HOW ICT INTRODUCTION IS CHANGING PROCESSES IN MANUFACTURING SMEs

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Abstract:

Information and communication Technologies (ICTs) have the potential to help notably to economic growth. Given their many profits, small and medium businesses are bringing in ICTs to support their profitability, productivity and competitiveness. Nevertheless, small and medium enterprises (SMEs) have different behaviours than larger organization because of the particular characteristics of SMEs, such us resources constrains. This paper studies some aspects of ICT adoption trying to explain why organizations should introduce them in their processes, such as the key factors that influence the adoption and use of ICTs, the direct and indirect effects of ICT introduction or some drives, risks or barriers that organizations will have if they are thinking about introducing ICTs in their processes.

Keywords: SMEs, ICT, manufacturing processes, digital transformation, digital evolution, smart factory, internet of things, industry 4.0, digital divide, e-commerce, e-business, social media networks (SMN), supply chain, co-working, manufacturing enterprises.

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Chapter 1 Introduction

This work will discuss how the introduction of ICT is changing the manufacturing processes within SMEs. In order to do this, the first step will be to look into what a manufacturing enterprise actually is.

Manufacturing enterprises are complex organizations consisting of a number of departments with activities that are closely interrelated[1].

The purpose of a manufacturing organisation is to create a product or a possible service, which can then be sold to either a wholesaler, retailer or end consumers depending on the firms supply chain. Some manufacturing companies are independent companies; however, other companies can be a joint venture between two or more firms.

Manufacturing companies are created to achieve specific goals. Production companies are generally created for generating profits in the production and sale of goods. Manufacturers work in a factory and use personnel and equipment to convert raw materials into finished products. Some manufacturers rely heavily on mass production equipment. Others rely on personalized or high quality products.

Manufacturing companies play a very important role with regards to traditional distribution. Distribution channels are groups of companies that take charge of the process of products starting from the ´Input´ stage right through your ´Transformation´ stage and lastly your ´Output´ stage. Manufacturing companies are responsible for the finished product or service that will then intact reach the end consumers. For this process to triumph, consumers must know the value of the goods they acquire. This value comes from a quality product at a reasonable price[2].

Once we know what a manufacturing company is, our objective is to focus on studying

1 https://link.springer.com/chapter/10.1007/978-3-8248-9415-4_22
2 https://bizfluent.com/facts-6148898-define-manufacturing-enterprise.html

the entire process of production and manufacturing of SMEs. It is clear that SMEs are of great value to the business world as they supply 99% of the countries within the European Union (EU) as well as a large amount of other nations around the globe.

With the use of online articles and textbooks we can see how SMEs are modifying and digitizing their production and manufacturing processes in order to remain competitive and achieve higher profits. To gain a competitive advantage and retain their profits, organisations are beginning to modify and switch their old production methods for new and improved digitized production. It is necessary to develop new production processes, as this is where ICT plays a crucial role.[3]

Within this day and age, one of the first things to introduce within a manufacturing process is the new and improved ICTs. Using ICTs, enterprises increase revenues and sales. Thus, being said it is not always easy to introduce ICTs, but indeed extremely crucial for an organisations and their success. A manufacturing organisation must always try to reduce waste within the production line of work. This is a clear example of why ICT is so important within a business as it can help an organisation to reduce waste and save time and money. The introduction of ICTs can allow companies to interconnect with other similar companies within the same field of work, which in return will allow valuable information to be shared amongst one and other.[4]

1.1 Online interconnections between firms. Two concepts: E-business and E-commerce

E-business (or electronic business) consists in the realization of online business, this includes sales and purchases of products, production control management, supplies and

[3] Sebastian Molinillo, Arnold Japutra. (2017) Organizational adoption of digital information and technology: a theoretical review

[4] https://www.evaluandosoftware.com/incorporacion-tic-sector-productivo/

services, service to each client, process payments, collaborate with business partners, and recruitment. [5]

E-business was first created in 1996 by IBM's company[6]

E-business is similar to E-commerce, but the difference between them is that E-business is not only focused on the purchase-sale of products-online service, but also includes a wide range of business processes, such as the supply chain, the management of relationships with each customer and the processing of orders electronically. Therefore, these electronic business processes in most of the cases help companies to operate more efficiently and effectively if it is incorporated correctly. [7]

The term E-commerce (or electronic commerce) is based on the online purchase-sale of goods and services, besides the transfer of both data and money to be able to perform transactions correctly. This term can sometimes refer to online sales of physical products, but also to any type of online commercial transaction.

The difference is that E-commerce focuses on transaction of goods and services whereas E-business focuses on all aspects of operations of an online business.

The first online sale, on August 11, 1994 was the period of when electronic commerce first began. It consisted in the sale of a CD by a Sting band through a web platform called Net-Market, which in fact was the first E-commerce sale.

Since the first online operation, there have been many improvements made to make these products conducted easier by retailers and online markets. This has resulted with benefits from SMEs. It is estimated that by 2020 it will reach 27 billion dollars in global sales of electronic commerce[8].

Today clients are interconnected by the use of the internet. For customers, it is usually more convenient to make their purchases digitally, through the use of their own phone,

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5 https://searchcio.techtarget.com/definition/e-business
6 https://en.wikipedia.org/wiki/Electronic_business
7 https://www.techopedia.com/definition/1493/electronic-business-e-business
8 https://www.shopify.com/encyclopedia/what-is-ecommerce

tablet, or computer. This saves the consumer time instead of physically entering a store or business to purchase their product or service. This can be easily done quickly from your home within a few minutes.

Board of directors and their manufacturers must establish a clear communication system or relationship between them, their end users and their current and potential consumers of their goods and services through the use of business to consumer (B2C) or business-to-business (B2B), in order to digitize the purchasing habits of consumers.[9]

The European Union established in 2010 the need for an industrial Europe, in which of every four jobs in the private sector, one corresponds to manufacturing industry. Knowing this, companies are gradually introducing ICT in their manufacturing processes in order to achieve that goal. They are pursuing advanced manufacturing, which consists of linking ICT with manufacturing processes of each company. Countries like the USA or China have an advantage over Europe since they have been introducing ICTs in their manufacturing processes for years. Thus being said, Europe has to work hard and focus on digital transformation by increasing its investments in ICT, which will then have a knock-on effect on their competitive opportunities against countries such as the USA and China.[10].

1.2 The case of myBot

Developed countries are already aware of the importance of introducing E-commerce within their organisations. Applications installed on mobile devices and social media networks (SMN) are revolutionizing the world of E-commerce. On the other hand, the lack of knowledge due to its premature introduction is causing problems due to the fact that research is still being developed within this area. The next step is to explain how E-commerce is applied to SMEs, and what factors will influence this application.

[9] https://www.manufacturing.net/article/2018/06/role-b2b-e-commerce-modern-manufacturing

[10] http://www.interempresas.net/Robotica/Articulos/142896-El-papel-de-las-TICs-en-la-cuarta-revolucion-industrial-la-fabricacion-inteligente.html

MyBot, a firm created to the purpose of developing the rural-based handicraft industry in Botswana, took advantage of the innovative ability to bond with old customers to receive a boost and use Facebook to its maximum potential. MyBot works from an area in which resources such as ICT applications and other operating system tend to be scarce. This allows the application to capitalize on the ease of using Facebook to do business.

To achieve the correct adoption of E-commerce through Facebook, it must be advertised in a social environment where trust is at the forefront. This creates a strategic relationship between myBot and customers within the United States. Studies on this topic show the importance of Facebook in advancing E-commerce in myBot. Through the use of previous studies, MyBot indicated that social media networks (SMN) have a leading role in the development of E-commerce in SMEs. None the less, this is not the only thing that myBot indicates on, but also other tools such as Internet or email must also be used to achieving a leading role. Another fact to keep in mind is that on the first day of myBot´s launch, the payment method was only possible through credit or debit card, thus, having a knock on effect and creating a possible disadvantage because some people may not have a credit or debit card but may prefer to only pay in cash this cause issues for MyBot.

The findings of MyBot corroborate what was said in the study, particularly in the concept of market orientation. In the US, this niche market provides an extension of the business spirit of E-commerce. In addition, the work that is done in China presents a similarity. China predicted that social networks can be implemented with a web technology and achieve an economic benefit in the company. It should be noted that in myBot your website is still unlimited, except for advertising on your products.

Regarding to the limits of the application on the web, these findings confirm what was said in previous findings as [11] in Malaysia,[12] in Tanzania, and early research findings by [13] in Canada.

[11] Ramayah, T., Ling, N. S., Taghizadeh, S. K. and Rahman, S. A. 1(2016)
[12] Kabanda & Brown (2017)
[13] Lefebvre, et al., (2005)

Regarding to what factors influence the introduction of E-commerce using SMN, the two key factors that should be highlighted are both the innovation and the commitment of the manager. This has as a difference with respect to the findings of previous studies that know the ICT methodology to innovate in the adoption of E-commerce, not as in [14], [15]; What the manager of myBot did is to look for alternative ways to establish links with buyers to improve the position of their company in the business area. The manager of myBot has been brave and has done business using Facebook beyond what was done in Botswana. These findings give the answer to what was said in[16] and[17].

As predicted, at the end of a purchase process, trust should be analysed as a key factor: the Lerato manager, both of myBot and global consumers. This aligns with the part of being cognitive and behavioural, trustworthy aspects. By having contact with consumers, a relationship of trust can be established and, therefore, orders can be repeated. These results coincide with[18], who affirms the need to establish a relationship of trust through the SMN.

In summary, with the application of contextualism, it is possible to understand the operation of an E-commerce enterprise, as well as its application in SMEs.[19].

1.3 Social media networks: Online meeting between firms

In the previous section, we have been talking about the convenience of doing online businesses between companies. For this, the first thing to do is to know each other. And here is where social networks come into play.

Social media networks are a key tool if what you want is to expand your contacts, whether commercial or social, through social networks such as Twitter, Facebook, Google+ or LinkedIn[20]. In business and in companies, social media networks are used

14 Kabanda & Brown (2017)
15 Alyoubi, (2015)
16 Ghobakhloo & Tang, 2013
17 Ghobakhloo, et al., 2011
18 Alsaad, et al., 2017; Bocconcelli, et al., 2017
19 E-commerce and entrepreneurship in SMEs: the case of myBot
20 https://whatis.techtarget.com/definition/ social-networking

both to market products or brands and to connect with old customers or create new contacts.

People can create profiles and exchange pictures, information; they can communicate or share interest creating communities[21]. This can add value to the organization and its business, because networkers individuals can participate in social-economic development, wealth creation or innovation in ways never considered before.

This gives to an industrial company the opportunity to connect with the bosses and make joint decisions in a wide variety of industries. You can create profiles of both a senior position and the company itself. In any case, this will encourage the promotion of the business[22].

[23]Finds evidence of potential advantages of using social media networks for SMEs. The findings made indicate that a web presence integrated with sustained and meaningful social media promotion have a positive impact on business success increasing aspects such as revenues, awareness and traffic. Also highlights how social media networks can help SMEs with problems to communicate cost effectively with customers on a global scale, creating new opportunities for their sales and growth.

1.4 Cloud computing: A way to improve business[24]

Defined Cloud Computing as "an ICT service model where computing services (both software and hardware) are delivered on-demand to customers over a network in a self-service fashion, independent of location and service" [25].

Recent studies show that Cloud Computing use encourages business practices and boosts growth SMEs at all levels. Nevertheless, market studies indicate that European SMEs are not make the most of the profitable solutions that cloud computing offers. It

21 Silvia Fernandes, Ana Belo, Guilherme Castela, (2015)

22 https://www.webfx.com/industries/industrial/manufacturing/best-social-networks-for-industrial-companies.html

23 Jones, Nory; Borgman, Richard; Ulusoy, Ebru, (2015)

24 Dario Assante, Manuel Castro, Ileana Hamburg and Sergio Martin, (2016)

25 Marston S., Li Z., Bandyopadhyay S., Zhang J., Ghalsasi A. Cloud computing – The business perspective. *Decision Supp Sys* 2011:**51**. p.176-189

is not necessary to do big investments in software and hardware for SMEs, entering the market more easily due to the cost-efficient, integrated cloud computing services.

Also, in corporate sector arises a great interest in cloud computing, although several investigations show a lack of professionals able to work in this field.

The European Commission was studying some investments on strategies related to Cloud Computing investments. In 2012, they started the strategy “Unleashing the Potential of Cloud Computing in Europe”. This strategy includes three key actions, being the most important the “European Cloud Partnership”, providing strategic options to turn cloud computing into an engine for private services, innovation and cost-efficient public and sustainable economic growth.

Therefore, it is important for SMEs to acquire the most important strategic skills in order to remain ahead of the sector by adding newest technologies such as Cloud Computing.

1.5 Working online between firms: Supply chain

Once two companies have an established relationship with similar manufacturing processes, they must begin to work together by exchanging information between them. Here the term "Supply chain" comes into play.

A supply chain is a network of activities, organizations, individuals and resources involved in the production and sale of the product created, from the delivery of materials by the supplier to the final delivery to the end user. The whole process is what is known as supply chain.

Supply chain management (SCM) is the control or supervision of the entire supply chain presented in the previous paragraph. The three main flows in the supply chain are the flow of finance, the flow of information and the flow of products. SMC involves the coordination and integration of these flows both within companies and between them[26].

[26] https://whatis.techtarget.com/definition/supply-chain

It is essential to have an optimized supply chain, since costs and production times will be reduced[27].

On the other hand, companies do not always seek to work together with other companies to share information, sometimes they only seek to share office space in order to reduce costs. This idea can be grouped in the "Co-working" concept.

1.6 Sharing office space but not necessary sharing work: Co-working

Coworking is a term associated with the provision of business services that includes people who work in a shared or group space[28].

The term with such "Coworking" originated in San Francisco (USA), in 2005, presented by Brad Neuberg[29].

The standard user "Coworking" is an independent worker, self-employed or teleworker. There are companies that use these shared spaces to provide these companies with equipment, services and space that, if they did not share, they would not have enough money to acquire them and, therefore, they would not be able to use them for their use. There are also large companies that at certain moments need more work space and these shared spaces are an alternative to use[30].

1.7 "Smart factory", from digital to intelligence

Another concept that is always present when we are talking about digital transformation is the term "Smart Factory".

Companies are changing their mode of production due to the rapid development of information technologies, advanced manufacturing, electrical and electronic, which are

27 https://www.investopedia.com/terms/s/supplychain.asp
28 https://whatis.techtarget.com/definition/coworking
29 http://whatiscoworking.com
30 https://whatis.techtarget.com/definition/coworking

getting the manufacturing process is going from the digital to the smart. We are approaching an era that combines virtual reality technology based on the Cybernetic System (CPS).

Because of these new challenges, the manufacturing industries have seen their advantages diminished gradually. Because of the foregoing, the areas of advanced technology of the developed countries related to the manufacture of intelligent technology are paying attention to how this evolution is developing. Both Industry 4.0 strategy, Europe 2020 strategy and China 2025 strategy have been proposed as objectives. Due to the rapid advance of technology, the US has accelerated its process of reindustrialization so as not to lose ground with respect to other countries and not be left behind.

The transformation of digital to intelligent technology is revolutionizing and producing profound effects that will affect the future manufacturing of the whole world[31].

1.8 Gap between demographics and regions about ICT: Digital Divide

Not all regions of the world have access to technology. In fact, many do not have easy access to it and some do not have access. This can be explained with the term "Digital Divide", which explains this digital divide between different regions of the world. This concept explains the gap that exists between different regions when it comes to be able to access ICT, whether by telephone, internet or computers.

Until the end of the 20th century, when it began to be known as the digital divide, everyone characterized people who had technology like the one that had or did not have a phone. From the 90s, there was a change and began to understand the digital divide as those who have access to the Internet and those who do not.

[31] https://ieeexplore.ieee.org/document/8207346

This difference is present in several fields: people with the possibility of studying and those who do not have the opportunity to do so, those who live in large cities and those who live in towns, people with high economic power and those who have low economic power... If this is extrapolated worldwide, this difference can be summarized between the most developed countries and the least developed countries, industrially and technologically. The fact of being a country with little industrial and technological development results in slower internet browsing, worse performance, and lower speed in wireless connections or limited access to specific content.

As the technology advances and improves, the problems for the less industrialized countries are greater. We are moving towards a world in which videoconferences, virtual classrooms or on-line orders are in daily use and these technologically underdeveloped countries do not have the same speed and connection quality. As smartphones are introduced into the companies, the costs of data plans continue rising, which makes the reduction of the digital divide between developed and undeveloped countries impossible.

Those who defend the reduction until the disappearance of the digital divide maintain that this would help to improve the illiteracy, the economic equality and in addition, there would be a high economic growth[32].

1.9 Internet of Things (IoT): Digital interconexion of everyday items with Internet

Internet of Things (IoT) term is connecting any device with an on and off switch to the Internet. This includes everything from wearable devices, headphones, washing machines, cellphones, lamps or coffee makers. Also more complex items such as drills of oil rigs or jet engines of airplanes. If it has an on and off switch then chances are it can be an IoT part[33].

[32] https://whatis.techtarget.com/definition/digital-divide

[33] https://www.forbes.com/sites/jacobmorgan/2014/05/13/simple-explanation-internet-things-that-anyone-can-understand/#741ecfe71d09

Impact of IoT in manufacturing organizations is studied in[34]. A manufacturing organization has multiple domains and levels of different types of decision-making. A complex system has a big quantity of design variables and decision-making requires real time data collected from business environments, processes and machines. To support all decision-making activities, communication and data acquisition, are used enterprise systems (ESs). Enterprise system efficiency is been affected positively by ICT infrastructure for data acquisition and sharing.

Every important change of manufacturing paradigm has been supported by ICT advancement. For example, the technologies for computer-aided processing planning (CAPP), computer-aided manufacturing (CAM) and computer-aided design (CAD), made computer integrated manufacturing (CIM) practical.

IoT automates organization tasks and, consequently, makes organizations and people's live easier. Physical items are connected by IoT as a network and thus, can interact effectively.

1.10Fourth industrial revolution: Industry 4.0

"Industry 4.0" is a term referring to the union of IcT with manufacturing operations. Different technological fields such as IoT, cloud computing, data capture, artificial intelligence or advanced robotics are merging with each other in this new industrial revolution that is developing in the world during these last years[35]. What companies are doing is connecting their machines to a common cloud and thus be able to develop their own IoT. With this, what they get is to exploit a still virgin surface, with which they have the margin they need to increase and improve their growth and give them stability in their business[36].

34 Z. M. Bi, Chengen Wang, (2014)

35 https://www.businessnewsdaily.com/10156-industry-manufacturing-iot.html

36 https://www.forbes.com/sites/forbestechcouncil/2018/04/11/industry-4-0-the-smart-factory-and-machines-as-a-service/#73800f7e1dff

Being fully involved in Industry 4.0, the manufacturing industry is the place where more IoT projects are carried out and, therefore, where companies deposit more investment. IoT is a central pillar that supports both the industrial Internet and Industry 4.0. According to a study carried out in 2017, the manufacturing industry invested $ 178 billion in 2016 in IoT, more than double the second section with more expenses, transportation[37].

1.11 From being a driver of marginal efficiency to an enabler of fundamental innovation and disruption: the evolution of digital technology

Digital transformation that industries are suffering favours both the industry they belong to and society in general. These rapid advances that are taking place are remodelling what is the world in general. From 10 years ago, digital technology has evolved considerably. A high-end smartphone that cost $ 499 10 years ago, can now be obtained with similar features for approximately $ 10. Therefore, these advanced technologies are revolutionizing both business and society. In addition, digitalization could produce benefits that exceed the value created by the industry[38].

Most industry leaders share the idea that digital technology is changing in a very fast way, since it has gone from being an almost marginal efficiency factor to being an efficiency factor that facilitates innovation and interruption. In 2015, the DTI (digital transformation of industries) concept was launched. The World Economic Forum as part of the Future Internet Challenge initiative launched it. This initiative serves as a focal point for the initiation of new opportunities and emerging issues related to the latest trends and developments in the digitalisation of both society and business. One of the

[37] https://www.i-scoop.eu/internet-of-things-guide/internet-of-things-in-manufacturing/

[38] http://reports.weforum.org/digital-transformation/an-introduction-to-the-digital-transformation-initiative/

strengths of the DTI is the quantification of the value at stake, whether for society or for business, during the next decade, from the digital transformation of 6 industries[39].

[39] https://www.accenture.com/t00010101T000000Z__w__/ru-ru/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Local/ru-ru/PDF/Accenture-Digital-Transformation.pdf

Chapter 2 Literature analysis

2.1 Importance of ICT adoption in SMEs. Models of ICT adoption[40]

Within this day and age, ICT implementation in organizations contributes to increase the potential required to achieve significant economic growth.

Due to the great benefits that ICTs have provided to SMEs that have already implemented within their processes, the rest of the SMEs are betting on adopting ICT to improve their profitability, productivity and competitiveness.

Nevertheless, it exists a difference in ICT adoption between SMEs and large companies due, among other things, to the limited resources that SMEs have.

Article[41] shows that for ICT research have been used a number of theories about technology adoption. In these theories are included the Technology Acceptance Model (TAM), developed by[42], the Theory of Planned Behaviour (TPB) proposed by[43], and the Unified Theory of Acceptance and Use of Technology (UTAUT) conceptualized by[44]. These theories explain individual's intentions of ICT's use, their attitudes towards them and their adoption and acceptance[45].

At organization level, the most popular theories on ICT adoption are the Diffusion Of Innovation theory (DOI)[46], and the Technology, Organization and Environment framework (TOE)[47]. To explain ICTs adoption by organizations, the previous theories have been used, for either a combination with each other or others[48]; [49]; [50]; [51]. ICT

40 Paul Taylor, (2015)
41 Taylor, P. (2015)
42 Davis (1989)
43 Ajzen, (1991)
44 Venkatesh, Morris, Davis and Davis (2003)
45 Chen, Li & Li, (2011)
46 Rogers, (1995)
47 Tornatzky & Fleischer, (1990)
48 Ghobakhloo & S.H., (2011)
49 Huynh, Huy, Rowe, & Truex, (2012)
50 Martins & Oliveira, (2008)
51 Thong, (1999)

adoption is different in SMEs than in larger organizations, due to the spenvecific characteristics of SMEs, such as the limited access to technology, the required capabilities and skills needed and the resources constrains.[52]; [53]. Thus, to enable better appreciation of the key factors in organizations ICT adoption in developed and developing countries, is necessary to understand the theoretical models that have been used.

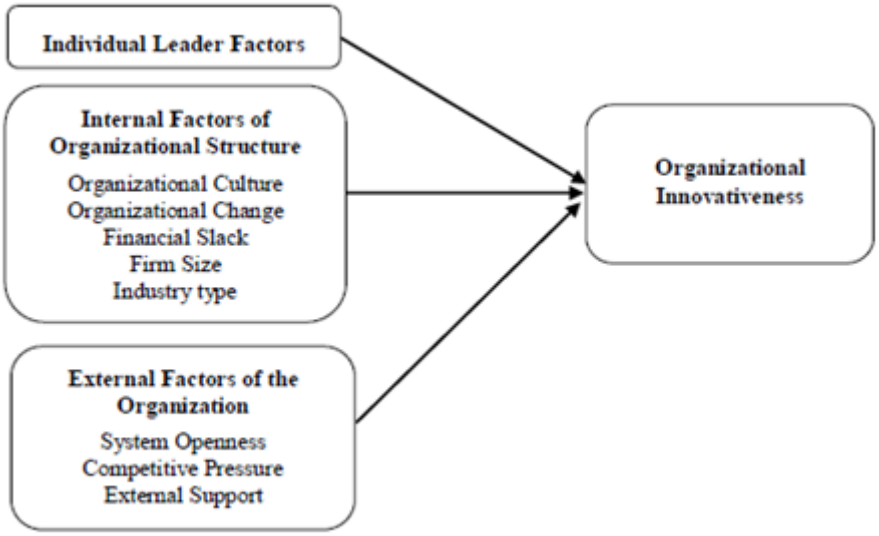
To do this, two theoretical models that explain ICT adoption in enterprises will be explained in order to understand which are the key factors that influence the adoption and use of ICT by organizations.

2.1.1- The Diffusion Of Innovation (DOI) theory

The Diffusion of Innovation (DOI) theory says that organizational structure, internal characteristics, external characteristics and individual characteristics of the organization are essential antecedents to organizational innovation[54]. Based on DOI theory, at organization level, innovation capacity is related to independent variables such as external factors of the organization, internal organizational structural factors and individual factors. (Scheme 2.6.1). Individual factors describe leaders' attitude towards change. Internal factors of organizational structure include the ICT knowledge and expertise of staff, organizational culture, financial slack, firm size and industry type. External factors include the extent to which the organization relates to and is affected by the external environment. Such factors include competitive pressure, as well as the availability and the access to external support.

Scheme 2.1.1: Diffusion of innovations (DOI) Model, Rogers (1995)

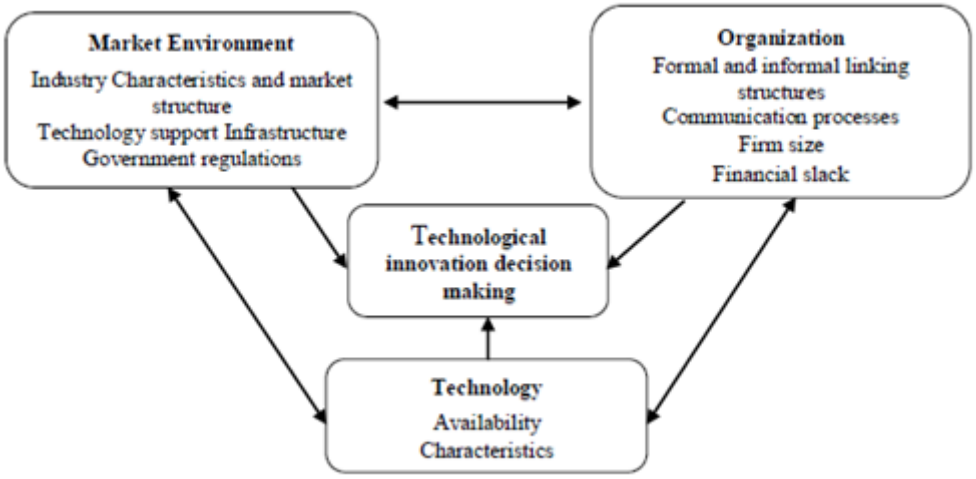
52 Avgerou, (2008)
53 Ghobakhloo, Sabouri, Sai Hong, & Zulkifli, (2012)
54 Rogers, (1995)



2.1.2- The technology, Organization, and Environment (TOE) Framework

[55]Developed the Technology, Organization and Environment (TOE) framework. The framework present three aspects of an organization's context (environmental, organizational and technological) that influence ICT adoption process. (Scheme 2.6.2)

Scheme 2.1.2: Technology, organization and environmental framework adopted from Tomatzky & Fleischer (1990)



This theoretical model describes how the organization context influences ICT adoption and implementation. The TOE framework is an organization-level that explains the

[55] Tornatzky & Fleischer (1990)

technological, the organizational and the environmental context of an organization's context that influence adoption decisions.

2.2 Factors of ICT adoption

We are going to analyse the economic, social and other factors that influence ICTs adoption[56].

2.2.1 Economic factors

The relevant economic factors include rank, wealth, return on investment, revenue, income, Gini coefficient and Gross Domestic Product (GDP). Typically, these factors are available publicly to researchers as well, making second data a real and adequate option, and sometimes, low-effort option for researching on the economic factors related to ICT adoption in a global context.

2.2.2 Social factors

The three most important social factor are the lack of education, security and digital divide. Technology has the power to provide opportunities for education through online earning, to increase security through standards and to access to the Internet through telecenters.

2.2.3 Other factors

Other factors that are considered drivers of global ICT adoption are cognitive, environmental and legal factors. In this area, research problems evident deal with declining environmental resources, corporate risks and cultural barriers. They include telecommunication methods and technologies that rise related services demand, mobile technologies for bill payments and hardware improvements for lower energy use.

[56] David M. Weber ⇑, Robert J. Kauffman, (2011)

2.3 ICT impact in SMEs

Globalization, economic effects and knowledge society affect the existence of separate countries, organizations and individuals[57]. The rapid development of ICTs influence in an important way the diffusion of the previous processes. It is known that the adoption and use of ICTs is closely related to fundamental aspects for an organization such as competitiveness and economic growth for organizations that can incorporate them[58]; [59]; [60]; [61].

Besides, ICT impact in the social and economic development of organizations had become an important topic during the last decades. [62] Emphasizes that there have been many studies that have analysed how ICT adoption affects organizations. For this, two types of studies have been differentiated:

- Related to the environment (findings of recent research confirmed that ICT has impact increasing the efficiency of energy and reducing greenhouse)[63].
- Related to productivity

In the coming years, the SME sector has an important role in the employment creation, the poverty reduction and the economic development of the development economies. UK study identified three different stages in ICT use in SMEs[64].

- Basic – minimal usage of ICT
- Substantial – several machines and applications in use
- Sophisticated – integrated several systems and constantly developed use of technology

[65]Argues that can be observed a staged progression in terms of harnessing technologies. As organization expands/grows, is more likely to need a specific department or function. Besides, the stage of harnessing infrastructures, technologies and ICT skilled personnel are closely related and could determine the positive ICT impact. Could be expected a

57 Asta Tarutė, Rimantas Gatautis, (2013)
58 Vehovar & Lesjak, (2007)
59 Higon, (2011)
60 Ollo-Lopez & Aramendia-Muneta, (2012)
61 Steinfield, LaRose & Chew, (2012)
62 Ollo-Lopez & Aramendia-Muneta, (2012)
63 Hall, Lotti & Mairesse, (2013)
64 Matthews, (2007)
65 Matthews, (2007)

positive impact in private sector if there are enough budged to invest in ICT, ICT personnel skilled and certain infrastructure. According to[66], ICT platforms (internet, mobiles or PCs) have four main contributions to organizations:

- Allow organizations to overcome traditional trade barriers
- More visibility to business organizations
- Facilitate financial transactions
- Provide more information to SMEs

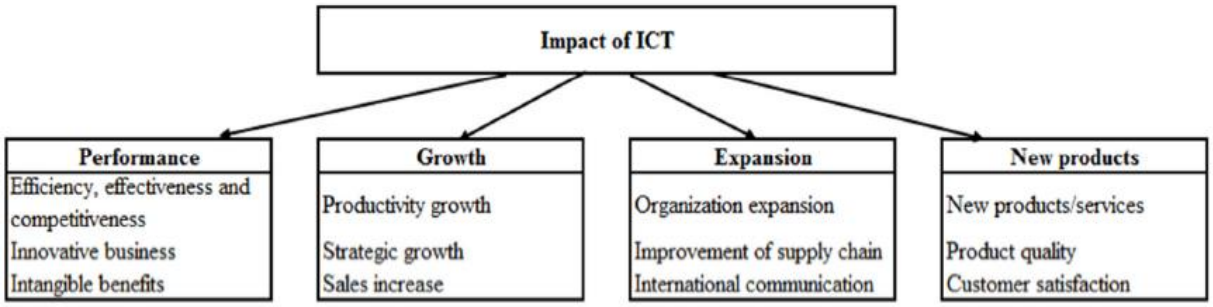
ICT influences organizations flexibility as well. Organizations that adopt ICTs tend to navigate better in market and differentiate services and products[67], directly or indirectly, depending on sectors and to have a good potential to support a sustainable development.

Social media network, e-commerce or e-mail use have significantly cut down the physical transportation involved in buying goods, advertising, banking and sending e-mails[68]. Nevertheless, we must know that the positive impact of ICT occurs after a while, not instantly. Therefore, we must emphasize the importance of ICT investment thinking on the future[69]; [70].

We must know that the role played by ICTS in SMEs is always an issue that must be paid attention and be studied correctly by companies. For a company, to complete its correct internationalization, it must be studied how to export, with what intensity and in what way that export process should be carried out. ICTs have different capacities such as the percentage of employees that the company can provide broadband, its online presence upper secondary ICT education and online transactions. It must be taken into account that when an organization incorporates ICTs, it must adjust its structure, make internal changes, in addition to reorganize and prepare staff to be able to perform their new functions.

66 Manochehri, Al-Esmail and Ashrafi (2012)
67 Ollo-Lopez & Aramendia-Muneta, (2012)
68 Manochehri, Al-Esmail and Ashrafi (2012)
69 Consoli, D. (2012)
70 Bayo-Moriones, A., Billon, M., & Lera-Lopez, F. (2013)

[71]Previously studied ICT impact in organizations and then identified and categorized the main ICT effects in four groups: new products, expansion, growth and performance (Scheme 2.2).



Scheme 2.2 presents the four main groups about where the greatest ICTs impact occurs. Each group has several dimensions such as product quality, productivity or efficiency. Studies show that the investments made in ICT organizations had a positive impact on economic growth and productivity labour force[72], [73]

Besides, ICTs increase manufacturing productivity in organizations and make it easier to market services[74]. Recent studies confirm a significant and positive effect on productivity. Other studies indicate that not only the effect of productivity is significant and positive, but also increases both in the public sector and in the private sector.

[75] Found out that Lau and Tokutsu (1992) analyzed the influence of ICT investment on US economic growth. Between 1960 and 1990, studies show that half of the economic growth in the EE.UU was caused by ICT investment. Reference is also made to the studies conducted in that period by the World Bank, which show a faster increase in employees, higher productivity, and sales increase faster due to ICT investment. [76] Supported this approach and stated that some empirical study shows that SMEs that use ICT have greater profitability and scope, and, therefore, can better position themselves for future expansion. ICTs not only function as a growth engine, but can also function as growth.

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71 Consoli, D. (2012)
72 Manochehri, Al-Esmail and Ashrafi (2012)
73 Sabbagh,Friedrich, El-Darwiche, Singh & Ganediwalla,(2012)
74 Manochehri, Al-Esmail and Ashrafi (2012)
75 Matei, A., & Savulescu, C. (2012)
76 Matthews, (2007)

Researchers have focused more on studying the direct effects (gains, productivity or growth), and less on indirect effects.

2.4 Relationship between ICT use and diversification of SMEs

Diversification concept could be explained as the degree or extent that an organization is operating at the same time in more than one industry in its field of activity and, therefore, in its corporate strategy[77].

The intensive use of ICTs in operational processes are related to productivity increases of diversified companies. Also, ICT adoption should lead to a positive increase in business results in organizations with several business lines.

A greater diversification degree requires a greater need for coordination information processing and assets within multi-business organizations.

According to[78], ICT demand is higher in organizations with diversified business lines related because these organizations need more resources coordination than organizations with unrelated businesses lines. The technologies impact on businesses is greater for organizations involved that for unrelated. Organizations that do not follow the unrelated diversification pursue diversification strategies and should prioritize the ICT adoption in operating activities.

Therefore, organizations can use ICT capital to coordinate their capabilities and resources across different markets, ICT capital can allow organizations to operate in several markets simultaneously and thus facilitate the realization of scope economies.

[77] Omar A. León, Juan I. Igartua, Jaione Ganzarain, (2016)

[78] Dewan, S., S.C. Michael, and C.-K. Min. Firm characteristics and investments in information technology: Scale and scope effects. *Information Systems Research* 1998; 9: 219-232

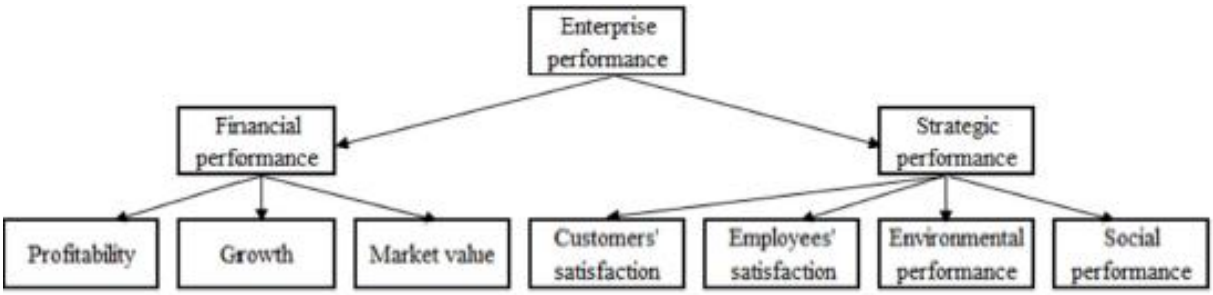
2.5 Direct and indirect effects of ICT in SMEs performance

Increasing importance is given to performance, one of the most important ICT impact groups. [79]Suggested that the ICT effects can be organized and analysed through indicators such as efficiency and competitiveness, intangible and innovative businesses and efficiency.

Undoubtedly, ICTs have a strong economic and social impact, and could be characterized by high productivity and economic progress[80], [81] and [82] identified that organization performance has two types:

- Strategic performance
- Financial performance

These two types could be represented by competitive aspects such as social performance, environmental performance, employee's satisfaction, customer satisfaction, market value, growth and profitability. (Scheme 2.3.1)



Scheme 2.3.1 shows a more detailed and structured analysis of enterprise's performance. [83] and [84] identified financial performance's dimensions. [85] Identified market value, growth and profitability, whereas [86] identified effectiveness and

79 Consoli, D. (2012)
80 Matei, A., & Savulescu, C. (2012)
81 Liang, You and Liu (2010)
82 Santos and Brito (2012)
83 Consoli, D. (2012)
84 Santos and Brito (2012)
85 Santos and Brito (2012)
86 Consoli, D. (2012)

efficiency. In the indirect effects, there is the main difference: [87] propose concrete dimensions such as social and environmental performance, whereas [88] propose only conceptual idea.

Dimensions	Indicators
Profitability	Return on Assets, Return on investment, Net income/Revenues, Return on equity, Economic value added
Growth	Earnings per share, Stock price improvement, Dividend yield, Stock price volatility, Market value added (market value / equity),
Market value	Market-share growth, Asset growth, Net revenue growth, Net income growth, Number of employees growth
Employees satisfaction	Turn-over, Investments in employees development and training, Wages and rewards policies, Career plans, Organizational climate, General employees' satisfaction
Customers' satisfaction	Mix of products and services, Number of complaints, Repurchase rate, New customer retention, General customers' satisfaction, Number of new products/services launched
Environmental performance	Number of projects to improve / recover the environment, Level of pollutants emission, Use of recyclable materials, Recycling level and reuse of residuals, Number of environmental lawsuits
Social performance	Employment of minorities, Number of social and cultural projects, Number of lawsuits filed by employees, customers and regulatory agencies

Table 2.3 proposed a similar approach than[89]. Given the results shown by the last mentioned authors, it is possible to confirm the positive effect that ICTs have on the organization's efficiency in terms of participation and market value, profitability and productivity. Besides, these studies confirms some effects in terms of intermediate performance measures such as customer satisfaction, flexibility, cost saving, service quality and process efficiency. All strategic performance's dimensions are indirectly affected by ICTs.

Although is common to use profitability measures in order to explain the organization performance indicators, is an inadequate decision because it can cause a misleading information. [90] Affirms that "recent researches define competitive advantage as the ability to create more economic value than the marginal competitor in its product market". According to[91], Global Competitiveness Reports of World Economic Forum are composed for 12 key factors of competitiveness, related to ICT's impact in financial and strategic dimensions of performance.

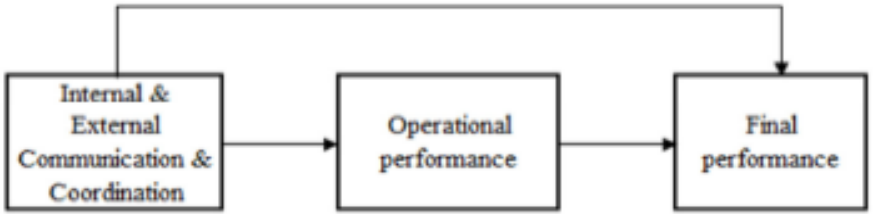
87 Santos and Brito (2012)
88 Consoli, D. (2012)
89 Alam and Noor (2009)
90 Santos and Brito (2012)
91 Matei, A., & Savulescu, C. (2012)

- Innovation
- Market size
- Financial market development
- Goods market efficiency
- Health and primary education
- Infrastructure
- Business sophistication
- Technological readiness
- Labour market efficiency
- Higher education and training
- Macroeconomic environment
- Institutions

[92] States that all 12 elements are powerfully interrelated and tend to reinforce each other, but a weakness in one area will have a negative impact in the rest of areas. [93] Indicates that is important to align ICT investments with the organizational processes and internal capabilities. Therefore, strategic performance's dimensions not only include indicators that measure changes in economic activities of the company, but also satisfaction or improvements made.

Studies have shown that effects of ICT performance vary according to the degree of adoption and the type of technology being used[94]; [95]. Besides, [96]investigated coordination on operational and final performances and effects of internal and external communications. (Scheme 2.3.2)

[92] Matei, A., & Savulescu, C. (2012)
[93] Consoli, D. (2012)
[94] Liang, You and Liu (2010)
[95] Bayo-Moriones, A., Billon, M., & Lera-Lopez, F. (2013)
[96] Bayo-Moriones, A., Billon, M., & Lera-Lopez, F. (2013)



According to[97], ICT's number has a significant impact on communication improvement. Improvement in communication induced by ICT adoption leads to a better operative performance. Therefore, operational performance and communication improvement are associated with a better final performance.

To sum up, it is important to highlight the importance of direct and indirect effects on ICTs depending on the twelve elements of competitiveness. SMEs performance and its dimension are closely related to other groups of main ICT's effects on private sector. To succeed in competitive markets, all performance dimensions have to be equally important.

2.6 SMEs Internationalization: ICT as facilitator

Participation of SMEs in export activities and the capabilities of ICT has been investigated by several teams and the results show a positive and significant relationship between them, although it is not always the same, since it depends on the level of each country on ICT capacities.

The decision to export is not the same in the developed countries as in the non-developed ones. In those where there is less development, a basic capacity such as online presence marks the decision. Besides, several studies show that export intensity is due more to the advanced capabilities of ICT than to the simple idea of exporting.

New and always useful marketing channels, their consequent sales, and the reduction of costs, are key points for SMEs.

97 Bayo-Moriones, A., Billon, M., & Lera-Lopez, F. (2013)

Each company marks the adoption of the distribution channels in SMEs. It varies depending on the resources available in each company. It is not the same if the first option is technology or the intensity of production.

Besides, it should be studied how ICT should be related to SMEs beyond the capital of information and communication technologies, since the studies that exist so far are mostly contradictory and scarce. The most recent studies are beginning to show a relationship with the use of electronic commerce or broadband applications.

The good use of online technology marks the results obtained in studies export sales.

In other reports, you can see that both the electronic businesses and the websites have a high relation to the export efficiency of these. It is emphasized that the use of the internet improves the export efficiency although not directly, and that the decision of a company to export or not depends significantly on the use of the company.

In addition, also in these reports you can see how an SME that uses ICT has a greater export performance and faster and greater growth.

In conclusion, an organization that has developed more technology than other organization, is going to have a stronger process of internationalization[98].

2.7 The mediating effect of business development

In order to explain which particular purpose ICTs have in business relationships and how they affect business performance and development, we must stop for a moment and analyse the possible effects of ICT in these two fields.

Studies show that the effects of ICT on the performance of a firm is mediated by a broad business development grouped in concepts such as product development or the business creation process. To be an effective company, it must first be assigned a specific purpose so that, once it is integrated into the production process, it performs the work correctly. Research also indicates that firms should be invested more to know the

[98] Hagsten, E. & Kotnik, P, (2016)

relationship between the performance that occurs within a company with a commercial relationship and the presence of ICT.

Thinking about the benefits that companies could obtain if a company reached 100% of ICT integration, we would talk about a company more competitive, generating new and better products, with the consequent improvement of company's health and the creation of more jobs[99].

2.7.1- Alignment between ICT and business strategy at the process level

One of the critical points that continues confronting Chief Information Officers (CIOs) is alignment. Although last years there have been notable advances in this area by ICT researchers, trying to understand how it works and what form this alignment has, it continues causing headaches to researchers[100].

It is usually easy to find the challenges associated with maintaining and achieving alignment being an ICT professional. Despite this, researchers are still trying to find different ways to measure the alignment with a high degree of precision. While the measurement is usually difficult and prone to errors, the alignment, which is a function of both the commercial strategy and the ICT strategy, is usually much less complex. Despite this, researchers have been able to develop measures to develop measures that include profile deviation, product terms and concordance.

Depending on the point of focus that has been given to the measurement, this will have been the results. Thus, if we draw a common conclusion, is that almost all can take an assumption that fits the ICT support in business strategies. Companies could appreciate ICT as a help tool. Managers saw ICT as tactical terms, and not as strategic, since it was subordinated to the business strategy.

Within this day and age, reality is different. Since managers generally accept that there is a strategic potential by introducing ICTs in their production processes. Their alignment measures cannot differentiate between ICT as a strategic enabler and ICT as a support

99 Cecilia Lindh, Emilia Rovira Nordman, (2017)
100 Kappelman et al., 2014

tool. One of the most common ways of measuring alignment, the use of profile alignment, is significant in this sense because when using square or Euclidean distances between ideal and real ICT, it treats as a misalignment all deviations. Thus, a deviation such as the ICT deficit can be a misalignment in the case of real use of ICT less than what an organization would need to support the commercial strategy that is finished or will be finished.

To support a business, organizations use the actual use of ICT. There are people who question whether these cases are too much for what organizations would need. Sometimes people argue that this is not a misalignment. When an organization has enough resources to cover the company's back, it means that there is ICT inactivity. Depending on the level you see, you can consider the ICT gap as a change in business strategy with ICT requirements, or as a waste.

It is simple but essential to change the way in which the deviation of the deficit profiles and lack of ICT is measured to trigger a confrontation on how ICTs can better be used by institutions.

In a more sophisticated study, it was found that the ICT value has a negative relationship with the ICT deficit, while the ICT business value has a positive relationship with the ICT gap. In the critical processes, the effects of ICT slack were greater, although in absolute terms they seemed to have less ICT slack. Therefore, ICT executives could see the alignment as a portfolio of securities they need to manage and change according to the conditions of each moment.

A non-adjustment of the clearance of the alignment measures would cause that ICT clearance to be incorrectly measured. Although it is unusual that there are situations in which the ideal use of ICT is exceeded by real use, researchers believe that it is time to analyse more deeply how to calculate the alignment, because if the alignment is measured correctly, changes could be significant[101].

[101] McLaren et al., 2011

Alignment is more than a simple ICT deficit, and lack of ICT do that companies have in mind to adjust business strategy with an ICT strategy to improve their profits. This will convince researchers that the time has come to think carefully about their alignment measures. Achieving a reduction in the gap between business strategy and ICTs would generate a debate about it.

[102]Also talks about the alignment between ICT and business process. It explains this alignment based on an emergent stream of research that considers business strategy and ICT at process level.

Because research often sees this alignment form through the lens of ICT support for business strategy, it does not take into account that new business strategies can be developed with ICT.

Consequently, it conceptualizes alignment between business strategy and ICT at process level using the lens of ICT shortfall (a support shortage for business activities) and ICT slack (too much ICT than needed to support business activities at the time).

317 EE.UU organizations have been studied and the results show that ICT shortfall is negatively correlated with ICT business value, whereas ICT slack is positively correlated with ICT business value.

Besides, it notes that ICT shortfall existence and ICT slack depends on organizations differences in business strategies and whether a process is critical or non-critical to reach that strategy's success.

2.7.2- ICT role in Collaborative Product Development (CPD)

Within this day and age, SMEs innovation is an important need for being present in the industrial business environment[103]. Success of manufacturing organizations has to do with their ability introducing new or developed items of high quality to the market speedily at relatively low costs. It is a risk for most organizations to introduce or develop a new product to the market. Many organizations do not individually have all necessary

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102 Paul Tallon, Magno Queiroz, Tim Coltman, Rajeev Sharma, (2016)

103 Chathurani Silva, Sanjay Mathrani, and Nihal Jayamaha, (2014)

resources and capabilities to develop new products with specific features and, therefore, collaborative product development is a useful solution.

CPD is an organizational strategy that is used to develop improved or new products through integration with two internal partners (for example, multifunctional teams) or with two external components (for example, customers and suppliers). Decisions to review new products development (NPD) projects made by development teams are more effective than the decisions made individually. Collaborations help to reduce or share risks related to NPD projects, in addition to develop new products at reduced time and cost. Collaboration time between companies is variable, being possible their collaboration throughout different stages (marketing, development and conceptualization) of the process of product development (PD).

Manufacturing organizations are increasingly investing collaborative product development (CPD) as a strategy to achieve an advantage with regard to rest of organizations through joint synergies in new products introduction in the market. Is evidenced recently a substantial increase in ICT use in CPD, consequently of the enhanced collaboration effectiveness and the extended spans between collaborative partners.

2.8 Customized products. Business networks

Within this day and age, SMEs are obliged to collaborate with each other in order to take advantage of the opportunities that the market offers them. Organizations must collaborate in business by stablishing non-hierarchical and dynamic business networks.

In order to develop the previous designed products successfully, it must be paid attention to both the simultaneous work and the exchange of information between organizations in real time. To transmit information in real time correctly, the e-mail and

the telephone are not enough. Web-based technologies (ICT) must be used to guarantee information exchange in real time between SMEs and thus, to achieve a correct manufacturing and development of manufactured products.

Using ICT like virtual organizations (VO), organizations could improve their products collectively, as well as the delivery of personalized products. With this, organizations also improve the potential for innovation and the collaboration is encouraged. Besides, the delivery time and the cost are reduced as well.

2.9 Drives, outcomes, risks and barriers of ICT adoption

It is always important for SMEs to know the way in which ICTs are adopted for the correct fusion with them. Organizations should review the results obtained after merging with each other.

To understand why the inclusion of ICT translates into an increase in competitiveness for an SME, three theories explained together will help us to understand it. These theories are diffusion of innovation theory, technology organization environment and institutional theory.

Benefits such as the reduction of information process and internal costs, or the greater facility that a manager has to control their employees are the most significant benefits.

Having said that, we can make a list of the nine best E-business drivers:

- Reduction of operating costs.
- Reduction of sales and purchase costs.
- Increase the quality and range of services to customers.
- Improve the speed of shipments.
- Increase the number of providers.
- Get ahead and avoid the loss of market share.
- Improve market share.
- Possess market intelligence.
- Improve the relationships between clients and partners.

With ICT's use in marketing area, organizations manage to maximize the investment made with the consequent improvement in production effectiveness, marketing effectiveness and financial effectiveness. Once ICTs have been introduced, the improvement in customer satisfaction will have a positive effect on improving business efficiency.

According to the number of clients, SMEs carries out an inversion in IS (information systems) to achieve the strategy compliance and the market position.

Thus, we can distinguish four competitive markets to make investments in information systems:

- Coordination (looking for maintaining relationships with the oldest customers.
- Efficiency (ISs are used to control business).
- Innovation (getting the IS at the centre of the business strategy).
- Collaboration (exchange of information with communication and customers).

Business opportunities and the assessment of internal capacity are the two aspects that business evaluation process is based. The knowledge/skills of ICT, the business model or the availability of resources to be used never give problems to adapt. However, relationship with customers, support and advise or broadband fast access are very important aspects when organizations configuring the perceptions of an organization by comparing the value of ICT with them.

Organizations want to introduce ICT to change owner's mentality about ICT values, to improve the possibility of reaching offline goals or to know the results about corporate sustainability. Taking care about last points, organizations can see if ICT's adoption have changed SMEs processes.

In order to have a positive impact on ICT's efficiency, and in particular in the e-business, organizations must first do a correct MO (market orientation).

Investments in interorganizational technology usually support market orientation capabilities. In smaller companies, if organizations see their business improved by investing in capacity to improve their results, they also will suffers a positive impact.

Interest in adopting technologies could increase due to the location of organizations in a dynamic environment. According to Internet, organizations could be classified according to their collaborative approach such as:

- Exchange innovative ideas from several sources (partners, customers and suppliers).
- Have speed to meet the needs of the client and greater flexibility.
- Have easy access to all information about customers and competitors at the same time.

Internet is very important to collect information related to environmental changes and once the information is available, share it and find responses to satisfy the needs that market offers. The responses always are supported by marketing orientation behaviours. Internet informs about the possibilities that exist to change marketing functions, such as automatization of sales force, disintermediation, CRM or massive personalization.

Slow adoption of E-commerce in UK is explained by the risk that organizations perceive when they implement it, taken both psychometric and technological risks. The risk is subjective, since is affected by cultural, demographic or social factors.

Risks that organizations think could exist investing in ICT mark investment decisions in ICT. Usually, small organizations do not have available complex tools for analyze investment decisions, and high charges of small organizations often have less perception of risk than high charges of high organizations because small organizations usually do not work with E-commerce.

[104]States that risk can be categorized in these eight sections:

[104] Sukumar and Edgar's (2009)

- Cultural, personal and leadership risks.
- Dependency and outsourcing risks.
- Tax and legal risks.
- Threats to security (internal or external).
- Risks at the strategy level.
- Brand risks
- Risks of customer expectations and reputation.
- Increase in technological risks.

Implementing ICT sometimes has problems of cyber security. The three most important risk of cybersecurity are those related to virus, denial of service attacks and card fraud. Other risk categorized less important are those related to legal risks, employees-related risks and those related to compliance.

Apart from risk, there are also barriers to e-business adoption. We can detect four barriers of SMEs e-business:

- Cost (i.e. the need for immediate return on investment, limited financial resources and implementation costs)
- Security (i.e. concern on fear of fraud and confidentiality)
- Management (i.e. insufficient experience of industry sector, insufficient time spend on planning or insufficient knowledge)
- Technology (i.e. lack of trust in external industry sector suppliers, complexity requiring new skills, limited in house industry sector skills and existing industry sector limiting future development)

E-commerce sometimes has failures. Many of these failures are caused for oversights at the time of taking into account different within the online sphere to a "traditional" business model, necessary for having operative and strategic success. Organizational readiness, firm size (which positively influences technological capabilities and negatively influences perception costs), barriers, risk perception (which is higher for SMEs), or knowledge deficits should be always controlled.

To sum up, ICT adoption makes organizations more competitive and increase their efficiency, particularly in marketing area. To invest in ICTs not only play an important role in innovation aspect, also in collaboration aspect. Coordination and performance are less important in ICT's inversion.

2.9.1 Adoption of ICTs using the concept of Digital Divide

There are many studies about ICT adoption. Nevertheless, only a few of them study ICTs adoption using the second order of the digital divide concept, related to the effective use of ICTs by organizations.

The first index studies ICTs use. This study shows that technology and Internet access are related factors with a more intense use of ICTs by organization.

It is not the same Internet access for a small organization than for a big organization despite of some surveys reveal the contrary. The results show that aspects like the availability of network technology (intranet, extranet or LAN), the speed of access or the type of connection (fiber, cable or 3G) are related to ICTs use. This prove that public policies that deal with quality technology access remain important.

Once an organization start to use internal and external systems to be connected with their customers and suppliers, speed connection and availability become more important.

Thus, 3G and 4G conexions point to this greater dependence. The issue of digital divide as a matter of ICT's access remains, but now also the quality access (stability and connexion speed) necessary to systems integration, customer’s chain and companies suppliers.

Problems related to ICT abilities measured by "the employee’s percentage who use Internet" and "operative system use of open source" or the attitude related to ICT measured in this research through "update or introduction software" are related to ICT use for both organization sizes. This means that ICT investment on learning and training (e-literacy) and innovation attitude through new system introduction are related to an intense use of ICTs.

Both small and big organizations had these variables with the highest values for the standardized Beta coefficient. This prove the high importance of organizational aspect in computerization of companies processes, related to the managerial concern with ICTs use, with the professional and owners' training in the company for its proper use and reflected in software updates.

Related to the alignment between company strategies and ICT investments, professionals dedicated to ICTs or the relevance of an area increase as the organization rise and they need to expand ICTs use.

Also, external factors are correlated with the index. Those that were considered subcontract ICT services had an increase in the index in small organizations. Also in small organizations, the study remarks the inputs purchase through the Internet, which may show that the integration with customers or larger suppliers in the value chain can boost ICT adoption.

Finally, these results also indicate that external environment factors can also influence the ICT use by organizations. This prove the relation between organization's sector and the use in both sizes, small and big companies[105].

2.10 The bond between broadband connected employees and labour productivity

Within this day and age, association between labour productivity and ICT intensity play an important role. Looking at some studies that were made in fourteen European countries between 2001-2010, we can say that results show that the proportion of broadband internet-enabled employees approximates ICT intensity. This value not only measure ICT adoption, but also diffusion among and within organizations. Data have been acquired by means of the distributed microdata approach (DMD) from registers on education, trade and business.

105 Cesar Alexandre Souza, Érica Souza Siqueira, Nicolau Reinhard, (2017)

This approach allows access to confidential information related to other organizations in dimensions very different from previously. The estimations are based on 400,000 observations of representative and harmonised datasets. Data show that in most of the countries exist a positive and significant relationship between labour productivity and the proportion of broadband internet-enabled employees in organizations[106].

This is also justified in[107], that affirms that manufacturers in eight out of fourteen and service firms in ten out of fourteen show an important relationship between labour productivity and broadband employees. Estimations show an increase in the proportion of broadband internet-enabled employees. This confirm the productivity effect. Table 2.5.1 show a ranking of the countries related to the same use intensity of ICT. Typically, countries where firms are already intensive ICT users, the increases in productivity is less remarkable. The deeper shades that are showed in the index column show larger estimations.

Table 2.10.1. Intensity and impact of broadband internet-enabled workers in enterprises

	Services 50t74		Manufacturing 15t37		
Country	Impact	Intensity	Impact	Intensity	Index
DE	0.222	8	*0.258*	6	1
PL	0.218	13	0.507	14	2
UK	0.154	6	0.225	4	3
IE	0.099	10	0.352	9	4
IT	0.092	12	0.113	12	5
LU	0.081	5	0.181	7	6
AT	0.073	11	*0.016*	10	7
FI	0.055	1	*-0.026*	3	8
NL	0.052	3	0.071	5	9
FR	0.044	9	0.056	8	10
SI	*0.026*	7	-0.146	11	11
DK	*-0.002*	13	*-0.012*	13	12
NO	*-0.002*	2	*-0.009*	2	13
SE	*-0.005*	4	*0.004*	1	14

Note: Two aspects are compared in this table. The first column show a classification of countries with broadband internet-enabled workers in the organizations during 2010.

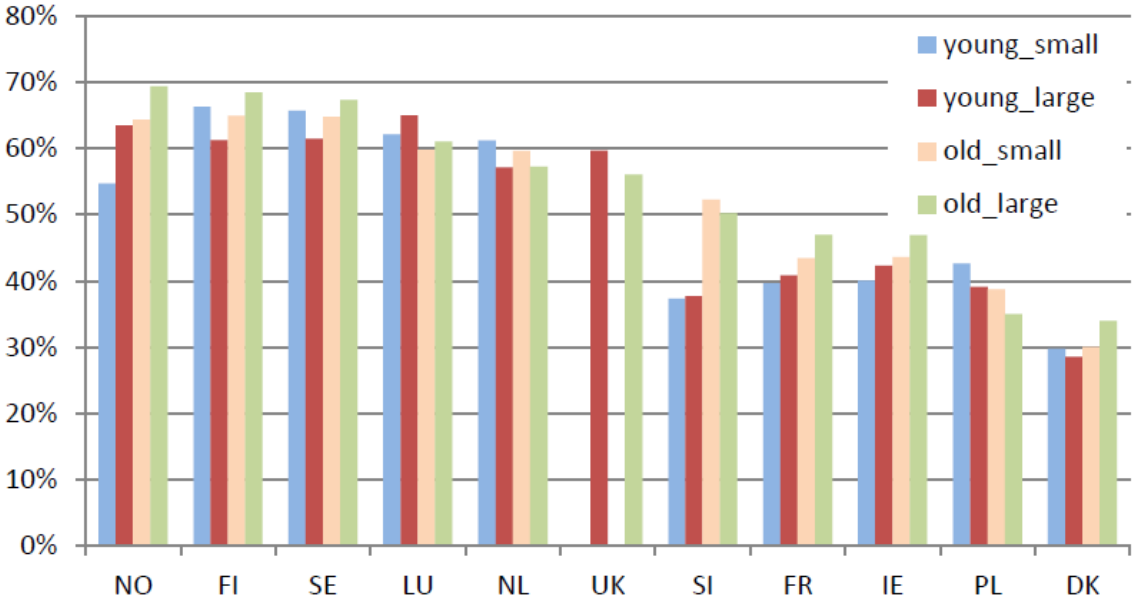
106 Eva Hagsten (2015)

107 Eva Hagsten, Michael Polder, Eric J Bartelsman, Patricia Kotnik, (2013)

The second column shows the impact of it. It represents the labour productivity consequence from a unit's growth of the identical variable form on combined organization-stage regression from 2001 to 2010. Cells with less than five per cent are represented by shaded estimates and cells without colour do not represent estimate.

In the figure 2.5.1 and figure 2.5.2 are represented data in dimensions previously not explored. This is possible thanks to large-scale microdata linking. In these two figures, the two measures of ICT intensity, BROADpct and ICTi, are represented by firm age and size. BROADpct is measured as the broadband internet-enabled employees proportion in firms and ICTi is an indicator derived from the estimated propensities of several ICT adoptions such us information sharing between mobile internet access and business functions, automated data exchange or e-commerce.

Figure 2.10.1. Broadband internet-enabled workers by age and size in 2010

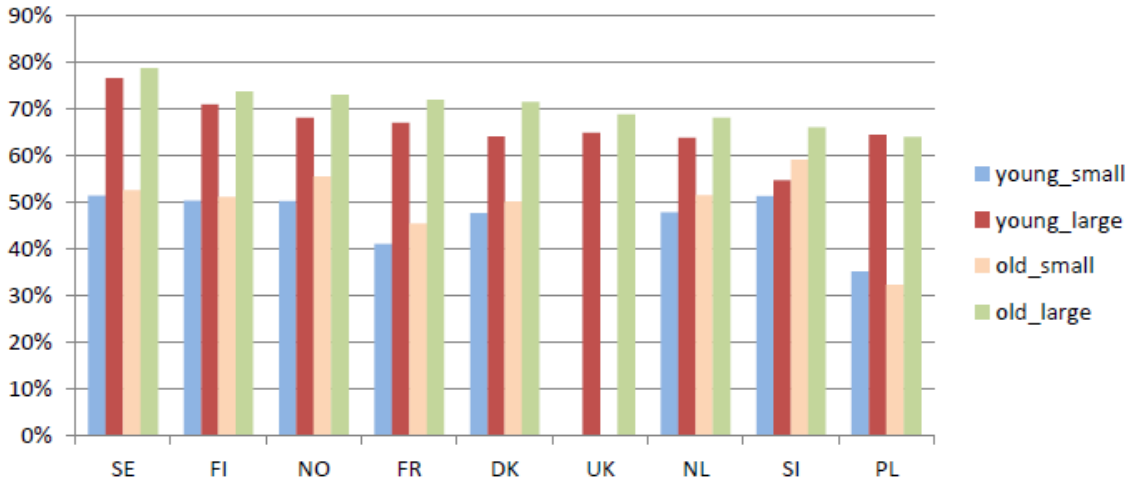


Note: Young is an organization with five years or less. Old is an organization with more than five years.

Comparing these data, we can see that employee internet access varies only across age and size in most of the countries. Besides, large and old organizations have a higher intensity than small and young organizations. However, data show the major and well-known disparity across European countries in ICT adoption.

The figure 2.5.2 investigate the composite ICTi indicator. Here the pattern changes and show that now the difference between countries are less visible than figure 2.5.1. Larger and old organizations are more ICT intensive and in this context, size of the organization is more important than age. The best example is Poland. In conclusion, differences in organization characteristics are represented by ICTi variable, whereas the usage of a general infrastructure at the national level are represented by BROADpct variable.

Figure 2.10.2. ICT-intensity in enterprises (ICTi) by age and size in 2010



Note: Young is an organization with five years or less. Old is an organization with more than five years.

In the figure 2.5.2, relationship analysis between ICT intensity (BROADpct from Figure 2.5.1) and organization performance is expanded by the ICTi variable. In general, this variable keeps following the same pattern as the employee internet access, where in some cases the too much use of ICT do not let to be benefited anymore for ICT. In addition, the ICTi receives higher estimates. Another interpretation that could be done is that a lower impact threshold for ICT intensity could benefit organizations.

Need to be taken into account the different time spans available for the two variables. Besides, the construction of the measures investigated when these results are interpreted need to be taken into account as well.

Table 2.10.2. Impact of alternative ICT intensities

	ICTi 2007-10		BROADpct 2001-10	
Country	50t74	15t37	50t74	15t37
UK	1.283	2.238	0.154	0.225
DE	1.027	*1.407*	0.222	*0.258*
PL	0.541	0.787	0.218	0.507
LU	0.379	*0.503*	0.081	0.181
AT	0.317	*-0.232*	0.073	0.016
FI	0.268	-0.293	0.055	*-0.026*
NL	*0.228*	*0.215*	0.052	0.071
SE	0.099	*0.179*	*-0.005*	*0.004*
FR	*0.089*	0.192	0.044	0.056
DK	*-0.041*	*-0.122*	*-0.002*	*-0.012*
NO	-0.191	*-0.086*	*-0.002*	*-0.009*
SI	*-0.280*	-0.743	*0.026*	-0.146
Mean	0.518	0.436	0.112	0.064
Min	-0.191	-0.743	0.044	-0.146
Max	1.283	2.238	0.222	0.225

Note: In table 2.5.2 is represented the estimated impact on labour productivity caused for an increase of ICT intensity. Shades estimates represent at the five percent at least. Deeper colours represent larger estimations and cells without colours represent not important estimate. 50t74 and 15t37 denote service enterprises and service manufacturers.

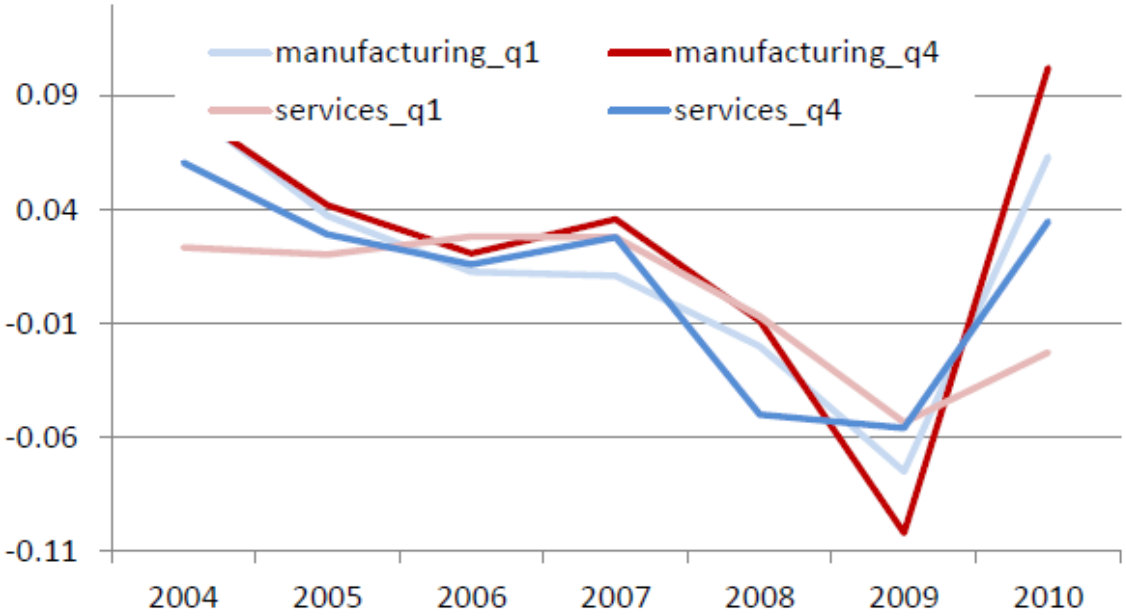
ICT impact can also be estimated using the country-industry-time panel of the MMD. It uses a specification where value added per worker, industry, country and year are included.

It observes that broadband percentage employees remains related to value added per worker.

Besides, study the organizations performance during financial crisis is important. We can analyse these data within the ESSLait project, in the length of the available panels. In figure 2.5.3, the labour productivity growth is illustrated for the organizations for the highest and lowest quartiles of ICT intensity. In the deepest period of the downturn (2008-2009) was when manufacturers were more strongly hit.

Nevertheless, ICT intensive organizations seemed to pick up again after the downturn where organizations had less intensive ICT, particularly in manufacturing field. Organizations with less ICT use had more problems to recover after the downturn.

Figure 2.10.3. Labour productivity raise by industry and ICT intensity of firms



Weighted averages is represented by the quartile distribution in 12 countries of the lagged BROADpct variable. Quartile 1 shows enterprises with lower ICT usage.

The causality is not completely clear but ICT intensive organizations are more volatile. It appears two situations: or organizations, which are in a more volatile environment, invest in ICT in order to reduce cost, or organizations willing to take risks investing in ICT advanced systems. We have studied how the employment and productivity growth and volatility of the organization output vary with ICT usage by the use of "long-panels" of organization-level production statistics from 1995 to 2010. Then we analyse temporary series and cross-sectional distribution of output and employment growth for this two types of organizations.

Table 2.10.3. Output and productivity raise dispersion by ICT intensity

	Time series				Cross section			
	Productivity growth		Output growth		Productivity growth		Output growth	
Country	ICT=0	ICT=1	ICT=0	ICT=1	ALL	ICT=1	ALL	ICT=1
DK	0.19	0.21	0.24	0.26	0.23	0.24	0.29	0.32
FI	0.19	0.28	0.21	0.31	0.25	0.27	0.3	0.33
FR	0.2	0.18	0.22	0.18	0.21	0.18	0.21	0.19
NL	0.13	0.14	0.11	0.13	0.22	0.24	0.2	0.21
NO	0.18	0.26	0.21	0.29	0.32	0.35	0.33	0.35
SE	0.2	0.26	0.32	0.38	0.33	0.37	0.49	0.52

Note: In table 2.5.3 is shown a study about productivity and output growth dispersion by ICT intensity. The first column shows the output and productivity growth of temporary series, whereas the second column shows the output and productive growth of cross section. The organization stage measures the standard deviation for a five years moving window. Each column is ICT=0 or ICT=1, which represent if and organization is ICT non-intensive or ICT intensive.

In table 2.5.3 we can see that intensive organizations with ICT=1 have higher dispersion measures, except France. The first two columns represent the average standard deviation of the organization-level temporary series of labour productivity. It uses a five years moving window. The organization-level dispersion is averaged into an industry series, using organization-size weights. To finish, the industry dispersion from 2003 to 2007 is averaged.

Columns with ICT=0 show data from organizations which are non-intensive in ICT. Both for productivity and output growth, organizations that have intensive ICT have larger dispersion. Besides, we have dispersion measures from the organization-level cross sectional distribution, both for output and productivity growth.

Observations are weighted by organization size when dispersion is calculated. In this exercise, ESSLait only collected information to the organizations with higher ICT use. In all countries, except France, ICT intensive organizations have a higher standard deviation of the cross-sectional distribution of organization level productivity and output growth.

[108]Also remarks that whereas organizations which have more production level, have more likely to have DSL broadband connection, broadband adoption don not associate with higher organization productivity or with the productivity growth of the organization. This case is not only when all types of broadband connections are joined, but also when it is investigated the higher speed DSL broadband adoption effects (higher than 2MBs) or other types such as frame relay, fibre optic cable or leased line.

In this article, when the sample is split into more homogenous groups of organizations by ownership, region, internet usage or size, we do not find any significant effect of broadband adoption on organizations productivity.

Their results coincide with[109], who found no kind of relation between organization productivity increase and broadband adoption increase, contrary with[110]. There are little of empirical support of the econometric studies at organization level about the fact that an accelerated adoption of high-speed broadband would benefit industrial productivity, as [111] says.

The availability of panel data about both local supply of DSL broadband services and organizations productivity allowed us to control the unobserved heterogeneity and address concerns about endogeneity. This is particularly important since they found evidence of reverse causation in organizations broadband adoption.

Service sector is an obvious extension to this strand of research. This sector could experiment big gains adopting broadband. Even more than manufacturing organizations. To date, service organizations have received less attention due to less data availability and greater difficulty of measuring and defining the services productivity.

Coming back to the article[112], services organizations have more widespread the association than manufacturing organizations. Services organizations have an average

108 Stefanie A. Haller and Sean Lyons, (2012)
109 Van Leeuwen and Farooqui (2008)
110 Grimes et al. (2012)
111 Kenny and Kenny, 2011
112 Eva Hagsten (2016):

significant estimate of 0.107 while manufacturing organizations have an average significant estimate of 0.149. Organizations of countries that are already intensive in employee connectivity mark a positive temporary tendency because they exhibit to a lesser extent a link to labour productivity.

The specific characteristics of the broadband variable and the time play an important role. The quantitative variable proportion of broadband internet-enabled employees has an advantage comparing with not only indicate adoption but also the dissemination across and within organizations. Besides, the variable does not reach saturation in all the period studied.

There are indications in a smaller group of countries that have a high level of employee's connectivity that embedded ICT are important for productivity. These variations in estimates magnitude between countries are not surprising and could be related to the industry structure, labour market rigidities or broadband connectivity general degree.

Data have been acquired by means of DMD from surveys on ICT usage, innovation activities and production as well as registers on education, trade and business. Although this approach still needs some fine-tuning, this work allows access to confidential information linked firm level and micro aggregated (MMD) in dimensions never available before.

Analyses depend on IT system, local operator and dataset for being more o less advanced. Besides, the number of times that data providers accept to re-run analytical codes could be restricted.

Unfortunately, difficult problems are not automatically solved by distributed access. Among these problems, we can find designs of sample surveys at statistical offices. In most of the times, these surveys produce accurate macro statistics without imposing responses too much high for organizations. This leads to small surveys overlaps.

The latter is difficult to deal with in impact analysis since are needed sophisticated econometric methods to handle endogeneity and to provide precise estimates. The

results should be interpreted as associations instead of causal effects due to methods used.

Panel data model use could be benefited if it existed an increased coordination of sample surveys. Besides, another useful thing that it could do is to move the analysis to a micro-aggregated level where panels without attrition are available. Depth analysis of how different ICT tools in organizations substitute or complement each other or other production factors could benefit future studies.

Results show two policy implication types. On the one hand, the adoption and dissemination of broadband among employees is very important for growth, particularly when saturation is not reached. If it already exist a high intensity level of broadband connectivity, efforts could be redundant.

On the other hand, the results show that data compilation strategies aimed to reduce the response burden of organizations, often very demanded by policy-makers, sometimes lead to serious difficulties in the search of impacts and drivers in the economy.

However, relationship strength varies across organizations and countries. Service organizations receive 50% smaller estimates than manufacturing organizations, and services organizations experience with more frequency the positive association.

Chapter 3 Conclusions

Close to 2020, ICTs adoption has converted as one of the most important things that organizations need to implement to keep growing. In general, firms that adopt and use ICTs grow faster, invest more, and are more productive and profitable than those that do not. These are the conclusion that most of the organizations have had previous their multiplex studies about it.

Besides, organizations that implement ICTs in their production processes are going to increase their possibilities of internationalization, increasing their export sales and expanding their brand, which is very important within this day and age.

The use of ICT at various stages, on one hand, simplify business processes and transactions while, on the other hand, it improves information and knowledge management for better decision making.

With all this, the change of technology in an organization or in a place always is a great challenge, since it generates in the human resource something very well-known called resistance to the chance; this is a fear caused towards what is considered as unknown or new within the usual process handled. We must therefore these changes of manufacturing processes not as such, but as a progress that will allow us to face and face the new and different challenges in this globalized environment.

References:

- Hagsten, E. & Kotnik, P, (2016), "ICT as facilitator of internationalisation in small and medium sized firms", Small Bus Econ (2017) 48: 431. https://doi.org/10.1007/s11187-016-9781-2
- Cecilia Lindh,Emilia Rovira Nordman, (2017) "Information technology and performance in industrial business relationships: the mediating effect of business development", Journal of Business &Industrial Marketing, Vol. 32 Issue: 7, pp.998-1008, https://doi.org/10.1108/JBIM-12-2016-0282

- Shamsuzzoha, A., Tosano, C., Carneiro, L., Kumar, V. and Helo, P. (2016) ICT-based solution approach for collaborative delivery of customised products. Production Planning&Control,27(4).pp.280-298.ISSN 0953-7287. http://dx.doi.org/10.1080/09537287.2015.1123322
- Sebastian Molinillo, Arnold Japutra, (2017) "Organizational adoption of digital information and technology: a theoretical review", The Bottom Line, Vol. 30 Issue: 01, pp.33-46, https://doi.org/10.1108/BL-01-2017-0002
- Cesar Alexandre Souza, Érica Souza Siqueira, Nicolau Reinhard, (2017) "DIGITAL DIVIDE OF SMALL AND MEDIUM-SIZED ENTERPRISES: AN ANALYSIS OF INFLUENCING FACTORS USING THE TOE THEORY", Mackenzie Management Review (Rev. de Adm. Mackenzie – RAM), *18*(2), 15-48 • SÃO PAULO, SP • MAR./APR. 2017 ISSN 1678-6971 (electronic version) • http://dx.doi.org/10.1590/1678-69712017/administracao.v18n2p15-48
- Shemi, AP and Procter, CT, (2018) "Ecommerce and entrepreneurship in SMEs : the case of myBot", Research output of the University of Salford http://dx.doi.org/10.1108/JSBED0320170088
- Eva Hagsten (2016): Broadband connected employees and labour productivity: a comparative analysis of 14 European countries based on distributed Microdata access, Economics of Innovation and New Technology, DOI: 10.1080/10438599.2015.1105547
- Eva Hagsten, Michael Polder, Eric J Bartelsman, Patricia Kotnik, (2013) "The Multifaceted Nature of ICT: Final report of the ESSNet on linking of microdata to analyse ICT impact", Eurostat Grant Agreement 50721.2013.001-2013.082, https://www.researchgate.net/publication/282859838
- Stefanie A. Haller and Sean Lyons, (2012) "Broadband adoption and firm productivity: evidence from Irish manufacturing firms", The Economic and Social Research Institute, Dublin https://mpra.ub.uni-muenchen.de/42626/
- Paul Taylor, (2015) "THE IMPORTANCE OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTS): AN INTEGRATION OF THE EXTANT LITERATURE ON ICT ADOPTION IN SMALL AND MEDIUM ENTERPRISES", University of the West Indies, Kingston, Jamaica Vol. III, Issue 5, May 2015 ISSN 2348 0386 *http://ijecm.co.uk/*
- Paul Tallon, Magno Queiroz, Tim Coltman, Rajeev Sharma, (2016) "Business Process and Information Technology Alignment: Construct Conceptualization, Empirical Illustration, and Directions for Future Research", journal of the Association for Information Systems · October 2016 DOI: 10.17705/1jais.00438
- Z. M. Bi, Chengen Wang, (2014) "Internet of Things for Enterprise Systems of Modern Manufacturing", IEEE Transactions on Industrial Informatics · May 2014 DOI: 10.1109/TII.2014.2300338
- Chathurani Silva, Sanjay Mathrani, and Nihal Jayamaha, (2014) "The Role of ICT in Collaborative Product Development: A Conceptual Model Based on Information Processing Theory", *International Journal of Innovation, Management and Technology, Vol. 5, No. 1, February 2014* DOI: 10.7763/IJIMT.2014.V5.484

- Asta Tarutė,*, Rimantas Gatautis, (2013), (2013) “ICT impact on SMEs performance”, Procedia - Social and .Behavioral.Sciences..110.(2014).1218–1225 https://www.sciencedirect.com/science/article/pii/S1877042813056085
- David M. Weber ⇑, Robert J. Kauffman, (2011), “What drives global ICT adoption? Analysis and research directions”, Electronic Commerce Research and Applications 10 (2011) 683–701 doi:10.1016/j.elerap.2011.01.001
- Silvia Fernandes, Ana Belo, Guilherme Castela, (2015), “Social network enterprise behaviors and patterns in SMEs: Lessons from a Portuguese local community centered around the tourism Industry”, Technology in Society 44 (2016) 15e22 http://dx.doi.org/10.1016/j.techsoc.2015.11.004
- Jones, Nory; Borgman, Richard; Ulusoy, Ebru, (2015), “Impact of social media on small businesses”, Journal of Small Business and Enterprise Development, Volume 22 (4): 22 – Nov 16, 2015 https://www.deepdyve.com/lp/emerald-publishing/impact-of-social-media-on-small-businesses-Mib2Q59QFs
- Dario Assante, Manuel Castro, Ileana Hamburg and Sergio Martin, (2016), “The Use of Cloud Computing in SMEs”, Procedia Computer Science 83 (2016) 1207 – 1212 doi: 10.1016/j.procs.2016.04.250
- Omar A. León, Juan I. Igartua, Jaione Ganzarain, (2016), “Relationship between the use of ICT and the degree and type of diversification”, Procedia Computer Science 100 (2016) 1191 – 1199 doi: 10.1016/j.procs.2016.09.138
- Irina Harris, Yingli Wang, Haiyang Wang, (2015, “ICT in multimodal transport and technological trends: Unleashing potential for the future”, Int. J.ProductionEconomics159(2015)88–103 http://dx.doi.org/10.1016/j.ijpe.2014.09.005
- V. Kanti Prasad, K. Ramamurthy and G. M. Naidu, (2001), “The Influence of Internet-Marketing Integration on Marketing Competencies and Export Performance”, Journal of International Marketing, Vol. 9, No. 4 (2001), pp. 82-110 https://www.jstor.org/stable/25048870
- Sukumar, A. and Edgar, D, (2009), “E-Business, SMEs and Risks: Towards a Research Agenda”, International Journal of Management Innovation Systems ISSN 1943-1384 2009, Vol. 1, No. 2: E4 www.macrothink.org/ijmis
- Roberta Bocconcelli, Marco Cioppi, Alessandro Pagano, (2017) "Social media as a resource in SMEs' sales process", Journal of Business & Industrial Marketing, Vol. 32 Issue: 5, doi: 10.1108/JBIM-11-2014-0244
- Subhanjan Sengupta Arunaditya Sahay , (2017)," Social entrepreneurship research in Asia-Pacific: perspectives and opportunities ", Social Enterprise Journal, Vol. 13 Iss 1 pp. - http://dx.doi.org/10.1108/SEJ-11-2016-0050
- Mohd Irwan Dahnil*, Kamarul Mizal Marzuki, Juliana Langgat, Noor Fzlinda Fabeil, (2014), “Factors Influencing SMEs Adoption of Social Media Marketing”, Procedia - Social and Behavioural Sciences 148 (2014) 119 – 126 doi: 10.1016/j.sbspro.2014.07.025
- Chrisanthi Avgerou & Boyi Li, (2013), “*Relational and institutional embeddedness*

of Web-enabled entrepreneurial networks: case studies of entrepreneurs in China", Info Systems J (2013) **23**, 329–350 doi:10.1111/isj.12012

- T. Ramayah ⇑, Niu Swee Ling, Seyedeh Khadijeh Taghizadeh, Syed Abidur Rahman, (2016), "Factors influencing SMEs website continuance intention in Malaysia", Telematics and Informatics 33 (2016) 150–164 http://dx.doi.org/10.1016/j.tele.2015.06.007
- Kabanda, S., Brown, I., (2017), "A Structuration Analysis of Small and Medium Enterprise (SME) Adoption of E-commerce: The Case of Tanzania", *Telematics and Informatics* (2017), doi: http://dx.doi.org/10.1016/j.tele.2017.01.002
- Louis-A. Lefebvre, Elisabeth Lefebvre, Elie Eliaa, Harold Boeck, (2005), "Exploring B-to-B e-commerce adoption trajectories in manufacturing SMEs", Technovation 25 (2005) 1443–1456 doi:10.1016/j.technovation.2005.06.011
- Adel.A.Alyoubi, Ph.D, (2015), "E-commerce in Developing Countries and How to Develop Them During the Introduction of Modern Systems", Procedia Computer Science 65 (2015) 479 – 483 doi: 10.1016/j.procs.2015.09.127
- Morteza Ghobakhloo, Daniel Arias-Aranda and Jose Benitez-Amado, (2011), "Adoption of e-commerce applications in SMEs", Industrial Management & Data Systems Vol. 111 No. 8, 2011 pp. 1238-1269 q Emerald Group Publishing Limited 0263-5577 DOI 10.1108/02635571111170785
- Morteza Ghobakhloo and Sai Hong Tang, (2013), "The role of owner/manager in adoption of electronic commerce in small businesses", Journal of Small Business and Enterprise Development Vol. 20 No. 4, 2013 pp. 754-787 *q* Emerald Group Publishing Limited 1462-6004 DOI 10.1108/JSBED-12-2011-0037
- F.Liébana-Cabanillasa, M.Alonso-Dos-Santos, (2017), "Factors that determine the adoption of Facebook commerce: The moderating effect of age", J. Eng.Technol.Manage.xxx(2016)xxx–xxx http://dx.doi.org/10.1016/j.jengtecman.2017.03.001
- Abdallah Alsaad, Rosli Mohamad, Noor Azizi Ismail, (2017), "The moderating role of trust in business to business electronic commerce (B2B EC) adoption", Computers in Human Behaviour 68 (2017) 157e169 http://dx.doi.org/10.1016/j.chb.2016.11.040
- Aarno Airaksinen, Andrea de Panizza, Eric Bartelsman, Eva Hagsten, George van Leeuwen, Mark Franklin, Mika Maliranta, Patricia Kotnik, Peter Stam, Petri Rouvinen, Shikeb Farooqui, Simon Quantin, Stefan Svanberg, Tony Clayton, Yoann Barbesol, (2008), "Information Society: ICT impact assessment by linking data from different sources", Eurostat Agreement No. 49102.2005.017-2006.128 https://ec.europa.eu/eurostat/documents/341889/725524/2006-2008-ICT-IMPACTS-FINAL-REPORT-V2.pdf/72f0967d-a164-46ad-a6d0-246be5a6d418
- Arthur Grimes • Cleo Ren • Philip Stevens, (2011), "The need for speed: impacts of internet connectivity on firm Productivity", J Prod Anal (2012) 37:187–201 DOI 10.1007/s11123-011-0237-z
- Robert Kenny Charles Kenny, (2011),"Superfast broadband: is it really worth a subsidy?", info, Vol. 13 Iss 4 pp. 3 – 29 http://dx.doi.org/10.1108/14636691111146127

- Fred D. Davis, (1989), "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology", MIS Quarterly, Vol. 13, No. 3 (Sep., 1989), pp. 319-340 https://www.jstor.org/stable/249008
- ICEK AJZEN, (1991), "The Theory of Planned Behaviour", ORGANIZATIONAL BEHAVIOR AND HUMAN DECISION PROCESSES 50, 179-211 (1991) https://www.sciencedirect.com/science/article/pii/074959789190020T
- Viswanath Venkatesh, Michael G. Morris, Gordon B. Davis and Fred D. Davis, (2003), "User Acceptance of Information Technology: Toward a Unified View", MIS Quarterly, Vol. 27, No. 3 (Sep., 2003), pp. 425-478 https://www.jstor.org/stable/30036540
- Shih-Chih Chen, Shing-Han Li, Chien-Yi Li, (2011), "RECENT RELATED RESEARCH IN TECHNOLOGY ACCEPTANCE MODEL: A LITERATURE REVIEW", Australian Journal of Business and Management Research.Vol.1No.9.[124-127]|December-2011 ://ajbmr.com/articlepdf/AJBMR_19_04i1n9a14.pdf
- EVERETT M. ROGERS, (1995), "DIFFUSION OF INNOVATIONS", THE FREE PRESS A Division of Simon & Schuster.Inc.1230.Avenue.of.the.Americas.New.York,.NY.10020 https://web.stanford.edu/class/symbsys205/Diffusion%20of%20Innovations.htm
- Tornatzky, L., & Fleischer, M., (1990), "The Processes of Technological Innovation", Chapter · January 1990 https://www.researchgate.net/publication/291824703
- *Morteza Ghobakhloo, Tang S.H, (2011), "*Barriers to Electronic Commerce Adoption Among Small Businesses in Iran", Journal of Electronic Commerce in Organizations, 9(4), 48-89, October-December 2011 DOI: 10.4018/jeco.2011100103
- LE Van Huy, Frantz ROWE, Duane TRUEX, Minh Q. HUYNH, (2012), "An empirical Study of Determinants of E-commerce Adoption in SMEs in Vietnam an economy in transition", *Journal of Global Information Management* (JGIM) v 20(3) July-Sep 2012 https://pdfs.semanticscholar.org/b530/fcc9a266d5cca9027bdb2882ce08fd96c22a.pdf
- Martins, F.O.M and Oliveira, T, (2008). "Determinants of Information Technology Diffusion: a Study at the Firm Level for Portugal." *The Electronic Journal Information Systems Evaluation* Volume 11 Issue 1, pp. 27 - 34, available online at www.ejise.com
- JAMES Y.L. THONG (1999), "An Integrated Model of Information Systems Adoption in Small Businesses", *Journal of Management Information Systems I* Spring 1999, Vol. 15, No.4. pp. 187~214 http://ssrn.com/abstract=1977980
- Chrisanthi Avgerou, (2008), "Information systems in developing countries: a critical research review", Journal of Information Technology (2008) 23, 133–146 doi:10.1057/palgrave.jit.2000136
- Morteza Ghobakhloo, Tang Sai Hong, Mohammad Sadegh Sabouri and Norzima Zulkifli, (2012), "Strategies for Successful Information Technology Adoption in Small and Medium-sized Enterprises", *Information* 2012, *3*, 36-67 doi:10.3390/info3010036
- Leon Kappelman, Ephraim McLean, Vess Johnson, Natalie Gerhart, (2014), "The 2014 SIM IT Key Issues and Trends Study", December 2014 (13:4) | MIS Quarterly Executive

https://www.researchgate.net/publication/269102386_The_2014_SIM_IT_key_issues_and_trends_study

- Tim S. McLaren, Milena M. Head, Yufei Yuan and Yolande E. Chan, (2011), "A Multilevel Model for Measuring Fit Between A Firm's Competitive Strategies and Information Systems Capabilities", MIS Quarterly, Vol. 35, No. 4 (December 2011), pp. 909-929 https://www.jstor.org/stable/41409966
- Vasja Vehovar Dušan Lesjak, (2007),"Characteristics and impacts of ICT investments: perceptions among managers", Industrial Management & Data Systems, Vol. 107 Iss 4 pp. 537 – 550 http://dx.doi.org/10.1108/02635570710740689
- Dolores Añón Higón, (2011), "The impact of ICT on innovation activities: Evidence for UK SMEs", International Small Business Journal 30(6) 684–699 DOI: 10.1177/0266242610374484
- Andrea Ollo-López ⇑, M. Elena Aramendía-Muneta, (2012), "ICT impact on competitiveness, innovation and environment", 0736-5853/$ - see front matter _ 2011 Elsevier Ltd. doi:10.1016/j.tele.2011.08.002
- Charles Steinfield , Robert LaRose , Han Ei Chew & Stephanie Tom Tong (2012) Small and Medium-Sized Enterprises in Rural Business Clusters: The Relation Between ICT Adoption and Benefits Derived From Cluster Membership, The Information Society, 28:2, 110-120, DOI: 10.1080/01972243.2012.651004
- Charles Steinfield , Robert LaRose , Han Ei Chew & Stephanie Tom Tong (2012) Small and Medium-Sized Enterprises in Rural Business Clusters: The Relation Between ICT Adoption and Benefits Derived From Cluster Membership, The Information Society, 28:2, 110-120,DOI: 10.1080/01972243.2012.651004
- Bronwyn H. Hall , Francesca Lotti & Jacques Mairesse (2013) Evidence on the impact of R&D and ICT investments on innovation and productivity in Italian firms, Economics of Innovation and New Technology, 22:3, 300-328, DOI: 10.1080/10438599.2012.708134
- PAUL MATTHEWS, (2007), "ICT ASSIMILATION AND SME EXPANSION", Journal of International Development J. Int. Dev. 19, 817–827 (2007) DOI: 10.1002/jid.1401
- Nick-Naser Manochehri, Rajab A. Al-Esmail, Rafi Ashrafi, (2012), "EXAMINING THE IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) ON ENTERPRISE PRACTICES: A PRELIMINARY PERSPECTIVE FROM QATAR", EJISDC (2012) 51, 3, 1-16 https://www.researchgate.net/publication/279687038_Examining_the_Impact_of_Information_and_Communication_Technologies_ICT_on_Enterprise_Practices_A_Preliminary_Perspective_from_Qatar
- Domenico Consoli, (2012), "Literature analysis on determinant factors and the impact of ICT in SMEs", Procedia - Social and Behavioural Sciences 62 (2012) 93 – 97 doi: 10.1016/j.sbspro.2012.09.016
- Alberto Bayo-Moriones Margarita Billón Fernando Lera-López, (2013),"Perceived performance effects of ICT in manufacturing SMEs", Industrial Management & Data Systems, Vol. 113 Iss 1 pp. 117 – 135 http://dx.doi.org/10.1108/02635571311289700

- KARIM SABBAGH, ROMAN FRIEDRICH, BAHJAT EL-DARWICHE, MILIND SINGH, SANDEEP GANEDIWALLA, RAUL KATZ, (2012), "Maximizing the Impact of Digitization", The Global Information.Technology.Report.2012.CHAPTER.1.11 http://www3.weforum.org/docs/GITR/2012/GITR_Chapter1.11_2012.pdf
- Ani Matei, Carmen Savulescu, (2012), "Empirical analysis of ICT, economic growth and competitiveness in the EU", *Proceedings of the International Conference on ICT Management (ICTM.2012),.Wroclaw,.Poland.September.17-18,.2012 http://apas.admpubl.snspa.ro/bitstream/handle/2010/463/ICTM2012_Matei%26Savulescu.pdf?sequence=1*
- Ting-Peng Liang, Jun-Jer You and Chih-Chung Liu, (2010), "A resource-based perspective on information technology and firm performance: a meta analysis", Industrial Management & Data Systems Vol. 110 No. 8, 2010 pp. 1138-1158 DOI 10.1108/02635571011077807
- Juliana Bonomi Santos, Luiz Artur Ledur Brito, (2012), "Toward a Subjective Measurement Model for Firm Performance", BAR, Rio de Janeiro, v. 9, Special Issue, art. 6, pp. 95-117, May 2012 www.anpad.org.br/bar
- Syed Shah Alam, Mohd. Kamal Mohammad Noor, (2009), "ICT Adoption in Small and Medium Enterprises: an Empirical Evidence of Service Sectors in Malaysia", International Journal of Business and Management Vol 4, No 2, February 2009 www.cesenet.org/journal.html
- Sean Marston, Zhi Li, Subhajyoti Bandyopadhyay, Juheng Zhang, Anand Ghalsasi, (2011), "Cloud computing — The business perspective", Decision Support Systems 51 (2011) 176–189 doi:10.1016/j.dss.2010.12.006
- Sanjeev Dewan, Steven C. Michael, Chung-ki Min, (1998) Firm Characteristics and Investments in Information Technology: Scale and Scope Effects. Information Systems Research 9(3):219-232. http://dx.doi.org/10.1287/isre.9.3.219