UNIVERSIDAD DEL ROSARIO

Impact of Information and Communication Technologies (ICT) in the productivity of a Colombian SME: The case of SERVELEC LTDA

Double degree – Montpellier Business School

Bachelor Thesis

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Montpellier, France

2020

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2020

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Glossary

Information and communication technologies (ICT): wide range of software, hardware, telecommunications and information management techniques, applications, and devices

Productivity: average ratio that allows an organization to measure how well it converts input resources into goods and services.

Small and medium enterprises (SME): A small enterprise with eleven to fifty employees and assets between five hundred and one and five thousand current monthly legal minimum wages. A medium enterprise is the one with fifty-one up to two hundred employees and assets valued between five thousand and one to thirty thousand current monthly legal minimum wages.

Glosario

Tecnologías de la información y la comunicación (TIC): amplia gama de técnicas, aplicaciones y dispositivos de software, hardware, telecomunicaciones y gestión de la información

Productividad: ratio medio que permite a una organización medir lo bien que convierte los recursos de entrada en bienes y servicios.

Pequeña y mediana empresa (PYME): Pequeña empresa con once a cincuenta empleados y activos entre quinientos y cinco mil salarios mínimos legales mensuales vigentes. Una mediana empresa es la que tiene entre cincuenta y uno y doscientos empleados y activos valorados entre cinco mil y uno y treinta mil salarios mínimos legales mensuales vigentes.

Abstract

Information and communication technologies have become one of the pillars for the development of companies, since they facilitate the flow and handling of information. This idea has led many companies to adopt these technologies to improve the productivity of their processes. Therefore, this research aims to identify the influence that the implementation of this type of technology has on the productivity of a Colombian SME.

Keywords: Information and communication technologies (ICT), productivity, Small and medium enterprises (SME).

Resumen

Las tecnologías de la información y la comunicación se han convertido en uno de los pilares para el desarrollo de las empresas, ya que facilitan el flujo y el manejo de la información. Esta idea ha llevado a muchas empresas a adoptar estas tecnologías para mejorar la productividad de sus procesos. Por lo tanto, esta investigación pretende identificar la influencia que tiene la implementación de este tipo de tecnologías en la productividad de una pyme colombiana.

Palabras clave: Tecnologías de la información y la comunicación (TIC), productividad, Pequeñas y medianas empresas (PYMES).

1. Introduction

Information and communication technologies (ICT) are becoming the center of attention for many businesses around the world, as it has emerged as a solution to gather and transmit information both within the organization as outside of it. Meaning that the adoption of new ICT within a business, has an impact on the way processes are developed and how stakeholders relate to each other. The facilitation that the implementation of these technologies has had on the flow of information has allowed to find a great variety of solutions that occur within the daily processes. One of the most important aspects being improved productivity, which in many cases can mean better performance in the market and higher value offering for customers.

In this sense ICT has played a central role in the economic development of countries, as it builds competitive potential (Szymczyk & El Emary, 2021), which helps nations and enterprises build their wealth. In this sense, improvement on productivity could translate into more productive workers, higher wages, higher living standards (Kretschmer, 2012). At a business level, the introduction of this type of technology has been described as a source of competitive advantage, as it allows companies to perform activities in a faster, more accurate and a more flexible way (Kijek & Kijek, 2019). Although it is presumed that ICT could be a driver of productivity, the link between both has not being well established, due to the lack of consensus on the advantages and the way enterprises use technologies. (Kijek & Kijek, 2019).

Thus, to help broaden the existence knowledge on this topic, this dissertation will aim to answer how information and communication technologies (ICT) impact the productivity of a Colombian small and medium enterprise (SME). There are two reasons for choosing these kinds of enterprises. The first one, is that because of its size could be easier to find the relation between the introduction of ICT and the productivity of the enterprise. On the other hand, SME composed the vast majority on the contemporary market economy (Szymczyk & El Emary, 2021), making their success a vital part for the economic growth of countries, especially in developing ones as it is the case for Colombia (Okundaye et al., 2019).

For this reason, is important to understand how ICT can impact the productivity in SME, as this knowledge can help to design and implement effective strategies that align technology with the business model and improve the performance in the market of this companies., as these technologies can be implemented to potentialize or transform the different process. This especially important in small companies, where sometimes the implementation of these technologies or systems can be more difficult or be seen as expensive and the not clear plans where or how it should be implemented.

To answer the question presented in this thesis, the company Servelec Ltda have been chosen. It is a Colombian enterprise that has implemented an information and communication to automatize different processes, giving and insight on how this type of technologies can have an impact on productivity. Thus, this thesis will be structure in four parts, that allows to approach the problem in such a way that it is easy to understand and to answer the question posed. First a Literature review, then the research methodology, the results and analysis, finally the theorical and practical applications of this work.

First, the literature review will be done to have a theoretical background and to get to know the importance of Information and communication technologies (ICT) and productivity in the academic space. Also, it intends to give an insight into the context of the company that will be the subject of this study. Therefrom, in the research methodology, it will be explaining how the study will be develop and the techniques that will be used to recollect and process the data needed to attempt to answer the proposed question. Then the results will be analyze using different techniques that allows to have a better insight on how productivity has been impacted after the implementation of an information and communication system in Servelec Ltda. Finally, the contribution and impact of this study will be discussed in the final section.

Therefore, this thesis is relevant as it can help the company to get an insight of the importance that the implementation of an information and communication could have in a company's general performance. Helping it to identify the areas where the system has more relevance and in the same way make improvement that will increase the whole productivity of the company as well as have a strategic impact. Especially, when productivity in SME has such an important role for developing economies and the way policymakers take decisions.

2. Literature Review

2.1. Productivity

2.1.1. Concept

Productivity has been one of the biggest concerns of companies and economies as this term is directly related to the performance and revenue that a company could obtain; the term is of such importance within productive activities that has been considered as the most important variable to be measure (Alby, 1994)Thus, the term has been largely discussed within the academy and business, which has defined the term in different ways and with different approaches. Nevertheless, this has been done in a "vaguely defined and poorly understood" way (Yadav & Sachin, 2015), as it is a very broad subject, because it not only serves a unique purpose or has a unique way to be measure (OECD, 2001).

In this way, one most widespread definition of the term is the relation between an output and an input. Thereby for Yadav & Sachin (2015) productivity is an average ratio that allows an organization to measure how well it converts input resources into goods and services. This means that productivity could be understood as the ability of an organization to produce a good or service in establish times in terms of quantity and quality, while taking advantage of the resources available. In other words, is how "efficiently production inputs, such as labor and capital, are being used in an economy to produce a given level of output" (Krugman, 1994). Further, Wong (2015) defines the concept and how it is applied to SME, and says that is "the measure of the effectiveness and efficiency of the SME in generating output using the resources available".

Moreover, productivity is a scientific concept in the sense that it can be logically defined and empirically observed, allowing it to be measured in absolute or relative terms (Alby,1994). In this way Alby (1994) defines productivity as the "quantity of physical work produced by a unit of labor directly engaged in its production". Highlighting that Productivity should not be confused with competitiveness and profitability, which are directly affected by it, but are also influenced by other unrelated factors, such as raw material costs transportation costs, overhead, financial costs and taxation.

Another definition of productivity comes from El Banco Nacional de Comercio Exterior de México which states that productivity is a qualitative change that gives better ways to do an activity, as well as the rational use of resources, the application of innovation and technological advances and the participation of workers and its results (1991). This means that productivity not only implies managing the resources in the best possible, but also involves the way in which companies are able to process these activities. This gives companies room to identify which activities generate more or less value for them.

2.1.2. Measuring productivity

Measuring is one of the most important things in productivity as it's helps company identify different areas that are potentially causing trouble. This means that productivity measurement serves different purposes that include the technical and efficiency changes, and the

impact on real cost savings (OECD, 2001). In this way through history there has been a development of different models that allows to do this in an efficient way. For example, the single factor productivity model, the multifactor productivity, the total productivity model, the management control ratio and the productivity costing. Although, this development has always been accompanied of information systems that helps companies and managers to process information in order to take decisions.

For Yadav & Sachin (2015) one of the most relevant it the total productivity model in which “all outputs and inputs are included in the productivity measure”. Outputs and inputs are defined in the total productivity measure as their economic values. The value of outputs minus the value of inputs is a measure of the income generated in a production process. It is a measure of total efficiency of a production process and as such the objective to be maximized in production process” (Yadav & Sachin, 2015). On the other hand, productivity measures that use one or more inputs or factors, but not all factors, are called partial productivities.

2.1.3. Importance of productivity

Steinmueller (2002) states that modern economic growth relies upon productivity improvement, since as mentioned earlier, productivity is the capacity of enterprises to produce goods and services of quality during a specific time. Although, the author proposes that an investment knowledge could potentially increase the productive capacity of capital goods, labor,

and natural resource inputs, as the success of enterprises is more reliant upon their effectiveness in generating and utilizing knowledge (Lundvall, 1992). He continues to say that "knowledge contributes to the economy by supporting productivity improvements, the formation and growth of new industries, and the organizational changes that are needed to effectively utilize new knowledge" (Steinmueller, 2002). ICTs support productivity improvement although, as in the case of the service industry, the rate and direction of the productivity improvement is often uneven.

On the other hand for Yadav & Sachin (2015) productivity is a crucial factor in production performance of firms and nations, as they say that increasing it can improve living standards due to people can obtain more real income and in this way purchase goods and services, enjoy leisure, improve housing and education and contribute to social and environmental programs.

Indeed, Productivity growth also helps businesses to be more profitable. Although, to achieve it, companies should be able to measure their productivity. Because this could support organizations strategic plans as corporate planning, organization improvement, or comparison to competitors. It can also be used for tactical reasons such as project control or controlling performance to budget (Yadav & Sachin, 2015). This means that productivity is critical variable for any enterprise to succeed in a competitive environment. So, it is important to find actions that allow the company to perform better than they competitors, if they want to succeed and be profitable in the long term. In this way, productivity implies that enterprises find ways to adapt their economic activities to the ever-changing business conditions to create value for all stakeholders based on process approach (Wong, 2015).

The Asian productivity organization (2015) says that a strong productivity foundation and a holistic productivity management system will allow SMEs to enhance their organizational systems and process, that could possibly lead to a competitive advantage that help the company to sustained business excellence in the long run. In fact, they highlight that "SMEs for both the manufacturing and service sector have to focus on productivity to meet their requirements of customers" (Wong, 2015).

Finally, we can say that "Productivity is, above all, a state of mind. It is an attitude that seeks the continuous improvement of what exits. It is a conviction that one can be do better today than yesterday, and that tomorrow will be better than today" (European productivity agency, Rome conference 1959).

2.2. ICT

2.2.1. Concept

"ICTs are a wide range of software, hardware, telecommunications and information management techniques, applications and devices. Collectively, these are used to create, produce, analyze, process, package, distribute, receive, retrieve, store and transform information" (Apulu & Latham; Porter & Millar, as cited in Taylor 2015).

Thus, the development of new technologies that help enterprises to collect data and manage information that help enterprises take better decisions has expanded over the last decade, as our society is turning into a "Knowledge society" which means that knowledge and information are essential to the economic development of countries and enterprises (Berisha-

Namani, 2009). In the case of enterprises, the management of information has become one of the key sources of competitive advantage (Steinmueller, 2002).

This need, has make a priority to enterprises to find solutions that helps them solved problems as the cost of producing, transferring and processing information, finding relevant information in and efficient way, transferring internal information between different areas, as well as assign a responsible of solving the problems using it. All of this in order to find ways in which company can use the information to improve processes, products or their organizational structure to improve their presence in the market, improve their customer relations or to improve their overall performance.

Specially the uncertainty and the accelerated pace changes of the environment, has make mandatory for organizations to adapt. Although, it's important for organization not only to invest in information technologies as a mandatory way, but to think of it as an investment that could give them a potential competitive advantage. As the author of leading digital has established, companies not should only focus on the development of their information and communication technologies, but also in leading capabilities, that allows the organization to works in a coherent way.

2.2.2. Importance

ICT as mentioned before has been evolved in the fast development and improvement of different industries, as it has help companies transform information and data into knowledge, which lately could represent a competitive advantage to the company. Because, information allows companies to identify their competitive position and of its rivals, as well as the possible changes that could happen in the future that could have an impact on their activities. So, if a company is able to manage their information and of its environment the company could take better decision and improve the possibilities to survive in the environment.

This assumption it is been noticed by Steinmueller (2002) who says that "the common assumption in studies of ICT diffusion has been that the increasing use of ICTs implies an ever-greater accumulation of competencies and, therefore, improvements in organizational 'fitness' and competitiveness". This means that several researcher and organizations expect that through the implementation ICT the companies could improve the productivity of the company, and later be translated as a competitive advantage, that allows the company to improve their position in the market.

Another potential benefit of implementing ICT in any company it is been directly related to the way company's process work, which is further explained by Westerman, Bonnet & McAfee (2014) who say that is necessary to combine people, processes and technology in a unique way in order for companies to outperform their competitors. Consequently, transformation required good data available in real time to the people and machines that need it. One example in which, the implementation of ICT could improve the process work is in the identification of bottlenecks that constrains the productivity of a company.

On top of that, many researchers has asses, ICTs are changing the way people and organizations works (as cited in Taylor, 2015) and for this reason they could have a potential impact in the economic growth. In this ways, this benefits has been attractive for SME's as this enterprises seen this tools as a support for their competitiveness, productivity and profitability (Taylor, 2015).

Paul Taylor (2015) made a review of the models available for ESM's to adopt ICT technologies and how this could influence the performance the companies in the environment. In his paper he explores the diffusion of innovation theory and the technology, organization and environmental framework and then propose an integrated theoretical model of ICT adoption by SMEs.

2.2.3. Digital mastery

Another concept that is interesting to develop if a company is intending to implement ICT in order to improve productivity is Digital mastery, which is developed in the book leading digital. Here, Westerman, Bonnet and McAfee addressed the importance of enterprises taking advantage of the implementation of information technologies, as tools that could help enterprises manage the constant information provided by their environment. As companies "could move from guesswork to inspired predictions and continuous hypothesis testing" that could help them

identified and understand better their stakeholder needs and wants, and the potential changes that the market could have.

So, they will be more prepare to afront the potential threats that living in an uncertain environment imply. In this way the authors introduce the concept of Digital masters which is defined as Companies that "use technology better than their competitors do and gain huge benefits" (Westerman, Bonnet, McAfee, 2014). Stating that companies that are capable to become digital masters can gain a competitive advantage, because is easier for them to identify bottlenecks or other types of constraints that decrease the productivity of the companies, affects the efficiency of the process, innovation or affects the customer experience.

In this way this led us to think that changes in companies as the implementations of information system could help them to make changes in information that later will result in more productivity and finally in more revenue or more value.

2.3. SME's

2.3.1. Definition

Small and medium enterprises (SMEs) play an increasingly important role in Asian economies in terms of their contributions to GDP and employment, and remain the core engines for productivity and economic growth. The Asian Productivity Organization (APO) recognizes the importance of enhancing and monitoring the progress of SME performance, and facilitating

the sharing of productivity performances and best practices among SMEs within the APO member economies. For this purpose, it was established that SMEs should embrace productivity measurement as an important process for improving their productivity, and for achieving sustained business growth and competitiveness.

In Colombia SME are defined by the 905 law of 2004, where it is established two criteria to classified this type of enterprises. The first criteria is by the value of their assets and the second one is by the number of employees. In such manner a microenterprise is considered as the one with no more than ten employees and assets below five hundred current monthly legal minimum wages. A small enterprise is the one with eleven to fifty employees and assets between five hundred and one and five thousand current monthly legal minimum wages. Finally, a medium enterprise is the one with fifty-one up to two hundred employees and assets valued between five thousand and one to thirty thousand current monthly legal minimum wages.

2.3.2. Relevance

SME has a great impact in the economy now a days as the OECD (as cited in Berisha & Shiroka, 2015) estimates that small and medium enterprises account for 90% of firms and employ 63% of the workforce in the world. This makes these companies become one of the largest contributors to GDP and employment, as well as the core engines for productivity and economic growth (Wong, 2015). This is not exception for a country as Colombia, where just in

2018 were registered 107.252 SME's in the chamber of commerce, becoming 6.85% of the enterprises registered 2018. Thus, according to the data of Confecamaras (as cited in Bancolombia, 2018) there is approximately 1.500.000 SME in the Registro Unico empresarial (RUES), although it is important to notice that this cypher includes natural and legal person.

After making a brief revision of the literature review, we could notice that to improve the productivity, companies should implement strategies that allows them to increase the amount of output, while taking advantage of the resource available (outputs). Is here when ICT, could help enterprises find new ways to arrange their resources and allocates them in a more efficient ways, as this tool help enterprises manage information in such a way that they can take asses better the current situation as well as take better decisions. Also, the implementation of ICT increased the possibilities to gain a competitive advantage and stay in the market for as long as possible. Similarly, If Servelec is capable of implementing a good ICT, that helps the company to manage the knowledge that is develop within the company the enterprise could, gain huge benefits as this is one of the critical aspects for the success in the industry.

3. Methods

This section aims to explain the type of research, the research approach and the techniques that were used in order to answer the proposed question. In the same way, make a

presentation of the company Servelec LTDA and of how it has implemented ICT to improve their productivity.

3.1. Research design

3.1.1. Type of research

In order to answer the question formulated in this thesis it was use an exploratory approach that give insights of the impact that the implementation of an ICT could have in the company Servelec LTDA. Exploratory research is used to collect information on the historical evolution of the company's ICT implementation, just as to understand the perception that different users have on the system, its benefits and constrains. In this way it is possible to start understanding the impact that this type of technology has on the EMS productivity. As well as, identify the areas that have benefitted more in terms of productivity, after the implementation of the system. Thus, with this information it is possible to generate hypothesis that could guide future research.

3.1.2. Methodological approach

Following this reasoning the methodological approach selected for this research is qualitative, as it allows to discover in-depth information and thoughts in relation to the studied concept from the opinions of experts, that in this case are the employees of Servelec LTDA. This

provides internal information of the subject that leads to a better understanding of the problem that is being addressed, as the qualitative approach manages to penetrate in the meanings and configurations that the users of the system have. This means that with this type of research it possible to understand how the managers and employees of Servelec LTDA have perceived that the implementation of ICT has some incidence on their daily work and on the productivity.

As well, this kind of method allows to identify and compare the different stages that the company has had to go through in order to see the expected results on productivity. Which will lead to a better understanding on how these technologies will impact an organization on different levels and especially on their productivity. On the other hand, it gives a more extend understanding on how the implementation of ICT in Servelec LTDA, has change the way activities are carried out within the company and see if the company has used this type of tool to make changes that have some kind of impact on its productivity. Finally, the qualitative approach helps to understand the reality of the company, its context and its needs.

3.1.3. Research technique

To carry out the research, two techniques will be used to obtain relevant results to answer the research question. The first technique will consist in the recollection on primary data through in-depth interviews with Servelec LTDA managers and employees. It was decided to use a

primary source of information because, in the first place there is no previous data on the company and secondly it is considered that this type of information can provide a more appropriate answer to the research question proposed in this investigation, since it allows a more detailed approximation of the problem. In this way the objective of the in-depth interviews is to comprehend the perception that the members of the organization have about the impact of ICT on productivity and identify the areas where this has more incidence. This method was chosen as it helps to comprehend the experiences and perspectives and to reveal more detailed and in-depth information than other data collection methods like surveys.

The second technique, involve the analysis of secondary data, in this case the company's financial statements. Which will allow to have a more in-depth understanding of the productivity results that the company has had after the implementation of ICT and in such way check more objectively how it has affected the organization. In addition to seeing the historical evolution of its impact. In this case a horizontal and vertical analysis will be held, to find the differences between one year and other and to understand the more relevant variables for the enterprise that later will be used to develop the productivity indicators. Although, the procedures performed to obtain the results will be explained in more detail in the following section.

3.2. Data collection

3.2.1. In depth interviews

In depth interviews was selected to recollect the primary data of this research as it allows to obtain more detailed information on how the ICT system of the company has impacted the development of the activities of the enterprise. The interviews were semi-structured and diagnostic. This means that there was an initial questionnaire that served to guide the interview, however as the conversation was developing new questions were asked to deepen the ideas and concepts mentioned by the interviewee. This is because the main objective of these interviews is to listen and understand the context, to subsequently identify the variables that has an incidence on productivity. Is important to notice that all the interviews were conducted via Skype due to the enterprise in based in Colombia. Also, as all the interviewer speak spanish the interviews were conducted in this language and afterwards translated to English.

In order to obtain the require information to answer the question, the interviews were addressed to two groups of users in the company. Which were identify using the organizational chart of the company (figure 1). This graphic helped to understand the roles they played within the organization and the relationship they had with the system. Thus, two types of users were identified, first those who were in the management levels, who used the system for decision making and coordination of the general operations of the company. On the other hand, the users at the operational level who use the system as a tool to carry out their daily operations.

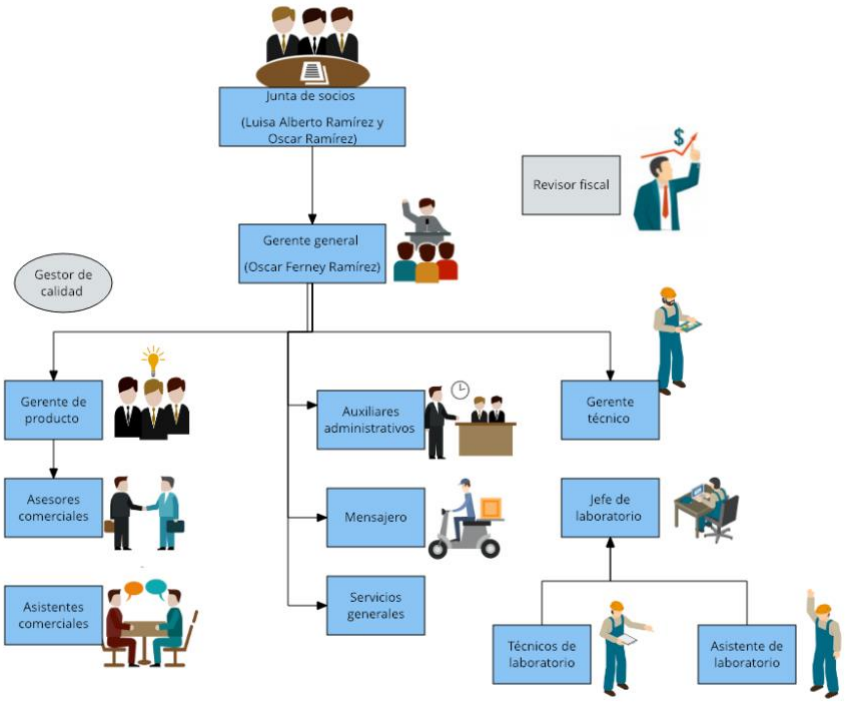

Figure 1. Organizational chart Servelec LTDA
Source: Self-production

The first group, the managers, was selected as they have a broader view of how the system has been implemented, its importance to accomplish the strategic goals and the impact that has had on the productivity of the company within years. Also, in the interview was discussed in which areas they have perceived a greater impact of the system on productivity and how has been the development of the system over the years. In this sense, from this group were selected two people who understand the way the system has been implemented, its main functions and how has been the impact since its adoption. Although the managers selected were from different areas to have a better understanding of how ICT have a distinct impact on the productivity in the different areas, as well to validate the perspectives of the managerial level.

The first-person interview was Oscar Ramírez the CEO of the company, a system engineer with a master of finances, who is in charge of the administration of the company as well as of its financial area. He was identified as a current user of the system and has a wide knowledge of how has been its implementation throughout the years, the evolution and the impact that it has for the organization. As well he has knowledge of the importance of productivity for the company and how this variable is measure. In this way this user is valuable for the investigation as he could give a greater insight on how the implementation of ICT could have influence the productivity on the enterprise, as well as to understand what are the reasons for having implemented it and if in fact it has accomplish it function.

The second interviewee is Luis Alberto Ramírez the operations manager of the company. He is in charge of supervising the technicians and directing the projects carried out by the company and help to administrate the company. In this sense he uses the system for another type of function and has a different perspective of how the system has influence the productivity of the operations, which gives a better insight of how the company has been impacted by its implementation. As well he also has been involved in the development of the system and understand the value that this kind of technologies has for the good performance of the company. Thus, he was selected as could give more information of how the system has an impact to perform the activities of the company and the way that the company in vision to use the system to improve their performance.

Therefore, the question made to this group covered a wide range of topics, as they know the overall implication of the system to the right functioning of the company, its productivity impact and its strategic relevance. The first part of the interview dealt with the strategic reasons

for implementing the system and how it had been implemented. Later, we started to talk about the importance of the system for the company and what changes they had perceived thanks to it. Then, we examined what had been the impact on the productivity of the system in each of the areas of the company as well as the general impact it has had for the company over the years.

Once the interviews to the managers were done, the talks with the employees and collaborators were carried out, since they are the direct users of the system but do not have a global perspective of its impact on the whole organization, that is to say they only know how the system impacts their daily work. In such a way the goal with this stage is to have a deeper understanding of how the system influence the development of their activities within the company and to understand the real impact that the system has on the daily productivity of the employees. The criteria used to select the two interviewees was the level of use they had of the system and the relevance it has for the development of their activities. So, this questioner was more focus on getting information on how the work had impacted the personal work and the way the use the system to be more efficient.

The first person interviewed from this group was Marcela Tovar, who is an industrial instrumentalist and who works as laboratory coordinator for Servelec. This means that she is the person in charge of maintaining contact with the companies to which the services are to be provided so the activities to be carried out by the technicians can be programmed. Thus, it was considered appropriate to conduct an interview with her since she has direct contact with the system and is a fundamental part of her daily work, therefore she can explain in depth the impact of the system. In this way, key variables could be identified to answer the question posed in this research.

Finally, Carlos Eduardo was selected due to the manager's emphasis on the importance to the organization of using the system to process the organization's financial information. Besides this, it was decided to interview him because the financial area is one of the ways in which the company has to measure the productivity of the company and see how it has been the evolution of this through the years. This way, he knew in a deeper way how this evolution has been and gave a more profound vision of how the system has influenced the productivity of the company. Besides, he is one of the users who knows the system best and who uses it as a fundamental tool to carry out his work.

The questionnaire made to the employees was a little modify as some question made to the top managerial level was more focus in the directive aspect than anything and could not be answer from an operative level perspective. In this way to this group the question includes how is the whole use of the system in their daily activities and how they have perceived the changes on their activities thanks to the system. Also, in the questioner was a part that include some questions that aimed to identify the constraints that the employees have to face while using the system and they perceived were affecting their overall productivity.

In table number one a summary of the people interviewed for this research is presented as well as relevant information on the location, duration and achievement of the interview. The questionnaires used to conduct the interviews are found in appendix number.

Table 1. Information interviewees in-depth interview

	Function of respondent	Date of interview	Duration	Place	Achievement
Oscar	CEO	05/03/2020	70 min	Skype	Understanding the overall importance of the system, its evolution and impact on productivity for the entire organization.
Luis	Operation manager	16/03/2020	55 min	Skype	Impact of ICT on the productivity on the operations of the company and commercial area of the company.
Marcela	Lab coordinator	18/03/2020	40 min	Skype	Realize the direct impact that ICTs have on the work and productivity of workers.

Carlos	Accountant	24/03/2020	50 min	Skype	Importance of ICT to measure productivity and manage information.

This table summarize the information of the interviews that were made as a basis for the thesis, and it also shows the achievement of each interview.

Source: Self-production

3.2.2. Financial statements

In the second stage of the research, the financial statements of the company were used as a secondary data sources to validate in a more objective way the impacts on productivity that were identified by the managers and workers. As mention by De La Hoz Granadillo et al productivity factors could be measure in reference to a particular productivity factor (2014). Which means this report could be useful as they are indicator of how are the resources of the company being manage. For this reason, it is considered that in order to validate the results obtain in the in-depth interviews about the productivity of the company and to compare the performance before and after the implementation of the system, financial states will be a great method. Although it is important to notice that this is still a preliminary result and it is aim to give a first insight of the productivity of the company.

In this way, the financial states that were used for this analysis were the year 2000 and 2001that were taken as a reference to know how the company's performance was before and after the implementation of the system. Afterwards, the years 2002 (year of implementation) until

2004 were selected to see the direct impact that this implementation had had. Finally, the years 2015 and 2016 were used to know the current state of productivity in the company and to evaluate if the system still has effects on it. It is important to mention that all the information used in the study where provided by Servelec LTDA.

3.2.3. Presentation of the field

Servelec LTDA was founded on March 2nd 1989, by Fabio Ramirez, Luis Ramirez and Oscar Ramirez as a Colombian company that provides engineering services to industry. The first activities carried out by the company consisted of support services to sound systems in shopping centers and maintenance to companies in the textile sector, where modifications were made to the weaving machines.

Already in 1995, the first commercial agreement was made with the multinational ABB, to carry out corrective and preventive maintenance of the drives of this brand as well as the distribution of its products. Towards 2001, agreements were made with SIEMENS and WEG of Brazil, which, in order to ensure the quality of the service provided, offered training to the technical team in the plants of the United States, Brazil and Colombia. This allowed the company to achieve accreditation to provide service worldwide. In 2002, Omimex oil company sold 90 pieces of equipment, being the first time that the oil sector uses variable speed drives for oil production in the country. With this implementation of technology, they were able to increase

production by 30%. In this same year the company decided to implement the software Adjer, that allows them to manage the information of the organization and share it within the different departments.

In 2005, exclusive distribution agreements were signed with Emotron in Sweden and Santerno in Italy. Servelec's growth was constant until 2008, when three customers stopped paying $600,000,000, generating an economic crisis that will end in 2015. During this period, it was necessary to adopt different strategies to save the company, including strengthening the service provision area and reducing equipment distribution. In 2015 an agreement was established with Panasonic of Colombia to provide the service of photovoltaic energy and during the last years installations have been made in Homecenter Cajicá, Alkosto de la 68, Plaza las Américas shopping center, Javeriana University, University of the Andes, Ecotower 93 building, Sinchi Institute in Leticia and Nacional de Chocolates in Río Negro being these one of the biggest photovoltaic installations in the country. In recent years, Emotron's exclusive distribution has been resumed and partnerships are being established with Celsia for photovoltaic projects in Colombia and Central America.

3.3. Data processing

3.3.1. In depth interviews

To process the information obtained in the interviews, the first step was to make the transcriptions with the help of the Watson by IBM software. Once the initial transcript was obtained, some improvements were made, and then the information was translated from Spanish to English. Thus, when the information was ready to be used it was classified in eight topics, to facilitate the identification of the most relevant quotes in the interviews, and then its analysis. The topics were decided taking into account the questions asked in the interview and the objectives of the research.

The first topic was the "importance of ICT" for the company and the second was the "motivation to implement or use this technology" in the company. The main objective with these issues was to understand the context in which the company uses ICT. This in order to understand what are their expectations about this type of technology, how they use it and what is the value they identify in them. This allows identify the factors that are relevant for the development of the company, that is to say those variables that have an impact on the development of its activity and therefore in its productivity.

With the third topic, "development of own software", and the third one its initial impact the goal was to understand how has been the development and obstacles of ICT within the company and what are the tools that the company uses. All of this to realize the role of this technology in the company and how has been the impact on the productivity within the years. Although this topic was discussed more deeply in the topics "productivity and ICT" and "areas/activities impacted by ICT" which main objective was to identify the variables that impacted the productivity and how this happened. Finally, the last two topics, "Impact of ICT on workers productivity" and "ICT and company strategy and innovation" aimed to find how the

information system impacted this variable that are of vital importance for the development of the company's activity and its productivity.

3.3.2 Financial statements

To process the financial information that was obtained from the company (financial statements) the Excel software was used. In the first instance, a table was made in which the main variables that would be used to calculate the productivity indicators were taken, that is to say, gross profit, operating profit, net profit, sales, payment to suppliers and inventories. In addition, the percentage variation of each of the variables was calculated in order to understand how the company's resource management has fluctuated over the years.

From this information the different indicators were calculated taking into account the formulas presented in the literature review of this research. First, the value added that the company generated in each of the years was calculated, and from this the calculation three productivity indicators were generated; they were organized in tables in order to facilitate its analysis. Later, with the information obtained, graphics were made to facilitate the visualization and analysis of the data obtained.

4. Results

4.1. Presentation of results

The objective of this section is to show the results and analysis obtained in the in-depth interviews and of the financial statements of the company.

4.1.1. In depth interviews

In order to present the results of the in-depth interviews the themes were divided by eight topics (shown in table number 2) which will give a general perspective of the statements given by the interviewers. In table number two it will be shown a summary of the overall opinions of the interviewers, so that can be easily identified the position regarding the topic study. After that in table number 3 there will be shown a summary of the overall opinion about the topic. So, it will be easy to review the results and make and analysis that could answer the question proposed in this investigation.

Table 2. Opinion of managers and workers on topics of in depth interviews

Topic	Managers	Workers
1. Importance of ICT	The managers expressed that the ICT system that the enterprise has implemented and use within the year has had a huge impact on the growth of the company as it facilitates administrative task and commercials activities, as it allows to manage all the information within the organization and generate indicators.	For workers this is an important tool to develop their activities, as is gives them the information they need about clients, products, prices and the activities that are being develop by the other areas of the company, which allow them to coordinate the technical visits. As well the system gives them all the financial information, they need to develop the accounting activities.
2. Motivation to implement/ use ICT	One of the main drivers for the managers to implement the ICT system was to manage the information of the company in a more secure and efficient way. In order to have a better vision on how the company was developing. As well to have some indicators of how was the activity of the enterprise developing.	The workers say the use the ICT system that the company has for most of the activities they develop in the company, as here they have access to the information about clients, products and employees. Which allow them to have a better control of the activities. Also, they express that is an essential tool to take decision in their areas.
3. Development of own software	For the managers is important to develop the system even further as they have identified that the system has principle role in the development on all the activities of the company.	The employees express that the system has son lagging which sometimes interferes with they work as it takes time to upload some information.

4. Initial impact	The managers said that the implementation of the management system caused an initial decreased in productivity as this implied a cultural change within the company. Although, this reduction didn't last much as the development of the software and its interface were easy to use which made that the employees adapted and started understanding its importance and use in their daily activities.	Workers indicate that at first the system is easy to use so they do not identify any negative effect on their productivity. Also, they indicate that the training provided by the company is sufficient.
5. Productivity and ICT	Both of the managers identified an improvement in the productivity of the company after the implementation of the ICT system, as workers could spend more time developing more impactful activities for the organization and not in administrative task. As well, they manifest that thanks to the systems is easier to manage the information within the company and generate indicator that facilitate the control of the different resources of the company.	The workers indicated that the system used by the company is an essential tool for carrying out their work, as it allows them to obtain all the necessary information efficiently. In the case of the commercial part they identify that this allows them to have all the information of the clients which enables them to give a better service as well as to assign the most suitable personnel to carry out the maintenance services. In the case of accounting, the system helps to perform all accounting processes efficiently, since the transactions within the organization are recorded.
6. Areas/ activities impacted by ICT	The managers expressed that there is an overall impact on all the areas of the company as the system they use, manage the information of all the areas of the company.	The workers recognize that the tool impacts most of the activities they carry out, however the case of the laboratory coordinator, the moment she is in the field the tool is not useful to her.

7. Impact of ICT on workers productivity	The managers say the have seen an improvement on the productivity of the workers thanks that the system allows them to make a better control on their activities. Also, that the system could help the employees relaxed and focused on activities with more impact for the organization. Although, they highlight is not only because of the implementation of the system, but also for the incidences of other factors.	The workers agree that the tool allows them to carry out their tasks more efficiently, since they save time in administrative tasks.
8. ICT and company strategy and innovation	Finally, the managers have seen that in general the system help with the accomplishment of the strategy of the company, as well as help them identify opportunities to develop new projects. Although they state that the success is not just base on this. On the other hand, the say that the innovation process does only depend on the system, as this variable is mainly depended of the mind and creativity of workers.	In this regard the employees expressed that they have not identify some benefit in terms of generating innovative ideas thanks to the system.

This table shows a comparison between the perspective that SERVELEC Ltda. managers and workers have on ICT and its impact on their work.

Source: Self-production

Table 3. Relevant comments on each topic of the in depth interviews

Topic	Most important quotes
Importance of ICT	"… have second by second information on the behaviour of the company's activities" "is very important because it becomes the controller and manager of all the company's information"

	“For me the system is very important because it allows me to have access to customer information, maintenance dates and products with which I can make decisions about the services to be provided”
Motivation to implement/use ICT	because all the information is recorded in the system and then the system shares that information... we are all integrated thanks to the information provided by this system.
Development of own software	"to see the need for the company itself to have automated processes that would allow it to have control over the operational side"
Initial impact	“…to make the cultural conversion and see that people already later begin to see the positive results of these new applications. See the advantages in time in security. Well, to see the number of things in favor that comes with it …”
	“After the implementation of the application, the system We saw a big growth of the company”
Productivity and ICT	“…one that is leveraged in information systems that are a lever or a multiplier of operational capacity…”
	“…All areas as such are improved in the service part…”
Areas/ activities impacted by ICT	“…In the sales area it allows one to make a selection, they allow one to prospect for customers in order to get there or to focus the sales effort there.”

Impact of ICT on workers productivity	"…So this means productivity, thanks to this application I am doing with very few man-hours many tasks that in manual conditions to achieve that amount of information and that quality of information would be enormous…"
ICT and company strategy	"the information that is stored in this database allows me to have information to extract management reports that facilitate decision making at any time"

This table shows the most relevant quotes of the topics that were explores in the different interviews made to managers and workers.

Source: Sel-production

4.1.2. Financial statements

In this section the financial statements of the company will be presented in table number 4, where the gross profit, operating profit, net income, sales, payment to suppliers, inventories and added value are presented. These accounts were chosen since these are the accounts that will be used to calculate productivity, which will make it possible to establish whether there is a relationship between ICT and company performance. Also, the years were chosen in order to have information that allows to make a comparison between the before and after of the implementation of ICT within the company.

Table 4. Main accounts of financial statements from different stages of the ICT implementation

	Before			After		Current state	
	2000	2001	2002	2003	2004	2015	2016
Gross profit	$134.672.900	$262.162.115	$446.992.000	$346.795.247	$541.498.334	$253.655.169	$516.384.906
Operating profit	$32.131.027	$74.001.882	$92.459.772	$42.626.081	$177.532.631	$105.562.370	$32.945.473
Net income	$18.513.924	$41.446.694	$52.865.772	-$12.812.723	$33.784.284	$27.115.291	$77.999.890
Sales	$352.425.000	$779.491.186	$2.098.183.000	$1.750.682.008	$1.744.361.285	$678.454.523	$865.382.525
Payment to suppliers	$45.558.000	$71.903.693	$240.598.674	$262.255.237	$244.292.436	$124.605.169	$119.846.941
Inventories	$38.654.900	$40.600.988	$160.600.899	$254.480.196	$306.915.591	$298.828.219	$272.911.421
Added value	$345.521.900	$748.188.481	$2.018.185.225	$26.009.243	$1.806.984.440	$852.677.573	$1.018.447.005

Summary of the financial statements of SERVELEC Ltda. of 2000, 2001, 2002, 2003, 2004, 2015 and 2016.

Source: Self-production

Graphs of the different accounts were drawn from the financial statements to visualize their evolution and facilitate their subsequent analysis. In each of these graphics the total value and the percentage variation were calculated to have a better understanding of what was happening in each year. In this sense the financial statements that were represented were the operating profit and net income.

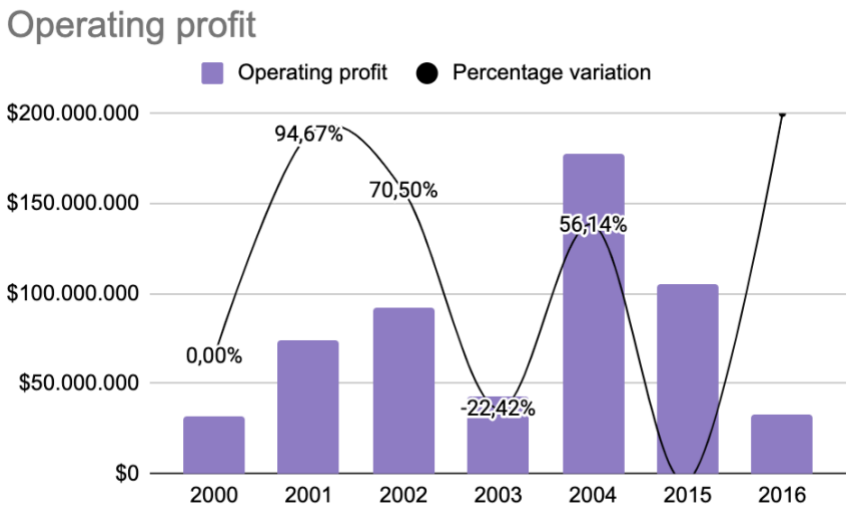

Figure 2. Operating profit
Source: Self-production

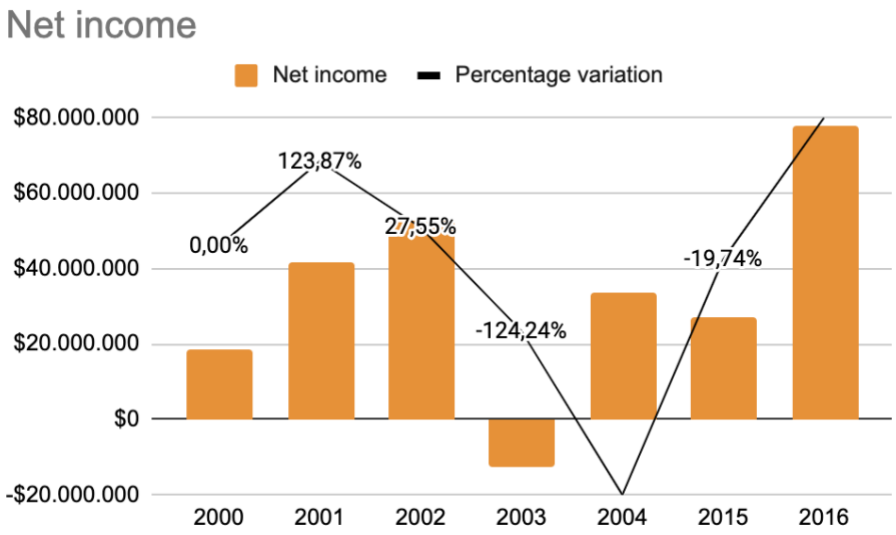

Figure 3. Net income
Source: Sel-production

With respect to the productivity indicators that were measured, the main one is value added, since it allows us to know how efficient the company is being. On the other hand, three more indicators are measured based on the different accounts of the financial statements, in order to have a more complete vision of the processes. As shown in the graphics.

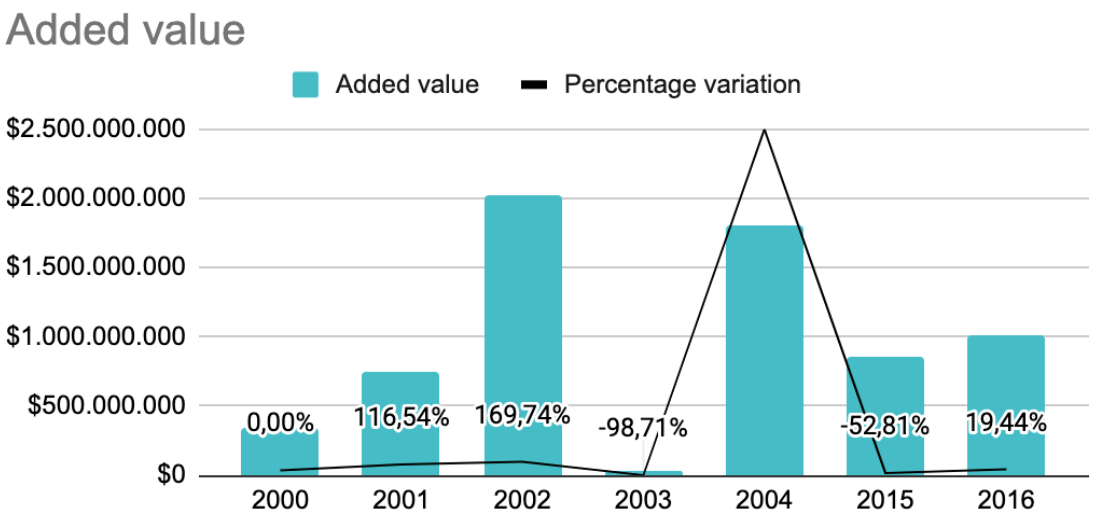

Figure 4. Added value
Source: Self-production

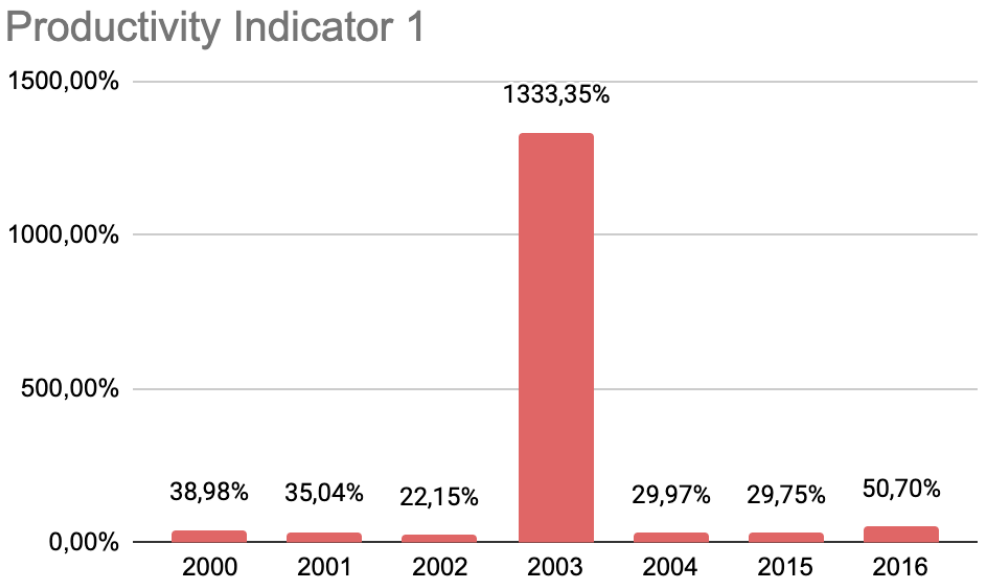

Figure 5. Productivity indicator 1
Source: Self-production

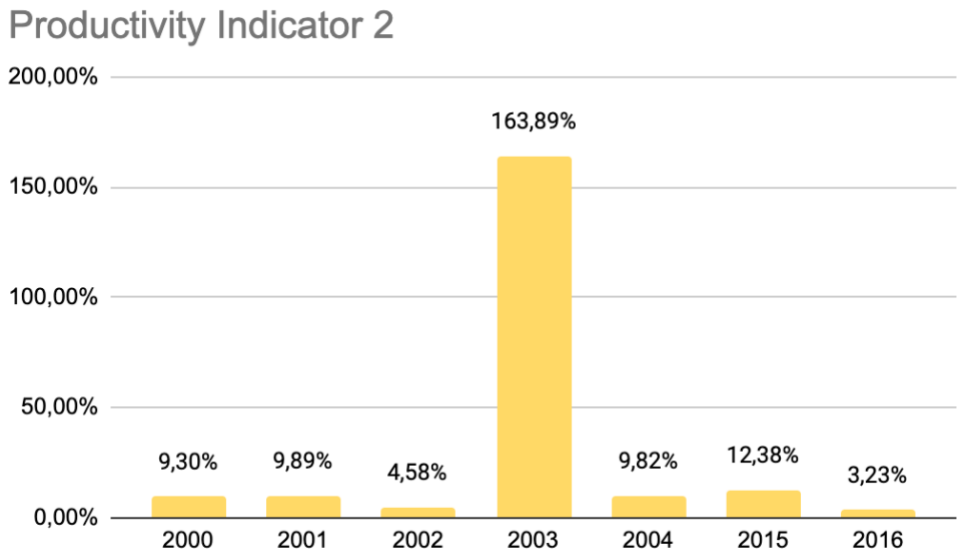

Figure 6. Productivity indicator 2
Source: Self-production

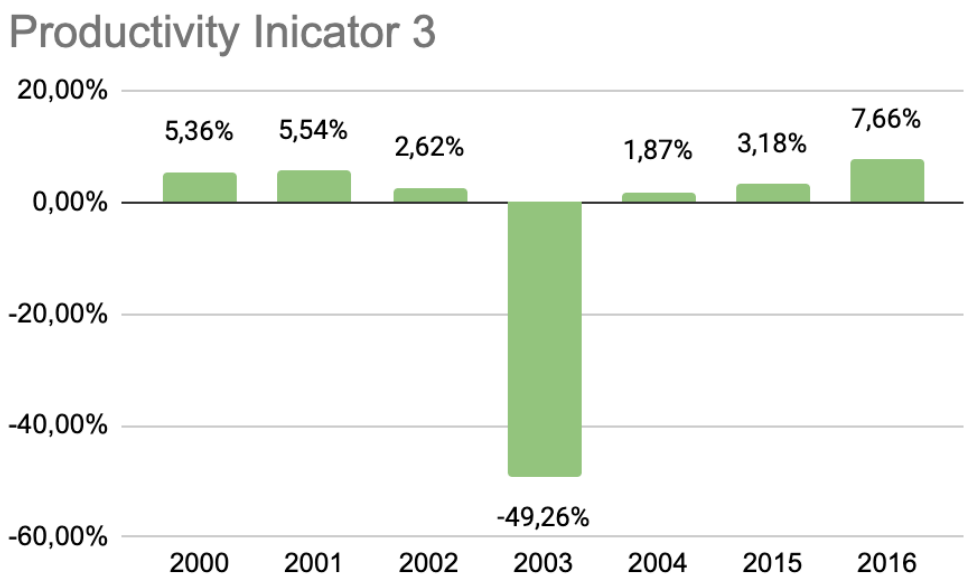

Figure 7. Productivity indicator 3
Source: Self-production

4.2. Results analysis

4.2.1. In depth interviews

In this section we will proceed to analyze the results obtained after processing the interviews with the managers and collaborators of the company. As was done in the presentation of results, these will be analyzed by topic and related to the concepts developed in the literature review.

In the first theme of importance of the ICT for the company it is identified that these have a fundamental role since they allow them to handle all the information that is generated within the company in a single place, which allows its easy access and later use. That is to say that

thanks to the implementation of the ICT the company is able to carry out all its activities, since it is able to process the data that are generated in each one of the areas to feed the different processes that allow that the company works. Therefore, it can be said that thanks to the system the company is able to efficiently combine its different resources to generate value and outperform it competitors as it is stated by Bonnet & McAfee. Which implies that for the company this type of technology is a catalyst for the strategies that are carried out and a driver of its competitive advantages.

When Servelec LTDA introduced the new system to the company change the way in which activities were carried out, that help them optimized the times they were spending doing some kind of activities, as for example the management of administrative task. In this sense this could be seen as an impact on the organization performs, because the company is spending less time and less energy, meaning they are doing in a better way. Which as said in the literature review is seen as productive because the company is capable to manage its resources in a better way.

4.2.2. Financial statements

It is evident a decreased in the added valued that the enterprise generated in 2003, a year that was identified as the adaptation period in the enterprise by the managers. Also, this is explained by the that after the implementation of an information system there is a period of

adaptation that momentarily truncate the productivity. In addition to this we must take into account that the added value generated by the company not only has to do with the productivity of workers, but also with the investments made by the company.

5. Discussion

This thesis has studied how the implementation of ICT impacted the productivity of Servelec Ltda, a Colombian company that has used this kind of technologies during a considerable time, which allows to make a comparison of its performance before and after. In this way this kind of study helps to broaden the current knowledge of the actual effect of the implementation of ICT in a SME and how these kinds of technologies are perceived by workers and managers. Although is important to have into account that this studied have a lot of limitations regarding the way productivity is measure, as is hard to consider all the factors that are involve.

In this sense this thesis tried to use a different method that helps to understand the positive link between ICT and productivity, as it has been said that is not clear because of various reasons. For example, that most enterprises do not look to include ICT on their process with the clear purpose of improving productivity (Kijek & Kijek, 2019). Thus, this studied tried to address this issue by comparing the historical performance of Servelec Ltda, with a standard

set of measurement as are financial statements, which set the basis to know how the performance have change over time. This information was also justified with the perception of various of the employers who on daily basis use the system of the enterprise and see a boost on their performance because of it. This means that a different method have been used than the once that were found in the literature review.

On the other hand, this study addressed a field that has not been explore much in Colombia. Which could probably be use for future studies in this topic and help small and medium size enterprises find new ways to include this kind of technologies in their processes. Also, this study could help to have an insight on how this companies could measure productivity and identify the areas that are decreasing their performance. So, it is expected this thesis could be used as an example on how an ICT strategy could be implemented even in small companies, where sometimes technology seems out of reach because of its cost or the difficulty of its integration.

But as mention before this study has multiple limitations, including that not all factors that impact productivity have been considered. This could mean a bias in the results, which is important to explore in more depth in future studies. In such a way that the role of ICT in all business processes or even in the culture of the company can be clearly seen. Also, it would be interesting to explore how these kinds of technologies impact in different ways different types of industries, as in this thesis it was only observed an automatization company, where the environment requires the company to be at the forefront of technology and its use for the different processes. In this sense, in future studies it should be consider a bigger sample to

facilitate comparisons and stablish some common patterns that help implement solution in a more extended way.

So, this thesis is relevant for the company since it allows it to understand in a deeper way how the processes carried out are related to its information system and understand what actions it can take to improve the company's productivity. Thus, is recommended that the managers look a way to expand the effect that the implementation of this kind of technologies can have on different areas of the company, as it can help to identify areas where process have bottle necks, or something is not running in a proper way. Also, innovate in the way information is captures in such a way that decisions are taken in a more data driven way.

In addition is recommended to make an update of the system to get faster results and make processes more agile, so that the company can respond in a more agile way to changes in the environment. Possibly increasing its flexibility and its chances of survival. However, all these changes must be aligned with the strategy to really have a significant impact on the company's performance. This is important to understand, because as mentioned in the literature review SMEs in Colombia contribute greatly to the economic growth of the country, but at the same time have a high mortality rate.

6. Conclusion

ICT systems have become a fundamental piece of the development of the modern world as it facilitates the transformation of information into knowledge. Which allow companies to improve processes, be more productive and take better decisions. All of this to maintain their position, survive and cope with the uncertainty of the market. In this sense it is important to analyze how this type of technologies influence the productivity of a Colombian SME, like Servelec LTDA, because they constitute a large part of the national industry and play a huge role in the economic growth of the country. In this way, is essential to understand the variables that influence their productivity and development to take measures that ensure a good performance and growth.

In this way this investigation aims to fill the gap existing in the Colombian literature about the impact that ICT has on SME, as there just a few studies about the subject. To do this, the investigation tried to answer how the implementation of an ICT could improve the productivity of a SME in Colombia, based on the particular case of Servelec LTDA. Where through an exploratory investigation we tried to identify the variables influenced by the system and the importance it has for the development of the company's activities. In addition to this, through the analysis of the company's financial statements, an attempt was made to establish the real impact on the company's productivity.

Identify the variables that can improve the performance of the company in the future, because in the measure that are identified as an information system impacts productivity in which areas can be made later adjustments that allow a better performance of the company and generate better results. See how increased productivity can generate a change in the company's strategic position or can become a source of competitive advantage within the company. As well

as investigating issues of the influence of these types of systems on quality. By performing more specialized qualitative analyses it will be possible to detect the areas in which more work is needed to benefit from this implementation. It is also possible to explore more areas such as the impact of the information system on customer relations.

The system facilitates communication between the different areas of the organization since the users can generate information from a department of the organization, upload it to the system and then it can be used by another user of the company to do their job. Thus, the company has at all times available information for the development of all its activities. Here you can see that the system improves productivity by reducing the time that a user needs to perform his work. In addition, if the information is available at all times, the user can take much less time to perform. As well, makes the users able to do their work in much less time since the information is available at all times.

The users of the system spend much less time in the development of mechanical activities that allow them to develop activities that generate greater value to the company and translate into better results, as is the case with sales. For example, the salesperson takes much less time to obtain information from a customer, which allows him to offer a much more personalized service and ensure the sale of the service. In other words, the time spent (input) has a greater impact on sales (output) which ultimately results in increased employee productivity. Finally, the coordination between sales and service activities can be scheduled.

In the investigation there is important to notice that the managers and the employees recognized that it is important to make adjustments and improvements to the system in order to have better results, as sometime the system used in the enterprise has some lagging, that make

too difficult to work with it, and make employees lose time, which finally lead to a little decreased on their productivity.

It out of reach of the study to make a quantitive analysis of how the productivity of the company has changed since the implementation of the system, although this kind of study will help to have a better understanding of what changes the company could make to take advantage of this kind of system Using other type of productivity indexes that could show how the system could impact the different areas of the company and to what extent.

The company can then perform more advanced productivity measurements so that the actual impact of ICT implementation on a company of this size can be measured, and the company can make better decisions regarding changes or improvements to the system. In the same way, the company can start to evaluate other possibilities that will allow it to exploit more the advantages that this type of implementation has.

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