

Strategies used by SMEs to adapt to Industry 4.0

Estrategias utilizadas por las PyMEs para adaptarse a la industria 4.0

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Abstract

In the last decade, organizations around the world have acquired a great interest in adapting their processes to an Industry 4.0. The objective of this research is to identify and analyze the strategies implemented by some Latin American and European companies in order to be competitive. The methodology used was a systematic review, with a search for information where databases such as Redalyc, Scielo, Dialnet, CONRICyT and ScienceDirect were included. 17 of 7,945 articles were selected for review, published in a period from 2015 to 2020. As a result, 12 studies carried out in Europe and 5 in Latin America were analyzed, 29% were carried out with a qualitative approach, 23% quantitative, 24% mixed and 24% case studies. The results indicate as strategies, the creation of awareness in i4.0, the generation of laws and regulations that benefit SMEs in this sense, generate cybersecurity schemes, promote research and technological development, and generate alliances with universities. It is concluded that the main recommended strategy is training in the use of technological tools so that they can understand the general panorama and become familiar with their use.

Resumen

En la última década, las organizaciones de casi todo el mundo han adquirido un gran interés por adaptar sus procesos a una industria 4.0. En esta investigación se tiene como objetivo identificar y analizar las estrategias que implementan algunas empresas de América latina y Europa para poder ser competitivas. La metodología utilizada fue una revisión sistemática, con una búsqueda de información donde se incluyeron bases de datos tales como Redalyc, Scielo, Dialnet, CONRICyT y ScienceDirect. Se seleccionaron 17 de 7,945 artículos para su revisión, publicados en un periodo de 2015 a 2020. Como resultado se analizaron 12 trabajos realizados en Europa y 5 en América latina, el 29% fue realizado con enfoque cualitativo, el 23% cuantitativo, 24% mixto y 24% estudios de caso. Los resultados indican como estrategias, la creación de conciencia en la i4.0, la generación de leyes y normas que beneficien en este sentido a las PyMES, generar esquemas de seguridad cibernética, promover la investigación y desarrollo tecnológico, y generar alianzas con las universidades. Se concluye que la principal estrategia recomendada es la capacitación en el uso de las herramientas tecnológicas para que se logre comprender el panorama en general y se vayan familiarizando con su empleo.

Industry 4.0, SMEs, Strategies

Industria 4.0, PyMEs, Estrategias

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Introduction

The fourth industrial revolution or Industry 4.0 came to drastically revolutionize the way businesses are managed, mainly affecting small and medium-sized companies (SMEs), where it should be noted that it is the growing integration of the economies of the entire world. In the world, only about 10% of Latin American SMEs export part of their production, in Europe the fraction of exporting SMEs amounts to at least 40% of the total (ECLAC, 2019).

On the other hand, the United Nations [UN] (2018) mentions that SMEs generate approximately 60 or 70% of employment in the world and it is for this reason that SMEs are essential in the economic development of a country. The Organization for Economic Cooperation and Development, or as it is well known OECD (2019), issued a publication where it argues that in most of the countries that comprise it, their economies are made up of SMEs but that, unfortunately, even with all those figures and regardless of their contribution to society and the world, they have to fight a great battle especially through their strategies to adapt to new forms of production and marketing of goods and services.

It is for this reason that the main objective of this research is to identify and analyze the strategies implemented by some specific small and medium-sized companies in Latin America and Europe, in order to concentrate them in a single document and see the possibilities that SMEs have of being competitive in this industry 4.0, for this it is necessary to develop some points that are relevant before entering fully into the analysis of these strategies.

Development

Industry 4.0

Throughout history, technological development managed to grow surprisingly and exponentially, all with the aim of improving industrial processes.

Thus, the changes that occurred from this were baptized as "industrial revolutions", something which can be defined as the transformation process that occurs in a period of time in the economic as well as the social part and is generally always accompanied by technology and innovative processes (López, Lovato and Abad, 2018).

The origins of the industrial revolutions that have arisen throughout the world, just to mention some authors such as Diaz (2018); Echeverría and Martínez (2018); López, Lovato and Abad (2018); Martínez, Catache and Huerta (2018) and finally Jacquez-Hernández and López (2018), agree that the so-called Industry 1.0 revolution that includes the end of the 17th century and the beginning of the 18th century (1784 to 1850 approx.), Consisted of looking for alternative energies finding in steam a perfect source to mechanize productivity, which gave way to the industrial revolution 2.0 approximately from 1850 to 1920, where mass manufacturing, assembly lines and division of labor originated. From this stage one of its most representative exponents was Mr. Henry Ford, to whom series production is mainly attributed. For 1960, a great leap was made in terms of technology since a stage in which production began to involve bioengineering, robotics, and it was where the term TIC's and the so-called Industrial Revolution 3.0 or Scientific Revolution arose, to give step to the term that is developed, the industrial revolution 4.0 (I4.0) that is accompanied by digital and cyber physical spaces or systems.

I4.0 brings with it a wide range of possibilities such as the internet of things, augmented reality, robotics, automated manufacturing, 3D printing, digitization, just to name a few. However, most of the time, companies and especially SMEs, do not know how to respond, that is, they have the problem of not being able to implement the idea of an I4.0 and have the limited capacity to adapt them to their strategies (Carro, Flores, Flores, Hernández, 2019; Collaborative Environments 2020; Jacquez and López, 2018;).

Position of SMEs in I4.0

SMEs are currently full of changes and uncertainties, all this as a result of I4.0 to the degree of paying greater attention to certain areas that directly impact to determine their competitive capacity, however, SMEs have to be able to develop all their adaptation capacities and to compete in increasingly extensive, dynamic and demanding markets (López, 2018).

It is clear that the objective of many entrepreneurs when migrating their activities to an automated industry is to dominate their competition and not only reach new markets, that is why in this context it is necessary to consider a hypothesis in which it revolves the present investigation; SMEs are able to compete if they adapt their strategies to an industry 4.0. But before going fully into the subject and answering the hypothesis, it is necessary to explain the context in which they are found, and that is that SMEs, although we regularly identify them as small and medium-sized enterprises, must take into account their legislative concept, and that is that from the moment they register with the SAT in Mexico, they have a series of rights and obligations, as well as the possibility of accessing specific financing channels (Gómez, 2016), which would allow them to implement various growth strategies, among them the migration to an I4.0 scheme.

On the other hand, statistically speaking, small companies are those that have a workforce of less than 50 workers and that their business volume or balance is less than or equal to 10 million pesos, it should be mentioned that this varies according to the country, while that medium-sized companies will have less than 250 workers and a business volume less than or equal to 250 million pesos (Peña and Bastidas, 2004).

As mentioned, SMEs are the engine of countries and to glimpse the panorama according to Romero (2016), countries such as Bulgaria, Czech Republic, Estonia, Croatia, Poland or Slovakia, SMEs contribute more than 50% of employment in the formal sector, while in Argentina it represents 70% of formal employment; in Brazil, 60%; in Chile, 86% and in Mexico, 48%, all these data just to mention a few.

What is clear to us is that poor, rich, powerful countries, all and without any distinction, can be affected by the competitiveness of their SMEs and as already mentioned, in one way or another they are immersed in the fourth industrial revolution, where customers tend to rapidly change their tastes and preferences, spontaneously changing products or services that meet their new requirements, that is why it is necessary for SMEs to be constantly changing and periodically modify their strategies and above all to adapt them to their new environment, that is, they make changes in essential areas such as production, promotion, marketing, and distribution, placing greater emphasis on their finances based on a conceptual scheme of Industry 4.0, with the purpose of keeping their customers and thus prevent them from migrating to the competition (Esteves, 2000).

It is worth mentioning that the adaptation of SMEs to an industry 4.0 is reiterated, not as something of life or death but as a transition process that must begin as soon as possible, since according to a study carried out by Buisán and Valdez (2017), mentions that 40 out of 100 SMEs in the next 10 years and that are not digitized will end up disappearing.

Methodology

The systematic review work has been carried out through an adaptation of the model proposed by Kitchenham et al. (2010), although initially it was introduced as a methodology applied to computational sciences, it is extremely easy to adapt them to other areas such as this case in social sciences, the present methodology consists of three fundamental steps, which are: planning, execution and results .

Planning

This section describes in detail the different search processes that were carried out and that allowed the compilation of each of the articles that were later presented in this research, it should be noted that everything was carried out in a systematic way, taking the following steps:

- Determine database: At this stage, the information bases were carefully selected and, due to the recent nature of the subject, five databases were chosen that have reliability, support by the scientific community and credibility, which are, Redalyc, Scielo, Dialnet, Conricyt and ScienceDirect.
- Keywords: for this research, certain keywords were proposed in order to find specific articles which were ("Industry 4.0", "Industry 4.0", "Fourth industrial revolution", "I4.0", "SME in industry 4.0", "SMEs industry 4.0").
- Search fields: most of the selected databases have "advanced search", which were chosen the same parameters for all, which were, "year of publication", "type of research", "discipline" and "language".
- Inclusion criteria: The criteria classification list was carried out as follows: articles that are from "2015 to 2020", publications that are exclusively "research articles", research that is "quantitative", "qualitative", "Mixed" or "case study", articles in "English" or "Spanish", which belong to the discipline of "social sciences", and finally publications that are exclusively from "Latin America" and "Europe".
- Exclusion criteria: articles whose publication year is less than 2015, all publications that are not scientific articles will also be omitted, such as book chapters, books, papers, etc., research articles whose methodology does not is the one mentioned above and finally, languages other than Spanish and English will not be accepted, for example, Portuguese, Mandarin, etc., since it should be noted that articles from other continents other than those mentioned above will not be accepted even if they contain valuable information.

Execution

In this stage of the process we undertake the task of locating the articles that will contribute to the results of this research, once entering the databases of Redalyc, Scielo, Dialnet, Conricyt and ScienceDirect, we enter the inclusion and exclusion parameters as required. which gives us a figure of Redalyc with 3225, Dialnet with 770, Scielo with 1200, ScienceDirect 2550 and Conricyt 500, which were rigorously reviewed and filtered by country of application since it should be remembered that only research that has been done would be studied In Latin America and Europe, Redalyc 35, Dailanet 20, Scielo 25, Conricyt 15 and ScienceDirect 50 remained as a result, resulting in 145 articles that were subsequently removed 4 articles that were repeated and two more to be filtered in Portuguese, finally analyzing the 139 publications that were analyzed in detail, to which a criterion of specificity of results was added, where there were 17 articles that contributed They were directly related to the results of this research, leaving Redalyc with 1, Dialnet 6, Scielo 2, Conricyt 0 and ScienceDirect 8, the process mentioned here is represented in Figure 1.

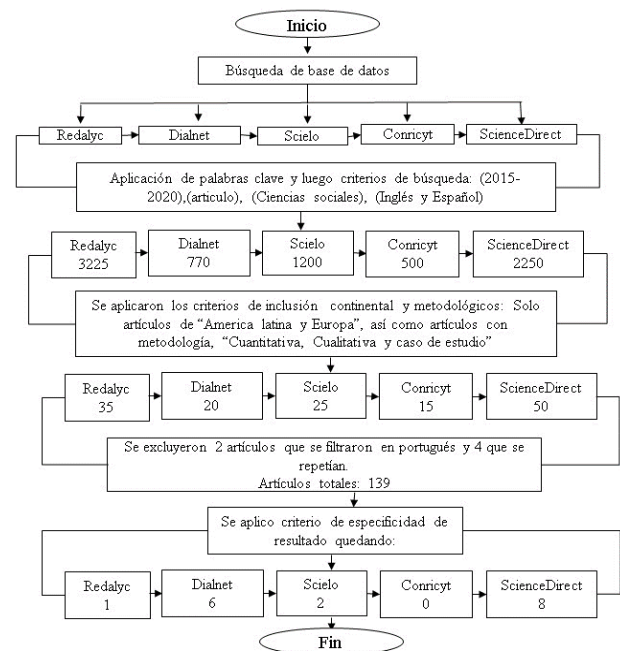


Figure 1 Search process

Note: Own elaboration based on Martínez-Usoralde, Gil-Salom and Macías-Mendoza (2020).

Results

The following section presents the results of the 17 publications that met each of the inclusion criteria, then a table with general data of the selected articles is shown.

No.	Title	Author (s)
A1	A Qualitative Study on Industry 4.0 Competitiveness in Turkey Using Porter Diamond Model	Erboz (2020)
A2	The Italian experience in implementing Industry4.0	Gaddi
A3	Digital Transformation of Industry 4.0	Garibaldo and Garbellini (2020)
A4	Peruvian technological mipymes to 2030. Strategies for their insertion into industry 4.0	Sampietro-Saquicela (2020)
A5	Reflections on Industry 4.0 from the Basque case	Gutarra yValente (2018)
A6	Three-stage maturity model in SMEs towards Industry 4.0	Navarro and Sabalza (2016)
A7	Business strategies in family SMEs in northern Mexico	Ganzarain and Errasti (2016)
A8	The impact of the fourth industrial revolution on the social and productive relations of the plastic industry Implastic S. A. In guayaquil-ecuador: challenges and perspectives	Sánchez, Hernández and Zerón (2017)
A9	Towards Industry 4.0: a SWOT-based analysis for companies located in the Sorocaba Metropolitan Region (São Paulo State, Brazil)	López, Lovato and Abad (2018)
A10	Industry 4.0 technology implementation in SMEs and A survey in the Danish-German border region	Silveira, Perles, Veiga, Azevedo, Lopes (2020)
A11	An empirical evaluation of industry 4.0 applications of companies in Turkey: The case of a developing country	Yu and Schweisfurth (2020)
A12	Industry 4.0 Adoption challenges and benefits for SMEs	Yüksel (2020)
A13	A Strategic Model to take the First Step Towards Industry 4.0 in SMEs	Masood and Sonntag (2020)
A14	Measures for a successful digital transformation of SMEs	Pinto, Silva, Costa, Campilho, and Pereira. (2019)
A15	Getting Small Medium Enterprises started on Industry 4.0 using retrofitting solutions	Volker Stich, Violett Zeller, Jan Hicking, Andreas Kraut (2020)
A16	A Survey on Digitalization for SMEs in Brandenburg, Germany	Niemeyer, Gehrke, Müller, Küsters, and Gries (2020)
A17	Digitalization, business models, and SMEs: How do business model innovation practices improve performance of digitalizing SMEs?	Kilimis, Zou, Lehmann and Berge (2019)

Table 1 General data

Source: Own elaboration

The selected articles were studied in detail, resulting in some of the following statistics.

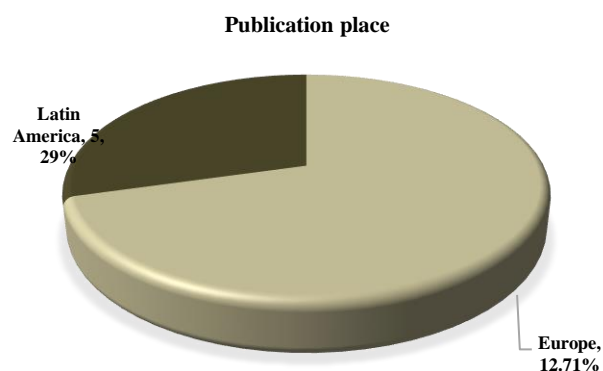


Figure 2 Publication place

In the methodology section, the inclusion parameters that were taken to determine the articles were shown and one of them was the place of publication taking only Latin America and Europe as a reference, resulting in that most of the works and for To be precise, 71% occur in Europe, in other words, Europeans are the ones who propose a large number of strategies to support SMEs, unlike Latin America, which barely reaches 29%.

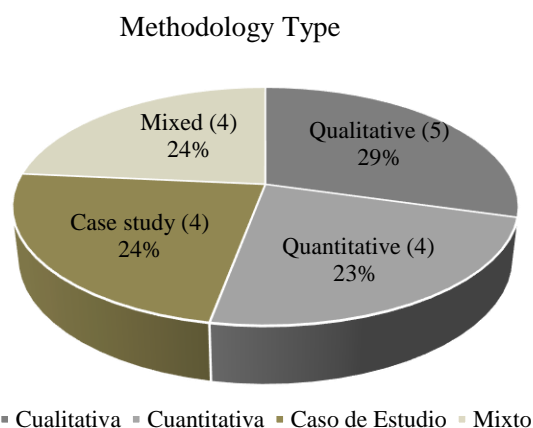


Figure 3 Types of methodology

In Figure 3, four different types of methodology are displayed which will be analyzed from the highest to the lowest, starting with the qualitative ones, which had 5 publications, reaching 29% where Erboz (2020) participates, where 14 were made Semi-structured interviews and managers of companies with more than 50 employees were interviewed, the investigation took 1 years to be carried out and finally the interview is divided into three parts: activities of the company, industry 4.0 and the competitiveness model.

Gaddi, Garibaldo and Garbellini (2020), with the help of the Italian government, conducted an interview with 30 Medium companies, where they interviewed managers, as well as partial samples of workers and delegates, their interview was divided into two parts: the smart factory and smart products, the investigation took a time of 2 years to carry out. Sampietro-Saquicela (2020), carried out a focus group with 100 companies, which were divided into two groups where there were medium-sized and small companies, the topics discussed were industry 4.0, automation and intelligent products, attended by managers or directors of their respective company, the work took 6 months to complete; Ganzarain and Errasti (2016), carried out an investigation lasting 1 year and 3 months, where they used a semi-structured interview with 43 managers of Spanish companies and the topics addressed were automation, maturity models and industry 4.0. Niemeyer, Gehrke, Müller, Küsters and Gries (2020), also held focus groups with owners, supervisors or managers of small or medium-sized companies, where they addressed the topics of the internet of things, sensors and automation.

Regarding the quantitative studies, which, like the qualitative ones, had 29%, authors such as Sánchez, Hernández and Zerón (2017) stand out, where the data collection was a questionnaire with a Likert scale that was applied in Ciudad Victoria and Tamaulipas, with a sample of 84 and 106 respectively, For their part, Yu and Schweisfurth (2020), collected information through a questionnaire, contacted 4669 SMEs from Germany and Denmark, of which only 669 decided to participate, which were sent by mail. Yüksel (2020), carried out and validated a questionnaire with a five-point Likert scale, which was sent to 1000 small and medium-sized companies in Turkey, whose objective was to compile the implementation processes of industry 4.0. Masood and Sonntag (2020), evaluated the challenges and benefits of industry 4.0, carried out a specific questionnaire for SMEs in the United Kingdom, the purpose of which was to collect information on the technology they used to propose strategies.

Finally, Bouwman, Nikou and De Reuver (2019), conducted a survey only to SMEs that had technology or at least used big data, therefore the questionnaire began by asking what technology they applied and if the filter did not pass, it was discarded, applied exclusively to managers, the questionnaire was translated into 11 languages as it was applied in 11 countries and finally the data was collected since 2017.

On the other hand, the works with mixed methodologies reached 24%, among which are the authors Gutarra and Valente (2018), this research was divided into two parts, the first a survey of 277 companies to determine the relevant variables of the Industry 4.0 and subsequently a semi-structured interview was conducted with 9 experts from two different countries on the variables that were relevant. Silveira, Perles, Veiga, Azevedo and Lopes, (2020), carried out a focus group as a preliminary phase to collect data from experts on the subject of industries 4.0, to then compare with the literature, which allowed them to elaborate a questionnaire which was applied to 227 medium and small companies in Sao Paulo Brazil. Pinto, Silva, Costa, Campilho, Pereira. (2019), divide their work into two phases, the first a questionnaire where it served to collect information on automation, internet of things, production and processes and ERP interface, which they applied to medium-sized companies with a sample of 350, to later focus on a single company as a case study which was divided into 8 phases: process study, decompose processes into simple tasks, system compatibility, income evaluation, implementation, improvement evaluation, evolution and evolution of processes. Navarro and Sabalza (2016), conducted a questionnaire to determine which companies were in the process or interested in Industry 4.0, with which they subsequently conducted 25 in-depth interviews with managers, directors or owners of SMEs.

Regarding the methodology, the case studies were also analyzed, the methodology with the lowest percentage of publications. On this study method, López, Lovato and Abad (2018), developed the case of the company Inplastic SA with a history of more than 25 years which has become a medium-sized company in Ecuador, and the purpose of the study was the determination of the processes that can be improved with industry 4.0 with a vision for 2030, proposing at the end a series of strategies to implement.

Stich, Zeller, Hicking and Kraut (2020), studied 11 different cases of companies with employees less than 250, among which manufacturing and production stand out, all this in order to obtain a valid and proven maturity model, the process was documented and evaluated by external evaluators. The study developed by Kilimis, Zou, Lehmann, Berge (2019), tried to explain the lag suffered by small and medium-sized companies, which is why they focused on 12 companies whose names remained anonymous, detailing the benefits they would have if they migrated to an industry 4.0

In Table 2, the strategies found, proposed and used by the different authors mentioned above will be presented in synthesis form to conclude with a brief explanation of them and give way to the discussion and conclusion.

No.	Author (s)	Strategy (s)
A1	Erboz (2020)	<ul style="list-style-type: none"> Employee training on the industry 4.0. Elaboration of a strictly detailed roadmap and invest in ID.
A2	Gaddi, Garibaldo y Garbellini (2020)	<ul style="list-style-type: none"> Training for SME owners to understand I4.0 Approach with the government for credit support Alliance of SMEs between different countries, Eliminate worthless activities that can be performed automatically and automate them with technologies
A3	Sampietro-Saquicela (2020)	<ul style="list-style-type: none"> Warehouse automation. Investment in smart machines. vertical and horizontal integration through Tic's

No.	Author (s)	Strategy (s)
A4	Gutarra y Valente (2018)	<ul style="list-style-type: none"> Establish a culture of entrepreneurship based on technologies Seek help from the government to promote regulations that encourage SMEs to use technology in their processes.
A5	Navarro y Sabalza (2016)	<ul style="list-style-type: none"> Basque industry 4.0 strategy: staff training, KET Strategy: Key Enabling Technologies which refers to investing in ID, Long-term machine cost reduction
A6	Ganzarain y Errasti (2016)	<ul style="list-style-type: none"> Diversification to products with technology Create a roadmap
A7	Sánchez, Hernández y Zerón (2017)	<ul style="list-style-type: none"> Diversification to products with technology Create a roadmap
A8	López, Lovato y Abad Peña (2018)	<ul style="list-style-type: none"> Technological renewal of machinery every certain time Incorporate the internet of things to carry out more efficient processes Conduct market research incorporating big data, Control in real time the entire production system through ERP or SAP Staff training.
A9	Silveira, Perles, Veiga, Azevedo y Lopes (2020)	<ul style="list-style-type: none"> Make alliances with universities to incorporate new human talent and train them in an industry 4.0 Partnerships with companies to obtain software or licenses, Seek alliance with companies from advanced countries.
A10	Yu y Schweisfurth (2020)	<p>Of the companies that investigated none showed interest in adopting an industry 4.0, for which they propose:</p> <ul style="list-style-type: none"> Implement training for SMEs so that they understand the benefits of I4.0
A11	Yüksel (2020)	<ul style="list-style-type: none"> Implement credits for the acquisition of machinery
A12	Masood y Sonntag (2020)	<ul style="list-style-type: none"> Introduce technology as possible, leaving a budget for your purchase
A13	Pinto, Silva, Costa, Campilho y Pereira (2019)	<ul style="list-style-type: none"> Reorganize SMEs Detect repetitive activities and automate it in order to reduce cost in the long term, Assign a budget for the purchase of machinery, implementation of big data or cyber physical systems

No.	Author (s)	Strategy (s)
A14	Stich, Zeller, Hicking y Kraut (2020)	– Implementation of ERP or SAP to supply chains and thus have information in real time, Introduce the internet of things
A15	Niemeyer, Gehrke, Müller, Küsters y Gries (2020)	– Training of staff of new tools, – Sensor introduction
A16	Kilimis, Zou y Ulrich (2019)	– Raise awareness of an organizational culture towards Industry 4.0 – Start using ERP systems to plan activities and reduce costs.
A17	Bouwman, Nikou y Mark (2019)	– Apply a maturity model in SMEs to determine if they are ready to enter an industry 4.0 and if they are not, adapt their organization and then begin to incorporate technology, cyber physical tools, the Internet of things or work in the cloud.

Table 2 Synthesis of strategies found

Source: Own elaboration

It is necessary to clarify that each of the strategies presented in Table 2 are those that are already being implemented or beginning to be used, therefore they are not generalized, as is the case in Spain or Italy where the government supports SMEs since they are, as mentioned previously, the backbone of its economy, and therefore create support for them. Another important point is ERP or SAP, which are systems that control, plan and manage information in real time, especially in the production area, which is aimed at medium-sized companies (Stich, Zeller, Hicking and Kraut, 2020). On the other hand, although some of the strategies can become risky or expensive, such as requesting a loan, acquiring machinery, diversifying the product or investing in research and development, it is necessary that SMEs carry out a prior evaluation of the organization to determine if it is prudent to take the step, as Bouwman, Nikou and De Reuver (2019) point out.

Conclusion

As a conclusion, it can be said that the objective of this research was fulfilled, which was to identify and analyze the strategies implemented by some companies in Latin America and Europe in order to be competitive and as a result we obtained 17 jobs where 12 were from Europe and 5 from America Latin America where something really interesting happens since in European SMEs you can see the support from the government, such as the strategy promoted by the government of Spain called "Connected Industry 4.0", in which they provide endless SMEs tools and programs so that they can implement in their businesses and together face this new era (Buisán and Valdez, 2017), meanwhile in Latin America, the country of Argentina is the one that makes the largest investment in technology, even though 76% of people believe that Industry 4.0 is an enemy and not an ally since they think that most of the jobs will be displaced by new technologies, following gone through Mexico and lastly Peru (Sampietro-Saquicela, 2020).

However, despite the fact that Latin America has low automation rates compared to Europe, SMEs from both continents need all the necessary support, so Braña (2020) mentions some strategies that countries could implement in order to develop the potential of business and thus migrate to an industry 4.0, a) create awareness of i4.9, b) establish financial incentives, c) create laws and regulations that benefit SMEs, d) take care of cyber security, e) promote ID f) alliances with universities to develop new human talents.

What, if it is a fact, is an opportunity that very few understand that it can enhance their company in the long term, since it is a gradual process, and therefore some authors propose as an initial strategy a training of the benefits and management of new technological tools so that they can understand the general panorama and become familiar with the tools, which is why 8 of the 17 publications propose this strategy, being the most cited and one of the cheapest.

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