

# Statistical Study on the Need for a Preliminary Assessment of the Effectiveness of the Implementation Process of ERP-Systems in Bulgarian SMEs

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## Summary:

This paper presents a statistical analysis of data obtained from an empirical study of a sample of Bulgarian SMEs to establish the need for a preliminary assessment of the effectiveness of the implementation process of ERP-systems in such enterprises. The analysis is carried out based on one-dimensional and two-dimensional empirical distributions and verification of statistical hypotheses formulated. The conclusions highlight the need to develop an original methodology and its implementation in software for evaluation of the effectiveness of implementation of ERP systems in SMEs.

**Key words:** ERP systems, evaluation of effectiveness, small and medium enterprises, business software

**JEL Classification:** C12, C4, C46, C83, L86

## 1. Introduction

Modern ERP systems are computer-integrated multi-dimensional, multi-functional systems built on a client-server-based technology and business - model for

planning, control and global optimization of the entire supply chain process, manufacturing and distribution of finished goods and the accompanying financial operations of an enterprise. Despite the many benefits that these systems offer, it is a well-known fact that the implementation of an ERP system is a complex process requiring significant resources and efforts, and the results are not always guaranteed (Dey, 2013) (Umble, 2003. ). In the international practice there are many examples of failed implementations. The high rate of failure in the implementation is due to the common pitfall that ERP projects are often taken only as an investment in the installation of IT infrastructure (Lazarova, 2010), and are not systematically planned for changes in the work, for reengineering of the business processes and for changes in the operation and management of the enterprise (You C.J., 2012).

Popular models for the implementation of ERP systems are based on identification of factors that may affect the implementation and operation of the system, namely the size of the company - differentiation between micro, small and medium enterprises, given

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the number of employees, the turnover, the scope and degree of organizational change. Several authors use the approach of the critical success factors (CSFs) for the study of implementations of ERP systems (Esteves J., 2001) (Fulane, 2012) (Hailu, 2012) (Mahdavian, 2012) (Sar, 2012) (Sternad, 2009) (Sultanate, 2012). Based on a set of surveys containing commented lists of critical factors in the implementation of ERP, the authors of (Esteves, 2000) unify these lists and create a uniform CSF model. In the model, the critical factors in implementing ERP are categorized into different groups and each factor is identified and defined accordingly. Management of CSF in the implementation process remains unsolved question in the field of scientific research. Also the use of CSF as a universal tool in the implementation of ERP systems is impossible because in practice these factors don't have one and the same meaning for different companies and in the different phases of the implementation process.

In our country ERP systems have already been introduced in many small and medium enterprises (SMEs), allowing us to explore the strategies, methods and critical success factors from the perspective of this kind of enterprises (ENTERPRISE, 2010). Characteristic feature here is that from the one hand small businesses try to maintain their competitiveness by reducing the costs throughout the chain, shorten delivery cycles, minimize warehouse and increase product quality. On the other hand, they are rarely willing to accept systems that promise solutions to all these questions, but seem complex, costly and often designed to comply with the characteristics and needs of a large company. Number of features in the organization and operation of SMEs, as well as the fact that the introduction of ERP systems in these enterprises cannot be based directly on the experience of big

companies, determine the need for study of implementation processes in companies and enterprises of small and medium scale.

In a previous work (Futekova, 2015) we presented the results of an empirical study aimed to determine the need for a preliminary assessment of the effectiveness of the process of implementing ERP systems in Bulgarian SMEs. The study was conducted in a sample of fifty-five Bulgarian enterprises, clients of Aloe Co. Ltd., a Bulgarian developer of systems for business management. For this purpose a specially developed questionnaire was used, consisting of 14 questions included in a single section of "Identifying the need for pre-measuring the effectiveness of implementation process." A copy of the questionnaire is presented in Appendix 1. In the following sections of the article we present the results of the statistical processing of the obtained in (Futekova, 2015) empirical data. In particular, Sections 2 and 3 contain one-dimensional and two-dimensional empirical statistical distributions of the responses to the questionnaire. In Section 4 statistical hypotheses are formulated and proven, and section 5 gives a generalized analysis of the results. The main findings and conclusions of this study are presented in Section 6. For statistical processing and analysis of data we used the specialized software system IBM SPSS Statistics and the alternative open source software GNU PSPP.

### 2. One-dimensional distributions

The one-dimensional distributions show the absolute and relative frequency with which responses to the questionnaire occur. Below are also shown the valid and cumulative percentage of responses. Based on the summary of the statistical characteristics of each distribution, the arithmetic mean, standard deviation, minimum and maximum value are also

calculated. Graphical representation of the results is done by means of pie charts.

To question № 1, all respondents have answered that are in the category of SMEs under the SME Law and from the responses to question № 2 it becomes clear that all respondents are clients of Aloe Co. LTD. One-dimensional empirical distributions of the responses to the other questions are as follows.

**One-dimensional distribution of responses to question № 3, How long**

More than a half (specifically 54.55%) of respondents 55 companies replied that they have implemented ERP system for 1 to 3 years. Nearly one-third (30.91%) work with an integrated ERP system in less than one year and about 15% of the respondents have ERP system more than three years. General statistical characteristics like arithmetic mean, standard deviation, maximum and minimum values are shown in Table 1.2. The graphical representation of the results is shown in Figure 1.

Table 1. 1. One-dimensional distribution

Value label	Value	Frequency	Percent	Valid percent	Cum percent
Less than a year	1	17	30,91	30,91	30,91
Between one and three years	2	30	54,55	54,55	85,45
More than three years	3	8	14,55	14,55	100,00
<i>Total</i>		55	100	100	

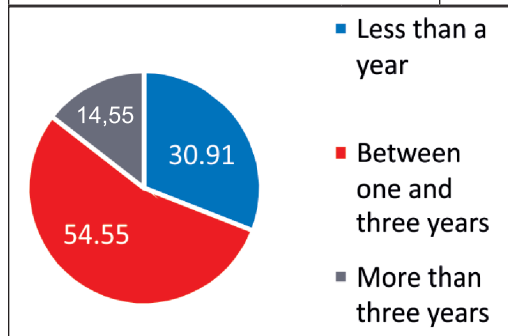


Fig. 1. Graphical representation of the results

How long has it been since you implemented ERP system in your company?

**One-dimensional distribution of responses to question № 4 of How do you assess your satisfaction with the used ERP system?**

About 90% of the respondents assess as satisfactory the work with ERP system, fully satisfied are 38.18% of them, and 51% answered "rather satisfy us." Dissatisfied are 10.91% of the respondents (Table 2.1). General statistical characteristics (arithmetic mean, standard deviation, maximum and minimum values) are shown in Table 2.2. The graphical representation of the results is shown in Figure 2.

How do you assess your satisfaction with the used ERP system?

**One-dimensional distribution of responses to question No 5 of Have it been conducted a preliminary assessment of the expected economic impact of ERP system at the stage of its implementation?**

Table 1. 2. . General Statistical characteristics

N	Valid	55
	Missing	0
Mean		1.84
Std Dev		.66
Minimum		1.00
Maximum		3.00

**has it been since you implemented ERP system in your company?**

Statistical distribution of responses to the question gives the results shown in Table 1.1.

Table 2. 1. One-dimensional distribution

Value label	Value	Frequency	Percent	Valid percent	Cum percent
It satisfies us completely	1	21	30,91	38,18	38,18
It rather satisfies us	2	28	54,55	50,91	89,09
It rather not satisfies us	3	6	14,55	10,91	100,00
<i>Total</i>		55	100	100	

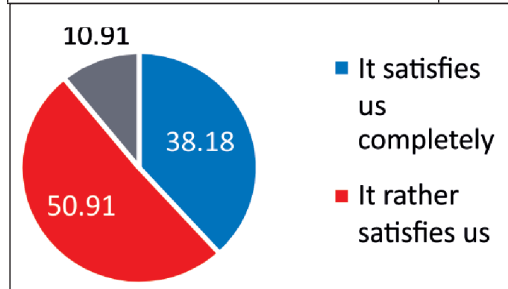


Fig. 2. Graphical representation of the results

Table 2. 2. . General Statistical characteristics

<i>N</i>	<i>Valid</i>	55
	<i>Missing</i>	0
<i>Mean</i>		1.84
<i>Std Dev</i>		.66
<i>Minimum</i>		1.00
<i>Maximum</i>		3.00

Preliminary assessment of the expected economic impact of ERP system implementation have been conducted by 40% of the respondents, 60% of them have omitted this step (Table 3.1). General statistical characteristics (arithmetic mean, standard deviation, maximum and minimum values) are shown in Table 3.2. The graphical representation of the results is shown in Figure 3.

Have it been conducted a preliminary assessment of the expected economic impact of ERP system at the stage of its implementation?

**One-dimensional distribution of responses to question No 6 of The preliminary assessment of the economic impact was carried out with.**

Table 3. 1. One-dimensional distribution

Value label	Value	Frequency	Percent	Valid percent	Cum percent
No	0	33	60,00	60,00	60,00
Yes	1	22	40,00	40,00	100
<i>Total</i>		55	100	100	

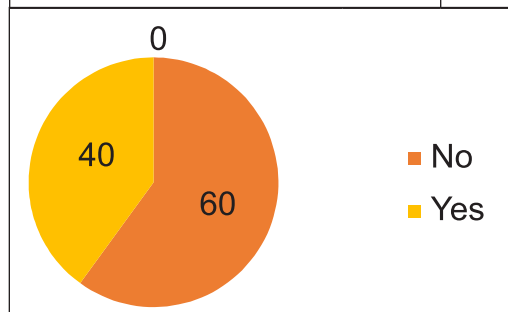


Fig. 3. Graphical representation of the results

Table 3. 2. General Statistical characteristics

<i>N</i>	<i>Valid</i>	55
	<i>Missing</i>	0
<i>Mean</i>		1.73
<i>Std Dev</i>		.65
<i>Minimum</i>		1.00
<i>Maximum</i>		3.00

Assessment of the expected economic impact of implementation (Table 4.1) was carried out using quantitative methods by

Table 4. 1. One-dimensional distribution

Value label	Value	Frequency	Percent	Valid percent	Cum percent
Quantitative methods	1	13	23,64	59,09	59,09
Quantitative methods	2	9	16,36	40,91	100
	-	33	60,00	Missing	
<b>Total</b>		<b>55</b>	<b>100</b>	<b>100</b>	

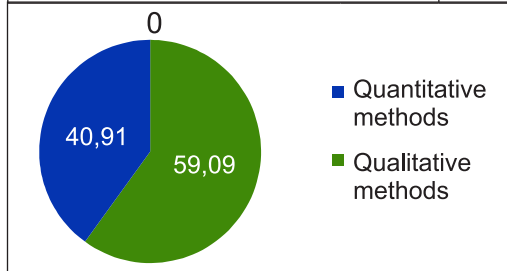


Fig. 4. Graphical representation of the results

Table 4. 2. . General Statistical characteristics

<i>N</i>	<i>Valid</i>	<b>22</b>
	<i>Missing</i>	<b>33</b>
<i>Mean</i>		<b>1.41</b>
<i>Std Dev</i>		<b>.50</b>
<i>Minimum</i>		<b>1.00</b>
<i>Maximum</i>		<b>2.00</b>

23.64% of the respondents, qualitative methods were used by 16.36%, and the remaining 60% of companies have not made an estimate of the effect of implementation of ERP system. General statistical characteristics (arithmetic mean, standard deviation, maximum and minimum values) are shown in Table 4.2. The graphical representation of the results is shown in Figure 4.

The preliminary assessment of the economic impact was carried out with?

**One-dimensional distribution of responses to question No 7, Preliminary assessment of the effect of the implementation is done by**

The team of the company-implementer carried out an evaluation of the implementation in 23.64% of the respondents, this represents 59% of the evaluations, 16.36% have made this assessment with the forces of an own team (almost 41% of the evaluations). Data are shown in Table 5.1. General statistical characteristics (arithmetic mean, standard deviation, maximum and minimum values) are shown in Table 5.2. The graphical representation of the results is shown in Figure 5.

Preliminary assessment of the effect of the implementation is done by?

Table 5. 1. One-dimensional distribution

Value label	Value	Frequency	Percent	Valid percent	Cum percent
Team of the company implementer	1	13	23,64	59,09	59,09
Team of your own company	2	9	16,36	40,91	100
	-	33	60,00	Missing	
<b>Total</b>		<b>55</b>	<b>100</b>	<b>100</b>	

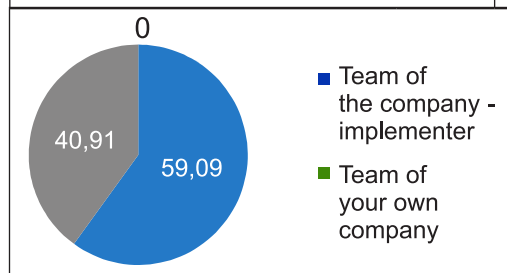


Fig. 5. Graphical representation of the results

Table 5. 2. . General Statistical characteristics

<i>N</i>	<i>Valid</i>	<b>22</b>
	<i>Missing</i>	<b>33</b>
<i>Mean</i>		<b>1.41</b>
<i>Std Dev</i>		<b>.50</b>
<i>Minimum</i>		<b>1.00</b>
<i>Maximum</i>		<b>2.00</b>

**One-dimensional distribution of responses to question No 8, The results of the preliminary assessment of the effectiveness are used by?**

The three possible answers to the question are distributed as follows. The results of the preliminary assessment of the effect of the implementation are used by the management of the company-implementer in 77.27% of cases, and the remaining 23.73% of the cases are used by the management of a company that has implemented the ERP system. None of the respondents indicated the third possibility, i.e. by both managements. Data are shown in Table 6.1. General statistical characteristics (arithmetic mean, standard deviation, maximum and minimum values) are shown in Table 6.2. The graphical representation of the results is shown in Figure 6.1.

Table 6. 1. One-dimensional distribution

Value label	Value	Frequency	Percent	Valid percent	Cum percent
Management of the company implementer	1	17	30,91	77,27	77,27
Management of your own company	2	5	9,09	22,73	100
	-	33	60,00	Missing	
<i>Total</i>		55	100	100	

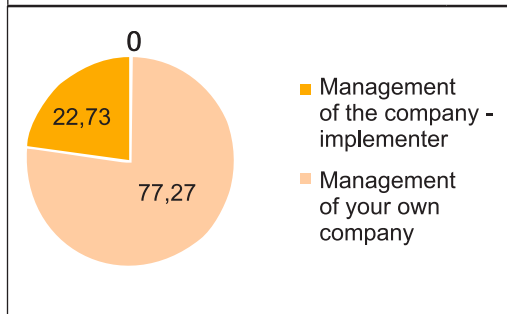


Table 6. 2. . General Statistical characteristics

<i>N</i>	<i>Valid</i>	22
	<i>Missing</i>	33
<i>Mean</i>		1.23
<i>Std Dev</i>		.43
<i>Minimum</i>		1.00
<i>Maximum</i>		2.00

The results of the preliminary assessment of the effectiveness are used by?

Fig. 6.1. Graphical representation of the results

**One-dimensional distribution of responses to question No 9, What functionality would you like to have your ERP system?**

This question is characterized with that each respondent can choose more than one of the eight possible answers. One dimensional distribution of the received responses is shown in Table 7.

Table 7. One-dimensional distribution of responses to question 9

	Frequency	Responses		Percent of cases
		Number	Percent	
<b>Question No 9: What functionality would you like to have your ERP system?</b>	Manufacturing	25	11.46%	45.45%
	Supplies	24	11.01%	43.64%
	Clients	28	12.84%	50.90%
	Warehouse	29	13.30%	52.72%
	Marketing	31	14.22%	56.36%
	Accounting	27	12.38%	49.10%
	Finance	29	13.30%	52.72%
	Other, specify.....	25	11.46%	45.45%
<i>Total</i>		218	100.00%	396.34%

In the column "Percent" it is shown the percentage of received responses against all the answers, and the column "Percentage of cases" shows the percentage of responses against the respondents. The data in the table strikes with the distribution of responses

minimum values) are shown in Table 8.2. The graphical representation of the results is shown in Figure 8.

Do you perform any assessment of the benefits and efficiency achieved for your company as a result of implementation of ERP system?

Table 8. 1. One-dimensional distribution

Value label	Value	Frequency	Percent	Valid percent	Cum percent
No	0	31	56,36	56,36	56,36
Yes	1	24	43,64	43,64	100
<i>Total</i>		55	100	100	

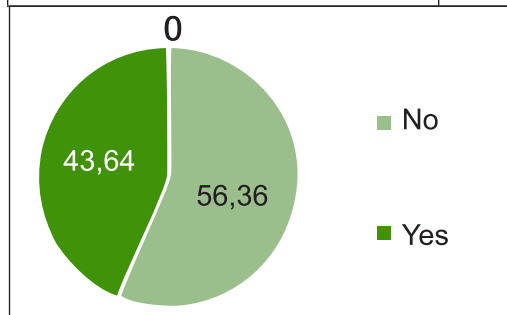


Fig. 8. Graphical representation of the results

to questions regarding the module "accounting". Only 27, or 49.10% of the respondents SMEs answered positively to the question of the inclusion of this module in the system, while the remaining 28 of the companies (50.90%) do not want the inclusion of this module in its ERR system.

**One-dimensional distribution of responses to question No 10, Do you perform any assessment of the benefits and efficiency achieved for your company as a result of implementation of ERP system?**

Statistical distribution of responses to this question is shown in Table 8.1. 56.36% of the responses were negative, 43.64% were positive. General statistical characteristics (arithmetic mean, standard deviation, maximum and

Table 8. 2. . General Statistical characteristics

<i>N</i>	<i>Valid</i>	55
	<i>Missing</i>	0
<i>Mean</i>		.44
<i>Std Dev</i>		.50
<i>Minimum</i>		.00
<i>Maximum</i>		1.00

**One-dimensional distribution of responses to question No 11, Do you think it is appropriate to use utility software for pre-establishing the effectiveness of implementation of ERP system?**

Nearly three-fourths of the respondents (72.73%) considered appropriate to use a utility software for pre-establishing the effectiveness of the implementation of ERR system. Only 23.64% do not consider it appropriate. 3.64% of respondents failed to answer this question (Table 9.1). General statistical characteristics (arithmetic mean, standard deviation, maximum and minimum values) are shown in Table 9.2. The graphical representation of the results is shown in Figure 9.

Do you think it is appropriate to use utility software for pre-establishing the effectiveness of implementation of ERP system?



Table 9. 1. One-dimensional distribution

Value label	Value	Frequency	Percent	Valid percent	Cum percent
No	1	13	23,64	24,53	24,53
Yes	2	40	72,73	75,47	100
	-	2	3,64	Missing	
Total		55	100	100	

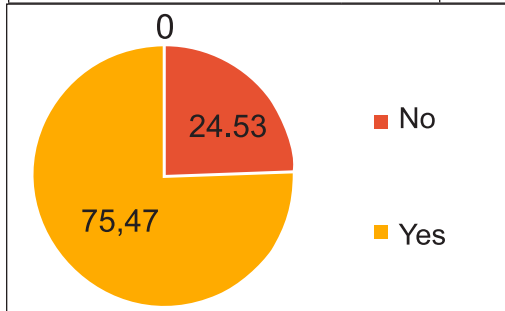


Table 9. 2. . General Statistical characteristics

N	Valid	53
	Missing	2
Mean		.75
Std Dev		.43
Minimum		.00
Maximum		1.00

**One-dimensional distribution of responses to question No 12, If the results of the use of software to measure and evaluate the effectiveness show that your company is appropriate for ERP system implementation, would you do it?**

Fig. 9. Graphical representation of the results

**evaluate the effectiveness show that your company is appropriate for ERP system implementation, would you do it?**

In 76, 36% of the cases the answer is "Yes", and in the remaining 23, 64% "No". The data are shown in Table 10.1. General statistical characteristics (arithmetic mean, standard deviation, maximum and minimum values) are shown in Table 10.2. The graphical representation of the results is shown in Figure 10.

If the results of the use of software to measure and evaluate the effectiveness show that your company is appropriate for ERP system implementation, would you do it?

Table 10. 1. One-dimensional distribution

Value label	Value	Frequency	Percent	Valid percent	Cum percent
No	0	13	23,64	23,64	23,64
Yes	1	42	76,36	76,36	100
Total		55	100	100	

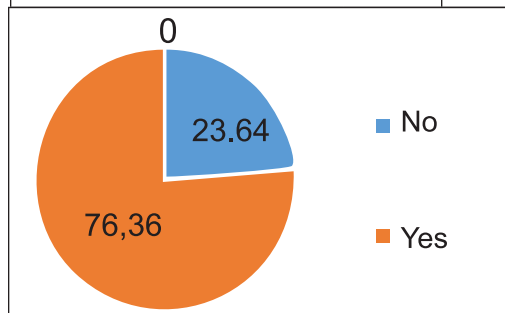


Table 10. 2. . General Statistical characteristics

N	Valid	53
	Missing	2
Mean		.75
Std Dev		.43
Minimum		.00
Maximum		1.00

The last two questions of the questionnaire are related to the trust of enterprises surveyed in the company Aloe Co., Ltd. and their willingness to pay to use the utility software for pre-measuring the effectiveness of implementation of ERP system. In particular to question No 13, Do you think it is appropriate Aloe Co., Ltd. to develop

Fig. 10. Graphical representation of the results

In particular to question No 13, Do you think it is appropriate Aloe Co., Ltd. to develop



**an original methodology for assessing the effectiveness of ERP systems in SMEs?**, 44 of the respondents answered "yes", which represents 80% of the answers and 11 respondents, representing 20% answered "no" when filling in this section of the questionnaire. The distribution of responses to question **No 14, Would your company pay to use methodology and support software for preliminary measure of the effectiveness of ERP system implementation?** is as follows: Willingness to pay to use utility software for preliminary assessment of ERP system effectiveness expressed 30 companies or 54.55% of the respondents, while 25 firms or 45.45% of the respondents would not pay for such software.

### 3. Two-dimensional distributions

This type of statistical distributions shows the distribution of responses in pairs of questions from conducted empirical study, they allow us to determine interconnections

between different cases. Below are presented two-dimensional distributions of responses to selected pairs of questions from the questionnaire allowing necessary to draw relevant conclusions.

#### Two-dimensional distribution of responses to questions:

**No 3: How long has it been since you implemented ERP system in your company?**

**No 4: How do you assess your satisfaction with the used ERP system?**

Two-dimensional distribution of responses to both questions is shown in Table 11. The data in each cell are count, % rows, % columns, % total. The table also shows the results of non-parametric test "Chi-square test", to check the statistical relationship between the variables.

How long has it been since you implemented ERP system in your company?\*

How do you assess your satisfaction with the used ERP system?\*

Table 11. Two-dimensional distribution of responses to questions No 3 and No 4

	How do you assess your satisfaction with the used ERP system?			Total
	It satisfies us completely	It rather satisfies us	It rather satisfies us	
How long has it been since you implemented ERP system in your company?	5,00	10,00	2,00	17,00
	29,41%	58,82%	11,76%	100,00%
	23,81%	35,71%	33,33%	30,91%
	9,09%	18,18%	3,64%	30,91%
Between one and three years	14,00	12,00	4,00	30,00
	46,67%	40,00%	13,33%	100,00%
	66,67%	42,86%	66,67%	54,55%
	25,45%	21,82%	7,27%	54,55%
More than three years	2,00	6,00	,00	8,00
	25,00%	75,00%	,00%	100,00%
	9,52%	21,43%	,00%	14,55%
	3,64%	10,91%	,00%	14,55%
Total	21,00	28,00	6,00	55,00
	38,18%	50,91%	10,91%	100,00%
	100,00%	100,00%	100,00%	100,00%
	38,18%	50,91%	10,91%	100,00%

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### Chi-square tests

Statistic	Value	df	
Pearson	4,14	4	.39
Likelihood Ratio	4,97	4	.29
Linear-by-Linear Association	,21	1	.65
N of Valid Cases	55		

In the displayed data we can make "cuts" respectively in columns or rows. For example, Table 12 shows the percentage distribution of responses by columns. Data show that out of the companies that are fully satisfied by the ERP system used, 23.81% have used

Table 12. Percentage distribution of responses by columns

How long has it been since you implemented ERP system in your company?	How do you assess your satisfaction with the used ERP system?			Total
	It satisfies us completely	It rather satisfies us	It rather not satisfies us	
Less than a year	23,81%	37,71%	33,33%	30,91%
Between one and three years	66,67%	42,86%	42,86%	54,55%
More than three years	9,52%	21,43%	21,43%	14,55%
Total	100,00%	100,00%	100,00%	100,00%

the system in less than one year, 66.67 percent have used the system between one and three years, and 9.52 percent have had implemented ERP system for more than three years. At the same time, out of the businesses that are not satisfied by the ERP system used, 33.33% have used the system in less than one year and 66.67% have been using the system between one and three years. The table shows also that there are no unsatisfied companies, including those that have used ERP systems for more than three years.

How long has it been since you implemented ERP system in your company?\*

How do you assess your satisfaction with the used ERP system?

**Two-dimensional distribution of responses to questions:**

**No 11: Do you think it is appropriate to use utility software for pre-establishing the effectiveness of implementation of ERP system?**

**No 13: Do you think it is appropriate Aloe Co., Ltd. to develop an original methodology for assessing the effectiveness of ERP systems in SMEs?**

The distribution of responses to both questions is shown in Table 13. An important result here is that among the companies that consider appropriate the use of utility software for the preliminary assessment of the effectiveness of the implementation of the ERP system, 75.00% find it appropriate that Aloe Co., Ltd.

should develop an original methodology for such assessment.

Do you think it is appropriate to use utility software for pre-establishing the effectiveness of implementation of ERP system?\*

Do you think it is appropriate Aloe Co., Ltd. to develop an original methodology for assessing the effectiveness of ERP systems in SMEs?

**Two-dimensional distribution of responses to questions:**

**No 13: Do you think it is appropriate Aloe Co., Ltd. to develop an original methodology for assessing the effectiveness of ERP systems in SMEs?**

**No 14: Would your company pay to use methodology and support software for preliminary measure of the effectiveness of ERP system implementation?**

The distribution of responses to both questions is shown in Table 14. An interesting result is that a larger part of the firms that

Table 13. Two-dimensional distribution of responses to questions No 11 and No 13

Do you think it is appropriate to use utility software for pre-establishing the effectiveness of implementation of ERP system?	Do you think it is appropriate Aloe Co., Ltd. to develop an original methodology for assessing the effectiveness of ERP systems in SMEs?		Total
	No	Yes	
No	1,00	12,00	13,00
	7,69%	92,31%	100,00%
	9,09%	28,57%	24,53%
	1,89%	22,64%	24,53%
Yes	10,00	30,00	40,00
	25,00%	75,00%	100,00%
	90,91%	71,43%	75,47%
	18,87%	56,60%	75,47%
Total	11,00	42,00	53,00
	20,75%	79,25%	100,00%
	100,00%	100,00%	100,00%
	20,75%	79,25%	100,00%

rely on Aloe Co., Ltd. to develop an original methodology for assessing the effectiveness of ERP systems in small and medium enterprises, expressed in 56.82% would also pay for the use of such methodology.

Do you think it is appropriate Aloe Co., Ltd. to develop an original methodology for assessing the effectiveness of ERP systems in SMEs?\* Would your company pay to use methodology and support software for preliminary measure of the effectiveness of ERP system implementation?[count, row%, column%, total%]

Table 14. Two-dimensional distribution of responses to questions No 13 and No 14

Do you think it is appropriate Aloe Co., Ltd. to develop an original methodology for assessing the effectiveness of ERP systems in SMEs?	Would your company pay to use methodology and support software for preliminary measure of the effectiveness of ERP system implementation?		Total
	No	Yes	
No	6,00	5,00	11,00
	54,55%	45,45%	100,00%
	24,00%	16,67%	20,00%
	10,91%	9,09%	20,00%
Yes	19,00	25,00	44,00
	43,18%	75,00%	100,00%
	76,00%	83,33%	80,00%
	34,55%	45,45%	80,00%
Total	25,00	30,00	55,00
	45,45%	54,55%	100,00%
	100,00%	100,00%	100,00%
	45,45%	54,55%	100,00%

#### 4. Statistical hypotheses

In carrying out of the statistical survey it is necessary to perform comparison of the data obtained, in addition to their description. For this purpose, we formulated statistical hypotheses (Saikova, 2002), representing assumptions about the values of the studied parameters of the population.

The check of the hypothesis goes through the following main phases:

- definition of the hypothesis;
- definition of the level of significance;
- choice of test for the verification of the hypothesis;
- Statistical inference.

Based on the results of the survey, below are formulated and analyzed the following statistical hypotheses.

**4.1.** Define the following null hypothesis:  $H_0: X_{10} = X_{12}$ , where variables  $X_{10}$  and  $X_{12}$  indicate questions with numbers 10 and 12 of the questionnaire. With this hypothesis we study, if there is a relationship between the assessment of the benefits and effectiveness of the ERP system and its implementation. The next stage of the check of the hypothesis is to define the level of significance. It is compared with the risk of error  $\alpha$ . If it is greater than  $\alpha$ , a true null hypothesis is accepted and the alternative is rejected and vice versa, if the level of significance is less than  $\alpha$ , a true alternative hypothesis is accepted and the null is rejected. In socio-economic research it is adopted to work with an error risk of 5%. In this analysis we have accepted a risk for error  $\alpha = 0,05$ .

In this case the two variables are qualitative and therefore check of the hypothesis is performed with Chi-square analysis. For the performance of this analysis, the following three requirements should be satisfied:

- No theoretical frequencies lower than 1;
- Permitted are theoretical frequency lower than 5, but these cannot be more than 20% of cases;
- The volume of the sample should be greater than 50 units.

To measure the strength of the relationship with Chi-square analysis we use the coefficient of Cramer. It is the most appropriate, because it is normalized in the range between 0 and 1. It is assumed that when it is in the range of 0 to 0.3 - the relationship is poor, from 0.3 to 0.7 - the relationship is medium, and 0.7 to 1 - the relationship is strong. To interpret the coefficient of Cramer, we should check whether it is statistically significant by comparing the level of significance to error  $\alpha$ . When the level of significance  $< \alpha$  (0,05), this coefficient is significant and can be interpreted.

To analyze the results, the requirements of chi square test (Table 15) must be fulfilled.

The first requirement, namely: no theoretical frequencies lower than 1 is satisfied –the minimum theoretical frequency is 5.67 (shown below the table). The second requirement (Permitted are theoretical frequency lower than 5, but these cannot be more than 20% of cases) is satisfied, since the theoretical values of frequencies are 0%. The third requirement (The volume of the sample should be greater than 50 units.) is also fulfilled, sample of 55 units. The three requirements are met and the results can be interpreted.

Table 15 shows that the coefficient of chi square is 2,926. This coefficient represents the empirical characteristic of the analysis. As  $Asymp.Sig = 0,087 > 0,05$ , therefore true null hypothesis is accepted. The conclusion is that there is no statistically significant relationship between conducted assessment of the benefits and effectiveness of the ERP system and its implementation. Cramer's coefficient (Table 16), which measures the

Table 15. Chi-Square analysis

Chi-Square Tests

	Value	df	Asy mp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.926 <sup>b</sup>	1	,087		
Continuity Correction	1.933	1	,164		
Likelihood Ratio	3,083	1	,079		
Fisher's Exact Test				,116	,080
Linear-by-Linear Association	2,873	1	,090		
N of Valid Cases	55				

a. Computed only for a 2x2 table

b. 0 cells (,0%) have expected count less than 5. The minimum expected count is 5,67.

strength of the relationship is statistically insignificant, as the level of significance (Approx. Sig.) = 0,087 >  $\alpha$ . Its value is 0.231, which is within the range of weak relationship, but since it is insignificant we are not going to interpret it.

4.2. Define the following null hypothesis:

Table 16. Cramer's coefficient Symmetric Measures

	Value	Approx. Sig.
Nominal by Phi	.231	.087
Nominal by Cramer's	.231	.087
N of Valid Cases	55	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

H0: X13 = X14, where variables X13 and X14 indicate questions with numbers 13 and 14 of the questionnaire. With this hypothesis we study, whether there is a relationship between evaluating the feasibility of developing a

methodology for assessing the effectiveness of ERP systems in SMEs and willingness to pay for utility software. And here again, the next stage of the check of the hypothesis is the definition of the level of significance. It is compared with the risk of error  $\alpha$ . If it is greater than  $\alpha$ , a true null hypothesis is accepted and the alternatives rejected and vice versa, if the level of significance is less than  $\alpha$ , a true alternative hypothesis is accepted and the null is rejected. We accept the risk for error  $\alpha = 0,05$ .

As in the previous case, the two variables are qualitative, therefore the examination of the hypothesis is performed by Chi-square analysis. Above mentioned requirements for the implementation of this analysis are met and as measure of the strength of the relationship, the coefficient of Cramer will be used.

Table 17 shows the results of the chi-square test

To analyze these results the relevant

Table 17. Chi-Square analysis

Chi-Square Tests

	Value	df	Asy mp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,458 <sup>b</sup>	1	,498		
Continuity Correction	,115	1	,735		
Likelihood Ratio	,457	1	,499		
Fisher's Exact Test				,502	,366
Linear-by-Linear Association	,450	1	,502		
N of Valid Cases	55				

a. Computed only for a 2x2 table

b. 0 cells (,0%) have expected count less than 5. The minimum expected count is 5,00.

Table 18. Cramer's coefficient Symmetric Measures

		Value	Approx. Sig.
Nominal by Phi		.091	.498
Nominal Cramer's		.091	.498
N of Valid Cases		55	

- a. Not assuming the null hypothesis.
- b. Using the asymptotic standard error assuming the null hypothesis.

requirements of chi square analysis must be fulfilled. The first requirement, namely: no theoretical frequencies lower than 1 is satisfied –the minimum theoretical frequency is 5.00 (shown below the table). The second requirement (Permitted are theoretical frequency lower than 5, but these cannot be more than 20% of cases) is satisfied, since the theoretical values of frequencies are 0%. The third requirement (The volume of the sample should be greater than 50 units.) is also met, the sample consists of 55 units. The three requirements are met and the results can be interpreted.

The table shows that the coefficient of chi square is 0.458. This coefficient represents the empirical characteristic of the analysis. As  $Asymp.Sig = 0,498 > 0,05$ , therefore true null hypothesis is accepted. The conclusion is that there is no statistically significant relationship between evaluating the feasibility of developing a methodology for assessing the effectiveness of ERP systems in SMEs and willingness to pay for utility software.

Cramer's coefficient (Table 18), which measures the strength of the relationship is statistically insignificant, as the level of significance ( $Approx. Sig. = 0,498 > \alpha$ ). Its value is 0.091, which is within the range of weak relationship, but since it is insignificant we are not going to interpret it.

## 5. Analysis of the results

Statistical processing of data from a questionnaire survey conducted in 55 companies enables us to characterize some of the capabilities and requirements of the surveyed enterprises, and also to formulate specific requirements for the development of a methodology for measurement and assessment of the economic impact of the implementation of ERP systems in SMEs. As noted all of these enterprises are in the category of SMEs according to SMEL and they are all clients of Aloe Co., Ltd.

Based on the one-dimensional empirical distributions of responses to questions № 3 and № 14 of the questionnaire, the following conclusions can be drawn.

More than a half of the respondents have implemented ERP system for the period between one and three years, indicating that companies feel the need of using this type of system. However, only one not large part of the respondents, about 10% is not satisfied with the use of the ERP system. At the same time it is clear that the majority of companies (60%) did not perform a preliminary assessment of the economic impact, which could be one of the factors for dissatisfaction with the subsequent implementation of the ERP system.

The distribution of answers to questions № 6, 7 and 8 is indicative for the types of methods used for a preliminary assessment of the economic efficiency, of whom this assessment has been made and who has used the results. Hence it appears that companies in which a preliminary assessment has been carried out predominantly have used quantitative methods (59.09%) in the majority of cases (over 59.09%) assessment has been carried out by the company implementer and the results of this assessment are used primarily by the management of



the company implementer (77.27%). It is noteworthy in this case the low percentage (22.73%) of the companies in which it have been carried out a preliminary assessment of the economic efficiency and which managements have not used the results of that assessment to improve their business.

Question № 9 of the questionnaire allows for the specification of more than one answer and outlines the requirements of the surveyed enterprises in terms of the preferred functionality of the ERP system. The one-dimensional distribution of the responses presented in Table 7 shows that four of the modules are specified by more than 50% of the respondents, namely: Clients (50.91%), Warehouse (52.73%), Marketing (56.36%) and Finance (52.73%). The remaining four modules - Manufacturing (45.45%) Supply (43.64%), accounting (49.09%), other modules (45.45%) were appointed by 40% of the respondents. These results indicate the high need of these relevant features of the ERP system.

In general, the majority of respondents (56.36%) do not conduct assessment of the benefits and efficiency achieved by the implementation of ERP system. One dimensional distribution of responses to question № 11, however, shows that the majority of companies (72.73%) consider appropriate to use a utility software for pre-establishing the effectiveness of ERP system implementation.

Positive answers to all three questions with numbers 12, 13 and 14 are more than 50%, respectively they are 76.36%, to the first question, 80% to the second and 54.55% to the third. These answers are all in favor of the necessity of development of an original methodology for assessing

the effectiveness of ERP systems in SMEs and its implementation in innovative software product.

In the current study we made also two-dimensional distributions of the responses to pairs of questions (№ 3, № 4), (№ 11, № 13) and (№ 13, № 14) of the questionnaire. This type of distributions enables us to determine the attitude of the respondent enterprises to a specific question in case a certain condition is met in another question. On the other hand some of the two-dimensional distributions are used for the formulation and verification of relevant statistical hypotheses.

Two-dimensional distribution of the answers to № 3 and № 4 aims to examine whether the satisfaction of enterprises using ERP system depends on the period of time during which it is used. Table 11 shows that the highest percentage of fully satisfied (66.67%) used the system between one and three years. Simultaneously, however, the largest percentage of completely dissatisfied (over 66.67%) also used the system between one and three years. From this result we could make the conclusion that there is no dependence between the satisfaction of a given ERP system and the duration of its use.

Two-dimensional distribution of the answers to questions № 11 and № 13 aims to examine what part of the respondent enterprises that consider appropriate the use of utility software for preliminary determination of the effectiveness of ERP system implementation would also consider it appropriate Aloe Co., Ltd. to develop original methodology for such assessment. The main conclusion of this two-dimensional distribution is that among the companies that find appropriate the use of utility software, a



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significant proportion (75%) also consider appropriate Aloe Co., Ltd. to develop its own original methodology.

Two-dimensional distribution of the answers to questions № 13 and № 14 aims to examine what part of the companies that rely on Aloe Co., Ltd. to develop an original methodology for assessing the effectiveness of ERP systems in SMEs would also pay for the use of such methodology. The result of this study shows that the majority of these companies, representing 56.82% would also pay for preliminary measuring of the effectiveness of ERP system.

In the present survey we also formulated and tested several statistical hypotheses aimed to identify any statistical correlation between the responses of pairs of questions (№ 10, № 12) and (№ 13, № 14) of the questionnaire. Checks of the null hypotheses were carried out using a non-parametric test chi square and show that there is no statistical relationship between the responses of the corresponding pairs of questions.

### 6. Conclusion

Generally, the most important conclusions from the survey and the statistical processing of the empirical data can be summarized in the following form.

Firstly nearly 75% of the companies find it useful to use a utility software for preliminary establishment of the effectiveness of ERP system implementation.

Secondly, in case of positive estimate of the efficiency of use of an ERP system, more than 75% of businesses would proceed to its implementation.

The third important finding is that a particularly high percentage of

respondents (80%) expressed their confidence in the company Aloe Co., Ltd. to develop an original methodology for assessing the effectiveness of ERP systems in SMEs.

Significant conclusion, having regard to the return on investment in the development of a methodology and software solution for assessment of the effectiveness follows from the fact that most of the companies that have a need for such a methodology and software would also pay for their practical use.

### References

Dey, P.K., Clegg, B., Cheffi, W., 2013. Risk management in enterprise resource planning implementation: A new risk assessment framework, *Production Planning and Control*, Volume 24, Issue 1, pp. 1-14.

ENTERPRISE 2010, Zelenata kniha na sistemite za upravljenie na biznesa i upravenskoto konsultirane v Bulgaria, ENTERPRISE, tom 2

Esteves, J., Pastor, J., 2000. Towards the Unification of Critical Success Factors for ERP implementations, 10th Annual BIT conference, Manchester, UK. November 2000, pp. 44.

Esteves J., J. Pastor, 2001. Analysis of critical success factors relevance along sap implementation phases, 2001 — Proc. Seventh Americas Conference on Information System, pp.1019-1025.

Fulane, O., Único, B., Alturas, B., Lage, E., 2012. Critical factors in ERP implementation projects in two Mozambican banks, Iberian Conference on Information Systems and Technologies, CISTI, Article number 6263188.

Futekova, N., V.Monov 2015 Empirical study on the need for a preliminary assessment of the effectiveness of the implementation process of ERP-systems in Bulgarian SMEs, *Economic Alternatives*, №2

Hailu, A., Rahman, S. , 2012. Evaluation of key success factors influencing ERP implementation success *2012 IEEE 8th World Congress on Services, SERVICES 2012*; Honolulu, Article number 6274036, pp. 88-91.  
Lazarova, V., 23-24 April 2010, Ispolzovane na metodi za otdalechen dostap pri izgrazhdane na desktop prilozhenia za malak i sreden biznes.Mezhdunarodna nauchna konferentsia "Sistemi za upravlenie na biznesa v malki i sredni predpriqtia", Svishtov

Mahdavian, M., Wattanapongsakorn, N., Azadeh, M., Ayati, A., Mahdavian, M., Jabbari, M., Bahadory, S. ,2012 , Identifying main resistance factors in ERP implementation: A case study, 9th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology, ECTI-CON 2012;Phetchaburi; Article number 6254311.

Sar, A., Garg, P., 2012. Analysis of critical failure factors in ERP implementation: An Indian experience, *International Journal of Business Information Systems*, Volume 11, Issue 3, pp. 360-378.

Saikova I. ,Stoikova-Kanalieva A. ,Saikova S. ,2002, Statistichesko izsledvane na zavisimosti,Sofia,UI "Stopanstvo"

Sternad, S., Bobek, S., Dezelak, Z., Lampret, A., 2009. Critical success factors (CSFs) for enterprise resource planning (ERP) Solution implementation in SMEs: What does matter for business integration, *International Journal of*

*Enterprise Information Systems*, Volume 5, Issue 3, pp. 27-46.

Sultanate, J., Khoshsir, M., 2012. How can technology transfer concepts lead to a successful ERP implementation? *Research Journal of Applied Sciences, Engineering and Technology*, Volume 4, Issue 23, pp. 5222-5229.

Umble,E.J., R. R. Haft, M. M. Umble, 2003. Enterprise resource planning: Implementation procedures and critical success factors, *European Journal of Operational Research* 146, pp. 241–257.

You C.J., Lee C.K.M., Chen, S.L., Jiao R.J., 2012. A real option theoretic fuzzy evaluation model for enterprise resource planning investment, *Journal of Engineering and Technology Management - JET-M* Volume 29, Issue 1, pp. 47-61.

## Appendix 1

### Questionnaire

Determination of the need for preliminary measurement of the implementation process effectiveness

1. Type of Enterprise?
  - Within the SME category according to LSME
  - Outside the SME category according to LSME
2. Are you client of Aloe Co Ltd.?
  - Yes
  - No
3. How long has it been since you implemented ERP system in your company
  - Less than one year;
  - Between one and three years;
  - More than three years.
4. How do you assess your satisfaction with the used ERP system?

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- It satisfies us completely
- It rather satisfies us
- It rather not satisfies us
- It does not satisfy us

5. Have it been conducted a preliminary assessment of the expected economic impact of ERP system at the stage of the its implementation (if the answer is "no" –go to question 9)

- Yes
- No

6. The preliminary assessment of the economic impact was carried out with:

- Quantitative Methods
- Qualitative methods

7. Preliminary assessment of the effect of the implementation is done by:

- Team of the company implementer
- Team of your own company

8. The results of the preliminary assessment of the effectiveness are used by:

- Management of the company - implementer;
- The management of your company;
- Both of them

9. What functionality would you like to have your ERP system?

	Functionality	Yes	No
1	Manufacturing		
2	Supplies		
3	Clients		
4	Warehouse		
5	Marketing		
6	Accounting		
7	Finance		

8	Other, specify.....		
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10. Do you perform assessment of the benefits and efficiency achieved for your company as a result of implementation of ERP system?

- Yes
- No

11. Do you think it is appropriate to use utility software for pre-establishing the effectiveness of implementation of ERP system?

- Yes
- No

12. If the results of the use of software to measure and evaluate the effectiveness show that your company is appropriate for ERP system implementation, would you do it?

- Yes
- No

13. Do you think it is appropriate Aloe Co., Ltd. to develop an original methodology for assessing the effectiveness of ERP systems in SMEs?

- Yes
- No

14. Would your company pay to use methodology and support software for preliminary measure of the effectiveness of ERP system implementation?

- Yes
- No