

## METHODOLOGY OF ERP SYSTEM IMPLEMENTATION – A CASE STUDY OF PROJECT-DRIVEN ENTERPRISE

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**Abstract:** Enterprise resource planning (ERP) systems are an application software implemented in a great number of manufacturing companies worldwide. The implementation of an ERP system is performed to integrate business processes, allocate company's resources efficiently and provide important data for decision support. Implementing an ERP system is expensive and time-consuming. A lot of research activities are focused on key success factors of ERP implementations. But what does a successful implementation of an ERP system mean? If an ERP project is completed according to the schedule, the budget was not exceeded and the scope was realized, does this mean that the implementation was successful? The implementation of an ERP system is a long-term undertaking, and not only a short-term project that is finished just after the system installation. Especially for a project driven enterprise that realizes engineer-to-order production, the evaluation should encompass a long period of time. In this article a methodology of ERP system implementation dedicated for project driven enterprises is presented. The methodology is based on a set of assumptions and limitations that enable to indicate if the strategic goal of the ERP implementation is reached. The evaluation of ERP projects is based on the calculation of different productivity ratios of the enterprise in several periods. An illustrative example is given.

**Keywords:** enterprise resource planning (ERP), project driven enterprise, implementation methodology, productivity, case study.

### 1. Introduction

Enterprise resource planning is software packages that integrate departments, functions and coordinate business processes in different running through functional areas of a company onto a computer system. Enterprise-wide resource planning systems (ERP systems) attempt to integrate all corporate information in one central database, they allow information to be retrieved from many different organizational positions, and in principle they allow any organizational object to be made visible. It has been suggested that such systems facilitate unprecedented levels of organizational integration (Davenport, 2000). Every year companies invest a lot of money in the implementation of enterprise resource planning (ERP) systems. The ARC Advisory Group estimates that the total ERP market in 2006 was \$18.4 billion and foresaw an annual growth of the market to the level of 6.7 %. It means that by 2011 the value of the market will have reached \$24 billion. The implementation of an ERP system in a company is not only expensive but mostly introduces a lot of disturbances into enterprise operation activities and, in the worst case, can lead to full paralysis of the firm. The ERP systems are developed from almost 20 years especially for manufacturing companies. Typical branches where ERP systems are used include enterprises that complete discrete production such as the automotive, electronic or furniture industry. Organizations that practise engineer-to-order production such as machine construction, building companies or other project-driven enterprises are often convinced that standard ERP software can not be implemented to support projects completion.

In the last few years the number of scientific publications dealing with ERP systems increased rapidly (Botta-Genoulaz, 2005) in the following areas: implementation of ERP systems, optimization of ERP systems, management through ERP systems, ERP software, ERP and supply chain management, case studies. Some researchers add (Basoglu, 2007) ERP selection, ERP success factors, and cultural issues in ERP to the classification. Many researchers investigated critical factors (e.g., top management support, sufficient training, appropriate project management, communication, etc.) for the success of ERP implementation. For example, Hong and Kim (Hong, 2002) define the concept of organizational fit of ERP and

examine its impact on ERP implementation on the basis of surveys from 34 organizations. Motwani *et al.* (Motwani, 2005) use a case study methodology grounded in business process change theory to understand the factors that lead to the success or failure of ERP projects. The results from comparative case study of 4 firms that implemented an ERP system suggest that a cautious, evolutionary, bureaucratic implementation process backed with careful change management, network relationships, and cultural readiness have a positive impact on several ERP implementations. Al Mashari *et al.* (Al Mashari, 2003) present a taxonomy of the critical success factors in the ERP implementation process that measurement takes place in a balanced perspective, and for the purpose of providing useful information that can enable the decision-making process and, which can help deliver the corporate objectives and therefore lead the business competitively forward. On the basis of a series of case studies and an extensive survey Mabert *et al.* (Mabert, 2003) analyse the impact of different sizes of companies on ERP implementations across a range of issues. Nicolaou and Bhattacharya (Nicolaou, 2006) examine the long-term financial performance effects of ERP system changes/revisions for firms that have previously reported ERP adoptions. The article is based on experience of implementing ERP systems in several companies from machine construction branches where ERP systems are implemented. The presented methodology takes into account the specificity of the project driven enterprise and enables the preparation a successful implementation of ERP and measurement of the impact on the enterprise condition. In the next paper the model of project driven enterprise and the methodology of ERP implementation are proposed.

## 2. Project driven enterprise and ERP implementation methodology

The project driven enterprise deals with the design and manufacturing of unique products and services (projects) for individual clients. The project-driven enterprise realizes engineer-to-order projects, for example, there are some mechanical engineering firms that belong to the category of small and medium-sized enterprises. Let us consider the Polish company *Alpha* that produces machine tools and technological lines for industry. The average completion time of a project in the *Alpha* company is between 6 and 12 months. For the enterprise, efficient knowledge and business experience management are key success factors that decide about product competitiveness. The management of the enterprise makes a decision about the necessity of implementing an enterprise resource planning system. A range of the analysis can be difficult to define because the management of the small and medium-size enterprise often does not have enough knowledge about ERP systems. To make a final evaluation of the efficiency of implementing an ERP system, a set of evaluation measurements should be defined and the decision about the implementation of an ERP system should be preceded by a detailed analysis of business processes running in the enterprise. After the mapping of business processes the top management of the *Alpha* company, the following critical goals of the ERP implementation were defined:

1. Time reduction of offer preparation – quick evaluation and calculation of product costs.
2. Time reduction of product design – quick preparation of BOM (bill of material).
3. Better prototype costs estimation.
4. Monitoring of projects work in progress – monitoring of design, technology and assembly operations.
5. Monitoring of real costs of the project.
6. Inventory reduction.

For the critical goals the following assumptions and limitations for ERP system are specified:

- A detailed calculation scheme is prepared.
- The whole BOM can be copied from one product to another and new indexes during the copying function can be generated.
- Each operation in the *Alpha* company can be registered and assigned to production order.
- The material management processes can be totally changed.

For the specified goals, a new methodology of ERP system implementation is prepared that includes: determination of most important data sets, description of general procedures of business processes execution in the ERP system and specification of measurement factors that enable to evaluate the ERP system efficiency during the implementation process and in the next years. After the first three steps the ERP system supplier can be determined and the scope, budget and schedule of ERP implementation should be prepared. The milestones of the ERP project should be determined to evaluate implementation progress. The methodology is presented in Fig. 1.

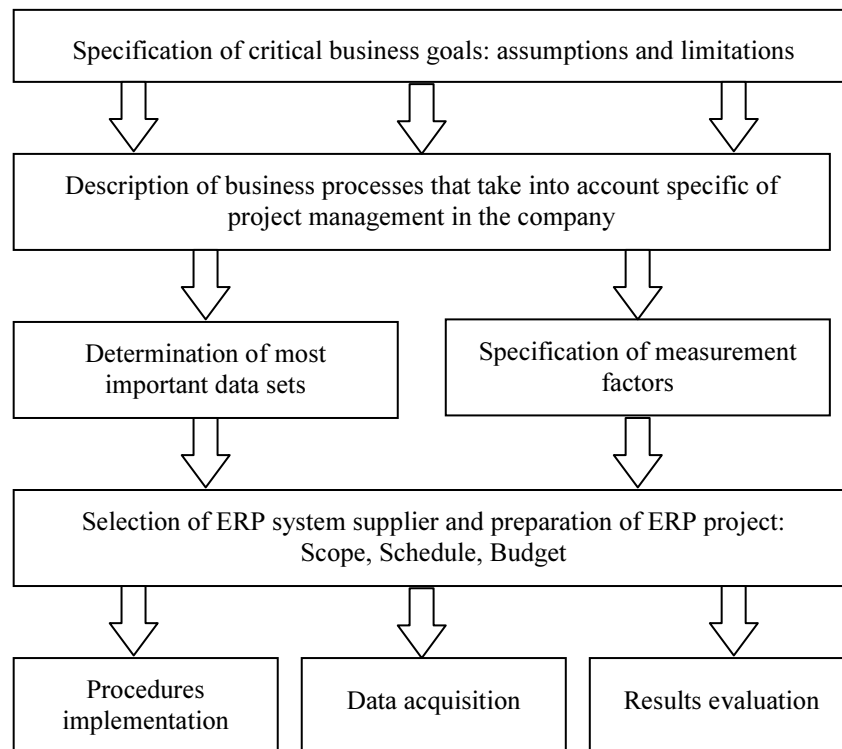


Fig. 1. The methodology of ERP implementation in a project driven enterprise

The project of ERP system implementation was performed in the *Alpha* company in 2002-2003. A big problem of the ERP implementation is shown by a number of material indexes and complexity of bill of materials that include thousands of positions. An ERP system requires a detailed specification of material quantities from the constructor (manufacturer, designer). The bill of material preparation enlarges operation time and labor intensity in the product design functional area of the *Alpha* company. But in the sales department of the company the time of calculation preparing is reduced. That means the first goal was reached at the expense of the second goal. To fulfill the second goal an additional function for ERP is implemented that enable to generate BOM from CAD system to ERP automatically (Klos, 2005). Detailed specification of BOM and registration of operation times in product design, technology and assembly areas enable to build the knowledge database. On the basis of history the rapid calculation of the new prototypes is possible. The implementation of ERP in the *Alpha* company requires time registrations by each employee of the company. The work breakdown structure of each project is present in the system and each operation completed in any functional area should be registered for the project in the ERP system. It enables monitoring of the project work in progress and growing labor costs. Before ERP implementation, the required materials were ordered individually for every project in the *Alpha* company. The implemented MRP function (Material Requirement Planning) enables to order comprehensive materials for many projects. Each project is divided into many production orders that determine the required materials and the set of technological operations. Each production order is determined by start and end data. The start data determine when the required materials should be accessible in the warehouse, but material should not be in the warehouse for more than 7 days.

To evaluate the efficiency of the ERP system in the project driven enterprise, the productivity factors are used. In the next chapter the evaluation procedure of the ERP system is presented.

### 3. Evaluation of ERP system implementation in project driven enterprise

To evaluate the implementation of the ERP system in the *Alpha* company, some data are selected and presented in Table 1 from 2002 to 2006. On the basis of the data the ratios of total enterprise productivity, inventories productivity and labor productivity are calculated.

**Table 1.** Important ratios of the project driven enterprise 2002–2006

Ratio	2002	2003	2004	2005	2006
Net income	57535039	70321448	86688575	87189582	104712076
Costs	40636458	44612068	60098533	69003845	73612411
Inventories	14914622	17149945	18543308	16673952	12477788
Number of registered hours	8216	361491	286290	257219	167121
Number of production orders	–	14741	9075	8437	8072
Number of sales offer		650	941	1100	1077
Enterprise productivity	1.42	1.58	1.44	1.26	1.42
Inventory productivity	3.86	4.10	4.67	5.23	8.39
Labor productivity	–	194	302	338	626
Sales offer productivity	–	109213	92606	80090	97729
Production orders productivity	–	4770	9552	10334	12972

The total productivity of the considered company is decreased after ERP implementation (1.44 in 2004 and 1.26 in 2005) but the inventory productivity is increased and especially in years 2005 and 2006 (see Fig. 2).

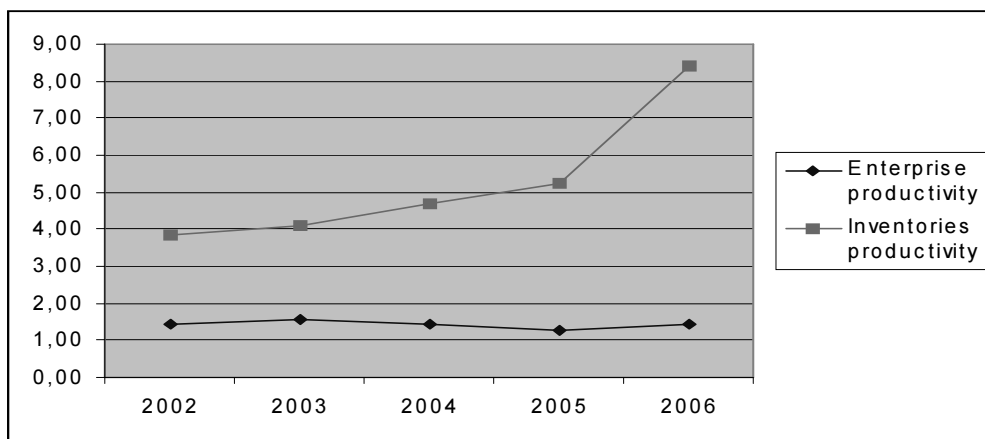
**Fig. 2.** Productivity ratios of Alpha company.

Fig. 3 shows an example of material storage. The material is very expensive and often ordered by the *Alpha* company. It is simple to observe that after 2004 the method of material purchase is changed. At the end of 2006 it can be seen that the quantity of the material in the warehouse is dramatically increased. The number of registered hours in the enterprise is smaller and smaller every year (361,491 in 2003 and 167,121 in 2006). This results from the outsourcing of a lot of activities. Increased labor productivity of the company does not result from higher efficiency of employees but from the small quantity of registered hours.

The productivity of production orders shows that income on the production order is getting better from year to year. The analysis of changing sales offer and sales offer productivity shows that the annual number of offers is about 1000. The sales offer productivity stays on the same level (levels off) at about 100,000. It is not possible to measure if the time of offer preparation was reduced because the users of ERP did not introduce the times of offer preparation (data of start and end of the offer preparing), but probably the critical goal was not properly selected because the annual number of offers is stable. The example shows that to evaluate if any goal of ERP implementation is reached, the determined data should be introduced to the system. Some evaluation data can be introduced automatically (for example, opening a new offer automatically generates the start date and printing or sending the data generates the completion date). As many data for ERP evaluation as possible should be generated automatically to not charge the ERP user. Every year the *Alpha* company should make ERP audit with user evaluation.

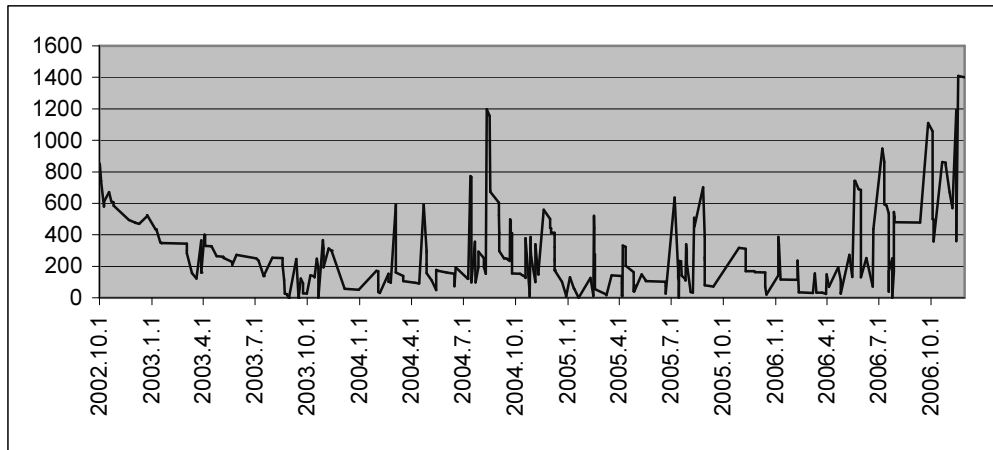


Fig. 3. An example of material storage in the *Alpha* company

#### 4. Conclusions

In the paper the implementation methodology of ERP systems in project driven enterprise is presented. The methodology is based on the measurement of the impact of ERP on productivity ratios of the enterprise. The methodology was used four times to implement ERP systems in a project driven enterprise but for the same ERP vendor (without the step of selecting the ERP system supplier). The ERP systems are relatively expensive and the management are interested if the investment in the IT area is profitable, and the proposed methodology not only enables to evaluate an implementation of ERP but also enables to proper fit the project driven enterprise requirements for the ERP system possibilities. The methodology will be expanded for data and business processes analysis to support the development of the ERP system. To evaluate the ERP implementation the standard economical ratios can be analyzed such as: return on sales, return on investment, return on assets, current ratio, quick ratio or working capital. Using the indexes in the proposed methodology and making analyses every month make quick reactions to problems with enterprise management possible. The special ERP efficiency report can be generated monthly as a basis for enterprise evaluation.

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