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Érica Souza Siqueira  
erica\_ssiqueira@hotmail.com

Cesar Alexandre de Souza  
calesou@usp.br

Nicolau Reinhard  
reinhard@usp.br

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# **P05. Digital Divide in Small and Medium Business: an Analysis of Sector Differences in Brazilian Companies based on Data from a Nationwide Survey**

Érica Souza Siqueira  
erica\_ssiqueira@hotmail.com

Cesar Alexandre de Souza  
calesou@usp.br

Nicolau Reinhard  
reinhard@usp.br

## ***Abstract***

“Information Era” is the term used to designate the current economic period, in which information, especially through technology production and innovation generation, is very important in the conduct of a business and to generate added value. In this environment, investing in Information and Communication Technologies (ICT) enables access to information and knowledge, as well as improvements in the inter- and intra-organizational integration. Therefore individuals, organizations and countries, which have little or no access to ICT, cannot profit from these benefits: they are the "digitally excluded." This situation, which affects mainly small and medium companies (SMCs), is still underrepresented in the literature, motivating the present exploratory study that aims at describing the digital divide of Brazilian companies, taking into consideration their size and market segment. The research used micro-data from the 2011 report "ICT Use in Brazilian Households and Enterprises" a survey that is performed annually by the Brazilian Internet Steering Committee (CGI) and has data for over 6,000 companies of diverse sectors in all regions of the Country. The main contribution of the present is paper is the development of an index of digital inclusion at company level that takes into account its size and economic activity.

## ***Key words***

*ICT Use; SMCs; Digital Divide*

## **1. Introduction**

Information and Communication Technologies (ICT) enable the quick access to information and knowledge, as well as a quick integration and sharing of information among individuals, businesses and countries. This is a result of the radical change provided by the ICT in the manner of acquiring, storing, processing and transmitting knowledge, which, at the same time, eliminates the physical barriers and enables a new social and economic configuration (Lojkin, 2007; Boltansky & Chiapello, 2009). This increased dependency on the use of information and knowledge has created a new type of exclusion: the digital exclusion, impacting people, companies or countries that either do not have access to ICT or that, although having access to ICT, cannot make use of it in order to obtain their benefits (Sanchez, 1998; Dewan & Riggins, 2005). In other words, the digital divide can exclude people, companies and countries from our

information- and knowledge-based society and economy, preventing them from having the possibility to change, think and participate. Small and medium companies (SMCs) seem to be more vulnerable. Venkatesh & Sykes (2013) argue that there are still few studies on the digital divide among companies and that a more widespread ICT use in small and medium companies could result in greater operational effectiveness and efficiency for those companies.

The Economic Commission for Latin America and the Caribbean (ECLAC) in its action plan for an information society in Latin America and Caribbean (eLAC), CEPAL (2010) recognized that there is a significant digital divide, affecting more the SMCs and recognizes the importance of both the access to and a more complex use of the ICT, such as telework or electronic commerce for company performance. In order to inform public policy making for digital divide reduction and economic development the Center of Studies on Information and Communication Technologies (CETIC.br) (CETIC), a department of the Brazilian Internet Steering Committee (CGI.br), has a diversified statistical survey program to collect data on the use of ICT in the Country. In order to allow international comparability, these studies comply with UNCTAD survey methodology and standards. In its last edition, in 2013, the "ICT Enterprises" survey had a sample of 6,429 companies of all sizes, distributed throughout Brazil (CGI, 2014). By analyzing the 2013 survey results, it is possible to note that, regarding the ICT use, small and medium companies are lagging behind their larger counterparts because, even with most of them (97%) having computers and access to Internet (96%), only 56% have their own website, and only 26% claimed to use an ERP system to integrate data into a single system, as compared to the large companies: (89% have website and 69% use ERP) (CGI, 2014).

This deficiency had already been identified by DeLone who, back in 1988 published an article in MIS Quarterly, addressing the issue of the ICT use in SMCs (DeLone, 1988) and showing that although computers were becoming more accessible, companies were still making inadequate use of these ICT resources. The objective of this research is to identify and analyze the digital divide of Brazilian SMCs, according to their size and economic activity. This analysis, based on the data of 2,070 companies of the 2011 "ICT use in Enterprises" survey, led to the development of a company ICT usage index to be used to analyze the digital divide among companies.

## **2.Theoretical Reference Model**

### **2.1.Digital Divide in Companies**

There are several definitions for the digital divide concept in the literature. For the OECD's, for example, digital divide is the difference between individuals, families, companies and geographical sites regarding the access to ICT and its use to perform diverse activities. For Fong (2009), however, digital divide can be observed when a group or segment is deprived of that which information technologies and communication have the potential to provide, including economic growth and innovation, which, according to the author, are associated with the technological progress also provided by ICT.

For Dewan & Riggins (2005), digital divide can be separated into two categories: the first order digital divide is related to the access and possibility of ICT acquisition, while the second order digital divide considers the differences in intensity and quality in the ICT use among those who already have access to technology. These authors reason that the technologies are becoming more and more commercially accessible and widely available and, consequently,

most participants in any social system have access to them. However, the effective use and the results obtained from this use depend on aspects beyond the mere ownership of ICT. They depend on aspects such as proper management of resources, incorporation in the company's processes, cultural changes and incorporation of new individual and organizational skills. Therefore, second order digital divide becomes nowadays an even more relevant issue.

The authors proposed a conceptual model to analyze both first order and second order digital divide under three perspectives: a) individual perspective, b) organizational perspective and c) global perspective, considering the first order (access) and second order (use) digital divide. In their model, the authors point out theoretical perspectives for studying second order digital divide in companies, among them, the theories of dissemination and adoption of technology. The authors present, then, the adoption of ICT as a process in which the use is the last step. Therefore, to develop the proposed digital divide index, this article will use the dimensions of the ICT organizational use, which are detailed in the methodology session.

## **2.2 The problems of the digital divide for SMCs**

SMCs account, in Brazil, for approximately 40% of the employed labor; and 32% of total wages (IBGE, 2010). The representativeness of SMCs in Brazil is very similar to other countries, for example, in the European Union, where small and medium companies account for 37% of employed people and 36.5% of added value (Schmiemann, 2008). The data that stands out in the comparison is the GDP share: while in Brazil micro, small and medium companies represent 20% of the GDP (La Rovere, 2002), in Europe, this amount reaches 60%. (Schmiemann, 2008).

The study developed by CEPAL (2013) on SMCs in Europe, Latin America and Caribbean has data on the major participation of these companies in generating employment and recognizes the existence of a productivity gap when comparing them with large companies. In Brazil, for example, according to the study, small companies have 27% of the productivity of large companies, and the medium ones, 40%. According to the document, this gap could be reduced by integrating technology, innovation and knowledge. Therefore, the study recommends promoting the ICT use and management innovation, taking into account technology management elements in the company and support systems. (CEPAL, 2013 p.21)

In addition to low productivity, another problem of the SMCs is the high number of early enterprise mortality. Filion (2008) observed that the chance of survival increases when the administrator is experienced and knowledgeable in the business and market, emphasizing the extreme importance of information availability for these organizations. Another very significant aspect in Brazil are the regional differences. While the Southern regions of the Country have higher development index, the North and Northeast regions still have challenges regarding infrastructure for business and the development of human resources.

SMCs, therefore, can be seen as being very important for job creation in the country, but they suffer from low productivity and high mortality, with many authors defending that the adoption of ICT could contribute to changing this scenario and developing the SMCs.

## **2.3 "ICT Enterprises" survey**

One of the important initiatives in the promotion of the digital divide reduction is the production of statistics on the use and application of ICT, mapping regions and places with the lowest access to ICT benefits. In 2005, for example, during the World Summit on the Information Society (WSIS), the importance of developing comparable ICT indicators to measure digital divide and then asking nations to make the effort to create inclusive public

policies was emphasized. In Brazil, the Brazilian Internet Steering Committee (CGI.br) is a civil society organization that received from the government the task of coordinating the Internet services in the Country, ensuring technical quality, dissemination of access and innovation (CGI, 2013). Among CGI's main tasks are: a) Internet regulation; b) recommendation of standards; c) promotion of studies and safety standards; d) management of Internet addresses (IPs) and the registration of domain names using the Top Level Domain .BR and; e) collection, organization and dissemination of information, including indicators and statistics. The Center of Studies on Information and Communication Technologies (CETIC.br) is the CGI research center responsible for developing studies that provide data on the ICT use in many sectors of the society, in order to support the development of policies and actions of CGI.br. The center conducts the following surveys: a) ICT Households, b) ICT Enterprises, c) ICT Kids Online, d) ICT e-Government, e) ICT Education, f) ICT Internet Providers, g) ICT Telecenters, h) ICT NGOs and, i) ICT Health.

The "ICT Enterprises" survey is performed yearly since 2005, with the objective of measuring the ownership and use of information and communication technologies (ICT) in Brazilian enterprises with 10 or more employees. The Survey follows a methodological standard proposed in the United Nations Conference on Trade and Development Manual, prepared together with the Organization for Economic Cooperation (OECD) and Eurostat (Statistical Office of the European Commission) (CGI, 2013). Therefore, the several dimensions and questions of the survey are established in order to be internationally comparable. The dimensions addressed by the survey are the following: a) General information on access to ICT systems; b) Internet use; c) Use of Electronic government; d) Electronic commerce; e) ICT skills and management; f) Software. There are more than 90 questions covering these dimensions, to be answered by the company manager and, if available, the person responsible for the ICT area.

This paper is based on the Data of the 2012 "ICT Enterprises" Survey (collected in 2011). The access to this data was made possible through to partnership that CGI.br maintains with researchers of Brazilian universities, in order to promote research and studies based on the available information.

### **3. Methodology**

#### **3.1 Sample and its Demographic Characteristics**

The 2011 "ICT Enterprises" survey microdata include the information of 5,593 companies of all sizes. Of this total, a set of 3,996 companies with between 10 and 249 employees was selected, focusing only in SMCs. Excluded from this subset were the answers containing "I do not know" or even missing answers for any of the variables included in the ICT use index. After this process, the selected sample resulted in 2,070 small and medium companies. In Table 1 the sample was distributed according to the size of the company.

In order to measure the digital divide in different economic activity sectors, the paper will explore the differences in the ICT Use index among the business sectors included in the selected sample, namely: a) Manufacturing Industry; b) Construction; c) Trade; repair of motor vehicles and motorcycles; d) Transport, storage and mailing; e) Accommodation and food; f) Information and communication; g) Real estate activities; h) Professional, scientific and technical activities; i) Administrative activities and complementary services; j) Arts, culture,

sports and recreation. In Table 2 the sample was distributed according to the segment versus size of the company.

Size (qty of employees)		Qty	Percentage	Cumulative percentage
Small	From 10 to 19	290	14.0	14.0
	From 20 to 49	618	29.9	43.9
Medium	From 50 to 99	521	25.2	69.0
	From 100 to 249	641	31.0	100.0
Total		2070	100.0	

**Table 1:** Sample Distribution by Size

	Range of total employees				Total
	From 10 to 19	From 20 to 49	From 50 to 99	From 100 to 249	
C Manufacturing Industry	12%	28%	23%	37%	100%
F Construction	9%	26%	31%	34%	100%
G Trade; repair of motor vehicles, personal belongings	14%	29%	25%	32%	100%
H Transport, Storage and Mailing	10%	22%	25%	44%	100%
I Accommodation and Food	18%	41%	22%	19%	100%
J Information and Communication	14%	37%	25%	24%	100%
L Real Estate Activities	13%	28%	33%	28%	100%
M Professional, scientific and technical activities	19%	29%	30%	22%	100%
N Administrative activities and complementary services	16%	29%	28%	27%	100%
R Arts, culture, sports and recreation	15%	30%	23%	33%	100%
TOTAL	14%	30%	25%	31%	100%

**Table 2:** Sample Distribution by Segment vs. Size

### 3.2 ICT Use Index

In order to perform the data analysis, an index was developed to measure the ICT use by companies, in a comparative manner. An index, as highlighted by Prabhu et al. (1999), is the result of a calculation in which indicators are used as variables (which should have their relations established), producing an added value. Khanna (2000) explains that an index can be understood as a high-category indicator. For Januzzi (2001), an indicator should be replicable and be able to be unfolded into levels, for example, geographically. The indicator should also be periodically updated and enable comparison over time.

In order to create the ICT use index for this work, the dimensions proposed by Zwicker, Souza & Vidal (2006) were taken into consideration. These authors, based on Tu (2002), proposed and validated the following dimensions for the use organizational ICT based information systems: a) horizontal integration (internal systems such as ERP, CRM and others); b) decision-making support (decision and management support systems); external integration systems (SCM, Internet and e-Commerce); and use of tools for knowledge and innovation generation.

From the variables available in the CETIC survey, we selected those most directly related to this model's dimensions. The analysis included a binary exploratory factor analysis, as well as the structural equation modeling through PLS (Partial Least Square), using the SmartPLS

software version 2.0. The model validation is presented in Table 3. Note that the CETIC survey has no variables to measure the Knowledge Management dimension. Further details of the process for obtaining the index are presented in Anonymous (2013). Using the factor scores obtained from PLS, an index of ICT Use was calculated linking to the adoption of technologies with the enabled performance of the business functions, as described in the reference model. The values were transformed to fit the 0-1 range (0 for the lowest value obtained and 1 for the highest value obtained on each dimension). The values obtained for the 2,070 companies are presented in Table 4. Table 5 shows that the sectors with the lowest average ICT Use, such as Arts, culture and sports, are below the overall average of 0.55.

Dimension of the ICT Use	Questions in ICT Enterprise Survey
Internal Integration	Used ERP to integrate data and processes Used CRM to manage client information Training and education Recruit internal and external staff
Decision-making support	Market monitoring Search for information in products or services Search for government information
External Integration	Order or booking system Provide after-sales support Customization of products for clients

**Table 3:** Adapted model of ICT Use after factor analysis and PLS

	n	Average	Std. Deviation	Minimum	Maximum
ICT Use	2,070	0.55	0.20	0	1

**Table 4:** Statistics of the ICT Use variable

Size	Economic Activity Category	External	Internal	Decision	ICT Use
Small	Real Estate	0,51	0,54	0,84	0,54
Small	Information and Communications	0,49	0,51	0,90	0,53
Small	Commerce	0,58	0,51	0,82	0,52
Small	Manufacturing	0,50	0,52	0,83	0,52
Small	Administrative activities and complementary services	0,47	0,51	0,79	0,50
Small	Construction industry	0,44	0,44	0,86	0,49
Small	Professional, scientific and technical activities	0,43	0,51	0,79	0,47
Small	Accommodation and food	0,53	0,51	0,81	0,47
Small	Transportation and Storage	0,56	0,42	0,80	0,46
Small	Arts, Culture, Sports and Recreation	0,44	0,47	0,77	0,38
Medium	Information and Communications	0,54	0,71	0,91	0,67
Medium	Real Estate	0,62	0,58	0,92	0,63
Medium	Commerce	0,54	0,63	0,88	0,62
Medium	Professional, scientific and technical activities	0,50	0,61	0,92	0,60
Medium	Manufacturing	0,50	0,58	0,87	0,59
Medium	Accommodation and food	0,55	0,55	0,85	0,57
Medium	Construction industry	0,50	0,56	0,87	0,55
Medium	Professional, scientific and technical activities	0,58	0,56	0,83	0,55
Medium	Transportation and Storage	0,50	0,50	0,85	0,52
Medium	Arts, Culture, Sports and Recreation	0,42	0,50	0,80	0,47

**Table 5:** ICT Use among business sectors

In order to verify whether the index difference among the sectors is significant, a statistical analysis was conducted using the ANOVA method, which enables the simultaneous comparison of the averages of different groups. ANOVA works well in the case of deviations

of the regular distribution, but it assumes that there is homogeneity among the variances of different groups (Glass & Hopkins, 1996). Therefore, for this test, Levene's test was first applied in order to verify whether the variance of the ICT Use among the segments is homogeneous (Table 6).

Variable	P-value	Result
ICT Use and Sector	.388	Null hypothesis of homogeneity of variance rejected

**Table 6:** Levene's Test

As there is homogeneity, the use of the ANOVA test is then justified to verify if there a statistically significant ICT use index average difference among the several market segments. The test result, according to Table 6, indicates a P-value <0.05, which refutes the hypothesis of average equality among different CNAE (National Code of Economic Activity), that is, at least one market segment presents a significant average difference in relation to the others.

	Statistics	df1	P-value
ANOVA	6.213	9	.000

**Table 7:** ANOVA Test - ICT Use and Sector

After confirming the existence of a significant difference among the groups, the Tukey-Kramer post-hoc test can be used to find out which groups present significant average differences. Such test is proper for homogeneous variances within groups of different sizes (Garson, 2014). Table 8 lists only the pairs of market segments that presented significant average difference. For example, the segment "Manufacturing Industry" presents a statistically significant difference of 0.13 in the index in relation to the segment "Arts, culture, sports and recreation".

Market Segment	Segment with Average Difference	Difference	Standard Deviation	Pvalue
C Manufacturing Industry	R Arts, culture, sports and recreation	0.13	0.03	< 0.01
G Trade; repair of motor vehicles, personal belongings	H Transport, Storage and Mailing	0.08	0.02	< 0.01
	I Accommodation and Food	0.07	0.02	< 0.01
	N Administrative activities and complementary services	0.05	0.02	< 0.01
	R Arts, culture, sports and recreation	0.15	0.03	< 0.01
J Information and Communication	H Transport, Storage and Mailing	0.1	0.03	< 0.01
	I Accommodation and Food	0.09	0.03	< 0.01
	R Arts, culture, sports and recreation	0.17	0.04	< 0.01
L Real Estate Activities	R Arts, culture, sports and recreation	0.16	0.04	< 0.01

**Table 8:** Average difference in the ICT Use among different CNAE

### 3.3 Correspondence Analysis

After verifying the existence of significant average differences in the ICT use index among sectors, the next step was to verify whether the segments are grouped according to their average ICT Use. For that, a qualitative analysis through a perceptual map, created by the correlation analysis method, was performed. A perceptual map, according to Hair et al. (2009), can be used to verify the similarities among the objects in a two-axis chart, X and Y. In order to prepare the perceptual map, a new ordinal qualitative variable was developed, called Included/Excluded, based on the ICT Use index. To that end, the index variation, which ranges

from 0 to 1 (where 0 means a wide divide and 1 no divide), was divided into four groups, according to Table 9. This transformation is a requirement of the correlation analysis method, which groups diverse cases based on categorical or ordinal variables.

ICT Use Index Range	Classification Assigned
From 0.00 to 0.25	Excluded
From 0.2501 to 0.50	Partially Excluded
From 0.5001 to 0.75	Partially Included
From 0.7501 to 1	Included

**Table 9:** Included/Excluded Variable

However, before performing this analysis, it was checked whether there is a correlation between the two variables in question: "Included/Excluded" and "Sector". A correlation between both variables is a prerequisite for correlation analysis and map construction. Therefore, the correlation was checked using a chi-square test, resulting in a statistical value of 70.24 and P-value of 0.00, indicating the existence of correlation.

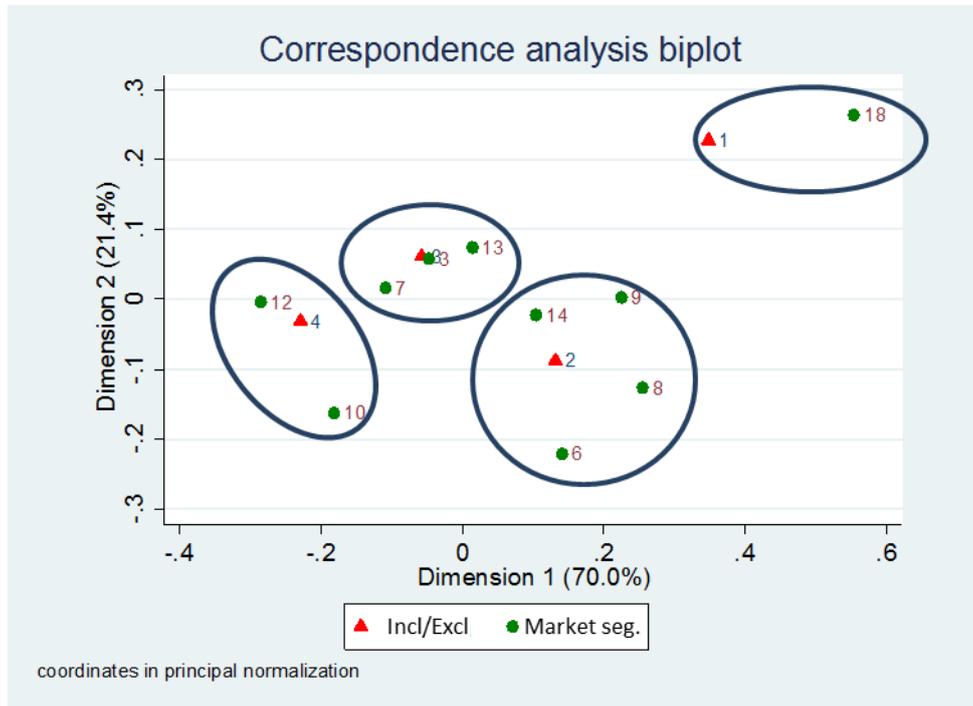
The correlation analysis and the perceptual map assembly showed that both dimensions, 1 and 2, or X and Y, which comprise the map, explain 91% of the variability, indicating a major explanatory power to the map. The perceptual map presented in Figure 1 allows the search for a grouping standard of the segments in relation to their classification in the Incl./Excl. variable. The legend in Table 10 helps in understanding the perceptual map.

Variable	Value
▲ Included/Excluded (Included)	1 for Excluded 2 for Partially Excluded 3 for Partially Included 4 for Included
● Market Segment	5 Manufacturing Industry 6 Construction 7 Trade; repair of motor vehicles, personal belongings 8 Transport, Storage and Mailing 9 Accommodation and Food 10 Information and Communication 11 Real Estate Activities 12 Professional, scientific and technical activities 13 Administrative activities and complementary services 14 Arts, culture, sport and recreation

**Table 10:** Key for interpretation of the map by Market Segment

The analysis allows the segmentation of the market in four groups, which were named according to their proximity to the Included/Excluded variable:

- Group 1 – Companies excluded, from the Arts, culture, sports and recreation segment;
- Group 2 – Companies partially excluded, from the following segments: Construction, Transport, Accommodation, and Administrative activities and complementary services;
- Group 3 – Companies partially included, from the following segments: Industry, Trade, Professional, scientific and technical activities;
- Group 4 – Companies included, from the following segments: Information and Communication, and Real Estate Activities;



**Figure 1:** Perceptual Map by Market segment

Table 11 shows that 3% of the companies are part of group 1 and 2, (excluded and partially excluded). 62% are in group 3, which is the group formed by the two segments with the highest number of samples: Trade and Industry. Table 11 shows that the companies in the most included group have a higher number of computers and higher relative percentage of users connected to the Internet, as well as a higher percentage of bandwidth use, free Software use and IT specialists hiring. Thus, it is possible to develop hypotheses stating that factors related to technology, such as broadband, or factors related to technology management (existing IT department) may be correlated to a larger ICT use index and, therefore, a greater digital inclusion. Network infrastructure, e-mail and Internet banking use are well disseminated among all the companies, whether included or excluded.

Market Segments	Number of companies	Percentage	Cumulative percentage
<b>Excluded:</b> Arts, culture, sports and recreation	40	1.9	1.9
<b>Partially excluded:</b> Construction, Transport, Accommodation, and Administrative activities and complementary services	600	29.0	30.9
<b>Partially Included:</b> Companies partially included from the following segments: Industry, Trade, and Professional scientific and technical activities	1,278	61.7	92.7
<b>Included:</b> Information and Communication, and Real Estate Activities	152	7.3	100.0
<b>Total</b>	2,070	100.0	

**Table 11:** Frequency distribution by group

## 4. Conclusions

In order to study the digital divide in different economic sectors that include Brazilian SMCs, an ICT Use index was used to assign a score to companies, based on their use of technologies to perform business tasks. Based on this index, the research explored the differences in the average index value between sectors. The segments with the most excluded (where the divide

is bigger) companies were: Arts, culture, sports and recreation; Construction, Transport, Accommodation and Administrative activities and complementary services.

This study also tried to group the segments according to their average ICT Use, and obtained four groups of companies. Network structure, use of e-mail and Internet banking services are well disseminated among all four groups. However, the group of the most included (where the divide is narrower) companies showed the highest percentage of computers connected to the Internet, the highest percentage of companies with broadband access and the existence of an IT department. With this paper, we hope to enable the creation of hypotheses for future studies on digital divide in companies.

	<b>Excluded:</b> Arts, culture, sports and recreation	<b>Partially excluded:</b> Construction, Transport, Accommodation, and Administrative activities and complementary services	<b>Partially Included:</b> Companies partially included from the following segments: Industry, Trade, Professional, scientific and technical activities	<b>Included:</b> Information and Communication, and Real Estate Activities
Average number of computers	29	33	38	51
Wireless Network	93%	90%	95%	97%
Wired Network	80%	79%	79%	82%
Users Connected to the Internet	45%	51%	53%	83%
Fiber	20%	22%	22%	39%
3G	30%	55%	56%	64%
Dedicated Link	35%	41%	50%	65%
IT Department	48%	46%	58%	73%
E-mail Use	95%	99%	99%	98%
Internet Banking	80%	90%	94%	89%
Implementation of New Software	20%	36%	42%	50%
IT specialist hiring	28%	30%	28%	39%
open source S.O	28%	32%	45%	59%

**Table 12:** Characteristics of the Companies according to their exclusion (divide) level

One of the limitations of this article relies on the use of less recent data (2011). Access to the microdata (database) of the most recent survey (2013) was not granted when this paper was written. Although the statistics analysis was made using data from 2011, the type of analysis conducted – the development of a digital exclusion index – can be considered valid even if the data is not the most recent. Also, the results seem to be still valid for more recent datasets. When we observe conclusions and analysis from the most recent survey that is available on the internet (2013) we can conclude that small and medium business still don't use ICT in order to improve their internal and external integration.

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