

Analysis of the relationship between IT and Industry 4.0 technologies with internationalization and business performance

Análisis de la relación de TI y de las tecnologías de la Industria 4.0 con la internacionalización y rendimiento empresarial

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ABSTRACT

The impact of information technologies (IT) on organizations has attracted the attention of professionals and academics in recent years. In this article, since Industry 4.0 technologies have not yet been implemented at the same level as general purpose information technologies, they are analyzed separately to understand their relationship with internationalization and business performance. Through a survey of 168 companies in the city of Bogotá, Colombia, different regression analyses were performed according to a research model proposed to estimate the effects of the determined variables. It was evident that the companies with a greater use of IT present a higher degree of internationalization. Likewise, the proposed model demonstrates the direct relationship between the use of IT and Industry 4.0 technologies and business performance. The software R studio was used for statistical analysis.

Keywords: IT, Industry 4.0, internationalization, business performance

RESUMEN

El impacto de las tecnologías de la información (TI) en las organizaciones ha atraído la atención de profesionales y académicos en los últimos años. En este artículo, dado que las tecnologías de la Industria 4.0 aún no han sido implementadas al mismo nivel que las tecnologías de la información de uso general, se analizan de manera separada para entender su relación con la internacionalización y el rendimiento empresarial. A través de una encuesta a 168 empresas en la ciudad de Bogotá, Colombia, se realizaron diferentes análisis de regresión de acuerdo con un modelo de investigación propuesto para estimar los efectos de las variables determinadas. Se hizo evidente que las empresas con mayor uso de TI presentan un mayor grado de internacionalización. Asimismo, el modelo propuesto demuestra la relación directa entre el uso de TI y las tecnologías de la Industria 4.0 con el rendimiento empresarial. Para el análisis estadístico se utilizó el software R studio.

Palabras clave: TI, Industria 4.0, internacionalización, rendimiento empresarial

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Introduction

The contribution of IT in different organizational processes is well known. This is often analyzed from a theoretical perspective in terms of the investment that companies should make in this resource in order to increase their productivity, because the market is requesting it or the competition is already doing it. However, some companies are not clear about the true effect of these technologies within their organization. For this reason, quantifying the impact that IT has on business processes is essential to analyze its potential and challenges, and also to propose methodologies for its proper implementation. In this sense, the impact of IT on companies substantially improves business efficiency especially thanks to the use of the Internet, since it provides opportunities in different fields such as the development of new products and services. As a result, these technologies offer a wider market that contributes to distribution channels and customer service regardless of geographical distances. They facilitate contact between clients and suppliers, and provide improvements in the processing and storage of

organizational information (González, Alfaro-Azofeifa, and Alfaro-Chamberlain, 2005).

Currently, new technologies developed under the concept of Industry 4.0 have been incorporated. The use of these resources is a fundamental factor for the optimization of company processes. These technologies have evolved in different aspects, such as 3D printing, reverse engineering, big data, and artificial intelligence, which generates a huge

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impact of transformation in the manufacturing industry and services. They also facilitate consumer analysis, offering new business alternatives and giving companies the ability to adapt to market changes. (Lasi, Fettke, Kemper, Feld, and Hoffmann, 2014).

In this context, a new business management model based on technology is proposed (Lu, Riddick, and Ivezic, 2016), making information processing more effective and efficient, meeting the needs of the value chain from product design to customer service and involving all the parts who are interested in the product life cycle. (Garbi and Loureiro, 2013). With this advancements, one of the main goals of the use of IT in terms of cost optimization and reduction of deadlines is expected to be met, thus reaching new markets and mitigating risks in organizations (Cerezo-Narváez, Otero-Mateo, Rodríguez-Pecchi, and Pastor-Fernández, 2018). According to this, companies have turned these technologies into a resource of great strategic influence for the improvement of business performance, generating changes in the increase of their productivity and in their management model (Baena, Cano, Jarrin, and Pérez, 2014).

The use of IT has allowed companies to reach new international markets, offering benefits in efficiency, saving time and travel expenses, being an intermediary of assertive communication between two stakeholders, facilitating the construction of relationships, and providing negotiation alternatives (Baena et al., 2014). Internationalization is an opportunity for companies to be projected totally or partially into an international environment and different commercial flows (Leandro, 2009). The influence of IT on this activity can facilitate exports and favor the development of foreign trade operations that were only possible for multinational companies (Barber and Cobos, 2002).

To determine whether these aspects truly affect an organization, it is important to analyze their relationship with business performance. Studies on the relation between the use of IT and business performance have been especially aimed at understanding the so-called Solow paradox, which claims that the computer age can be seen everywhere but in the productivity statistics (Wilkesmann and Wilkesmann, 2018). Therefore, it has been considered important to determine the type of relation between IT, the technologies of Industry 4.0, and business performance.

It is important to understand that, due to the size of the company and the fact that some of the technologies of the industry 4.0 are still expensive, the penetration of these technologies has not been widespread. Although today's market offer has brought a wider range of solutions with options of all kinds, it is necessary need to measure the use of IT (general use technologies) and Industry 4.0 technologies separately in this study, while also avoiding the bias towards the low amount of information obtained from the analyzed companies.

That said, the objective of this study is to contribute to the literature and the business sector through the empirical demonstration of the relation between the use of IT and Industry 4.0 technologies in the degree of internationalization

and business performance. This analysis aims to demonstrate that companies who use these technologies to a greater degree will also increase in the afore-mentioned aspects.

The document begins with the theoretical background on the relation between IT, Industry 4.0 technologies, internationalization, and business performance, on which the fundamentals of this study are based. The second part presents the development, methodology, and the model used for analysis. Then, the results regarding the relation between the identified variables are presented. The study ends with the conclusions and contributions that can be offered in this field of research.

Framework

The conceptual and theoretical elements that guide this research are presented below, starting with the relationship of information technologies with internationalization, continuing with its relationship with business performance, and ending with the relationship of Industry 4.0 technologies with business performance.

IT and internationalization

Internationalization is defined as the entry of a company into new business beyond geographical limits. Companies that implement this expansion strategy can use IT to coordinate their resources and capacities through different markets that facilitate the realization of economies of scope, thus allowing companies to operate in several markets simultaneously. (Mai and Ness, 1999; Ray, Xue, and Barney, 2013). Thus, the bet on IT that companies make plays in favor of the use of some specific firm assets across the borders of the country (Chari, Devaraj, and David, 2007).

Some research shows that the development of efficient virtual relations through computers and mobile devices is a significant factor in the creation of more effective work relationships, regardless of distance (Aren, José, and Baena Rojas, 2013). The use of IT leads companies to build customer-supplier relationships during the process in question. As a result, this allows a better contact between the negotiators, providing multiple communication options (visual, verbal, or written), focusing on the importance of negotiation, saving travel expenses, and allowing better access to communication (Aren et al., 2013). In this way, through the interaction and behavior of these electronic media, companies integrate IT within their business structure as a channel of negotiation in internationalization, thus yielding more efficient results as opposed to traditional face-to-face negotiation and obtaining a faster offer.

The reviewed studies show that the impact on internationalization is a positive function of the level of IT investment made by the company (Chari et al., 2007; Liu and Ravichandran, 2008; McElheran, 2014). This impact could be significantly positive (for companies with high IT investment), significantly negative (for companies with low IT investment), or neutral (for companies with medium level with IT investment) (Chari et al., 2007).

Empirical research mostly relates internationalization to IT, as its expense or investment significantly complements this strategy and is generally related to business results. (Chari, Devaraj, and David, 2008; Esteben, 2007; Hu, Zhang, and Teng, 2011; Liu and Ravichandran, 2008; Ravichandran, Liu, Han, and Hasan, 2009; Shin, 2006). In these studies, investment in IT is evidenced as the most frequent way to measure this variable for analysis. However, this investment has been treated by the literature as a black box, and its impact on measured performance is considered within a narrow context, while the level of adoption and use of IT can place said investment in perspective (Devaraj and Kohli, 2003). For this impact to be evident within the processes of the value chain, it is considered appropriate consider the use of these technologies as a unit of analysis, which few studies are evident and has been suggested in others. (Devaraj and Kohli, 2003; Sandulli, Fernández-Menéndez, Rodríguez-Duarte, and López-Sánchez, 2012).

Hypothesis (H1.1). Companies with activity abroad (internationalization) have a higher level of IT use than companies that do not have activity abroad. **(H1.2).** Companies with a greater use of IT present a higher degree of internationalization.

IT and Business Performance

Since the end of twentieth century, there is a strong impetus for companies to adopt the Internet as a way to improve their business behavior. This has spread throughout most sectors of the economies of developed countries (Alwahaishi and Snášel, 2013). In this sense, some of the improvements that companies have experienced with the incorporation of IT refer to the coordination among collaborators, the ability to catalogue and share the base knowledge of the company, the expansion of traditional boundaries of the business areas, and the efficiency due to the processing of information and the promotion of innovation (Dewett and Jones, 2001). This reveals that IT is a key element within companies to ensure economic growth (K. S. Ravichandran and Lorenz, 2007), and they are a way to remain competitive by improving productivity, profitability, and quality of operations (Devaraj and Kohli, 2003).

Currently, companies can see the continuous search to achieve compliance with their objectives and improve their business performance. For this, the use of IT offers a positive impact on these factors, not only in terms of productivity, but also at the level of processes, quality of services, customer satisfaction, and innovation in the market (Brynjolfsson and Hitt, 2000). In addition, the use of IT meets the objective of improving business performance in aspects such as business strategies, service design, policy creation in the sector, implementation of informative websites, and other search alternatives for different partners and customers in the market (Barbosa and Ayala, 2017). Consequently, the effects of IT can influence companies not only in sales growth sales, but also in process standardization and optimization.

According to Patalas-Maliszewska (2012), the implementation of these technologies depends on the intention of a company

to achieve its strategic objectives (e.g. in the implementation of an ERP). In this sense, the aim is that through the implementation of information technologies companies can increase their productivity, profitability, efficiency of client relationships, human resources management effectiveness and improve the reliability of the financial reports.

On the other hand, a company's ignorance of these technologies prevents its growth, since the benefits of its use are not recognized. These benefits include the fact that IT leads to an increase in productivity by reducing costs; thus allowing companies to increase the quality and output of new products. (Brynjolfsson and Hitt, 2000). In this sense, the innovations achieved by IT have offered opportunities to improve processes and develop new business models and applications (Kim, 2013). IT also helps companies expand their competitive advantage potential by allowing them to carry out activities and products at a lower cost (Porter, 2015), extending the marketing potential of the company, facilitating the formation of business networks, and streamlining the transmission of information and knowledge regardless of distances (Vilaseca and Torrent, 2003).

Hypothesis (H2). The relation between IT and the performance of the company will depend partially on its IT usage, thus, a greater investment will encourage greater business performance.

Industry 4.0 Technologies and business performance

The term 'Industry 4.0' was coined in Germany with reference to the digital transformation of the industry, which came to be known as 'intelligent factory' or 'industrial internet', as well as to name the fourth industrial revolution (Morales, España, Zárate, González, and Frías, 2017). Thus, Industry 4.0 constitutes an easy alternative to adapt to changes in accordance with market demand, based on the interconnection of all elements, generating great satisfaction for customers and improving performance within companies.

The advancement of technology has accompanied the development of the industry from the early adoption of mechanical systems to support production processes, up to the current, highly automated assembly lines. It responded and adapted to the current, dynamic requirements and demands from the market. Under the concept of Industry 4.0, amazing growth in the advancement and adoption of information technology and social networks has increasingly influenced the perception of consumers regarding product innovation, quality, variety, and delivery speed (Lee, Kao, and Yang, 2014). The advancement of these technologies will allow the development of smart factories through innovation at each stage of the value chain (Matthyssens, 2019), as well as having a positive role in companies sustainable business performance and opening great opportunities for industries (Büchi, Cugno, and Castagnoli, 2020; Haseeb, Hussain, Ślusarczyk, and Jermisittiparsert, 2019).

According to industry and research experts, this industrial revolution was caused by the Internet, which allowed communication between humans and machines in cybernetic

systems through large networks (Frank, Dalenogare, and Ayala, 2019), giving rise to digital transformation within companies. This transformation has been directly supported in the development and use of technologies such as Big Data, with the ability to collect, store, and analyse large amounts of data; or the simulation of virtual industrial plant models with specialized engineering that allow management and control, as well as ensuring the quality of processes and products. Other technologies such as 3D printing, internet of things, cloud computing, wireless payment modes or recent advances in artificial intelligence, make the industry 4.0 have an increasingly greater penetration in organizations. The use of these technologies makes the flow of information between the production line, the level of business management and the management of the supply chain be more transparent and organized, reducing labour costs and providing a better working environment (Fatorachian and Kazemi, 2020; Lee et al., 2014).

Another important aspect of advancement in the technologies of Industry 4.0 is the integration of robotics, with the ability to be programmed to execute tasks at specific times and dates (Bahrin, Othman, Azli, and Talib, 2016). In this way, these advances have covered various fields such as biotechnology, genetics, and nanotechnology, giving a way to the development of artificial intelligence and additive manufacturing (3D printing), which implies a qualitative and significant leap for the companies in their value management chain (Mon, Del Giorgio, De María, Figuerola, and Querel, 2018).

Thereupon, companies have been structuring themselves in manufacturing by using computers connected to the Internet and in advanced analysis platforms, where they process data to produce final products. Likewise, the communication offered by these technologies is synchronized by means of devices that allow the connection of production plants, offices, and dependencies, where they can share information and communicate in real time, regardless of their location.

On the other hand, due to the size of the company and the high cost of some of these technologies, their adoption has not been easy. Such is the case of 3D printing, which in the beginning was a very expensive manufacturing and whose materials were very scarce. However, there are several types of materials compatible with this form of manufacture that are currently available. Nowadays, the market offer has brought a wider range of solutions with options of all kinds, which is why access to them has begun to be democratized. In this sense, SMEs implement the use of technologies that are within their reach, such as cloud computing, which has a great impact on the management of their information involving reduction of capital and operating costs regarding aspects such as database management, email management, business intelligence, customer relationship management, and business resource planning, among others. Through these tools, companies aim to demonstrate a competitive advantage in the manufacturing market, essentially in the smart industry for a better management and a positive impact on their business performance (Morales et al., 2017).

Hypothesis (H3). In accordance with the above, we can define the following as a study hypothesis: companies that have a greater use of Industry 4.0 technologies improve their business performance.

Thus, a general research model is presented which aims to relate the study variables and verify the hypotheses. These variables are the support for the design of the research instruments that were applied to the study sample. This model shows that the IT variables and technologies of Industry 4.0 affect the degree of internationalization and performance of companies. This can be seen in Figure 1.

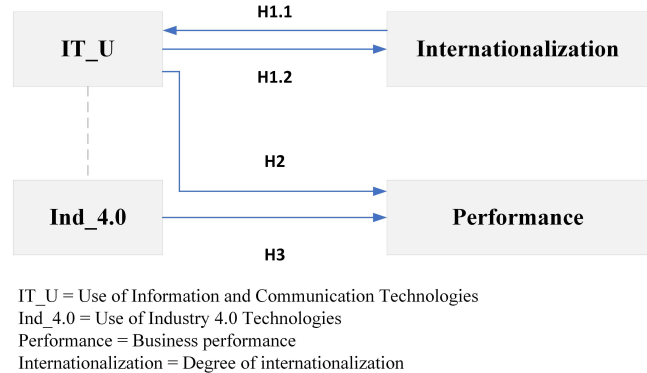


Figure 1. Proposed Research Model.
Source: Authors

Methods

This study was carried out through the implementation of a research instrument aimed at managers of SMEs established in the city of Bogotá D. C., Colombia. To collect the information, a structured questionnaire was used as primary source. This instrument was sent to managers of companies (to principal directors or to whom they delegate) established in the city of Bogotá, Colombia.

The sample was formed according to the obtained response rates and according to the characteristics defined in the population, discarding those companies that, by answering the questionnaire, did not comply with these characteristics. In total, 195 questionnaires were received, out of which 27 were cancelled because they were not properly completed. The final sample consisted of 168 companies that answered the questionnaire submitted in online and physical format, during the period from February to September, 2018 (95% confidence level, $pq = 0,50: 10,5\%$). From the obtained sample, 26,2% of the companies classified as Other Services; 19,1% as Information and Communications; 17,4% as Manufacturing Industries; 9,5% as Professional, Scientific, and Technical Activities; 5,2% as Accommodation and Food Services; and 4,3% as Construction with.

For the empirical analysis, the data set of the sample was analyzed by means of statistical tests according to the variables used. For the first Hypothesis (H1) a bivariate test was performed to verify the significant differences between

the uses of IT in two identified company categories. For this case, because the variable *IT_U* did not behave normally in the two categories, it was necessary to use a non-parametric test (Whitney U). Subsequently, the regression of ordinary least squares (OLS) estimated the relation between the use of IT and Industry 4.0 technologies with the degree of internationalization and company performance (Hypotheses 1.2, 2 and 3).

Measurement of variables

IT Use variable (IT_U)

The variable *IT_U* refers to the use that a company gives to the Information Technologies that it has implemented. Managers were inquired to determine how much a set of selected technological tools were being used according to the reviewed studies, including both IT and communications elements. The list of selected tools was suggested by the International Telecommunication Union (ITU) and the OECD, and identified in other studies (Albarracín, Erazo, and Palacios, 2014; Guzmán, Serna, de Lema, Enríquez, and Adame, 2010). This list includes the use of computers, internet access, web presence, e-mail, VoIP, social networks, e-recruitment, e-learning, online services to customers, e-commerce, electronic banking, ERP, SCM, CRM, technological surveillance, and e-government.

This variable consists of the arithmetic mean obtained from a five-point Likert scale, in which the directors indicated the level of use of each of the presented technologies. To validate this measure, the reliability of the scale was verified by Cronbach's alpha (0,932) and KMO (0,889), and communalities higher than 0,4.

Use of Industry 4.0 Technologies (Ind_4.0)

To measure this variable, some of the main technological tools of Industry 4.0 were identified (3D printing, cloud/client architecture, big data, intelligent machines, augmented reality, wireless payments, IoT). To this effect, the directors were asked to indicate what the level of use for each of the selected tools is. The list of tools was suggested by trends recognized by ITU studies. This variable consists of the arithmetic mean obtained from a five-point Likert scale. To validate this measure, the reliability of the scale was verified by Cronbach's alpha (0,842) and KMO (0,843), and communalities greater than 0,6.

Business performance (Performance)

Business performance refers to the level of success of a company (Chelliah, Sulaiman, and Yusoff, 2010). While performance in most cases is recognized in accordance with quantifiable measures such as income, sales, market share, etc., other measures are customer satisfaction, skill development, improvement of the workflow, etc. (Khan, Khalique, and Nor, 2014). This makes performance a multidimensional concept which depends on both financial and non-financial indicators, but the number of indicators

must be consistent with the strategic management style of the organizations (Muralidharan, 1997).

In this sense, the performance of the company WAS measured through the scale developed by Schuh, Potente, Wesch-Potente, Weber, and Prote (2014). This scale has been tested empirically and has produced solid reliability and validity. In addition, this measurement of the performance of the company involves data reported by the manager, who can examine the financial and non-financial dimensions of performance within the organization (sales growth, income growth, growth in the number of employees, net profit margin, product and service innovation, innovation process, product/service quality, variety of products/services, adoption of new technologies, and customer satisfaction). A Likert scale of five points was used to evaluate the performance in the most recent years of the companies. The use of this measure is appropriate in this study because it is convenient when studying small and medium size companies (Dess and Robinson, 1984) since they allow a broader definition of the performance of the company (Cronbach's alpha 0,890, KMO 0,791, and communalities higher than 0,6).

Internationalization

The internationalization variable was measured in two ways. There was a dichotomous categorical measure that identified two categories of companies: those that have international activity (1) and those that do not perform international activities (0). It was expected that companies with international activity have a greater degree of IT use. A second measure of this variable was a composite index suggested by Sullivan (1994) through the use of two indicators: the intensity of operations abroad (external sales ratio over firm total sales) and its geographic scope (number of countries in which the companies operate), these being the two most commonly used indicators to measure the scope of international operations (Tallman and Li, 1996). These two measures allow the proposed analyses to be carried out.

Results and Discussion

IT and Internationalization

Under Hypothesis 1.1, variables *IT_U* and internationalization were contrasted. To analyze the relationship between the variables of this hypothesis, a bivariate test was used in order to verify the significant differences between the use of IT in the two company categories (companies that have international activity and companies that do not present international activity). By means of the test for independent samples, the equality of means of the dependent variable in each of the defined categories was analyzed. If the assumption of equality of means is right it is assumed that the variables are independent, since the mean would be the same regardless of the company group. If the null hypothesis can be rejected, it is assumed that there is a relation between the variables.

Before this analysis, the distribution of the populations should be revised, which means that the samples must come from

populations distributed in a normal way. According to the size of the sample in this study, a Kolmogorov-Smirnov statistic was obtained below the level of significance established for the No category (0,017) and higher for the Yes category (0,200), with which it can be stated that the variable does not behave normally in both categories and makes it necessary to use a non-parametric test. This is shown in Table 1. One of the most used tests in this case is the Whitney U. It is a nonparametric test with which differences are identified between two populations based on the analysis of two independent samples.

Table 1. Descriptive analysis

	Type	N	Mean	Std. Deviation	Std. Error
IT_U	No	105	3,3679	0,6708	0,0651
	Yes	63	3,9120	0,7958	0,1021

Source: Authors

The average IT_U of the companies with international activity was higher than those without, in the sense proposed in Hypothesis 1.1. To check if this difference is explanatory, the value of asymptotic (bilateral) significance of the Z statistic (0,000) was analyzed. The Whitney U analysis led us to conclude that the null hypothesis was rejected and the mean IT_U is similar in both groups. With these values, it can be indicated that the companies that present a higher level of IT use are more likely to carry out activity abroad (Hypothesis 1.1). We decided to complement this analysis by determining if the level of IT use has a direct relation with the degree of internationalization. In this sense, Hypothesis 1.2, which defines this association, was raised. For this analysis, only companies with international activity (63) were taken to measure their degree of internationality, as stated above, through a composite index proposed by Sullivan (1994) and the use of two indicators: the intensity of operations abroad and their geographic scope. Specifically, principal components factorial analysis was used to reduce the two variables. This multivariate method suggests that these relations can be explained from a series of variables called factors, where the number of factors is much smaller than that of the actual variables (Piera and Carrasco, 2010).

For factor analysis to provide a useful composite index, it is necessary to correlate the two variables and load them into a single factor. For this case, the two variables had a correlation of 0,473 ($p < 0,00$) and were loaded in a component that explains 73,6% of the cumulative variance. Each variable presented a load of 0,858 in the extracted component. These results from the factor analysis indicate that composite measure is a useful index of internationalization. Having obtained the values of the variables, we proceeded to perform the correlation analysis of the two variables of interest, IT_U and degree of internationalization. The Correlation Coefficient (Pearson) had a positive value (0,336) with a statistically significant coefficient ($p = 0,008$), so it can be concluded that both variables are associated in the population from which the analysed sample comes, and that association shows a direct correlation. With these correlation values, it was possible to

complement the statistical study through linear regression analysis to evaluate this relation. To this effect, the following model was considered, using a linear regression by OLS (ordinary least squares). It is described using Equation (1):

$$\text{Internationalization level} = b_0 + b_1 IT_{U_i} + b_2 Size_i + b_3 Age_i + \varepsilon_i \quad (1)$$

The regression results (Adjusted $R^2 = 0,096$) indicate that 9,6 % of the variability of the degree of internationalization is associated with the use of IT. In turn, the ANOVA table showed that the variables are linearly related to a level of significance of 0,008 (Durbin-Watson 1,476). Likewise, a non-standard coefficient for UTIC of 0,108 was identified, with VIF values close to 1 (1,000). It is shown in Table 2. With these results, it can be concluded that the two variables are either associated or linearly related in the population from which the sample comes, and that the relation of the variables is direct. These results show that companies with a greater degree of use of IT have a greater degree of internationalization, thus confirming Hypothesis 1.2.

Table 2. Model summary

Model	R	R ²	Adjusted R ²	Std. Error	FChange	Sig. F Change
1	0,333 ^a	0,111	0,096	0,24944	7,590	0,008

a. Predictors: (Constant), IT_U
b. Dependent Variable: Internationalization

Source: Authors

The results of these analyses indicate that information technology is a key factor for companies to expand their markets beyond the borders of their home country. Since greater internationalization implies an increase in the number of countries in which the company operates, information processing promoted by IT is especially relevant to take advantage of a greater geographical reach. It is necessary to highlight in the results that, despite a positive and highly significant influence of the use of IT on the degree of internationalization (which is in line with the findings of (Chari et al., 2008; Honarmand, 2011)), it should be moderate when extrapolating the results of this analysis, since although they indicate a real relationship between the predictors and the response variable, the adjusted R^2 is low. Similarly, it is important to note that, contrary to what was expected, no significant influence of company age and size was found.

IT and Business Performance

The study assumes that the greater the use of IT, the higher the performance of a company. For this analysis, a correlation analysis was performed between these two variables: IT_U and Performance. It can be seen in Figure 2.

It has been determined that the correlation coefficient (Pearson) has a positive value (0,422) with a statistically significant coefficient ($p = 0,000$), so it can be concluded that both variables are directly associated. With these correlation values, it is possible to complement the statistical study

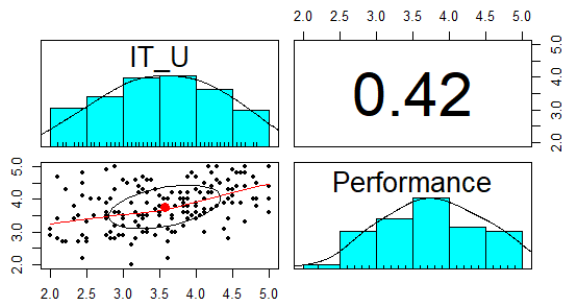


Figure 2. Statistical Analysis of IT_U and Performance.
Source: Authors

by means of a linear regression analysis to evaluate the relation. The Kolmogorov-Smirnov test showed that the data meet the requirements of normality. The following is the analysis model, using a linear regression by OLS. The variables size and age of the company have been included in the regression model for control purposes. This is described using Equation (2)

$$\text{Performance} = b_0 + b_1IT_{U_i} + b_2Size_i + b_3Age_i + \varepsilon_i. \quad (2)$$

The determination coefficient R^2 (0,256) indicates that 25,6% of the variability of business performance is explained by the model. The ANOVA statistic (analysis of variance) has a low value of 0,000, which confirms that the variables are linearly related. This is shown in Table 3. A non-standardized coefficient is also identified for IT_U 0,331, with values close to 1 VIF (1,024) in the variables used, which indicates that multicollinearity did not affect the results. These results show that companies with a higher degree of IT use have a higher level of business performance. Therefore, Hypothesis 2 is confirmed.

Table 3. Model summary

Model	R	R ²	Adjusted R ²	Std. Error	FChange	Sig. F Change
1	0,506 ^a	0,256	0,242	0,58071	18,818	0,000
a. Predictors: (Constant), IT_U						
b. Dependent Variable: Performance						

Source: Authors

With this analysis, it has been possible to statistically demonstrate this relation, concluding that companies that make greater use of IT will see it reflected on a better performance of the businesses they have entered. These results are in agreement with Aydiner, Tatoglu, Bayraktar, and Zaim (2019) regarding the use of technologies and information systems to improve business performance. It is important to clarify that, in order to obtain the expected results, it is necessary to align these technologies with the business strategy so that it has better influence on business performance, which also agrees with Luftman, Lyytinen, and Zvi (2017). As expected, the size variable shows a significant value (0,010), corroborating the importance and influence of this characteristic on the use of technologies and business performance, which, in turn, is in accordance with

what was exposed by Spinelli, Dyerson, and Harindranath (2013). In contrast, the age variable does not represent a significant value.

Industry 4.0 Technologies and Business Performance

Hypothesis 3 assumes that, as companies have greater use of Industry 4.0 technologies, business performance will also be higher. For this analysis, a correlation analysis was made between these two variables: Ind_4 and Performance. It can be seen in Figure 3.

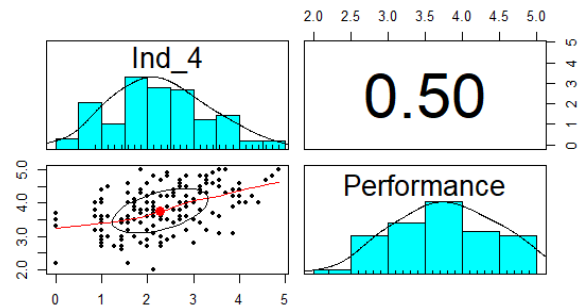


Figure 3. Statistical Analysis of the Industry 4.0 Technology and Performance.
Source: Authors

It has been determined that the correlation coefficient (Pearson) has a positive value (0,500) with a statistically significant coefficient ($p = 0,000$), so we can conclude that both variables are directly associated. The Kolmogorov-Smirnov test showed that the data meet the requirements of normality. The following is the analysis model, using a linear regression by OLS (ordinary least squares). The variables size and age of the company have been included in the regression model for control purposes. This is described using Equation (3):

$$\text{Performance} = b_0 + b_1Ind_{4.0_i} + b_2Size_i + b_3Age_i + \varepsilon_i. \quad (3)$$

The adjusted R^2 coefficient of determination (0,302) indicates that the model explains 30,2% of the business performance variability. The ANOVA statistic (analysis of variance) has a low value (0,000), which confirms that the variables are linearly related. It also identifies a non-standardized coefficient for IT_U 0,294 (VIF 1,062). This is shown in Table 4. These results show that companies with a higher degree of use of Industry 4.0 technologies have a higher level of business performance, thus confirming Hypothesis 3. These results would be in line with the evidence in the literature claiming that the incorporation of these new technologies to optimize processes of companies, as well as their use within organizations, will have a positive impact on business performance (Dalenogare, Benitez, Ayala, and Frank, 2018; Haseeb et al., 2019).

Regarding the control variables, only company size was found to be significant, which is in line with what was stated by Horváth and Szabó (2019), in that large companies are more prepared to implement Industry 4.0 technologies which provides opportunities for performance measurement and evaluation.

Table 4. Model summary

Model	R	R ²	Adjusted R ²	Std. Error	F Change	Sig. F Change
1	0,561 ^a	0,315	0,302	0,55732	25,116	0,000

a. Predictors: (Constant), ind_4.0
b. Dependent Variable: Performance

Source: Authors

To complement this analysis, according to the descriptive results obtained in the sample, the average Industry 4.0 Technology use in the analyzed companies is 1,90 out of 5,0. This indicates that such technologies continue to have low implementation levels, which agrees with other studies (Stentoft, Jensen, Philipsen, and Haug, 2019). By analyzing the use of each of these technologies, and their possible influence on business performance, it is observed that cloud computing (3,1) is the one with the highest valuation. This indicates a commitment by companies to this technology. Likewise, companies have been increasing the use of the Internet of Things (2,09). Contrary to this, the use of autonomous robots (1,25), and additive manufacturing (1,33) present the lowest valuation and show a still incipient development within the companies and industries of the region. One of the main reasons why such technologies have lower use may be high purchase prices and low availability of supplies necessary for their operation.

Conclusions

The results derived from this research contribute to the theories based on the relation between the use of IT and the strategies developed by companies to implement their internationalization activities to improve business performance. The study shows that IT technological resources and Industry 4.0 technologies provide tools for organizations to boost foreign markets and positively stimulate business performance.

The theoretical framework presented in this document contributes to IT managers and those responsible for internationalization strategies in decision-making within the company to leverage these resources, promote greater internationalization of the organization, and improve business performance.

Companies make the decision to internationalize for various reasons (to grow, increase sales, gain prestige or promote an innovative product, among others), but there are still many that consider internationalization a privilege that only large corporations can access. However, SMEs can leverage the use of IT and reap their great benefits to develop strategies that allow them to reach other geographical areas and improve their performance.

It is then evident that the development of new information and communication technologies has allowed companies to get closer to their customers, responding more quickly to their needs and adapting to the dynamic environment of the current economy. These technologies (internet access, e-recruitment, e-learning, online services to customers,

e-commerce, electronic banking, ERP, SCM, CRM, IoT, augmented reality, artificial intelligence, 3D printing, etc.) are driving new business models and major changes in the internal structure of organizations that aim for internationalization and performance improvement.

After the application of the analysis model in the variables of this research, we verified that companies with a greater use of IT have a higher rate of internationalization, unlike companies that do not use it within their business model. Thus, the impact of these technologies influences the knowledge of new markets abroad and the opportunity to be identified in an international context.

According to current trends in the use of emerging technologies and the results obtained in research, we found that an increase in business performance is characterized by the use of Industry 4.0 technologies (with cloud computing and Internet of Things being increasingly used), which transitions companies towards an intelligent industry management, while also involving changes in manufacturing and process management for business development and growth.

Future research can focus on the specific analysis of the relation between each of the identified technologies and the internationalization indexes and the financial and non-financial elements of business performance.

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