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INFLUENCE OF SME'S SIZE ON INTERNET CONNECTIVITY

Abstract. *This paper presents an overview of the part of the research performed to define the ways and criteria for determining the degree of success of the digitalization of small and medium-sized enterprises (SMEs). During the research, an Index of the Digitalization of SMEs (IDSME) was defined. After a brief introduction into the IDSME index, because of the importance of Internet connections, the authors analyzed whether and how the company size is connected to the Internet connectivity dimension. The research covered 226 companies of different sizes and business orientations from Slovakia, Serbia, and Russia. During the research, the main research question was: What is the relationship between the size of SMEs and their links to the Internet expressed through the "Connection to the Internet" dimension of the IDSME index? The answer to this question was found by examining the correlation between these two variables, where the "Connection to the Internet" dimension appeared as the dependent variable. The independent variable was the number of employees in SMEs.*

Keywords: *Digitalization, SME, Internet, IDSME Index, Business Process.*

1 Introduction

Due to the development of the market and automation, the elimination of borders and competition, or the inability to adapt to the new conditions, many companies are failing. Small and medium-sized enterprises (SMEs) have appeared as possible ways of survival of their owners and employees. It is good that SMEs can quickly adapt to new business conditions, but their size is often a problem because of the size of both the material and human resources available to them. More about SMEs is discussed in many literature sources, such as, for example, [1], [2], [3], etc. It can be noted that according to the data of the Serbian Chamber of Commerce [4] 340,112 SMEs with 837,532 employees operated in Serbia in 2016, making 99.8% of the number of companies, and by number employees 65.7%. In Germany, one of the most developed economies in the world, 99.5% of companies in 2018 were classified in the SME group [5, p. 2]. A very similar situation is also in other countries.

Digitalization is a term that is widely used nowadays. Many criteria have been created to point out to the level of digitalization of individual economies and countries, e.g. DESI - Digital Economy and Society Index [6], I-DESI International Digital Economy Index [7], EDI - Enabling Digitalization Index [8], GCI - Global Connectivity Index [9], and other indices, but the area of SMEs remained neglected.

Considering the data presented and the importance of SMEs, it is very important to consider the factors that influence and can influence the efficiency and quality of the work of these legal entities. Bearing in mind the ubiquity of information technologies, digitalization is imposed as an undeniable influence on the functioning of small and medium-sized companies.

This research was carried out as part of the preparation of the doctoral dissertation [10], a broader study of the impact of business process digitalization on increasing the performance and sustainability of SMEs. It was carried out in three countries, Slovakia, Serbia, and Russia. In this paper, the accent is placed on the dimension of the Connection to the Internet. Since authors are not aware that the previous research on digitalization measurements at the level of SMEs exists, the authors consider this research a pioneering work in that field.

2 The SME Digitalization Index

The SME Digitalization Index (IDSME) allows SMEs to carry out self-evaluation and determine to what level they are digitalized and on what they need to pay attention to in their development plans. Its dimensions are Connection to the Internet, Digital Skills, Integration of Digital Technologies, and Internet Usage. The IDSME measures the progress of SMEs in the digitalization process. It was developed on the principles and recommendations given in the handbook on constructing composite indicators [11]. Twenty-eight indicators are grouped into 10 sub-dimensions and four dimensions. Dimensions and sub-dimensions are weighted, but indicators are not. The aggregation method is presented in Section 2.2.

The structure of the IDSME index and weightings are explained in detail in [10] and [12]. Therefore, they will not be fully discussed here, and only the part that relates to this research will be shown here.

2.1 Dimension – Connection to the Internet

This dimension, the connection to the Internet is today the precondition of all conditions. Except in extremely rare applications, e.g. connecting ATMs or fiscal cash registers, dial-up connections to the Internet cannot be considered a favorable solution. Therefore, fast internet connections can be considered as a very significant dimension of IDSME indicators. This dimension is divided into four sub-dimensions, each focusing on one aspect of connecting to the Internet:

- *Connectivity to broadband Internet.*
- *Connection to the Internet via a public telecommunication network.*
- *Internet speed* as a factor influences processes in SMEs and focuses on the

ability (and desire) of a business to make better use of the Internet's capabilities. As the "high-speed Internet" limit, the declared value of the Internet access speed of 30 Mbps is taken because of the comparability of companies from different countries. At the time of writing this work, the standard offer in Serbia was 20/4 Mbps and the optimal 100/10 Mbps. The boundary speed will certainly be a parameter that will change over time. As an indicator in the model, a subscription to a fast broadband Internet above the limit value in the year under review was considered a limit value subscription. Table 1 shows the structure of SMEs' Internet connectivity.

Table 1. Results of the survey on the connection of SMEs to the Internet.

SMEs	Dial-up	Broadband Internet			
		Cable	Medium declared speed [Mb/s]	Mobile	Medium declared speed [Mb/s]
Medium	40.4%	91.5%	117.7	51.1%	41.3

Small	64.6%	89.6%	118.6	57.3%	32.1
Micro	48.2%	49.4%	108.7	57.8%	36.0
Total - have	53.5%	75.2%	115.0	56.2%	36.5

Source: Authors' research

- *Possibility to work from a remote location* (or the possibility to work on a remote computer) is an option that has been seriously talked about for some twenty years, and which gets its importance in time especially in crises such as with COVID-19. This sub-dimension focuses on the willingness of SMEs to organize and use distance working. As a criterion, the percentage of employees is taken here about the total number of employees. It is obvious that if corrections are not introduced, there may be unjustified favorability for micro-companies to others. Therefore, the model set the limit to 10% of the total number of employees. With ten or more percent of those who worked remotely the surveyed SMEs achieved the maximum number of points according to this criterion. Survey results related to the possibility to work from a remote location for this set of SMEs are shown in Table 2.

Table 2. Survey results related to the possibility to work from a remote location.

SMEs	Enable	Criterion A	Criterion B
Medium	48.9%	6.9%	3.3%
Small	50.0%	13.4%	6.5%
Micro	56.6%	54.3%	27.7%
Average	52.2%	10.4%	5.0%

Criterion A – % of those who worked remotely related to the number of employees in SMEs that enable distance work

Criterion B – % of those who worked remotely related to the number of employees in SMEs

Source: Authors' research

2.2 Aggregation

The aggregation of indicators in the Internet connectivity dimension was conducted on the way that the indicators were aggregated into the sub-dimensions, and then the weighted values of the sub-dimensions were aggregated into dimension Internet connectivity.

The aggregation of indicators into dimension was done as follows:

1. Before aggregation, the normalization of the indicators was done to unify the units. It was performed using the min-max method by the linear projection of each indicator on a scale in the range 0 to 1. The zero corresponds to the minimum value and the one to the maximum value (see Table 4).

2. In the second stage, the indicators are aggregated into sub-dimensions by simply summing their values.

3. In the third stage, the sub-dimensions were weighted using the w values shown in Table 4 and by summing aggregated into the Internet connectivity dimension.

Table 3. Structure of inclusion the indicators into the dimensions Connection to the Internet

Dimension	Sub-dimension	Indicator	Criterion	min	max
1. Connection to the Internet	1a. Connectivity to broadband Internet (w=25%)	1a1. Connection to a fixed broadband Internet	Possession of an active connection	0	1
		1a2. Connection to a mobile broadband Internet	Possession of an active connection	0	1
	1b. Connection to the Internet via a public telecommunication network (w=15%)	1b1. Connection to the Internet via phone line	Possession of an active connection	0	1
	1c. Internet speed (w=30%)	1c1. Subscription to fast BB access	Declared access speed \geq 30Mbps	0	1
		1d. Possibility to work from a remote location (w=30%)	1d1. Users of the working from remote location option	% of employees who used this opportunity in the last three months	0

Source: [12]

In the case of aggregation of the Internet connectivity dimension (ICD) for the i^{th} SME, the following formula was applied [12]:

$$ICD(SME_i) = Connection_to_broadband_Internet(SME_i) * 0.25 + + Connection_via_a_public_telecommunication_network(SME_i) * 0.15 + + Internet_speed(SME_i) * 0.3 + Share_of_distance_working(SME_i) * 0.3$$

3 Methodology of Research

This research is exploratory with elements of explanatory and descriptive. The research used an empirical method as an analytical method that enables reliable conclusions on the interdependence of certain observed elements and trends in individual phenomena. The statistical analysis covered the relevant data that enabled the detection of the legality of mass events covered by this analysis.

Of the general methodological methods in this research, analytical and synthetic methods, induction and deduction, as well as historical and comparative methods, were used. When necessary, multivariate analysis was also used. The research is based on checking hypotheses. Although the samples should be randomly selected, it was not possible to provide absolute randomness of the samples in this survey because the SMEs' addresses were mostly obtained by Internet mining. It is acceptable because the topic of work is focused on studying the impact of digitalization on the work of SMEs that use the Internet in some way.

3.1 The research question and results of the research

By applying the presented methodology to the sample of 226 respondents, the ICD dimension for each SME was calculated, and the results were grouped according to the size of the SME and the country in which it operates. In the calculations, the Regression option was used within the Data Analysis of the MS Excel program, a part of the MS Office 365 software package.

For SMEs that were reliably identified to work in a particular country, the results were grouped and the average ICDs for a particular country and all SMEs covered by the survey were calculate.

During the research, the research question (A) arose: What is the relationship between the size of SMEs and their links to the Internet expressed through the "Connection to the Internet" dimension of the IDSME index?

The answer to this question was found by examining the correlation between these two variables. The subject of research is the dimension of "Connection to the Internet", so it appears as the dependent variable (y), and the independent variable (x) is the number of employees in SMEs. For this analysis, the significance limit has been adopted at the level of 0.05 (5%). The following indicators were considered in the "Connection to the Internet" dimension:

- Is SME connected to a broadband Internet access network?
- Is SME connected to the mobile Internet?
- Is SME connected to the Internet via a fixed telephone network?
- Whether at least one connection method provides an Internet access speed greater than or equal to 30 Mbps?
- The share of those who worked from a remote location in the previous three months in the total number of employees.

The null hypothesis for the research question A was defined as:

H_{A0}: *There is no strong relationship between the size of SME and its connection to the Internet expressed through the "Connection to the Internet" dimension of the IDSME Index.*

The alternative hypothesis for the research question A is then:

H_{A1}: *There is a strong connection between the size of SMEs and its connection to the Internet expressed through the "Connection to the Internet" dimension of the IDSME index.*

The results of statistical data processing for the relationship between the size of SMEs and its connection to the Internet expressed through the dimension "Connection to the Internet" of the IDSME index for this set of SMEs are shown in Table 5.

Table 5. Results of statistical data processing for the relationship between the size of SMEs and its connection to the Internet expressed through the dimension "Connection to the Internet"

Regression Statistics						
Multiple R		0.07754				
R Square		0.006013				
Adjusted R Square		0.001576				
Standard Error		0.03771				
Observations		226				
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.08510	0.003092	27.52	8.283E-74	0.07901	0.0912
X Variable 1	4.636E-05	3.983E-05	1.16	0.24563	-3.212E-05	0.000125

For this case, the value of the Pearson's coefficient of correlation is $\rho=0.07754$, which is significantly less than 0.3 and very close to zero. The P-value is greater than the limit value of 0.05, so the results obtained for this set of data do not reject the null hypothesis H_{A0} .

4 CONCLUSIONS

In analyzing the results obtained, it should first be pointed out that the IDSME index is primarily intended for self-evaluation of SMEs, allowing them to see their achievements and weaknesses, and to establish plans for improving their businesses.

This analysis of the influence of SME size on Internet connectivity conducted using the appropriate IDSME index dimension showed that *there is no strong correlation between the size of SMEs and their links to the Internet expressed through the dimension "Connection to the Internet" of the IDSME index*. The probable reason is that the sample covers the whole range of SMEs that differ in their origin, maturity, size, and activity, so it is not possible to detect significant interdependence. If the sample included a huge number of similar SMEs, it would be possible to establish a more significant dependency. Obtained results show that each SME must be connected to the Internet in its way, adapted to their current needs. It can be expected that larger companies have a greater need for faster Internet access, but also that the need for fast Internet access depends not only on the number of users but also on the type of business activity.

Although the research results indicate that there is no dependency between the size of the company and the analyzed characteristics, the results are significant because they are part of a wider mosaic that enables the company to look at its position in the business environment and to select elements that need to be significantly influenced and elements that can be less affected. If planning for its growth, the company can see that over-investing in this dimension will not have a significant effect on the company's growth, although it will most likely have a positive impact on the business results.

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