

# Using Analytic Hierarchy Process Method in ERP system selection process

Rima Tamošiūnienė<sup>1</sup>, Anna Marcinkevič<sup>2</sup>

**Abstract.** IT and business alignment has become of the strategic importance and the enterprise is forced to be able to perform well under the abundance of information and hyper competition conditions. It encourages business to invest in ERP projects as ERP systems can integrate all the business processes and help to improve the effectiveness of them. ERP implementation projects and ERP system and vendor selection are characterized by complexity, variety of processes and time consuming. Companies avoid participation in ERP selection process and usually transfer the responsibility on consultants and vendors chosen by the consultants. Authors propose to use AHP model as a supportive decision making tool for ERP selection in order to participate in ERP implementation actively and achieve higher benefit take-up rate.

**Keywords** – Enterprise Resource Planning (ERP), ERP selection process, ERP selection criteria, decision making methods, AHP model.

## I. INTRODUCTION

In the fast Information Technology (IT) society of today, there have been various changes in the organization behaviour. The enterprise is forced to be able to perform well under the abundance of information and hyper competition conditions. The basis of the enterprise survival in the market and the core development factors are innovation, improving efficiency, reducing costs and increasing competitive advantage by effectively managing informational knowledge. The information has become a strategic corporate resource and encourages business to invest in IT projects.

Different measures are used to support the information and knowledge management processes and one group of them are variety of IT and information solutions such as Enterprise Resource Planning (ERP) systems. ERP systems are software packages that enable the integration of transactions oriented data and business processes throughout an organisation. ERP integrates all the enterprise processes, and thus allows controlling and optimizing the business and its individual processes.

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ERP allows companies to operate more efficiently and move on to the next and higher quality stage. However, there are number of examples where enterprises, which invested in the ERP systems and informationization, fail to fully realize their original purpose (Xu *et al.* 2008). In fact, the ERP implementation projects success rate mostly depends on the level of the enterprises participation in ERP system and vendor selection process (Tamošiūnienė, Angelov, 2011). The problem of enterprises involvement and active participation in the ERP implementation projects occurs. Due to the variety of ERP systems and vendors as well as due to the tedious and time consuming ERP selection process according to complex company's environment and needs, usually all the responsibility for ERP selection and implementation is being transferred on consultants and vendors chosen by those consultants. Moreover, many companies implement their ERP systems quickly without fully understanding the implications for business or that it should be harmonized with overall organizational goals and strategies (Tamošiūnienė, Marcinkevič, 2011). Inappropriate ERP system minimizes ERP implementation benefit take up rate. Therefore, more attention should be paid to ERP implementation process overall and ERP selection process as a part of these projects.

The aim of this paper is to propose to use supportive Analytic Hierarchy Process (AHP) method as a decision making tool in ERP selection process.

For this reason, benefits and peculiarities of ERP implementation projects are presented in this paper. After the analysis of various ERP selection criteria ERP selection methods are reviewed and case study of ERP vendor selection supported by using AHP model is being presented. Methods used: scientific literature analysis, generalization, evaluation, estimations.

## II. BENEFITS AND PECULIARITIES OF ERP IMPLEMENTATION

In an environment marked by continual transformation, competitive organizations increasingly rely on the business and IT alignment based on agility. To survive and thrive, enterprises must capture and exploit new business and IT opportunities before competitors do (Mendez 2010).

In today's business climate, where trust between business and IT in most companies has never been more fragile, possibilities to completely rethink IT have to be

found, and IT have to be transformed into a strategic asset for the companies. Moreover, IT needs to become more tightly integrated with the broader business, not just aligned with it, and that means embedding IT throughout the organization (Klaus *et al.* 2000; Hinssen 2008).

However, business and IT alignment allows the company to create higher value only when there is technology, management and operational excellence (Fig. 1).

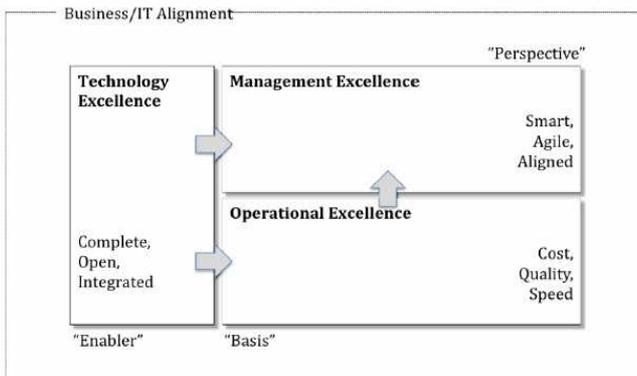


Fig. 1. Business/IT alignment (Source: Vlek 2010, Oracle 2009)

ERP allows companies to operate more efficiently and move on to the next and higher quality stage as well as to increase business value.

Worldwide statistics show that ERP are worth to implement in order to increase enterprise performance and to gain higher business value (Aberdeen Group survey conducted in 2009-2011; Panorama Consulting Group ERP report 2011).

Despite the fact that ERP implementation can improve different business processes and to improve various key performance indicators, there are ERP implementation problems due to which ERP benefits decrease and companies fail to fully realize their original purpose of ERP implementation.

There are several reasons for failure of ERP implementation. Enterprises lack of the knowledge and experience of project management ERP system implementation is thought to be the major reason for project failure which causes another ERP implementation issues (Bulotienė 2010).

Due to these reasons companies usually transfer responsibility for the project implementation on consultants who are not fully informed about the complex company environment and specific needs. Due to this reason feasibility studies of ERP implementation are usually weak and due to this inadequate ERP software which does not meet the needs of company is being selected (Bulotienė 2010; Paliulis 2010; Panorama Consulting Group 2011; Paškevičiūtė 2010).

Thus, it is not enough to rely solely on ERP vendors and consultants for high ERP implementation project results and ERP selection model should be supported.

### III. ERP SELECTION CRITERIA AS A PART OF ERP IMPLEMENTATION PROCESS

ERP implementation project usually consist of those stages: ERP readiness assessment, ERP implementation planning, ERP implementation and ERP exploitation.

These questions arise during the implementation stage: ensuring the fluent ERP and business process integration, selection of optimal information systems and customization, data consistency etc.

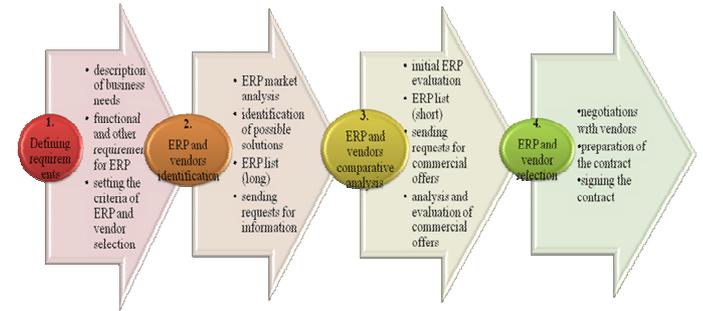


Fig. 2. ERP and vendors selection process (Source: made by author)

ERP software selection is a strategic decision. The decision makers are responsible for all the consequences of this choice. Thus, the selection process should be fully measured and accomplished.

ERP selection criteria are of strategic importance as according to these criteria the plan and fact can be compared and the level of quality of ERP implementation project can be assessed. The extended list of requirements for ERP and vendors should be prepared. The requirements are prioritized according to the specific business needs. Clear requirements will ease the analysis of ERP market, evaluate the analysis and evaluation of ERP and vendors.

The most important ERP selection criteria are thought to be: functionality of software, software’s ability to fit the business or functional fit, level of support from the solution provider, growth potential of software (additional modules, modifications or flexibility), vendor’s reliability (vendor credentials), data security, reporting and analysis features, total cost of ownership, return on investment (ROI), implementation time, ease of implementation and use etc. (Kimberling, Kaas 2009; Bulotienė 2010; Oracle 2012).

Each ERP implementation project is unique and the criteria should be chosen according to the needs of particular company. Therefore, we cannot distinguish universal criteria. Each company should choose own ERP implementation strategy and to lean on it’s own Key Performance Indicators.

Therefore, the variety of selection criteria and vendors of ERP and complexity of this process force companies to use appropriate supportive and complex decision making methods.

**IV. ERP SELECTION METHOD REVIEW**

ERP selection is a complex, subjective process with more than a few realistic options. It is obvious that company needs some metrics in order to choose the right ERP and its vendor.

There are number of qualitative and quantitative ERP selection methods which support this process. Widely used methods include scoring, ranking, mathematical optimization and multi-criteria decision analysis.

As not all ERP selection criteria are easy to measure and ERP selection process should be as objective and easy as possible, in this case the AHP model created by Thomas Saaty in the 1970s, is useful system because it combines two approaches – the "black and white" of mathematics, and the subjectivity and intuitiveness of psychology – to evaluate information and make decisions that are easy to defend (Saaty 1980).

AHP method, directs how to determine the priority of a set of alternatives (both economic and non-economic criteria are transformed into the quantitative expression) and the relative importance of attributes in a multiple criteria decision-making problem.

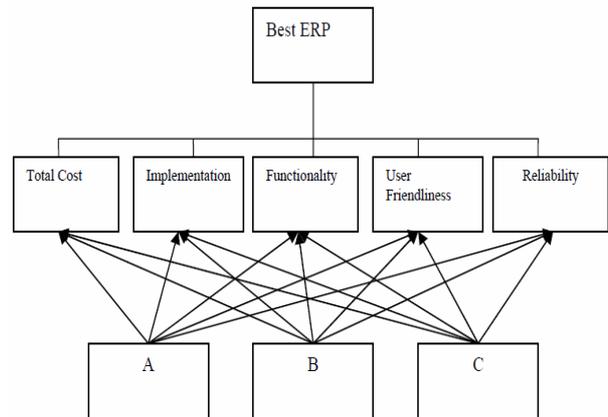
AHP is one of the most widely used multi-attribute decision-making methods. In this method, the decision-maker (DM) performs pair-wise comparisons, and, the pair-wise comparison matrix and the eigenvector are derived to specify the weights of each parameter in the problem. The weights guide the DM in choosing the superior alternative (Babak, Turan 2011).

**Case study**

Author offers to use quantitative technique or AHP method in order to make ERP and vendor selection process as objective and easy as possible.

The first step of ERP selection process is to make ERP selection criteria list and to determine which of them are very important and which of them are less important. Each criterion is assigned a number on a scale. If attribute A is

absolutely more important than attribute B and is rated at 9, then B must be absolutely less important than A and is valued at 1/9.



**Fig. 3.** Decomposition of the problem into a hierarchy

Author makes an assumption that selection criteria of ERP system are total cost (TC), implementation time (IT), functionality (F), user friendliness (UF) and reliability (R) and there are 3 options (A, B, C) of ERP system. Hierarchical categorization of the ERP system selection problem is shown in Figure 3.

Once the model of hierarchy is built, the next step is to evaluate the elements by making pair wise comparisons or the comparison matrices of decision maker for ERP software selection (see Table 1).

For example, total costs are 5 times more important than functionality of ERP etc.

In order to determine the priority of all the criteria, we have to divide the number indicated in each cell by the sum of the column and then to show the sum of each row (see Table 2). For example  $1/9,533333=0,104895$ ;  $3/9,533333=0,314685$  etc.

**TABLE I.**  
**COMPARISON MATRIX OF ERP SELECTION CRITERIA (1)**

\* 0,2 = 1/5; 0,333333 = 1/3; 0,142857 = 1/7

	Total costs	Implementation time	Functionality	User friendliness	Reliability
Total costs	1	0,333333*	5	0,2*	3
Implementation time	3	1	7	3	5
Functionality	0,2*	0,142857*	1	0,2*	0,333333*
User friendliness	5	0,333333*	5	1	3
Reliability	0,333333*	0,2*	3	0,333333*	1
SUM	9,533333	2,009524	21	4,733333	12,33333

(Source: made by author)

TABLE 2.  
COMPARISON MATRIX OF ERP SELECTION CRITERIA (2)

	TC	IT	F	UF	R	SUM
TC	0,104895	0,165877	0,238095	0,042254	0,243243	<b>0,794364</b>
IT	0,314685	0,49763	0,333333	0,633803	0,405405	<b>2,184857</b>
F	0,020979	0,07109	0,047619	0,042254	0,027027	<b>0,208969</b>
UF	0,524476	0,165877	0,238095	0,211268	0,243243	<b>1,382958</b>
R	0,034965	0,099526	0,142857	0,070423	0,081081	<b>0,428852</b>
	<b>SUM of the last column</b>					<b>5</b>

(Source: made by author)

After that we have to divide the sum of each row by the sum of the last column in Table 2. These calculations show the priority of each ERP selection criteria. Thus, the calculations are as follows:

$$W_{TC} = 0,794364 / 5 = \mathbf{0,158873}$$

$$W_{IT} = 2,184857 / 5 = \mathbf{0,436971}$$

$$W_F = 0,208969 / 5 = \mathbf{0,041794}$$

$$W_{UF} = 1,382958 / 5 = \mathbf{0,276592}$$

$$W_R = 0,428852 = \mathbf{0,08577}$$

The next step is to determine the normalized weights of each system (A, B, C) according to the each criteria (TC, IT, F, UF, R). The aim of this action is to prioritize A, B, C systems according to each ERP selection criteria. Analogous calculations have to be made after which ERP systems priorities according to each selection criteria can be determined (see Table 3).

TABLE 3.  
COMPARISON MATRIX OF ERP SYSTEMS ACCORDING TO EACH SELECTION CRITERIA

Total costs				Total costs				Total costs				ERP priority according total costs	
A	B	C	SUM	A	B	C	SUM	A	B	C	SUM		
A	1	0,2	0,3333	A	0,1111	0,1304	0,0769	A	0,1111	0,1304	0,0769	0,3185	0,1062
B	5	1	3	B	0,5556	0,6522	0,6923	B	0,5556	0,6522	0,6923	1,9	0,6333
C	3	0,3333	1	C	0,3333	0,2174	0,2308	C	0,3333	0,2174	0,2308	0,7815	0,2605
SUM	9	1,5333	4,3333					SUM of the last column				3	
Implementation time				Implementation time				Implementation time				ERP priority according implementation time	
A	1	5	3	A	0,6522	0,7895	0,4286	A	0,6522	0,7895	0,4286	1,8702	0,6234
B	0,2	1	3	B	0,1304	0,1579	0,4286	B	0,1304	0,1579	0,4286	0,7169	0,239
C	0,3333	0,3333	1	C	0,2174	0,0526	0,1429	C	0,2174	0,0526	0,1429	0,4129	0,1376
SUM	1,5333	6,3333	7					SUM of the last column				3	
Functionality				Functionality				Functionality				ERP priority according functionality	
A	1	0,1111	0,3333	A	0,0769	0,0847	0,0526	A	0,0769	0,0847	0,0526	0,2143	0,0714
B	9	1	5	B	0,6923	0,7627	0,7895	B	0,6923	0,7627	0,7895	2,2445	0,7482
C	3	0,2	1	C	0,2308	0,1525	0,1579	C	0,2308	0,1525	0,1579	0,5412	0,1804
SUM	13	1,3111	6,3333					SUM of the last column				3	
User friendliness				User friendliness				User friendliness				ERP priority according user friendliness	
A	1	3	5	A	0,6522	0,6923	0,5556	A	0,6522	0,6923	0,5556	1,9	0,6333
B	0,3333	1	3	B	0,2174	0,2308	0,3333	B	0,2174	0,2308	0,3333	0,7815	0,2605
C	0,2	0,3333	1	C	0,1304	0,0769	0,1111	C	0,1304	0,0769	0,1111	0,3185	0,1062
SUM	1,5333	4,3333	9					SUM of the last column				3	
Reliability				Reliability				Reliability				ERP priority according user reliability	
A	1	0,1111	0,2	A	0,0667	0,0847	0,0323	A	0,0667	0,0847	0,0323	0,1837	0,0612
B	9	1	5	B	0,6	0,7627	0,8065	B	0,6	0,7627	0,8065	2,1692	0,7231
C	5	0,2	1	C	0,3333	0,1525	0,1613	C	0,3333	0,1525	0,1613	0,6472	0,2157
SUM	15	1,3111	6,2					SUM of the last column				3	

(Source: made by author)

After these steps all the estimations are summarized (see Table 4).

TABLE 4.  
SYNTHESIS OF ERP SYSTEM SELECTION EVALUATION

Criteria	TC	IT	F	UF	R	ERP system evaluation
Priority of criteria	0,158873	0,436971	0,041794	0,276592	0,08577	
ERP system A	0,106156	0,623406	0,071433	0,633346	0,061223	<b>0,472691</b>
ERP system B	0,633346	0,238967	0,748164	0,260498	0,723054	<b>0,37038</b>
ERP system C	0,260498	0,137627	0,180402	0,106156	0,215722	<b>0,156929</b>
					<b>SUM</b>	<b>1</b>

(Source: made by author)

ERP system evaluation is made by multiplying each priority of criteria by each ERP system priority according to these criteria and by summing these results. For example, ERP system A evaluation is  $0,106156 * 0,158873 + 0,623406 * 0,436971 + 0,071433 * 0,041794 + 0,633346 * 0,276592 + 0,061223 * 0,08577 = 0,472691$  etc.

The sum of the last column is 1. It means that calculations are correct. According to this evaluation, priority of ERP system A is the highest and it is the best solution to be selected for implementation.

#### IV. CONCLUSION

The responsibility for ERP selection and implementation is usually being transferred on consultants and vendors chosen by those consultants. Despite the fact that ERP selection is strategic and complex decision making process, company can make ERP selection decision by oneself using supportive method.

Qualitative and quantitative techniques should be connected in order to make the process of ERP selection as objective and effective as possible.

AHP is combination of intuitive and quantitative aspects in ERP selection process. Therefore, the priority of one best ERP system can be distinguished.

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