

ERP SYSTEMS SELECTION CRITERIA: A COMPARATIVE STUDY OF SLOVAK AND SLOVENIAN SMES

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Abstract

Enterprise resource planning (ERP) system selection process is an important step in ERP adoption, since inadequately selected ERP may affect companies' market share and implementation time, effort, and cost. The selection process is not very well understood, as there are very few empirical studies of it. The research conducted in Slovakia and Slovenia focused on selected criteria, which influence the enterprise resource planning system selection process in small and medium enterprises (SMEs). Examined were criteria, which are both system- and vendor-specific. The article estimates the importance and differences of factors in relation to a country, company size, turnover growth, information strategy, and representation of the IT department on the board level.

1. Introduction

The enterprise resource planning (ERP) system is an integrated set of programs that provides support for core business processes, such as production, input and output logistics, finance and accounting, sales and marketing, and human resources. An ERP system helps different parts of an organization to share information to reduce costs and to improve management of business processes [1]. Authors of [10] argue that ERP systems aim to integrate business processes and ICT into a synchronized suite of procedures, applications, and metrics which goes over firms' boundaries.

ERP systems used to be a domain of large companies, but there is an increasing number of SMEs adopting them as well. There are some reasons for this trend, including a saturation of the market, as most large organizations have already implemented an ERP system, increasing possibilities and

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need for the integration of systems between organizations and the availability of relatively inexpensive hardware [6]. An interesting research question arises: What ERP system selection criteria should be included in the decision making?

ERP systems received a lot of attention in recent years; there are many ERP systems research instances and quite a lot of reviews, e.g. [4], [9] and [3]. However, the latter does not mention the ERP system selection issue at all – although evaluation of information systems investments as such is rather old. Researchers, such as [5] and [7], began working on evaluation of information systems in 1960s. But also according to [8] very little had been written about ERP system selection criteria even in academic journals. This was the motivation for our research.

2. Data and Methodology

The questionnaire research was conducted in May and June 2007. Questionnaire forms accompanied by cover letters were mailed to randomly selected companies in Slovakia and Slovenia. Lists of addresses and information about the number of employees were retrieved from respective Statistical Bureaus. In each country, 600 questionnaires were sent to small companies and 300 to medium companies. The number of questionnaires mailed to small companies was double the number of medium companies because small companies constitute the highest proportion of companies and based on our personal experience, they are less likely to respond. In total, there were 110 responses (61 from Slovakia, and 49 from Slovenia).

The questionnaire survey is based on criteria identified in [2]. Y2K readiness and EURO currency conversion were left out because they are not relevant anymore. Criteria used in the research are: reduced cycle times, enhanced decision making, improved service levels/quality, incorporation of business best practices, business process improvement, integrated and better quality of information, e-business enablement, increased organizational flexibility, increased customer satisfaction, improved innovation capabilities, enabler for desired business processes, organizational fit of system, software costs (licenses, maintenance, etc.), functionality of the system, system flexibility, systems reliability, advanced technology, operating system independency, system interoperability, internationality of software, system usability, vendor reputation, vendor support, market position of vendor, availability of an industry focused solution, short implementation time, enabling technology for CRM, SCM, etc., connectivity (intra/extranet, mobile comp., ...). The importance of these dependent variables is measured on Likert scale 1-5, where 1 is of very little importance and 5 is of very high importance.

Independent variables are country, company size, turnover growth, representation of the IT department on the board level (CIO) and information strategy. The research was conducted in Slovakia and Slovenia. Analyzed are small and medium companies, where companies from 10 to 49 employees are considered to be small enterprises and companies from 50 to 249 employees are considered to be medium enterprises. Turnover growth over the years 2004-2006 is divided into five categories: reduction in turnover, stable turnover, turnover growth of 0-5%, turnover growth of 5-10%, and turnover growth of more than 10%. Information strategy stands for formal information strategy, and representation of the IT department on the board level means that there is a CIO or a like director for IT.

All analyses (tables 1-14) are analysis of variance (ANOVA). A multivariate approach is used and results are commented on confidence level $\alpha = 0,05$. Significant relationships in the tables are marked by an asterisk (*). The Tukey-Kramer multiple-comparison test is used to identify significant differences between instances of an independent variable. Standardized Cronbach's alpha is used to measure consistency of chosen selection criteria. It is suggested that it should be at least 0,7.

3. Empirical Results

This section offers statistical tests of relationships between ERP selection criteria and independent variables. The first 13 subsections analyze the following individual criteria: reduced cycle times, incorporation of business best practices, business process improvement, integrated and better quality of information, e-business enablement, system flexibility, advanced technology, system interoperability, system usability, vendor support, market position of vendor, availability of an industry-focused solution, enabling technology for CRM, SCM, etc. The last subsection analyzes the relationship between all the criteria. There was no significant relationship found between enhanced decision making, improved service levels/quality, increased organizational flexibility, increased customer satisfaction, improved innovation capabilities, enabler for desired business processes, organizational fit of system, software costs, functionality of the system, systems reliability, operating system independency, internationality of software, vendor reputation, short implementation time, connectivity, and independent variables, so these criteria are not present in the following subsections.

3.1. Reduced cycle times

The analysis of the impact of country, company size, turnover growth, representation of the IT department on the board level (CIO), and information strategy on the importance of reduced cycle times is presented in Table 1.

Table 1: Reduced cycle times

Source Term	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	P-value
		9,029022	9,029022	11,69	0,000974*
Country	1	3,852307	3,852307	4,99	0,028220*
Company size	4	8,998839	2,249710	2,91	0,026185*
Growth	1	0,748736	0,748736	0,97	0,327760
CIO	1	0,387838	0,387838	0,50	0,480617
Information strategy	1	64,90678	64,90678		
S	84	87,95699			
Total (Adjusted)	92				
Total	93				

The importance of reduced cycle times depends on the country (it is 3,23 on average in Slovakia and 3,88 in Slovenia), company size (3,77 on average in small and 3,34 in medium companies), and turnover growth (there is a difference between companies with reduction in turnover (2,75) and companies with growth of 5% and more (3,92 for 5%-10% growth and 3,88 for 10%+ growth)).

3.2. Incorporation of business best practices

The analysis of the impact of country, company size, turnover growth, representation of the IT department on the board level (CIO), and information strategy on the importance of incorporation of business best practices is presented in Table 2.

Table 2: Incorporation of business best practices

Source Term	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	P-value
		0,455090	0,455090	0,65	0,420720
Country	1	0,439723	0,439723	0,63	0,428643
Company size	4	4,410525	1,102631	1,59	0,185714
Growth	1	0,017752	0,017752	0,03	0,873408
CIO	1	3,137959	3,137959	4,52	0,036626*
Information strategy	1	56,28276	56,28276		
S	81	64,1			
Total (Adjusted)	89				
Total	90				

The importance of incorporation of business best practices depends on information strategy (it is 4,12 on average in companies with information strategy and 3,70 in companies without information strategy).

3.3. Business process improvement

The analysis of the impact of country, company size, turnover growth, representation of the IT department on the board level (CIO), and information strategy on the importance of business process improvement is presented in Table 3.

Table 3: Business process improvement

Source Term	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	P-value
Country	1	0,327082	0,327082	0,56	0,456017
Company size	1	0,015500	0,015500	0,03	0,870887
Growth	4	1,876963	0,469241	0,80	0,525649
CIO	1	0,947048	0,947048	1,62	0,206086
Information strategy	1	2,564150	2,564150	4,40	0,039043*
S	83	48,40089	0,583143		
Total (Adjusted)	91	53,25			
Total	92				

The importance of business process improvement depends on information strategy (it is 4,45 on average in companies with information strategy and 4,08 in companies without information strategy).

3.4. Integrated and better quality of information

The analysis of the impact of country, company size, turnover growth, representation of the IT department on the board level (CIO), and information strategy on the importance of integrated and better quality of information is presented in Table 4.

Table 4: Integrated and better quality of information

Source Term	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	P-value
Country	1	1,210149	1,210149	1,90	0,171744
Company size	1	0,002190	0,002190	0,00	0,953385
Growth	4	7,983189	1,995797	3,13	0,018663*
CIO	1	0,072090	0,072090	0,11	0,737420
Information strategy	1	0,212241	0,212241	0,33	0,565354
S	86	54,79854	0,637192		
Total (Adjusted)	94	63,53684			
Total	95				

The importance of integrated and better quality of information depends on turnover growth (there is a difference between companies with growth of 0-5% (3,95) and companies with growth of 10% and more (4,73)).

3.5. E-business enablement

The analysis of the impact of country, company size, turnover growth, representation of the IT department on the board level (CIO), and information strategy on the importance of e-business enablement is presented in Table 5.

Table 5: E-business enablement

Source Term	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	P-value
		39,24377	39,24377	40,59	0,000000*
Country	1	0,228351	0,228351	0,24	0,628261
Company size	4	3,187652	0,796913	0,82	0,513426
Growth	1	0,787138	0,787138	0,81	0,369516
CIO	1	0,199575	0,199575	0,21	0,650777
Information strategy	1	80,24929	0,966859		
S	83				
Total (Adjusted)	91	126,5543			
Total	92				

The importance of e-business enablement depends on the country (it is 3,08 on average in Slovakia and 4,45 in Slovenia).

3.6. System flexibility

The analysis of the impact of country, company size, turnover growth, representation of the IT department on the board level (CIO), and information strategy on the importance of system flexibility is presented in Table 6.

Table 6: System flexibility

Source Term	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	P-value
		0,102943	0,102943	0,19	0,663682
Country	1	0,173136	0,173136	0,32	0,572956
Company size	4	3,390241	0,847560	1,57	0,190496
Growth	1	0,344332	0,344332	0,64	0,427075
CIO	1	3,134955	3,134955	5,80	0,018245*
Information strategy	1	44,86554	0,540549		
S	83				
Total (Adjusted)	91	52,55435			
Total	92				

The importance of system flexibility depends on information strategy (it is 4,50 on average in companies with information strategy and 4,09 in companies without information strategy).

3.7. Advanced technology

The analysis of the impact of country, company size, turnover growth, representation of the IT department on the board level (CIO), and information strategy on the importance of advanced technology is presented in Table 7.

Table 7: Advanced technology

Source Term	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	P-value
Country	1	0,055819	0,055819	0,10	0,749386
Company size	1	2,216926	2,216926	4,08	0,046652*
Growth	4	2,405247	0,601312	1,11	0,359033
CIO	1	0,521222	0,521222	0,96	0,330240
Information strategy	1	0,479804	0,479804	0,88	0,350118
S	82	44,55272	0,543326		
Total (Adjusted)	90	50,72527			
Total	91				

The importance of advanced technology depends on company size (it is 4,10 on average in small and 3,77 in medium companies).

3.8. System interoperability

The analysis of the impact of country, company size, turnover growth, representation of the IT department on the board level (CIO), and information strategy on the importance of system interoperability is presented in Table 8.

Table 8: System interoperability

Source Term	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	P-value
Country	1	11,717350	11,717350	19,07	0,000038*
Company size	1	0,022426	0,022426	0,04	0,848983
Growth	4	3,254410	0,813603	1,32	0,268387
CIO	1	0,611390	0,611390	1,00	0,321587
Information strategy	1	1,221729	1,221729	1,99	0,162477
S	78	47,92391	0,614409		
Total (Adjusted)	86	63,95402			
Total	87				

The importance of system interoperability depends on the country (it is 3,22 on average in Slovakia and 3,99 in Slovenia).

3.9. System usability

The analysis of the impact of country, company size, turnover growth, representation of the IT department on the board level (CIO), and information strategy on the importance of system usability is presented in Table 9.

Table 9: System usability

Source Term	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	P-value
Country	1	0,262696	0,262696	0,42	0,519418
Company size	1	0,230460	0,230460	0,37	0,546164
Growth	4	1,985934	0,496483	0,79	0,534181
CIO	1	1,627981	1,627981	2,60	0,111138
Information strategy	1	3,814723	3,814723	6,08	0,015805*
S	80	50,18757	0,627345		
Total (Adjusted)	88	57,97753			
Total	89				

The importance of system usability depends on information strategy (it is 4,58 on average in companies with information strategy and 4,11 in companies without information strategy).

3.10. Vendor support

The analysis of the impact of country, company size, turnover growth, representation of the IT department on the board level (CIO), and information strategy on the importance of vendor support is presented in Table 10.

Table 10: Vendor support

Source Term	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	P-value
Country	1	0,536445	0,536445	0,69	0,408580
Company size	1	0,414320	0,414320	0,53	0,467462
Growth	4	2,017594	0,504398	0,65	0,629274
CIO	1	1,180969	1,180969	1,52	0,221323
Information strategy	1	4,214826	4,214826	5,42	0,022403*
S	80	62,18150	0,777269		
Total (Adjusted)	88	69,97753			
Total	89				

The importance of vendor support depends on information strategy (it is 4,55 on average in companies with information strategy and 4,06 in companies without information strategy).

3.11. Market position of vendor

The analysis of the impact of country, company size, turnover growth, representation of the IT department on the board level (CIO), and information strategy on the importance of market position of the vendor is presented in Table 11.

Table 11: Market position of vendor

Source Term	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	P-value
Country	1	5,637192	5,637192	5,89	0,017474*
Company size	1	0,461574	0,461574	0,48	0,489314
Growth	4	3,794333	0,948583	0,99	0,417112
CIO	1	1,445402	1,445402	1,51	0,222629
Information strategy	1	2,715079	2,715079	2,84	0,095984
S	79	75,56821	0,956560		
Total (Adjusted)	87	87,89773			
Total	88				

The importance of market position of the vendor depends on the country (it is 3,03 on average in Slovakia and 3,56 in Slovenia).

3.12. Availability of an industry-focused solution

The analysis of the impact of country, company size, turnover growth, representation of the IT department on the board level (CIO), and information strategy on the importance of availability of an industry-focused solution is presented in Table 12.

Table 12: Availability of an industry focused solution

Source Term	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	P-value
Country	1	0,603140	0,603140	0,94	0,336403
Company size	1	0,177795	0,177795	0,28	0,600988
Growth	4	3,119191	0,779798	1,21	0,313398
CIO	1	2,716925	2,716925	4,21	0,043354*
Information strategy	1	0,203510	0,203510	0,32	0,575850
S	81	52,24138	0,644955		
Total (Adjusted)	89	59,28889			
Total	90				

The importance of availability of an industry-focused solution depends on representation of the IT department on the board level (it is 3,64 on average in companies with CIOs and 4,00 in companies without CIOs).

3.13. Enabling technology for CRM, SCM, etc.

The analysis of the impact of country, company size, turnover growth, representation of the IT department on the board level (CIO), and information strategy on the importance of enabling technology for CRM, SCM, etc. is presented in Table 13.

Table 13: Enabling technology for CRM, SCM, etc.

Source Term	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	P-value
Country	1	6,08563	6,08563	5,85	0,017891*
Company size	1	5,24739	5,24739	5,05	0,027516*
Growth	4	5,80307	1,45077	1,40	0,243468
CIO	1	1,31748	1,31748	1,27	0,263810
Information strategy	1	4,36072	4,36072	4,19	0,043954*
S	78	81,11736	1,03997		
Total (Adjusted)	86	100,9195			
Total	87				

The importance of enabling technology for CRM, SCM, etc. depends on the country (it is 3,11 on average in Slovakia and 3,66 in Slovenia), company size (it is 3,64 on average in small and 3,13 in medium companies), and information strategy (it is 3,64 on average in companies with information strategy and 3,14 in companies without information strategy).

3.14. Intercriteria comparison

Although there is a high correlation between selection criteria (standardized Cronbach's alpha = 0,902 724), there are significant differences between the selection criteria. The analysis of the impact of country, company size, turnover growth, representation of the IT department on the board level (CIO), information strategy, and criterion on criteria evaluation is presented in Table 14.

Table 14: Intercriteria comparison

Source Term	Degrees of Freedom	Sum of Squares	Mean Square	F-Ratio	P-value
Country	1	20,90492	20,90492	26,90	0,000000*
Company size	1	0,05316	0,05316	0,07	0,793713
Growth	4	17,92208	4,48052	5,76	0,000129*
CIO	1	8,63452	8,63452	11,11	0,000871*
Information strategy	1	27,87283	27,87283	35,86	0,000000*
Criterion	27	370,00890	13,70403	17,63	0,000000*
S	2516	1955,497	0,77722		
Total (Adjusted)	2551	2385,827			
Total	2552				

The importance of selection criteria depends on country (it is 3,85 on average in Slovakia and 4,04 in Slovenia), turnover growth (there is a significant difference between companies with turnover growth of 5-10% on one hand and all three groups of companies with lower turnover (i.e. reduction

in turnover, stable turnover, turnover growth of 0-5%) on the other hand; and between companies with turnover growth of 0-5% on one hand and companies with turnover growth of more than 10% on the other hand; it is 3,84 on average in companies with reduction in turnover, 3,91 in companies with stable turnover, 3,86 in companies with turnover growth of 0-5%, 4,08 in companies with turnover growth of 5-10%, and 4,01 in companies with turnover growth of more than 10%), representation of the IT department on the board level (it is 3,88 on average in companies with CIOs and 4,00 in companies without CIOs), information strategy (it is 4,06 on average in companies with information strategy and 3,83 in companies without information strategy), and criterion, which is presented in Table 15 in detail.

Table 15: Comparison of selection criteria

Criterion	Average	Criterion	Average
Internationality of software	3,16	Advanced technology	3,95
Market position of vendor	3,29	Increased organizational flexibility	4,01
Enabling technology for CRM, SCM, etc.	3,40	Enhanced decision making	4,09
Vendor reputation	3,45	Software costs (licenses, maintenance, etc.)	4,09
Operating system independency	3,50	Increased customer satisfaction	4,19
Improved innovation capabilities	3,57	Business process improvement	4,26
System interoperability	3,65	Vendor support	4,29
E-business enablement	3,67	System usability	4,29
Reduced cycle times	3,69	System flexibility	4,34
Incorporation of business best practices	3,77	Improved service levels/quality	4,35
Enabler for desired business processes	3,82	Organizational fit of system	4,38
Short implementation time	3,87	Functionality of the system	4,41
Connectivity (intra/extranet, mobile comp., ...)	3,88	Integrated and better quality of information	4,46
Availability of an industry focused solution	3,92	Systems reliability	4,61

In Table 15, there are significant differences between criteria, where averages differ by at least 0,49. It should not be concluded that the criteria in Table 15 with lower rating are not important. Even they score above average, since only criteria believed to be relatively important were chosen.

4. Conclusion

The top 10 ERP selection criteria for Slovak and Slovenian SMEs are:

1. systems reliability,
2. increased customer satisfaction,
3. business process improvement,
4. vendor support,
5. system usability,

6. system flexibility,
7. improved service levels/quality,
8. organizational fit of system,
9. functionality of the system,
10. integrated and better quality of information.

There is no significant difference between systems reliability and the remaining nine criteria. Price (software costs), which might be intuitively expected to rank high because of economic reasons, is the 11th most important one. So, there is a significant difference between system reliability and price. All other criteria, which are significantly different from price, are of lower importance.

A surprising finding is that availability of an industry-focused solution is less important for companies with representation of the IT department on the board level. A probable reason is that SMEs, which are highly IT-focused, can utilize general-purpose ERP systems for their purposes.

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Perspective(s) of Future(s)