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## INCREASING COMPETITIVENESS OF ENTERPRISES BY INVESTING IN INNOVATIONS AND NEW TECHNOLOGIES

### Abstract

*In the theory of resource based theory, the competitive advantage can be achieved by lower costs, as well as by a higher efficiency of the company and product differentiation. The lack of innovations in SMEs is connected with the lack of a formed vision, weak management structure, weak growth strategy, lack of resources and increasing exposure to global factors and competition. This paper, in this respect, supports the potential positive impact of the experience and knowledge in the field of information technologies on the IT competences of employees and management. The paper presents the results of empirical research on investing in innovations and new technologies. The main estimate of the paper is that investing in innovations and new technologies is in some forms more significant, while it is still insufficient in relation to the pace of introduction of new technologies and the needs of the global market.*

**Keywords:** investment, innovations, new technologies, competitiveness

**JEL classification:** O31,O32

## ПОВЕЋАЊЕ КОНКУРЕНТНОСТИ ПРЕДУЗЕЋА ИНВЕСТИРАЊЕМ У ИНОВАЦИЈЕ И НОВЕ ТЕХНОЛОГИЈЕ

### Апстракт

*Конкурентска предност у теорији заснованој на ресурсима може да се постигне нижим трошковима као и већом ефикасношћу фирме, диференцијацијом производа. Недостатак иновација у МСП је повезан са неформулисаном визијом, слабом менаџмент структуром, недостатком ресурса и све већом изложеношћу глобалним факторима и конкуренцијом.*

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*У овом раду су дати резултати емпиријског истраживања о инвестирању у иновације и нове технологије, које је вршено у Моравичком округу на узорку од 137 малих и средњих предузећа. Основни закључак рада јесте да је инвестирање у иновације и нове технологије у неким облицима значајније, док је ипак још недовољно у односу на темпо увођења нових технологија и потреба глобалног тржишта.*

**Кључне речи:** *инвестирање, иновације, нове технологије, конкурентност*

## Introduction

The time we live and do business in is marked by the speed of information transfer, the globalization changes, fight for new customers, productivity increase in order to achieve the competitive advantage. Also, modern business is conditioned by the scientific and technological revolution, especially by information and communication technologies, globalization of economy and other factors, so in this regard the transformation of the companies means a change that encompasses all aspects of the organization, including the change of organizational structure (Medenica, Momirović, & Mikša, 2012).

All of these qualities and features are characteristics that define the modern business (Vulović, Papić & Damjanović, 2010). The emphasized dynamics and present levels of competitiveness of modern markets are forcing the enterprises to be flexible, innovative and responsive to consumer demands. They achieve this by applying advanced business solutions in regulating and functioning of their internal business relations and in establishing business relationships, as well as when making connections with external partners, customers or suppliers (Damjanović, Jovanovic, Šljivić, Jevtic & Grozdanić, 2011). ICTs play a key role in creating the enterprise's ability to be agile, connected and innovative and to quickly exchange all information internally and externally. Information system within small and medium-sized enterprises (SMEs) has become one of the basic mechanisms of control of business operations by each individual manager. Starting from the software for accounting, through the electronic monitoring of raw materials and finished products, to the automation of production itself  $\frac{3}{4}$  of ICTs have become an integral part of every enterprise.

The main objective of ICTs is to provide enterprises with the sustainable competitive advantage. Due to the fast-growing benefits of the Internet and other communication technologies, companies have become more skilled in gathering information about individual customers and business partners (suppliers, distributors, retailers) (Kotler, Wong, Saunders & Armstrong, 2007).

A very important element of success in modern enterprises is the high-quality harmonization of the opportunities that ICTs offer with the aim of improving business activities, functions and processes. IT has become a major factor in the performance and improvement of business activities and decision-making process in the enterprise. It affects the information management and represents a catalyst of fundamental changes in the structure, business operations and the very process of management (Đuričin, Janošević & Kaličanin, 2009). Therefore, it is inevitable to include ICTs in the enterprise development strategy, so that their strategic goals are fully consistent with each other.

A ticket to the world of ICTs is becoming cheaper, the costs are falling dramatically, and the equipment is getting cheaper. ICTs today bring a number of benefits, cost savings, improvements and enhancements, so the strategic perspective of companies is also slowly changing. ICTs take on a new role in the development of strategies; it is no longer economically feasible to look at ICTs as a tool that supports only operational processes (Veljović, Vulović & Damnjanović, 2009).

The subject of the research presented in this paper are the issues of increasing the enterprise competitiveness by means of investing in innovations and new technology. There are many reasons for choosing this topic as the subject of the research, as well as its social relevance. Many modern organizations have realized that regardless of the importance of technologies, the key driver for global trade division is the model of business innovation. The most dramatic developments in the modern era take place in the information technologies (Samuelson & Nordhaus, 2009).

Innovativeness is positioned at the centre of the EU development strategy (Europe 2020). In the field of innovativeness, Serbia significantly lags behind the average and the majority of the EU members. The biggest innovation backlog is created in the field of intellectual property. The application of modern technologies in the function of competitive business operating of the modern enterprise, shows that according to the equipment and the use of computers in business, Serbian SMEs are slightly behind the average of EU-27 and highly developed countries, but when it comes to the use of the Internet, they are significantly lagging behind most EU member states. The internet is most often used in order to provide banking and financial services, while e-business (buying and selling) is still under-represented, as well as electronic communications in procurement, especially with foreign countries, communicating with customers, interaction of relations with potential clients and in the area of improving of a portfolio of services and products in relation to the market's perception and creation of innovative offerings.

The lack of innovation in the use of new technologies and development of new products, high labour costs, lack of information on the needs of the market and low productivity have caused a significant deficit in the foreign trade of Serbia. The pace of changes in the business world will not slow down in the foreseeable future. The competition in most industries over the next few decades is likely to take place at a faster pace. The enterprises, wherever they are located, will be faced with even more dangerous risks and great opportunities, arising from the globalization of the economy, with related technological and social trends (Bešić, Sajfert & Damnjanović, 2009). Consequently, improvement of the productivity and competitiveness of small and medium-sized enterprises, must become the most important direction for further development, together with modern education for new technological competences, innovativeness and technological development, to make the growth potentials come to the fore even more and in order to achieve maximum effects. The enterprise must have a climate in which the innovation is the best means of operational improvement and it has to be directed not only to the benefit of the enterprise, but also to the benefit of each individual, both workers and managers (Bešić, Nikolić & Damnjanović, 2010). The level of experience of employees, but also their level of work satisfaction in the company, affect the quality of services provided, and thus the quality of the relationship with customers (Ratković, Grubić, Tasić, Damnjanović & Matić, 2011).

This research in this paper is, in this regard, focused on the scientific verification of the claims: that the investments in innovations and new information technologies have a positive impact on the internal performance of an enterprise, the relationships with customers and the performance of electronic communication in dealing with the environment.

The overall results of this research should indicate the validity of the research of the influence of modern technologies on the competitiveness of small and medium-sized enterprises in Serbia, on the level of innovative and technological inputs and their future impact on: the internal improvement of all functions of the enterprise, establishment of better communication and management relations with customers through modern information technologies, as well as the encouragement of enterprises to invest in the product innovation, export, and process of electronic communication with the wider community and institutions, as well as the global market. The desk research of theoretical basis, references, as well as of empirical results affect the possible restrictions, as well as the potential innovative research stemming from these results.

## **The subject, background and objectives of the research**

The research subject presented in this paper is the impact of investments in innovations and new technologies on the competitiveness of SMEs. The response to rapid changes in the environment in which SMEs carry out their business and wider social mission, which increasingly have an intermittent character, is found in the improvement of the strategic competitive performance through the use of modern technologies.

The rapid development of new technologies affects the creation of new business forms, which are becoming the foundation of infrastructure of modern, contemporary business. They impose new rules and challenges to business entities that they have to adapt to in order to survive in the market. The modern-oriented management should recognize all the advantages of modern technologies that affect the improvement and creation of new values, which contributes to the strategic advantage of SMEs to overcome the competition.

The emphasized dynamics and present levels of competitiveness of modern markets are forcing SMEs to be flexible, innovative and responsive to consumer demands. Modern technology should play a key role in creating SME strategic advantages, to make them agile, well-connected, with the ability to quickly exchange all information internally and externally. An important part of the SME success in the proper alignment of the opportunities provided by modern technology, with the aim of improving business activities, functions and processes.

Based on the previously mentioned, the paper objective has been defined as follows: The impact of investments and the use of modern technologies as an innovative input on the improvement of the overall performance of a company, knowledge and skills of employees and management, the establishment of new services and communication with consumers, benefits for employees and shareholders, suppliers and external communication with the community and global world, in the form of increased competitive and comparative advantages.

The SMEs which make up the biggest share of the Serbian economy, which significantly contribute to the development of economy, export and prosperity, but still

lack the understanding and are not able to rapidly introduce new technologies in their business, have been selected as the target group.

The research starts from the premise that innovative business models of SMEs based on the introduction of new technologies and communications, can significantly improve internal knowledge and abilities, strengthen the technical and technological capacity, achieve better access to new ideas and products and materials for modern production processes, research results and the commercialization of new values added, produced by the small and medium sized enterprise. This starting point ensures a sustainable strategic competitiveness and advantage of SMEs in the long term, which is the objective of introducing new technologies, knowledge and methods in business practices of Serbian SMEs.

## **The Basic Hypothesis of the Research**

The paper starts with a hypothesis, whose testing, by means of theoretical, desk and empirical research, enables the verification of the role and impact of new technologies, especially when it comes to information technologies, on achievement of the competitive advantage of small and medium-sized enterprises. The hypothesis and research are related to the technological input and output of the competitive capacity of SMEs.

The hypothesis: SME investments in innovations and new information technologies have had in the research period a positive impact on the relations with customers.

## **Theoretical and Methodological Framework of the Research**

For the purpose of testing the hypothesis and results of the empirical research, the statistical analysis of the basic control variables is used in the paper: the industry sector, enterprise size, age of the enterprise, education of the managers/owners, turnover of the company, the structure of the enterprise classified by export-import activities, funds invested in innovations and new technologies, level, types and forms of information technologies used in SMEs in the period given for collection of the data, on the territory of the country and in a special segment - Moravički region.

In terms of the theoretical basis of the statistical methods used in the research, the methods are divided into three basic groups:

The first of these represents the basic method of descriptive statistical analysis of the observed data. In this respect, we will first determine the so-called dominant characteristics of the observed group, i.e. calculate the basic parameters, the mean value and standard deviation for the hypothesis formed (variables) within the sample.

In the next stage of statistical analysis of the observed data, we perform statistical testing of dependence of variables, which we receive based on the individual responses of the surveyed SMEs, on the one hand, in relation to the size of the company, on the other hand. In this case we use the well-known Pearson's test of independent modalities of the two features of the sample set. Numerous procedures of statistical testing based on the so-called Pearson statistics represent the oldest methods of statistical inference.

However, as we shall see in our research, this group of statistical tests is today widely used in statistical practice and different areas of human activities.

Finally, for a formal test of the hypothesis of our research, we use a model called binomial logistic regression. Regression analysis reveals a form of (functional) dependency between two (or more) variables. The main problem in the quantitative description of such dependency is the selection of the appropriate model, as well as the variables that are essential for their description and connecting in the form of mathematical relation.

## Research methodology

We start from the hypothesis whose testing, by means of desk and empirical research, enables verification of the positive impact on the relations with customers by investing in innovations and new technologies.

The hypothesis explores the potential positive impact of innovations and investments in information technologies on the enterprise performance development. We form the hypothesis, together with the corresponding survey questions, as follows:

1. Are potential and actual customers included in the design and the improvement of services?
2. Are potential and actual customers and other interested parties included in the development of quality standards related to services and information?
3. Are the procedures developed and demonstrated in a simple and understandable way, customized for ordinary customers?
4. Are the responsible management system and the procedures for responses and appeals submitted electronically, being developed?
5. Are proactive and regular relations with the customers being maintained?
6. Is the opinion of important customers being underscored in resolving important company issues?
7. Are ideas, suggestions and complaints of customers and suppliers being encouraged and accepted, together with the use of appropriate mechanisms?
8. Does the enterprise own user-oriented web sites, customized to each customer individually?

To test the above mentioned hypothesis, the empirical research and statistical analysis of the degree of investing of funds in innovations and new technologies were used, as well as the level, types and forms of information technologies used in SMEs in the period given for data collection, on the territory of the country and in a special segment - Moravički region.

For this purpose, a sample of 137 SMEs was formed, classified according to the enterprise size. More specifically, within our sample there are 103 small enterprises (up to 50 employees) and 34 medium-sized enterprises (50 to 250 employees).

Whose owners (managers) were interviewed by using the aforementioned survey form. In doing so, the survey questions were made to determine the validity of the hypothesis. All respondents' answers are coded with 0 (no, a negative answer) or 1 (yes, a positive affirmative, answer). In this way, the answers obtained from the surveyed SMEs can be seen

as dichotomous random variables, with (only) two possible values: 0 and/or 1. The total ratio of these values gives an accurate insight into the extent and significance of investments in innovations and the development of information technologies for each individual, particular question of the survey, i.e. for each individual surveyed enterprise. In addition, the statistical verification of validity of the hypothesis was also determined, in relation to the size of the enterprises, and thus a more comprehensive picture is obtained of whether and how the enterprise size affects the degree of innovations in information technologies.

## Research results

For the defined hypothesis that assumes the positive impact of innovative activities of SMEs, we now provide appropriate conclusions. First, we introduce, in a formal way, the appropriate dichotomous variables that show (positive or negative) responses of the surveyed owners and/or managers of SMEs. Depending on the response given to each individual question of the survey, these variables will be changeable sizes that assume exactly two different values:

- yes /coded with 1/
- no /coded with 0/

The data obtained in such a way, were quantified, by means of a specially introduced dichotomous (0/1) variables that represent so-called *Indicators* of the observed characteristics within the sample. This, in other words, means that the very statistical analysis of the observed data, above all, will be based on the determination of the proportion (share) of affirmative responses in relation to the total number (sample scope) of 137 surveyed SMEs. In order to test the validity of the hypothesis, the results obtained can then be investigated in more detail, by means of different methods of statistical processing and quantitative analysis. These will now be discussed, while, with the aim of achieving transparency in the presentation of the results obtained and the methodology of statistical research, we analyse the stated hypothesis.

*Table 1. Interview questions*

	1	2	3	4	5	Mean
1. Are potential and actual customers included in the design and the improvement of services?	4,50%	9%	46%	18%	22,50%	3,45
2. Are potential and actual customers and other interested parties included in the development of quality standards related to services and information?	4,50%	18%	32%	18,50%	27%	3,45
3. Are the procedures developed and demonstrated in a simple and understandable way, customized for ordinary customers?	0%	9%	9%	32%	50%	4,22
4. Are the responsible management system and the procedures for responses and appeals submitted electronically, being developed?	23%	4,50%	23%	18%	31,50%	3,14

5. Are proactive and regular relations with the customers being maintained?	0%	9%	9%	36%	46%	4,18
6. Is the opinion of important customers being underscored in resolving important company issues?	4.5%	0%	9%	46%	41.5%	4,18
7. Are ideas, suggestions and complaints of customers and suppliers being encouraged and accepted, together with the use of appropriate mechanisms?	4.5%	4.5%	23%	41%	27%	3,82
8. Does the company own user-oriented web sites, customized to each customer individually?	32%	9%	14%	14%	31%	3,04

Figure 1. Are potential and actual customers included in the design and the improvement of services?

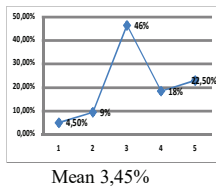


Figure 2. Are potential and actual customers and other interested parties included in the development of quality standards related to services and information?

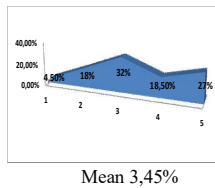


Figure 3. Are the procedures developed and demonstrated in a simple and understandable way, customized for ordinary customers?

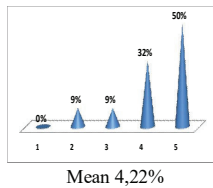


Figure 4. Are the responsible management system and the procedures for responses and appeals submitted electronically, being developed?

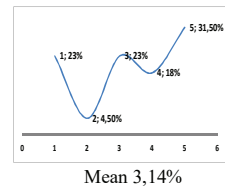


Figure 5. Are proactive and regular relations with the customers being maintained?

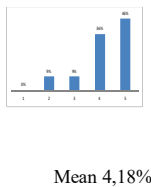


Figure 6. Is the opinion of important customers being underscored in resolving important company issues?

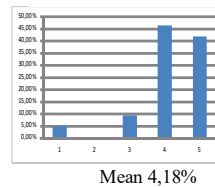


Figure 7. Are ideas, suggestions and complaints of customers and suppliers being encouraged and accepted, together with the use of appropriate

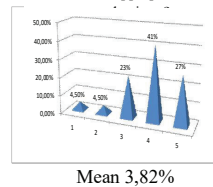
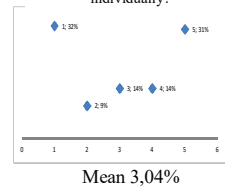


Figure 8. Does the company own user-oriented web sites, customized to each customer individually?



Further on, we examine the validity of the hypothesis which assumes that the investments in innovations and new information technologies of SMEs in the previously researched time period, had a positive impact on the relations with customers. A part of the survey questionnaire related to this hypothesis, has eight survey questions, i.e. the appropriate dichotomous variables whose values that were observed, along with other descriptive-statistical indicators, are shown in table 2.

The highest observed value has the  $X_5$  variable, which shows the positive attitude of surveyed SMEs on maintaining the proactive and regular relations with customers. Naturally, the vast majority of respondents, 83.58% of them, replied affirmatively to this survey question. Similarly, a high percentage of almost 80% positive responses is also expressed by the value of the  $X_7$  variable, i.e. the positive attitudes on the encouragement



and acceptance of ideas, suggestions and complaints of customers and suppliers. Then follows the  $X_1$  variable, where more than three quarters of the surveyed sample of SMEs answered affirmatively to a question whether they include potential and actual customers in the design and improvement of their services. We should point out the value of the  $X_3$  variable, based on which we can conclude that more than 70% of the subjects is developing the procedures that are in a simple and user-friendly manner customized for ordinary customers. The  $X_2$  variable has the value of more 50%, i.e., almost two thirds of SMEs surveyed claimed that potential and actual customers are involved in the development of quality standards of services and information in their enterprises.

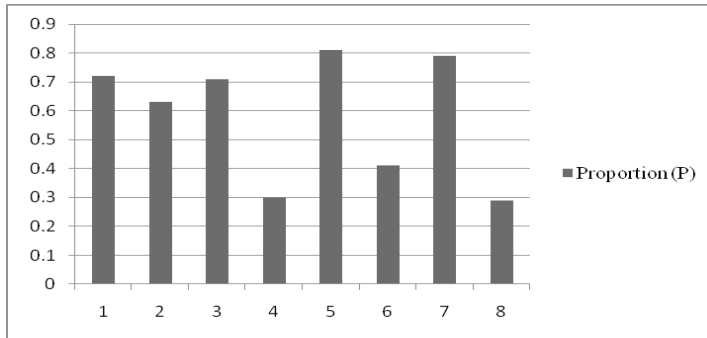
*Table 2. The number of observations, mean value and standard deviation of key variables*

<i>Variables</i>	<i>Description (survey questions)</i>	<i>SME Number</i>	<i>Proportion (p)</i>	<i>Standard deviation</i>
$X_1$	Potential and actual customers are involved in the design and improvement of conditions	102	0.7612	0.4264
$X_2$	Potential and actual customers are involved in the development of the service quality standards	87	0.6493	0.4772
$X_3$	Procedures customized for ordinary customers are being developed and demonstrated	97	0.7239	0.4471
$X_4$	A responsible management system and procedures for responses and appeals are being developed	40	0.2985	0.4576
$X_5$	Proactive and regular relations with customers are being maintained	112	0.8358	0.3704
$X_6$	The opinion of important customers in resolving important issues is being encouraged	57	0.4254	0.4944
$X_7$	The ideas, suggestions and complaints of customers and suppliers are being encouraged and accepted	106	0.7910	0.4066
$X_8$	The company has user-oriented web sites	38	0.2836	0.4507

*Source: The projection of the authors*

Contrary to the previous variables, convincingly, the lowest observed value has the  $X_8$  variable, i.e. a surprisingly small number of SMEs surveyed, only 28.36% of them, has stated to possess user-oriented web-sites that are customized for each customer individually. At the same time, not much larger number of them, only less than 30% of respondents claims to be developing a responsible management system i.e. the procedures intended for responses and appeals submitted electronically (the  $X_4$  variable). Finally, a number slightly higher than 42.54% of the surveyed SMEs in the observed sample, responded affirmatively to the question whether at some of the aspects of their business, they encourage underscoring of the opinion of important customers in resolving enterprise's important issues (the  $X_6$  variable). A graphical representation of the values of the share of positive responses of the surveyed SMEs, is given in Figure 9.

Figure 9: The diagram of the arrangement of proportions of positive responses of the surveyed SMEs



Source: The projection of the authors

The results of  $X^2$  testing of the above described variables, observed as the hypothesis modalities, in relation to the size of SMEs, are given in Table 3. The realized value  $X^2 = 28.24$  is slightly smaller than in the majority of the previously obtained values. This is, however, a consequence of the relatively small number of the degrees of freedom ( $n = 7$ ), because this value also of  $X^2$  statistics exceeds, at both levels of significance  $p < 0.01$  and  $p < 0.05$ , the critical values of  $X^2$  test which in this case are 14:07 and 18:48. Therefore, here too, with less than 1% of risk, we claim that there is a statistically significant relationship of the characteristic expressed in dichotomous variables ( $X_1, X_2, \dots, X_8$ ) to the size of SMEs.

Table 3. The realized frequency values by size of SMEs and  $X^2$  statistics of the independence test

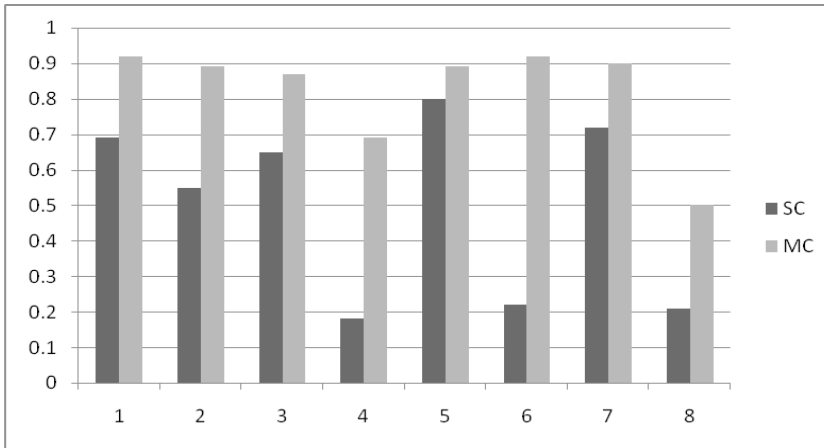
Variables	Small enterprises		Medium-sized enterprises		$\Sigma$
	$f_i$	$f_i'$	$f_i$	$f_i'$	
$X_1$	70	66.24	32	35.76	102
$X_2$	57	56.50	30	30.50	87
$X_3$	68	63.00	29	34.00	97
$X_4$	17	25.98	23	14.02	40
$X_5$	82	72.74	30	39.26	112
$X_6$	25	37.02	32	19.98	57
$X_7$	75	68.84	31	37.16	106
$X_8$	21	24.68	17	13.32	38
$\Sigma$	415	415	224	224	$X^2=28.24^{**}$

Source: The projection of the authors

In other words, a positive impact on relations with customers, realized by investments and innovations in new information technologies, is directly dependant on the size of SMEs. Clearly, here again, we see the presence of the “dominance” of the medium-sized enterprises that have to a greater extent expressed positive attitudes

in relation to the majority of survey questions of the hypothesis. This disproportion of affirmative responses is especially high among the  $X_4$ ,  $X_6$  and  $X_8$  variables that we have previously analysed. An insight into the formulation of survey questions that correspond to these three variables, gives a clear picture of the fact that a responsible management system, communication with customers and making of user-friendly web-sites, falls exclusively within the domain of larger, medium-sized enterprises.

Figure 10. The comparative diagram of the arrangement of proportions of positive SME responses



Legenda: SC-small companies, MC-medium companies

Source: The projection of the authors

## Regression Analysis

Finally, we should also consider here the binomial logistic regression analysis of the values of dichotomous variables of the hypothesis, observed based on the appropriate part of the sample of the surveyed SMEs. We obtain the values of the regression model parameters by using the following program procedure:

```

HIPOTEZA2B<-read.table("D:/My Documents/A. Damjanovic/H2B.txt")
HIPOT2B<-t(HIPOTEZA2B)
H2B<-data.frame(HIPOT2B[,1],HIPOT2B[,2],HIPOT2B[,3],HIPOT2B[,4],HIP
OT2B[,5],
HIPOT2B[,6],HIPOT2B[,7],HIPOT2B[,8])
REZ<-HIPOT2B[,9]
y12<-lm(REZ~H2B[,1]+H2B[,2]+H2B[,3]+H2B[,4]+H2B[,5]+
H2B[,6]+H2B[,7]+H2B[,8])
summary(y12)
y22<-glm(REZ~H2B[,1]+H2B[,2]+H2B[,3]+H2B[,4]+H2B[,5]+
H2B[,6]+H2B[,7]+H2B[,8])
summary(y22)

```

The values obtained in such a way, together with the values of the corresponding mean squared errors, OR-coefficients and their logit values are presented in columns (vertical indents) in table 4. Already mentioned variables ( $X_4$ ,  $X_6$ ,  $X_8$ ) have the negative values of OR-coefficients, while on the other hand, the value of other variables, is significantly higher than zero. The logistic regression coefficients are positive, but the quality of the resulting model is slightly weaker compared to the previous models.

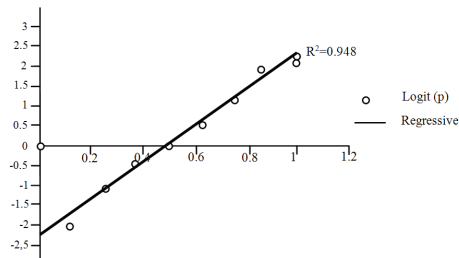
*Table 4. The realization of OR values, logit function and the estimated values of the logistic regression coefficients*

<i>Variables</i>		<i>Odds ratio</i>	<i>Logarithm of the odds ratio</i>	<i>Regression coefficients</i>	<i>Standard error of the evaluation</i>
<i>Regression constant</i>				-2.356	8.618(-2)
$X_1$		3.1875	1.1592	0.5363	5.639(-2)
$X_2$		1.8511	0.6158	0.6652	5.067(-2)
$X_3$		2.6216	0.9638	0.5084	5.606(-2)
$X_4$		0.4255	-0.8544	0.6294	5.831(-2)
$X_5$		5.0909	1.6275	0.6013	6.258(-2)
$X_6$		0.7403	-0.3088	0.7043	5.376(-2)
$X_7$		3.7857	1.3312	0.6413	5.939(-2)
$X_8$		0.3958	-0.9268	0.5979	5.539(-2)
<i>Total evaluation error (Q):</i>	0.2787				
<i>Determination coefficient (R<sup>2</sup>):</i>	0.9372				
<i>AIC:</i>	49.42				

*Source: The projection of the authors*

This fact is indicated by, above all, a greater value of the total mean squared error of the evaluation of the model ( $Q = 0.2787$ ), which is several times higher than in the previous logistic models. Also, the coefficient of determination ( $R^2 = 93.72\%$ ) is slightly lower. Finally, the coefficient  $AIC = 49.42$  is for the first time greater than zero, so it seems that the binomial logistic regression model here may not represent the most appropriate choice of the theoretical model. The comparison with the linear regression model, shown in Figure 11, contributes to this conclusion. The resulting linear model here has a slightly higher coefficient of determination ( $R^2 = 94.80\%$ ), i.e. it is better adapted to the dynamic structure of the observed responses of the hypothesis in relation to the logistic regression model.

Figure 11. The linear regression of SMEs investments in innovations and new information technologies



Source: The projection of the authors

## Syntesis of obtained results

At the very end of our research, we will try to integrate all the important results obtained so far and statistical indicators which are, mainly, related to the validity of the hypothesis. Let us recall that in the previous section, we conducted a detailed statistical analysis of the hypothesis, starting from the basic descriptive statistical methods (determination of the total number of positive responses, their proportions and standard deviations), then checking of the dependencies in relation to the size of SMEs, and finally to the construction the adequate regression models that describe in most detail the dynamic structure of the positive responses of the surveyed SMEs, interpreted in the form of adequate dichotomous variables. In particular, we would like to underscore that the entire statistical analysis performed, was based on the application of the relevant theoretical facts and modern directions in theoretical and statistical analysis of the related problems. Therefore, we find that the results obtained and conclusions made based on them, are completely authoritative, and they properly describe the empirically obtained results.

However, we consider it necessary to point out as a particularly important fact that all observed values of the proportions of positive responses *exceed one half of the observed sample*, i.e. most of the respondents mostly responded positively to the questions raised by the survey. This fact is encouraging because it indicates that most SMEs have a generally positive attitude towards innovations and investments in new information technologies. As a further illustration of the obtained observed values, we showed in the Figure 10., their comparative diagram, where, among other things, the “domination” of positive responses of the surveyed SMEs, can be seen, within the dichotomous variables expressing the hypothesis.

Table 5. The summary view of average values of basic statistical indicators

Average values	Projections
The number of SMEs	79.88
The proportion (p)	0.5961
Standard deviation	0.4413
$\chi^2$ - statistics	28.24**
The degrees of freedom (n)	7
The significance level ( $\alpha$ )	1.99(-4)
The coefficient of contingency (C)	41.72%
The odds ratio (OR)	2.2623
Logit (p)	0.4509
The regression coefficients	0.6105
Standard error	5.66(-2)
The relative error of evaluation	9.27%
The total relative error	12.32%
The coefficient of determination (logistic model)	93.72%
The coefficient of determination (linear model)	94.8%
AIC:	49.42

Source: The projection of the authors

We should consider now the second segment of the statistical research that checks the dependence of the hypothesis observed in relation to the size of the surveyed SMEs. We performed this check in a strictly formal manner by means of a well-known  $X^2$  test of independence of two features (characteristics of the basic set, i.e. its cause). All realized values of  $X^2$  statistics that we got in this manner are also shown in the above table 5., along with the corresponding number of degrees of freedom, and particularly interesting statistical indicators – *the coefficient of contingency* of two (dependent) features. This coefficient is defined as the measure of dependence on the observed characteristics, i.e. in a quantitative manner (in percentage), it expresses the degree of dependence that exists between them.

We should finally point out, as perhaps the most important of the facts which we have proved here, that we have in a formal manner demonstrated the positivity of all obtained estimated values of the regression coefficients. In this way, we expressed the positive impact of the established features and characteristics of a sample of SMEs on the degree and level of investing in new information technologies, that verifies the validity of the above-formed hypothesis.

## Conclusion

At the very end of our research, we will try to integrate all the important results obtained so far and statistical indicators which are mainly related to the validity of the hypothesis. Let us recall that we have conducted a detailed statistical analysis of this hypothesis, starting from the basic descriptive statistical methods (determination of the total number of positive responses, their proportions and standard deviations),

then conducted checks of dependence in relation to the size of SMEs and ultimately, to the construction of the corresponding regression model that in most detail describes the dynamic structure of the positive responses of the surveyed SMEs, interpreted in the form of appropriate dichotomous variables. Particularly, we would like to emphasize that the overall conducted statistical analysis was based on the application of relevant theoretical facts and contemporary trends in theoretical and statistical analysis of related problems. Therefore, we find that the results and conclusions based on them are completely authoritative, and that they properly describe the empirically obtained results.

The research has shown that the ICTs are being developed and applied very progressively, as they represent the basis for the establishment of business competitiveness of SMEs. The research confirmed that the application of ICTs to SMEs significantly and, clearly, in a positive way, impact their core business parameters (reduction of operating costs, differentiation of products/services, higher quality of products/services to the needs of customers, quick adapting to market conditions, expansion of the potential market, etc.), thus creating a greater value for consumers (acceptable prices, flexibility, differentiation, reducing of the delivery time, etc.), which is a precondition for winning their loyalty on the basis of increased competitiveness. From this research, the competitiveness and business performance of SMEs, without the application of information technologies, in the conditions of modern business, is unthinkable. Information and communication technologies effectively contribute to the competitiveness of SMEs but this trend has to be successfully monitored, raised and nurtured.

Still, we consider it necessary to point out as a particularly important fact that all observed values of the proportions of positive responses exceed one half of the research sample, i.e. the majority of respondents generally answered affirmatively to the questions raised by the survey. This fact is encouraging because it indicates that most SMEs have a generally positive attitude towards innovations and investments in new information technologies.

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