DIGITAL DIVIDE OF SMALL AND MEDIUM-SIZED ENTERPRISES: AN ANALYSIS OF INFLUENCING FACTORS USING THE TOE THEORY

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ABSTRACT

Purpose: This study describes the phenomenon of digital divide in small and medium enterprises in Brazil by means of an indicator of ICTs use in these organizations.

Originality/gap/relevance/implications: There are several studies on the adoption of ICTs by organizations, however rare are those that explore the topic using the concept of digital divide. This study addresses the second order digital divide, related to the effective use of ICTs by companies.

Key methodological aspects: The study was carried out based on a sample of 3,231 companies participating in the "TIC Empresas" survey of 2014 (published in 2015). By means of structural equations, an index was created to measure the intensity of the ICTs use in organizations and factors that affect it were verified through linear regressions.

Summary of key results: The first result concerns the feasibility of an index that measures the ICTs use. Then, when analyzing its distribution, we can see the discrepancy of values between companies in relation to their size. The regression analysis indicates that the access to technology and the Internet, as well as ICTs skills and attitudes are factors correlated to a more intense use of ICTs by organizations.

Key considerations/conclusions: Digital divide is a phenomenon related to high enterprise mortality rates and low productivity in small and medium-sized enterprises. This study outlines a possible way to study this phenomenon, integrating an adoption model (TOE) and a model of ICTs use in the context of second order digital divide.

KEYWORDS

Digital divide. TOE. IT organizational use. SMEs. ICT4D.

1. INTRODUCTION

Information and Communication Technologies (ICTs) allow access to information and knowledge by citizens and society in general, as well as improvements in the inter and intra-organizational integration of companies. This is a result of the radical evolution in the storage, acquisition, processing and distribution of data and information brought about by the continuous evolution of ICTs. At the same time that this phenomenon increases the dependence on the use of ICTs for several activities in diverse sectors, it also brings a new type of exclusion, the digital divide. This exclusion impacts people, countries or companies that do not have access to ICTs, or that do not have the skills to properly use them and benefit from them (Dewan & Riggins, 2005; Van Dijk, 2006). In the case of organizations, this phenomenon especially affects small and medium-sized enterprises (SMEs) (Wielick & Arendt, 2010).

Although the topic of digital divide among people, communities and countries has been extensively researched over the last decade (Quresh, 2014), the issue of digital divide in companies remains a topic that is not much discussed in the literature (Dewan & Riggins, 2005; Wielicki & Arendt, 2010; Bach, Zoroja, & Vukšić, 2013). However, this is a relevant topic as channels, media, products and services become more and more dependent on ICTs, the level of interconnection among the various members of supply networks increases, and this interconnection becomes increasingly fragmented and complex. In addition, innovation itself is increasingly dependent on advanced technology and knowledge, so the risks of digital divide for SMEs are increasing.

Dewan and Riggins (2005) proposed a model to guide studies in the field of digital divide, partitioning it into two types: first order divide, related to difficulties or impossibility to have access to technology; and second order divide, related to difficulties in using the available technology and obtaining results from this use to its full potential. According to the model defined by the authors, the adoption may be understood as a process, which begins with the creation of an innovation, passing through its availability and access by the companies and ending in proper use.

Regarding Latin American companies, the Economic Commission for Latin America and the Caribbean (ECLAC) acknowledged in its action plan for an information society in Latin America and the Caribbean (eLAC2015) that, despite all progress made, there is still significant digital divide affecting SMEs (Economic Commission for Latin America and the Caribbean,

2013). In its new action plan for 2018, ECLAC defined as one of its objectives the need to "foster the digital transformation of micro, small and medium enterprises, considering their technological trajectories and capacity development" (Economic Commission for Latin America and the Caribbean, 2015, p. 4).

Specifically, in relation to Brazil, the phenomenon of digital divide in SMEs is more related to the use of ICTs than to the access to them, thus characterizing a second order exclusion. The "TIC Empresas" survey of 2014, conducted annually by the Internet Steering Committee in Brazil (CGI.br) shows that these companies have computers and Internet access (96%), but only 62% of them are present on the Internet through a website and only 29% reported using an ERP system to integrate data into a single system (Comitê Gestor de Internet, 2015). In order to show the relevance of ICT use for SME management, for example, Terziovski's study (2010) pointed out the absence of information systems to monitor the company's performance as one of the main reasons for the mortality of American SMEs, along with informality in strategic planning. In Brazil, 27% of SMEs do not survive their first year of operation, and only 42% reach the end of their fifth year of operation (Serviço Brasileiro de Apoio às Micro e Pequenas Empresas, 2010).

In order to support digital divide studies, Dewan and Riggins (2005) recommend, among others, theories of innovation adoption, among which TOE (Technology – Organization – External Environment), proposed by Tornatzky and Fleischer (1990), which explains the adoption of technology in companies based on these three factors.

Thus, the objective of this article is to study the influence of technological, organizational and external factors on the use of ICTs in SMEs, considering that the low intensity of ICTs use by SMEs in Brazil is a situation related to second order digital divide. In order to conduct this research, we used micro data of a subsample of 3,231 companies participating in the "TIC Empresas" survey of 2014 (published in 2015), which had 7,198 companies interviewed.

Studies on digital divide can be divided between those concerned with measuring digital divide and those that seek to find factors related to the level of exclusion (Rodrigues & Maculan, 2013). In this way, this work contributes to both of these dimensions, that is, proposing a way to measure the digital divide in companies and studying factors that can influence it through the application of the TOE model. It also contributes by presenting an analysis based on a large sample of secondary data with sample validity, an unusual characteristic in studies of digital divide in companies (Bach *et al.*,

2013). Finally, this paper contributes to the literature by presenting an empirical validation of aspects related to second-order digital divide in SMEs.

2. TOE MODEL (TECHNOLOGY, ORGANIZATION AND EXTERNAL ENVIRONMENT)

There are several models of innovation adoption that take the user as a starting point, searching for individual characteristics that are related to the adoption. Examples of such user-centric models are the Technology Acceptance Model (TAM) and the integrated model of Venkatesh, Morris, Davis and Davis (2003).

However, user-centric adoption theories may not be the most appropriate to analyze the adoption of ICTs by organizations. According to Rogers (1995), studying adoption in companies is more complex since it involves more than one individual and an environment in which each individual plays a different role and requires adaptation both in the organization and in innovation itself.

In that sense, Akkeren and Cavaye (1999) argue that many applications of adoption models, when carried out in SMEs, are usually focused on perception, attitude or beliefs of the owner/manager of these companies, therefore still at the user level. However, in the authors' view it is also necessary to consider organizational factors and the external environment together.

Jeyaraj, Rottman, and Lacity (2006) surveyed existing theories to explain the adoption of technology and found four of them that are used to study adoption at the organization level: 1. Theory of Innovation Diffusion (Rogers, 1995); 2. Model of Diffusion and Implementation (Kwon & Zmud, 1987); 3. Tri-Core Model (Swanson, 1994); and 4. Technology, Organization and Environment (TOE) (Tornatzky & Fleischer, 1990).

The model of Tornatzky and Fleischer (1990), known as TOE (Technology, Organization and Environment), focuses on organizations and recognizes that there are different contexts that may influence the adoption of technology innovation, which are the technological and organizational environment and the external environment, according to Flowchart 1.

Tornatzky and Fleischer (1990) explain that the technological environment includes the whole infrastructure available in the company, and may even include resources available in the market, which could influence the adoption of IT according to the authors. The organizational context is related to characteristics as the company size, centralization, formalization and

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Flowchart 1

TOE MODEL
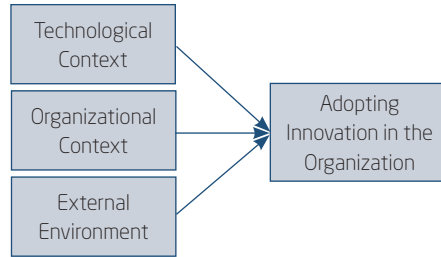
Source: Adapted from Tornatzky and Fleischer (1990).

complexity. It can also be related to the quality of human resources, the amount of resources available or informal relations among employees where information flows and decisions are made. Finally, the external environment is the one where the company conducts the business, involving characteristics of the market segment, competitors, access to resources provided by others, pressure from partners, customers and competitors and governmental implications.

As pointed out by Oliveira and Martins (2010), the main difference between the Rogers diffusion of innovation (DOI) and the TOE model is that in the latter variables of the external environment are incorporated, which may imply the adoption of IT due to threats and opportunities, for example, as a result of government regulation or incentive. In this same line, for Abrahamson (1991), the DOI model fails to explain adoptions that occur due to external factors such as political pressure, power or other subjective factors.

Although not seeking to understand the phenomenon of digital divide, the TOE model has already been used in several studies that seek to reveal important factors for the adoption of ICT in companies. For example, e-commerce adoption surveys (Zhu *et al.*, 2003; Zhu, Kraemer, & Dedrick, 2004), or adoption of business systems (Zhu & Kraemer, 2005).

There are still applications of combination of the TOE model with other theories, as presented by Teo, Tan and Buk (1997), in which the authors combined the TOE model with the contingency theory to study the adoption of Internet by companies.

In order to understand factors that condition the e-commerce adoption by SMEs, Awa, Ukoha, and Emecheta (2015) also used a combination of the

TOE model and the TAM model, adding to the first model characteristics of the individuals of an organization, such as Individual Differences (IDF – Individual Difference Factors).

Oliveira, Santos and Júnior (2013) did not apply the model, but proposed to study the influence of TOE factors in the decision-making process of ICT adoption by small companies, incorporating the TOE model into a decision-making model.

According to Ghobakhloo, Arias-Aranda and Benitez-Amado (2011), the TOE model has already been used for studies of the adoption of different types of ICTs in several locations, such as the European Union, America and Africa, in various sizes of companies and market segments, showing that the model is efficient to study the adoption in organizations.

Thus, based on factors identified in the literature of studies on the adoption of ICTs with the use of TOE factors, we developed the Table 1, that contains the list of factors relevant for adoption subdivided by the authors, in its Technological, Organizational or External Environment contexts. The list presented in Table 1 served as a basis for selecting the variables (proxies) from the "TIC Empresas" survey of 2014, as will be presented later.

(Table 1)
TOE FACTORS

Context	Factors	Author
Organizational	Strategic Alignment: aligning IT with the IT needs of the organization	Ramos, Silva and Alverga (2009); Mirchandani and Motwani (2001)
	Skills with ICT: skills in computer and internet use	Harindranath, Dyerson, and Barnes (2008); Ramos *et al.* (2009)
	Attitude: positive attitude of managers towards ICT	Li and Xie (2012); Harindranath *et al.* (2008); Dewan and Riggins (2005); Kuan and Chau (2001)
Technological	Infrastructure: computers, network, internet and connection type.	Oliveira and Martins (2010); Zhu *et al.* (2003); Li and Xie (2012); Ramos *et al.* (2009)
External Environment	External Support: support from vendors for use of solutions	Alshamaila, Papagiannidis, and Li (2013); Ramdani and Kawalek (2008); Del Aguila-Obra and Padilla-Meléndez (2006)
	Pressure/Influence of the Market, partners, suppliers and customers.	Alshamaila *et al.* (2013); Iacovou, Benbasat and Dexter (1995)

Source: Elaborated by the authors.

3. DIGITAL DIVIDE OF SMES

There are several definitions for Digital Divide in literature. In the definition of OECD, for example, digital divide is the difference between individuals, families, businesses and geographic locations, in terms of both access to ICTs and their use for various activities (Organization for Economic Co-operation and Development, 2001). The definition has evolved as field studies have expanded, reflecting the understanding that the phenomenon is more complex than a simple division between those who "have" and those who "do not have" technology (Van Dijk, 2006). For Van Dijk (2006), the material access to computers, networks and software is the first barrier to overcome digital divide. After this barrier is overcame, access to the necessary skills and knowledge is still necessary, and, finally, a purposeful use is necessary to obtain possible benefits from the technologies.

As for Fong (2009), digital divide can be observed when a group or segment is deprived of what information and communication technologies have the potential to promote, including economic growth and innovation that, according to the author, are associated with the technological progress also promoted by ICTs.

For Arendt (2008), specifically regarding digital divide in the case of companies, this is related to the discrepancy in the use of ICTs between large and small companies. For the author, the fact that small and medium enterprises cannot take advantage of the benefits of ICTs and electronic businesses in the same way that big companies makes SMEs more vulnerable to changes in the financial and competitive conditions of the market. The author also adds that digital divide is not only related to access to ICTs, but also to their appropriate use. According to Arendt (2008), and Stiakakis, Kariotellis and Vlachopoulou (2009), digital divide necessarily passes through adoption, and in this case, involves characteristics of users or companies.

Wielicki and Cavalcanti (2006) also found that, in relation to companies, digital divide is a phenomenon that occurs mainly in SMEs and companies located in rural regions. For the authors, this phenomenon is more related to educational issues, training and knowledge of the employees than to the lack of access or lack of financial funds to access ICTs.

Without specifically defining digital divide, Hashim (2007) discusses the importance of SMEs to the economy and the importance of using IT in them to boost job creation, growth and competitiveness. However, the author acknowledges that the companies he studied did not use IT and, the-

refore, were on the wrong side of digital divide, assuming there are two sides, the included companies and the excluded companies.

In addition to the authors cited, it is also possible to find in Dewan and Riggins (2005) a definition for digital divide. Following Van Dijk's (2006) reasoning, the authors distinguished a first order digital divide, related to barriers to access ICTs, and a second order exclusion, related to differences in the use of ICTs between groups that already have access to technology. They argue that technologies are increasingly commercially accessible and that most participants in any social system have access to them. Therefore, second order digital divide becomes even more relevant today.

The authors then proposed a conceptual model for the study of digital divide, both first order and second order, from three perspectives: individual perspective, organizational perspective and global perspective. In the organizational perspective, which is the focus of this study, Dewan and Riggins (2005) include as sources of survey questions related to the use of ICT by some companies to gain advantages over competitors, redefining market rules, while other companies cannot obtain the same success, being at strategic disadvantage.

In the same study, the authors pointed out some theoretical perspectives to study digital divide, among them the theories of diffusion and adoption of technology. For them, changes in ICT investment and adoption by companies become a social issue when it turns into a significant problem of competitive disadvantage, especially with small enterprises and businesses in rural areas and those whose owners are not aware of the importance of IT.

Srinuan and Bohlin (2011) surveyed publications on digital divide and observed that the subject is much debated in the world, but they found very few works in countries of Latin America. In general, they found out that the great majority of studies is focused on digital divide in countries, individuals or households, and few studies are related to small and medium-sized companies, thus recommending a deeper understanding of the topic.

In the same line, Bach *et al*. (2013) identified the existence of only 24 studies in their review of literature on the topic of digital divide in organizations. The authors have researched scientific articles published in the last decade in scientific journals and have concluded that few studies have focused on digital divide in companies and that most of the articles are studies conducted in developed countries based on the use of ICTs in general, use of the Internet or use of e-business as ICT proxies. The authors suggest that future studies on digital divide of organizations should deal with this topic in developing countries, preferably with secondary data, to allow for larger samples and more variability of types of companies analyzed.

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4. THE INDEX OF ICT USE AS A MEANS TO IDENTIFY THE DIGITAL DIVIDE OF SMES

This paper used the ICT use measurement model presented by Siqueira, Souza, and Reinhard (2015a), which evaluates the intensity of the use of ICTs by SMEs from a scale developed using secondary data from the national "TIC Empresas" survey. In order to calculate the index, we considered the ICT use dimensions for internal (vertical and horizontal) integration of the company and the use of decision support tools, according to the IT use model in organizations previously proposed by Zwicker, Souza, Vidal and Siqueira (2007). From the "TIC Empresas 2011" survey, and subsequently from the "TIC Empresas 2013" survey, Siqueira *et al.* (2015a) identified proxies to represent the dimensions of the model (Table 2), and from the microdata of these survey editions and the techniques of factorial analysis and modeling of structural equations by means of a PLS (partial least squares) estimation, the final model was obtained for the index represented in Flowchart 2. The model met all validity and reliability requirements imposed by the method. Additional details of model development can also be obtained in Siqueira *et al.* (2015b).

(Table 2)

PROXIES SELECTED FROM THE "TIC EMPRESAS" SURVEY

Dimension of IT Use	Questions of "TIC Empresas" Survey
Internal Integration	Did you use ERP to integrate data and processes? (yes/no)
	Did you use CRM to manage customer information? (yes/no)
	Training and education? (yes/no)
	Recruit internal and external staff? (yes/no)
Decision support	Market monitoring? (yes/no)
	Search for product or service information? (yes/no)
	Search for government information? (yes/no)
External integration	Order or reservation system? (yes/no)
	After-sales support? (yes/no)
	Customization or personalization of products for customers? (yes/no)

Source: Elaborated by the authors.

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MODEL FOR THE INDEX OF ICT USE OBTAINED FROM THE ANALYSIS OF THE MICRODATA OF THE "TIC EMPRESAS" SURVEY
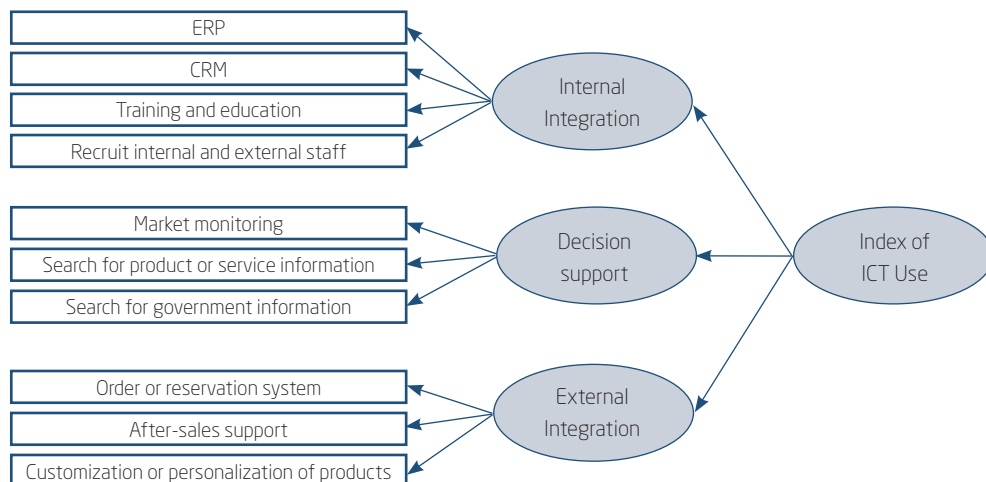
Source: Siqueira *et al.* (2015a).

5. RESEARCH MODEL AND METHODOLOGICAL ASPECTS

To carry out this study, two steps were necessary: the first one was the replication of the calculation of the IT use index presented in Flowchart 2 using the database of the "TIC Empresas 2014" survey, since such index had been proposed and evaluated considering the database of 2011 and replicated with the base of 2013, as described in the previous item. In the second stage, after obtaining the ICT use index for the companies in this sample, the data were analyzed using the multiple regression technique to identify which factors of the TOE model are related to the index, and therefore to the use of ICT. The assumption adopted here is that the factors identified will be related to the decrease in the digital divide of SMEs, being associated with a higher level of use of ICTs.

Flowchart 3 contains the model used for data analysis, based on the literature review of the TOE model and the digital divide index of SMEs. According to the model, the following hypotheses were tested:

- *H1*: characteristics of the technological environment positively influence the intensity of ICT use by SMEs

- **H2**: characteristics of the organizational environment positively influence the intensity of ICT use by SMEs
- **H3**: characteristics of the external environment positively influence the intensity of ICT use by SMEs

(Flowchart 3)
RESEARCH MODEL
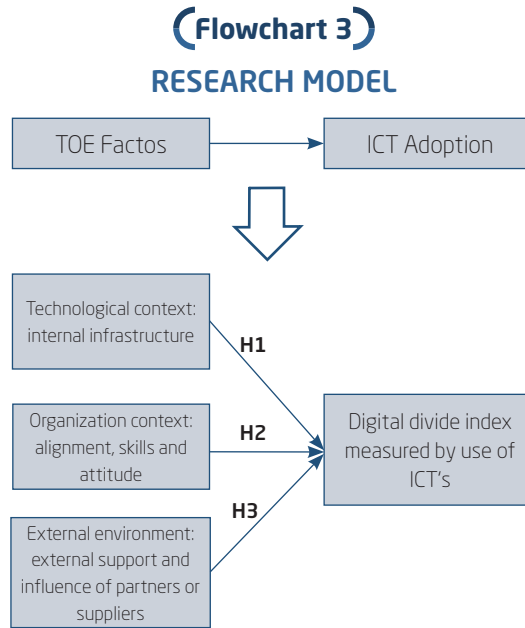
Source: Elaborated by the authors.

5.1. First Step: Index Replication

In this first step, the purpose is to validate the IT use index for a sample of the 2014 survey, demonstrating validity criteria and an analysis of the result according to the size of the company.

Secondary data supporting this research were collected by the CGI.br in 2014 and made available in 2015. CGI.br provides survey microdata for academic papers upon request and agreement with the educational institution of the researchers.

Selected sample

In the "TIC Empresas 2014" survey, 7,198 small, medium and large companies were interviewed. Among these, 5,346 were small and medium-sized

companies, the focus of this study. In order to select SMEs, we use the criteria of employed persons, following the definition of the European Statistical Office (Commission of the European Communities – Eurostat) and the United Nations (UN), Recommendation No. 2003/361/CE of May 6, 2003 of the Commission of the European Communities. It should be noted that CETIC. br adopts the same concept for the classification of the size in its surveys.

According to this definition,

- Microenterprises are those with up to 9 people employed.
- Small companies: from 10 to 49 people.
- Medium companies: from 50 to 249 people.
- Big companies: 250 or more people employed.

Those companies that did not respond or answered "I don't know" to any of the ten questions that represent the proxies used in the calculation of the ICT use index, presented in Table 2, were excluded. Thus, the final sample consisted of 3,231 companies. Chart 1 shows the distribution of the sample according to the size of the company, as measured by the number of employees.

(Chart 1)
DISTRIBUTION BY SIZE

Size (in function of quantity of employees)		Frequency	Percentage	Accumulated percentage
Small	From 10 to 19	598	18,5%	18,5%
	From 20 to 49	1,058	32,7%	51,3%
Medium	From 50 to 99	784	24,3%	75,5%
	From 100 to 249	791	24,5%	100,0%
	Total	3,231	100,0%	

Source: Elaborated by the authors.

Replication method

From the measurement model discussed in the section on use index, the same model was replicated in the SmartPLS software, obtaining a factorial score (a weighted sum of the answers in each dimension) for each company,

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and transformed to a range of 0 to 1, thus characterizing the intensity of use in each one of the dimensions. For the analysis of digital divide of SMEs, the companies were classified in 1. excluded; 2. partially excluded; 3. partially included; and 4. included, considering the quartiles obtained for the scores.

Analysis of values obtained in the index

Chart 2 shows the average value, standard deviation and quartile limits considering the entire sample of 3,213 companies. These limits were used to classify companies according to the "excluded" ranges (1st Quartile), "partially excluded" (2nd Quartile), "partially included" (3rd Quartile) and "Included" (4th Quartile). The distribution of the companies according to this classification within the classification by ranges is presented in Graph 1.

(Chart 2)
QUARTILES

|	SMEs sample	Average	Standard deviation	1st Quartile	Median	3rd Quartile
ICTs Use Index for SMEs in 2014	3.231	0.591	0.199	0.459	0.592	0.743

Source: Elaborated by the authors.

We may observe in Figure 4 that the concentration of excluded companies occurs in smaller companies.

Quality Measures of the Replicated Model for 2014 Data

The proposed model is considered as a confirmatory factorial analysis model, since it presents only the measurement model (Kline, 2015). It is a second-order model, since the construct "Use of ICTs" is measured by first--order constructs. The indicators used for the evaluation of structural equation measurement models estimated by PLS were the same as those used by Bido, Godoy, Araújo and Louback (2010): composite reliability (CC), which shall have values higher than 0.7; convergent validity, evaluated by the average variance extracted by the construct (AVE), which shall have values higher than 0.5, and by analysis of the factorial loads that must be significant and/or higher than 0.7; and discriminant validity, which can be assessed by cross-loading criteria (Hair, Hult, Ringle, & Sarstedt, 2014), and will be described

Graph 1

DISTRIBUTION OF DIGITAL DIVIDE OF COMPANIES ACCORDING TO THEIR SIZE
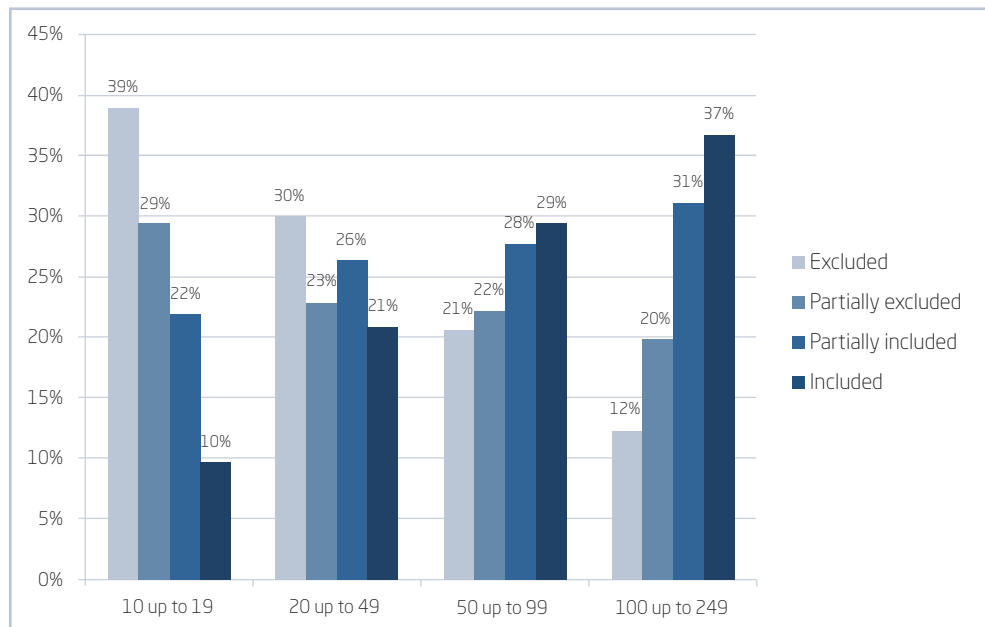
Source: Elaborated by the authors.

further. Each of the items considered in the quality analysis of the model will be described. The composite reliability values calculated for the model are shown in Chart 3. As we can observe, all values are above the limit of 0.7.

Chart 3

COMPOSITE RELIABILITY FOR THE CONSTRUCTS OF THE MODEL CONSIDERING THE DATA OF 2014

Construct	Composite Reliability
External integration	0.74
Internal Integration	0.76
Decision support	0.73
ICTs Use	0.72

Source: Elaborated by the authors.

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Chart 4 shows the factorial loads of the observed variables (indicators) related to the first three order constructs of the model. As we may observe, these are high within their constructs (above 0.5 and all significant – t-values are reported in parentheses), indicating the convergent validity and showing low values in the other constructs, and the discriminant validity. The t-values were obtained through the bootstrapping procedure, with 1000 replicates.

(Chart 4)

CONVERGENT AND DISCRIMINANT VALIDITY: CORRELATIONS BETWEEN THE OBSERVED AND LATENT PROXIES

(AND T-TEST VALUE IN PARENTHESES FOR FACTOR LOADS) Indicator	Internal Integration	Decision support	External integration
Do you use CRM?	0.65 (39.4)	0.15	0.04
Do you use ERP?	0.65 (42.6)	0.13	0.13
Do you use Internet for External/Internal Recruitment?	0.66 (48.0)	0.28	0.14
Do you use Internet for Training and Education?	0.68 (49.7)	0.19	0.19
Do you use Internet to Research Government Information?	0.19	0.72 (45.0)	0.11
Do you use Internet to Research Information on Products and Services?	0.11	0.60 (21.7)	0.06
Do you use Internet for market monitoring?	0.28	0.75 (52.0)	0.04
Do you have the option of Product Customization in the Website?	0.06	0.04	0.62 (21.0)
Do you have the option of Orders and Reservations in the Website?	0.20	0.11	0.79 (42.8)
Do you have the option of after-sales services in the Website?	0.12	0.05	0.67 (28.0)

Source: Elaborated by the authors.

Chart 5 shows the AVE values for each of the model constructs:

Chart 5

AVERAGE VARIANCE EXTRACTED (AVE)

Construct	AVE
External integration	0.48
Internal integration	0.44
Decision support	0.48
ICTs use	0.47

Source: Elaborated by the authors.

Although the AVE values are lower than the recommended 0.5, it should be considered that the index behaves as expected, as it presents higher values in the larger companies, as well as higher values in the companies that operate in the knowledge intensive sector, and the constructs show a discriminant validity, as indicated by the cross-load analysis and the correlation criterion among the constructs, presented in the next item.

Chart 6 shows the correlations between the first-order constructs, and diagonally presents the square roots of the AVEs. The criterion of discriminant validity requires the values of the diagonals to be greater than the correlations presented in the rows and columns. As we can see in the following table, this criterion is met.

Chart 6

DISCRIMINANT VALIDITY (CORRELATIONS BETWEEN THE CONSTRUCTS AND ROOT OF THE AVE ON THE DIAGONALS)

	External integration	Internal Integration	Decision support
External integration	0.70		
Internal integration	0.20	0.66	
Decision support	0.10	0.29	0.69

Source: Elaborated by the authors.

Finally, Chart 7 presents the factorial loads of the first-order constructs in relation to the construct "Use of ICTs" of second order, as well as their significance calculated by the use of bootstrapping with 1,000 replications. As we can observe, the loads are significant, indicating the convergent validity of the second-order measurement model.

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(Chart 7)

CONVERGENT VALIDITY FOR THE SECOND-ORDER
CONSTRUCT "USE OF ICTS"

Dimensions	Use of ICTs
Internal Integration	0.83 (91.0)
Decision support	0.66 (36.1)
External integration	0.52 (19.4)

Source: Elaborated by the authors.

Based on these evidences, we may conclude that the index has internal validity and, therefore, the methodology for construction of the index has been replicated for the data of 2014 with credible results, given the quality measures of the model, as well as given the quality of the data collection, observing the sampling and generalization standards used by CGI.br.

5.2. Second step: Identification of Toe Factors Via Multiple Linear Regressions

Next, the TOE model is operationalized to use a regression technique that allows finding factors related to the use of ICTs by SMEs.

Operationalizing the TOE Model

From the factors presented in the review of literature, specifically in Table 1, we selected the variables of "TIC Empresas" survey that could represent the dimensions of TOE model for the analyses proposed in this paper. The result of this selection is presented in Table 4.

Sample Selected for TOE Factor Analysis

Excluding the cases with missing values in the dependent variables listed when operationalizing the TOE model, there was a sample of 1,448 cases of medium-sized companies (50 to 249 employees) and 1,435 cases of small companies (10 to 49 employees), totaling 2,883 cases at this stage of the analysis.

Table 4

OPERATIONALIZING THE TOE MODEL FROM THE VARIABLES AVAILABLE IN "TIC EMPRESAS 2014" SURVEY

Dimensions	Factors	Questions in the "TIC Empresas" Survey	Type of Variable
Technological	Infrastructure	Number of computers (desktop/notebooks/tablets) in the company by employee (calculated from the variables in the microdata)	Metric
		Does the company have LAN/wired network?	Binary
		Does the company have LAN/wireless network?	Binary
		Does the company have Intranet?	Binary
		Does the company have Extranet?	Binary
		In the last 12 months, has the company used a dedicated link connection?	Binary
		In the last 12 months, has the company used a fiber optic connection?	Binary
		In the last 12 months, has the company used a cable connection?	Binary
		In the last 12 months, has the company used a radio connection?	Binary
		In the last 12 months, has the company used a satellite connection?	Binary
		In the last 12 months, has the company used a 3G or 4G modem?	Binary
		Higher access speed considering all connections is greater than 10 Mbps?	Binary

(continue)

Table 4 (conclusion)

OPERATIONALIZING THE TOE MODEL FROM THE VARIABLES AVAILABLE IN "TIC EMPRESAS 2014" SURVEY

Dimensions	Factors	Questions in the "TIC Empresas" Survey	Type of Variable
Organizational	Alignment	There is an IT area in the company (recoding the question: the person interviewed holds a position in IT: yes or no)	Binary
		Did the company have to hire IT professionals in the last 12 months?	Binary
	Skills with ICTs	% of employees who have used Internet for work purposes at least once a week in the last 12 months? (Calculated from the variables in the microdata)	Metric
		In the last 12 months, has the company used any open source operating system, such as Linux?	Binary
	Attitude in relation to ICTs	In the last 12 months, has the company introduced new software not previously used by the company?	Binary
		In the last 12 months, has the company updated the version of one or more software already used by the company?	Binary
External Environment	External Support	Any of the functions requiring IT specialists or the use of computers and Internet has been performed by external suppliers, in whole or in part, in the last 12 months?	Binary
	Market influence: Partners, suppliers, customers	In the last 12 months, has the company bought goods or services over the Internet?	Binary
		In the last 12 months, has the company sold goods or services over the Internet?	Binary
		Sector of operation (codified by binary variables for each of the sectors covered in the survey according to the CNAE code)	Category

Source: Elaborated by the authors.

Method

The research hypotheses were tested through multiple linear regressions, considering the index of use of the TICs as a dependent variable and the variables selected by the TOE model as independent (metric and binary). A regression was performed for each company size: small and medium, allowing the comparison of the importance of the factors according to the size of the company. For the "Sector" variable, binary variables were created for each of the sectors considered in the survey, with the exception of Housing and Food companies, which were selected as the base category for comparison in the case of small companies, and construction companies in the case of medium-sized enterprises, because it presents the lowest average value of the ICT use index in the companies surveyed (0.501 and 0.582 respectively).

The regressions were performed using the stepwise method in SPSS Software 19.0, considering the significance level of 5% for inclusion of the variables in the model. To check the quality of the regression model, we analyzed the normality of residues and the absence of correlation between the residuals and the adjusted values (Hair *et al.,* 2014). We also analyzed the collinearity, obtaining VIF indexes below 5 (Rogerson, 2001) for all variables, indicating the absence of multicollinearity problems.

Results of the regressions

The results of the regressions shown in Table 5 indicate that at least one of the variables selected in each of the dimensions of the TOE model is related to the ICT use index in at least one business size, and the majority is related to both the small and medium-sized enterprises.

Thus, we found the basis for the research hypotheses, in which, in the context studied (Brazilian SMEs), where the factors selected to represent the dimensions of TOE model positively influence the level of adoption and use of ICTs in companies. The only exception (negative influence) occurred in the group of small companies in the Information and Communication sector. Given all other constant conditions (same level of infrastructure conditions and organizational aspects), this means that these small companies use less ICTs than the others do. This point is interesting, since the use of infrastructure and trained personnel is expected in these companies because of the service they provide, but this do not necessarily results in the use of ICT to support their own business, as measured by the index. In any case, we could observe that in some sectors the companies use more ICTs in relation to others, showing the influence of the external environment.

(Table 5)

RESULTS OF REGRESSIONS

Dimensions	Factor	Questions in the Survey TIC Empresas 2014	Medium-sized enterprises: R² aj.= 31.4%		Small-sized enterprises: R²aj.=32.6%	
			Standard Beta	Sig.	Standard Beta	Sig.
		Does the company have LAN/wireless network?	.082	.000	.068	.002
		Does the company have Intranet?	.133	.000	.121	.000
		Does the company have Extranet?	.102	.000	.096	.000
		In the last 12 months has the company used a dedicated link connection?	.080	.001	.065	.004
Technological	Infrastructure	In the last 12 months, has the company used a fiber optic connection?	N.S. (*)		.053	.016
		In the last 12 months, has the company used a cable connection?	.060	.015	N.S.	
		In the last 12 months, has the company used a 3G or 4G modem?	.067	.003	.086	.000
		Higher access speed considering all connections are greater than 10 Mbps?	N.S.		.067	.003

(continue)

Table 5 (continuation)
RESULTS OF REGRESSIONS

Dimensions	Factor	Questions in the Survey TIC Empresas 2014	Medium-sized enterprises: R^2 aj.= 31.4%		Small-sized enterprises: R^2aj.=32.6%	
			Standard Beta	Sig.	Standard Beta	Sig.
	Alignment	Is there an IT area in the company?	.115	.000	N.S.	
		Did the company have to hire IT professionals in the last 12 months?	.068	.003	.070	.002
	Skills with ICTs	% of employees who have used Internet for work purposes at least once a week in the last 12 months? (Calculated from the variables in the microdata)	.161	.000	.187	.000
Organizational		In the last 12 months, did the company use any open source operating system, such as Linux?	.060	.016	.128	.000
	Attitude in relation to ICTs	In the last 12 months, has the company introduced new software not previously used by the company?	.177	.000	.162	.000
		In the last 12 months, has the company updated the version of one or more software already used by the company?	.055	.012	N.S.	

(continue)

(Table 5 (conclusion))

RESULTS OF REGRESSIONS

Dimensions	Factor	Questions in the Survey TIC Empresas 2014	Medium-sized enterprises: R^2 aj.= 31.4%		Small-sized enterprises: R^2aj.=32.6%	
			Standard Beta	Sig.	Standard Beta	Sig.
	External Support	Any of the functions requiring IT specialists or the use of computers and Internet was performed by external suppliers, in whole or in part, in the last 12 months?	.083	.000	N.S.	
External Environment	Market influence: Partners, suppliers, customers	In the last 12 months, has the company bought goods or services over the Internet?	.096	.000	.161	.000
		Sector: Transformation Industry	.136	.000	.047	.040
		Sector: "Business; repair of motor vehicles, personal objects"	.090	.000	N.S.	
		Sector: "Housing and Food"	.096	.000	N.S.	
		Sector: "Information and Communication"	N.S.		-.052	.033
		Sector: "Art, culture, sport and recreation; Other service activities"	.061	.009	N.S.	

(*) N.S. – not significant: the variable was not included in the model because it has shown a significance level under 5%.

Source: Elaborated by the authors.

Analysis of Regression Results

Although the "TIC Empresas" surveys reveal that access to technology and Internet seem to be equal in both small and large companies, the results indicate that the availability of network technology (LAN, intranet and extranet) and the type of connection (3G, fiber or cable), as well as the speed of access in the case of small companies, are correlated with the ICT use index, showing that public policies that deal with the quality of access to technology remain relevant. As companies begin to use more internal and external systems to connect with their suppliers and customers, they depend more on the speed of connection as well as its quality in terms of availability. Therefore, the presence of faster and more stable connections is an important factor for the evolution in the use of ICTs. The greater use of connections via 3G and 4G also points to this greater dependence, since it indicates the use of "contingency plans" and the concern with redundancy to maintain the operation of the systems in case of unavailability of the main connection. Thus, the issue of digital divide analysis as a matter of access to ICTs (Dewan & Riggins, 2005; Arendt, 2008) remains, but now considering the quality of the access (speed and stability of the connection) necessary to the integration of systems and the chain of customers and suppliers of companies.

The attitude in relation to ICT measured in this research through "software introduction or update" proxies, as well as issues related to ICT skills measured by the "% of employees using the Internet" and "use of open source operating systems", are also correlated with the use of ICTs for both company sizes, indicating that from the managerial point of view the investment in ICT training and learning (e-literacy) and an attitude of innovation through the introduction of new systems are related to a more intense use of ICTs by organizations. These were the variables with the highest values for the standardized Beta coefficient, in both sizes. This indicates the importance of organizational aspects in the process of computerization of companies, related to the managerial concern with the use of ICTs, reflected in software updates, and with the training of professionals and owners in the company for its proper use, as presented by Harindranath, Dyerson, and Barnes (2008). From a public policy perspective, entrepreneurship and skills training through incubators or the Brazilian Service for Supporting SMEs (Sebrae), for example, could cover information on existing ICTs, their benefits and how to use them.

In relation to the alignment between IT investments and company strategies (Ramos, Silva & Alverga, 2009), measured here by the proxy "Is there

an IT area in the company", showed that the relevance of an area or professionals dedicated to IT in medium-sized enterprises increases as the company grows and needs to expand the use of ICTs.

The index is also correlated with external environment variables. Specifically, for small enterprises, there was an increase in the index among those that considered outsourced IT services, corroborating Alshamaila, Papagiannidis and Li (2013), that identified that external support is a relevant factor for IT adoption in SMEs. Still regarding small enterprises, this study highlights the purchase of inputs through the internet, which may show that in this case the integration with larger suppliers or customers in the value chain can boost the adoption of ICTs (Awa, Ukoha, & Emecheta, 2015). Finally, companies' sector is correlated with use in both sizes, so these results indicate that factors of the external environment can also influence the use of ICTs by organizations.

6. FINAL CONSIDERATIONS

Several studies have focused on the adoption of ICTs by small and medium-sized enterprises, revealing both factors and barriers for them to be more successful in this adoption. One of the models used in this study is the TOE model.

No Brazilian papers approaching the adoption of ICTs by SMEs and discussing the phenomenon of digital divide have been identified. In this sense, the first contribution of this article lies precisely in bringing such a discussion to the national literature, since exclusion is a setback for the adoption and makes the competitive environment more unequal, enhancing the capacities of the companies included and weakening the excluded companies.

A second contribution concerns to the operationalization of a theoretical model through which digital divide can be measured. From a practical point of view, measuring this phenomenon may have implications for the formulation of public policies, an area so affected by the difficulty of measuring social and economic phenomena (Jannuzzi, 2002).

A third contribution is the proposition of a conceptual model based on the IT usage model and the TOE model. TOE is a model used to study adoption and, by positioning the use of IT as the last step of adoption (Dewan & Riggins, 2005), it was possible to combine both models, thus enabling future studies on ICT adoption to focus more on their use and not on access or investments. One of the benefits of using TOE as a reference model was the

possibility of grouping the factors into contexts, which made it possible, for example, to find that the fact that a company has IT services delivered by an external supplier increases its score in the index, which may raise a debate about the need to inform companies about technology and its potential benefits so that the organization can make a better decision on adoption without relying on the information provided by suppliers.

Finally, it contributes with a specific consideration on the CGI.br and the data used in this paper. CGI.br, which is responsible for the "TIC Empresas" survey, was created to fulfill the mission of disseminating data on the use of ICTs by companies (and also by people, schools, etc.), among others. In this sense, an additional contribution lies in the dissemination, use and interpretation of the data collected and made available by CGI.br, both for practical point of view and for the academic community. For the academic community, it contributes to the dissemination of a secondary database, whose collection meets strict criteria for sampling and whose data usability was proven in this article. Disclosure to this audience is understood as a contribution, since achieving primary quality data is an increasing difficulty in conducting scientific studies. For companies, the disclosure of data and how to interpret them brings a rich possibility of benchmarketing.

Following the guidelines of Bach *et al*. (2013), this article also sought to explore the issue of digital divide, considering as a unit of analysis the Brazilian small and medium-sized organizations, in accordance with the suggestion of the authors to maintain the focus of such studies in developing countries.

With these contributions, we hope to contribute to the evolution of the studies on digital divide, to support both a better understanding of the phenomenon and the definition of public policies that seek to reduce inequalities. We also hope that the operationalization of TOE model and the model that integrates TOE and the use of ICT in organizations will be useful for organizations.

7. FUTURE STUDIES

Since the "TIC Empresas" survey is annual and has been produced since 2005, it is possible to evaluate the evolution of the ICT use index over the years, which in theory could allow a panel study to find factors that condition an increase in the rate of ICT use over time, and thus produce a study on stages of adoption of ICT or a study of cause and effect. Another suggestion for future studies is to analyze the impacts of public policies for the

inclusion of SMEs. Dewan and Riggins (2005) also recommend responding to this question in digital divide studies. A suggestion for future studies is the exploitation of statistical techniques that can produce better results in the association of variables and its factors based on the "TIC Empresas" survey in order to improve the construction of the ICTs use index, as application of algorithms used in Data Mining and Machine Learning.

EXCLUSÃO DIGITAL DAS PEQUENAS E MÉDIAS EMPRESAS: UMA ANÁLISE DOS FATORES INFLUENCIADORES UTILIZANDO TEORIA TOE

RESUMO

Objetivo: Este estudo descreve o fenômeno da exclusão digital de pequenas e médias brasileiras por meio de um indicador de uso das TICs nessas organizações.

Originalidade/lacuna/relevância/implicações: Existem vários estudos sobre adoção das TICs no nível das organizações, entretanto, raros são aqueles que exploram o tema utilizando o conceito de exclusão digital. Este estudo aborda a exclusão digital de segunda ordem, relacionada ao efetivo uso das TICs pelas empresas.

Principais aspectos metodológicos: O estudo foi realizado com base em uma amostra de 3.231 empresas participantes da pesquisa "TIC Empresas" de 2014 (publicada em 2015). Por meio de equações estruturais foi criado um índice que mede a intensidade do uso das TICs nas organizações e, por meio de regressões lineares, foram verificados fatores que o impactam.

Síntese dos principais resultados: O primeiro resultado diz respeito à viabilidade de um índice que mede o uso das TICs; em seguida, ao analisar sua distribuição, percebe-se a discrepância de valores entre as empresas em função de seu porte. A análise das regressões indica que o acesso à tecnologia e à internet, além de habilidades e atitude em relação às TICs são fatores correlacionados ao uso mais intenso das TICs pelas organizações.

Principais considerações/conclusões: A exclusão digital é um fenômeno relacionado às altas taxas de mortalidade e baixa produtividade das pequenas e médias empresas. Este estudo traça um caminho possível

para estudar esse fenômeno, integrando um modelo de adoção (TOE) e um modelo de uso das TICs no contexto de exclusão digital de segunda ordem.

PALAVRAS-CHAVE

Exclusão digital. TOE. Uso organizacional de TI. PMEs. ICT4D.

BRECHA DIGITAL DE PEQUEÑAS Y MEDIANAS EMPRESAS: ANÁLISIS DE LOS FACTORES DE INFLUENCIA UTILIZANDO LA TEORÍA TOE

RESUMEN

Objetivo: Este estudio describe el fenómeno de la brecha digital de las pequeñas y medianas empresas en Brasil, por medio de un indicador de uso de las TIC en estas organizaciones.

Originalidad/laguna/relevancia/implicaciones: Hay varios estudios sobre la adopción de las TIC por las organizaciones, sin embargo raros son aquellos que exploran el tema utilizando el concepto de brecha digital. Este estudio aborda la brecha digital de segunda orden, relacionada con el uso efectivo de las TIC por las empresas.

Principales aspectos metodológicos: El estudio se realizó a partir de una muestra de 3.231 empresas participantes en la encuesta "TIC Empresas" de 2014, publicada a partir de 2015. Mediante ecuaciones estructurales se creó un índice para medir la intensidad del uso de las TIC en organizaciones. Factores que lo afectan se verificaron mediante regresiones lineales.

Síntesis de los principales resultados: El primer resultado se refiere a la viabilidad de un índice que mide el uso de las TIC. Entonces, al analizar su distribución, se pude ver la discrepancia de valores entre empresas en relación a su tamaño. El análisis de regresión indica que el acceso a la tecnología y la Internet, así como las habilidades y actitudes de las TIC son factores correlacionados con un uso más intenso de las TIC por parte de las organizaciones.

Principales consideraciones/conclusiones: La brecha digital es un fenómeno relacionado con altas tasas de mortalidad de la empresa y la baja productividad de las pequeñas y medianas empresas. Este estudio describe una posible

forma de estudiar este fenómeno, integrando un modelo de adopción (TOE) y un modelo de uso de las TIC en el contexto de la brecha digital de segundo orden.

PALABRAS CLAVE

Brecha digital. TOE. Uso organizacional de TI. PYMES. ICT4D.

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