERP system using cost-benefit analysis is essential for making a decision.

Consider how the cost-benefit factor in economic evaluation can be applied to an ERP system implementation project. The expected increase in market share due to customer satisfaction is defined in terms of the time and quality of the information cycle between customers and suppliers using a system based on fuzzy rules [12]. Cost-benefit analysis is a methodology that is often used when calculating the performance of a company after the implementation of an ERP system or other corporate information systems. In addition, Monte Carlo simulations are used to account for such uncertainties when calculating the expected net present value (NPV). Monte Carlo simulation, also known as multiprobability simulation, is a mathematical technique that is used to evaluate the possible outcomes of an uncertain event. In this paper, the Monte Carlo simulation method is used to calculate the expected net present value (NPV) of an investment in an ERP system.

When the input data is entered into the model, the probability distribution of the expected increase in sales is generated. In the analysis, the costs of implementing an ERP

system are structured into non-recurring costs and ongoing costs. These expenses consist of: installation costs, including hardware, software and its configuration; data control costs, including inventory records, bills of materials (BOMs) and routes; expenses for staff training, involvement of external consultants, etc.

The effects after the implementation of the ERP system, which were calculated, are derived from forecasts and probabilities of increasing revenue, cost savings, such as annual savings in materials on purchases, savings in inventory, and direct savings in labor. Profit growth variables are calculated taking into account the sales growth rates, which were estimated by a system based on fuzzy rules. The net present value of investment in the implementation of the ERP system was determined for 3 years (average implementation period), taking into account the average WACC rate according to the reporting data of the selected set of petrochemical companies.

3 Results

The simulation results allowed us to determine the range of effects from the implementation of ERP systems in the group of companies under study. In particular, within the framework of this study, we calculated the probability distribution for the following parameters: cost savings, profit increase, NPV of the project. According to the simulation results, cost savings for a sample of companies range from \$13,210,534M to \$18,366,427M. Savings in materials, inventory, and direct labor costs were calculated taking into account increased sales, unit costs, and cost savings rates (Fig. 3).

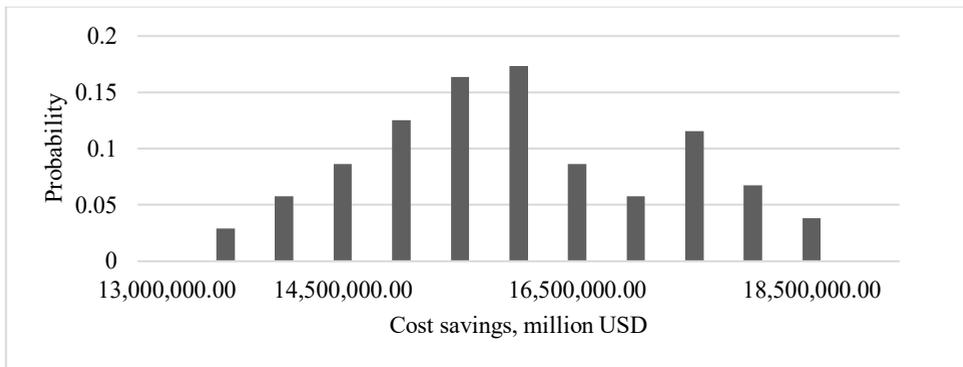


Fig. 3. Simulation results for total cost savings after implementing an ERP system, in millions of dollars

The profit increase ranges from \$452,390M to \$3,439,477M, as shown in Fig. 4.

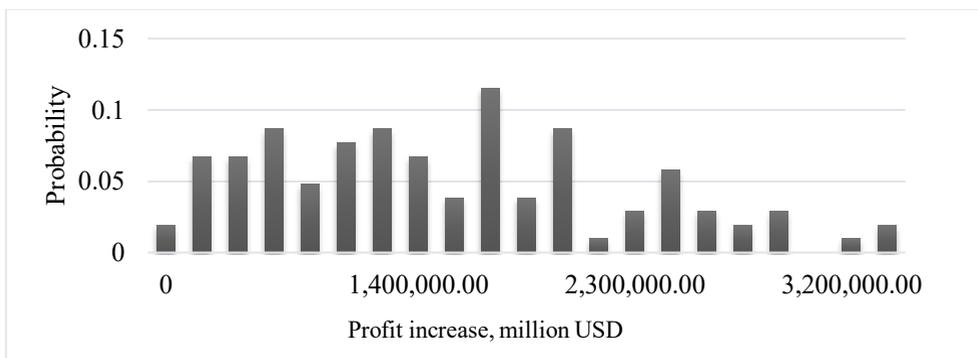


Fig. 4. Simulation results for profit growth after the implementation of the ERP system, in millions of dollars

Figure 5 shows the NPV distribution of investments in ERP with a mean of \$3,955,303M million USD and a standard deviation of \$1,987,365M million USD, ranging from negative value in \$58,737M to positive \$8,763,751M.

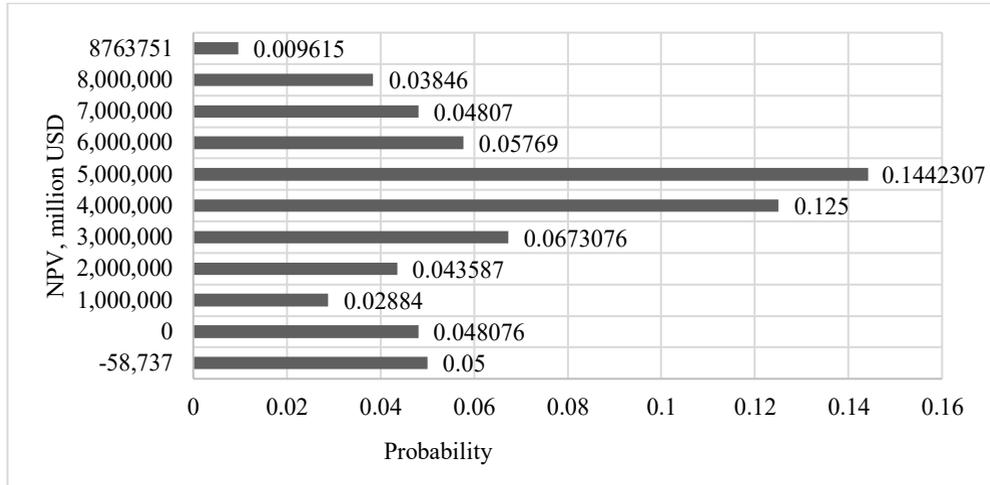


Fig. 5. Simulation results for NPV, in millions of dollars

According to the analysis, investments in an ERP system over a three-year horizon have more than a 95 percent confidence level that NPV will be positive, but there is a probability that investments in ERP systems will be unprofitable with a value of less than 5%. Thus, while this result helps managers make decisions about investing in ERP systems, managers must consider the potential for failure that could prevent the ERP system from delivering good performance. Table 1 shows the overall economic impact of implementing an ERP system in terms of overall economic and financial performance for the selected population.

Table 1. Economic effect from the implementation of the ERP system

Indicator	Efficiency, %
Reduction of labor costs in departments	20%
Accelerating the receipt of management reporting	70%
Accelerating the receipt of financial statements	15%
Decrease in inventories	10%
Reducing the cost of material resources	5%
Reduction of production costs	15%
Reduction of operational and administrative expenses	10%
Inventory turnover growth	8%
Reduction of terms of execution of orders / provision of services	20%
Reducing the cost of products / services	7%
Increase in the volume of products / services provided	25%
Profit growth	25%
Speed up order processing	40%
Labor productivity growth in production	15%
Reduction of accounts receivable	10%

It can be concluded that the introduction of an ERP system has a strong impact on both financial performance. We see the highest percentage in terms of speeding up the receipt of management reporting - 70% and speeding up the processing of orders. This is due to the fact that companies are primarily interested in automating financial and management accounting. In addition, the standard solution for setting up an ERP system at most facilities primarily includes an accounting and logistics module.

For a comprehensive assessment of the impact of the introduction of an ERP system on the efficiency of companies, we have identified 4 groups of generalizing indicators, such as: stocks and production; working capital; efficiency; labor and reporting. Each of the groups includes a number of performance indicators of the company. The results are presented in table 2.

Table 2. Indicators of economic efficiency of the implementation of the ERP-system

Performance indicator		Average value for a group of research objects
stocks and production	Decrease in inventories	20%
	Reducing the cost of material resources	11%
	Reducing production costs	12%
	Reducing the cost of products	8%
	Increase in output	29%
	Growth of labor productivity in production	14%
working capital	Growth of inventory turnover	25%
	Reduction of receivables	19%
efficiency	Speed up order processing	85%
	Reduction of terms of execution of orders	26%
	Reducing operating and administrative costs	20%
	Profit Growth	14%
labor and reporting	Reducing labor costs	35%
	Accelerating the receipt of management reporting	3 times
	Accelerating the preparation of financial statements	3.1 times

4 Discussion

Analysis of the results led to the conclusion that in most cases the introduction of an automated system provided: reduction in the time for obtaining management and financial reporting; reduction of production, operating and administrative costs; increase in inventory turnover; reducing labor costs and increasing labor productivity.

The introduction of a new information system is a significant, but also a difficult event for a company. Therefore, the implementation process of the selected system should not be

underestimated. To ensure the smooth progress of the entire implementation, it is important to carry out a risk analysis. We identified 20 possible types of risks (see Table 3).

Table 3. Characteristics of risks of implementing ERP systems

N	Type of risk	Probability of occurrence	Risk impact	Risk value
Personnel risks				
1	Lack of adaptation to change	Medium	Medium-negative	Medium
2	Ineffective employee training	Medium	High-negative	High
3	Communication failure	Medium	Medium-negative	Medium
4	Underestimating the need for risk management	Low	High-negative	Medium
5	Risk underestimation	Medium	High-negative	High
Organizational risks				
6	Failure to comply with the deadline	High	Medium-negative	High
7	Omission of original research	Medium	High-negative	High
8	Insufficient needs analysis	Medium	High-negative	High
9	Choosing the wrong system	Low	High-negative	Medium
10	Wrong choice of project team	Low	Medium-negative	Low
Financial risks				
11	Budget shortfall	Medium	High-negative	High
12	Non-refundable investment	Medium	High-negative	High
Security risks				
13	Security of computer stations	Medium	Medium-negative	Medium
14	Bad security system	Low	Medium-negative	Low
Technological risks				
15	Data corruption	Low	High-negative	Medium
16	Data backup	Low	High-negative	Medium
17	Data transfer	Medium	High-negative	High
18	Errors in the information system	Low	Medium-negative	Low
19	Non-compliance with the stages of project implementation	Low	Medium-negative	Low
20	Unpreparedness of the information environment	Low	Medium-negative	Low

High risk indicators arise mainly due to the discrepancy between the implementation deadlines planned, the lack of initial research and reengineering of business processes for the ERP system, insufficient analysis of the company's needs, budget overruns, irretrievable investments in a new information system that can bring the company less benefit than will cost implementation, incompleteness of data when transferred from one system to another.

5 Conclusions

Based on the results of the analysis, we can conclude that the ERP system has a positive effect on the company's activities. The profit growth of companies averaged 14%, which indicates a good trend. The increase in output amounted to 29%, which has a positive effect on the economy as a whole. The ERP-systems market is one of the fastest growing, however, the factors constraining its development are clearly distinguished: high level of investment costs and, as a result, fragmented implementation of automated systems; long terms of project implementation and relatively long payback period; inconsistency between the actions of the company's managers and specialists in the development and implementation of ERP systems; lack of specific goals and objectives for the implementation of the project; non-formalization of business processes; social and moral-psychological difficulties of adaptation of automated systems and resistance of workers.

Summing up the above, it can be argued that today for many companies the introduction of integrated automation is an urgent task. Business leaders come to understand that the implementation of an ERP system leads to positive changes in the company and makes it possible to save time and money in the long run. For this reason, the volume of investment in management information systems is increasing.

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