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Implementation of Lean Manufacturing Tools to Mitigate and Increase Productivity in MSMEs in the City of Popayán

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Abstract

Every day the industrial sector is constantly advancing in the development of micro, small and medium-sized enterprises (MSMEs), which is reflected in the high participation that these companies have in the economy, since globally they represent 90 % of companies also generate between 60% and 70% of jobs and are responsible for approximately 50% of global GDP. It is for this reason that it is important to keep track of either the application of tools that help improve or their performance to meet the desired objectives.

It should be noted that these institutions have a direct relationship with empirical knowledge, which is why they ignore the methods and methodologies for the development of different activities. This is why many entrepreneurs, when they are in their beginnings or in search of new horizons to revolutionize the market or the sector, do not take into account certain models or management systems and that is where they "venture into a sector without knowing what the market needs are; They do not investigate the strengths and weaknesses of their competitors, thus ignoring process problems just because the business is running; they do not use resources efficiently; They do not minimize activities that do not add value, among others. " Therefore, organizations must focus on the development of new techniques that help them optimize their processes, maintaining product quality and thus achieve lower costs through innovative high-impact methodologies such as Lean Manufacturing and six sigma.

Keywords
Lean Manufacturing, Six Sigma, MSMEs, Competitors, Development, Optimize, Innovative Methodologies.

1. Introduction
MSMEs present a high degree of ignorance of methods and methodologies for the development of the different activities necessary for the production process, which is why they venture to seek efficiency and productivity through trial and error; For this reason, many errors have been made, which is why the search for alternatives that contribute to an improvement and also adapt to the reality of the company begins.

The implementation of Lean Manufacturing tools can help mitigate productivity problems in MSMEs, since they focus on the elimination of waste and the design of optimization of processes and logistical operational systems; such as overproduction, waiting times, transportation, rework, inventory, movements, defects and unused knowledge of production processes, managing to reduce costs and improve production efficiency.

In order to identify these problems, it is necessary to carry out detailed monitoring of the critical processes that have the greatest impact within organizations, whether in terms of the production and quality of products or services. With the objective of analyzing each process for And that is where the processes are analyzed, the goals or objectives are defined, solutions are proposed, with the purpose of implementing the solution in this case the tool.

Thanks to each monitoring that is carried out, the purpose is to measure and monitor the results of the implementation of the solutions to evaluate their effectiveness and quality improvement, in turn taking into account the six sigma method, its main objective being in reducing variability in processes and, ultimately, minimizing defects or errors; in order to make adjustments if necessary. In order to maintain the focus on improvement, it continues to make a constant commitment to improve production processes.

It is important to keep in mind that the implementation of Lean Manufacturing and six sigma tools is not an easy or quick process and a sustained commitment is required to achieve significant results. However, if implemented correctly, these tools can help MSMEs improve their productivity and competitiveness in the market.

In Popayán, MSMEs face various problems that can hinder their operation and development. Some of the problems that often have a serious impact in the department of Cauca, centered on the metropolitan area of Popayán, are usually due to lack of financial access, since Many MSMEs struggle to access adequate financing sources to invest in their growth and low-cost or cheap labor operations. At the same time, the lack of access to technology and the need for training can limit the competitiveness of MSMEs in an increasingly digitalized business environment.

1.1 Objectives

General objective

Implementation of Lean Manufacturing tools to mitigate and increase productivity in MSMEs in the city of Popayán.

Specific objectives

- Design a tool that allows determining and prioritizing the changes present in the processes of the mypes under study in the city of Popayán.
- Implement Lean Manufacturing tools in the companies under study according to the results obtained from the application of the tool.
- Evaluate the results obtained from the implementation of Lean Manufacturing tools in the companies under study in the city of Popayán.

3. Method

To carry out this methodology, the seven seedlings and their productivity factors were first identified, in order to develop the questions related to the productivity factors. Saying

For this reason, the quantitative and qualitative qualification of each question was determined, with the purpose of giving a weight to the quantitative results to determine which is the change that most affects the company.

According to the most characteristic feature, the company is given options for Lean Manufacturing tools that they can use to increase productivity. In order to reach the next step in terms of carrying out a final diagnosis where the questions are answered again, after the implementation of the DIMAF tool; concluding with comparative graphs of the initial and final diagnosis.

4. Competition of MSMEs in Colombia

Micro, Small and Medium Enterprises (MSMEs) in Colombia face several challenges to compete in the market, focused on the industrial sector, where they depend on potential competitors, suppliers, buyers. Some of the main challenges are the access to financing, because MSMEs have difficulties obtaining certain resources, since the requirements to obtain loans are stricter compared to large companies in the country.

Today, we live in a century of constant evolution to be at the forefront of what is happening in the market. The lack of innovation in MSMEs is very common, allowing other companies to take greater advantage and take advantage of new opportunities that arise in the market with the vision of innovating. On the other hand, the competencies found within this sector of MSMEs often do not have access to the training and education necessary to improve their business skills and knowledge, which can limit their ability to compete in the market, generating low productivity. , due to lack of resources, lack of training and lack of adequate technology. Despite the constant challenges faced by MSMEs, they have advantages such as being agile and flexible, which allows them to quickly adapt to market changes. Additionally, the Colombian government has implemented policies and programs to support MSMEs, such as special credit lines and business training and advice programs.

5. Results and discussion

5.1 Importance of MSMEs in Colombia

Micro, Small and Medium Enterprises (MSMEs) are an important engine for the economy of cities in Colombia. Likewise, it has the implementation of mitigation strategies and increased productivity. Contributing significantly to its growth and development, since it represents more than 99% of the country's companies, generating approximately 79% of employment and contributing 40% to the Gross Domestic Product (GDP) (ANIF, 2021).

Confecámaras carried out a study indicating that "The economic activities where companies present the greatest risk of failure are: accommodation, restaurants, services and commerce (REATIGA, 2018). " For this problem, some strategies are presented that can be useful for MSMEs in this sense, such as the implementation of quality management practices to improve efficiency and reduce costs, which in turn can increase productivity.

Thanks to the arrival of industry 4.0 in recent years, the interaction between man and machine has emerged in terms of automating processes through digital and technological tools, thus providing help to MSMEs in terms of reducing time. and production costs, with the purpose of increasing productivity. They also intend to implement new and good practices that allow access to technologies or resources that are not available in the company, which facilitates increased efficiency for the organization's competitiveness. MSMEs are promoted through the development of new products or services, being key to the growth and advancement of MSMEs in the cities of Colombia.

- **Implementation of Six Sigma in Colombia**

The implementation of Six Sigma in Colombia has become a tool increasingly used by companies in the search for greater efficiency and competitiveness. Where relevant aspects stand out, such as initiatives for the creation of the continuous improvement program, which seeks to promote quality in companies. At the same time, offering training and training in Six Sigma through training and certification programs.

Six Sigma has been successfully implemented in various sectors in Colombia, including manufacturing, financial services, health and education, because they have reported significant improvements in quality, efficiency and cost reduction, which has resulted in an increase in customer satisfaction and greater competitiveness, thus being a valuable tool.

Companies in Colombia still face challenges in adopting this methodology, such as resistance to change, lack of resources, and the need for a quality-oriented organizational culture.

5.2 Economy of MSMEs in the city of Popayán

Popayán is a Colombian city with a diverse economy that covers several sectors, where Micro, Small and Medium Enterprises (MSMEs) have an important presence in different economic areas related to each other. Some of the main economic sectors in which MSMEs stand out in Popayán are commerce, restaurants, tourism, agriculture, among others.

Commerce is one of the most important sectors in the economy of Popayán, the majority of MSMEs have a strong presence in said market in the city. Because there are a large number of retail stores, supermarkets, restaurants and other commercial establishments that are owned by small business owners.

In addition to the sectors mentioned above, MSMEs also have an important presence in other economic sectors in Popayán. Some of them are:

- Manufacturing industry: Because, in the city, there are several small companies dedicated to the manufacturing of textiles, footwear, crafts and other manufactured products.

- Construction: MSMEs in industrialization also have an important presence in the construction sector in Popayán, since, with the constant expansion and development of the city, these industries are dedicated to the construction of homes, commercial buildings and public works.

- Technology and communications: In the city, there is a growing community of technology and communications companies, many of which are small businesses. These companies are dedicated to the

production of software, application development and other services related to technology and communications.

- Energy and environment: MSMEs also have an important presence in the energy and environment sector in Popayán. There are several small businesses dedicated to renewable energy production, waste management and other environmentally related services.

The importance of these sectors in the Payan economy benefits MSMEs from providing an important presence in various economic sectors in Popayán and the department, which indicates their importance for the economy of the city and region. These small businesses contribute to the economic and social development of the city and are an important source of employment and income generation for the local community. All with the aim of offering excellent local employment opportunities, which contributes to improving the quality of life of the population. Furthermore, MSMEs are a source of innovation and creativity in the local economy, which helps maintain a dynamic and diverse economy.

5.3 Proposed improvements

Implementation of management tools in MSMEs in the city of Popayán

In the business sector, according to the size of the companies registered in the Cauca Chamber of Commerce, there is the number of registered merchants by economic activity in the department of Cauca, with a total of 25,652 registered microenterprises. Highlighting a significant number of businesses that are dedicated to commerce with 52.05% (13,352) the rest are dedicated to various activities (CÁMARA DE COMERCIO DEL CAUCA, 2023).

On July 1, 2022. According to DANE, the business sector of Popayán has more than 14,800 microbusinesses that generate close to 21,000 jobs, contributing significantly to the economic development of the region (Figure 1) (Lozano, 2021).

Cauca business density

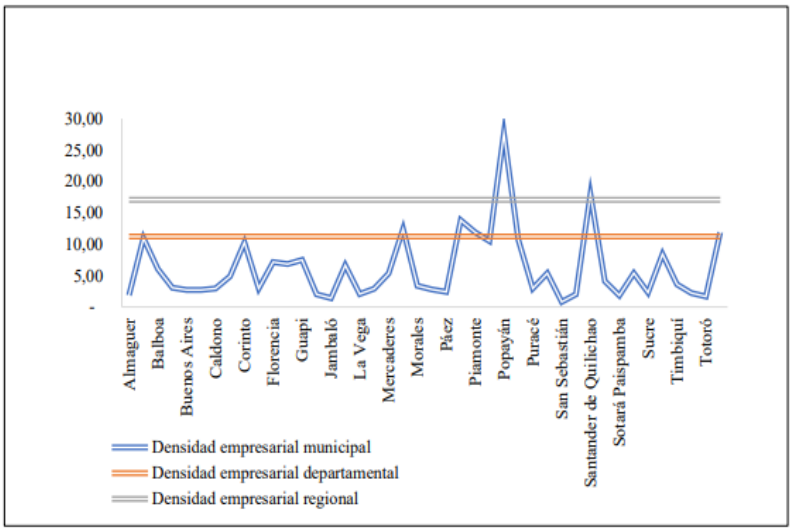

Figure 1. Preparation (GEE-SIC) from DANE (2021)

It is important that the city's SMEs use the resources available in the region to obtain better effectiveness in the products or services that the market needs, with the purpose of generating added value to differentiate themselves from the competition, applying factors that allow improvements and changes for the company.(VIVEROS, 2016)

These factors that allow such improvement are the implementation of management tools (Lean Manufacturing), giving a focus to the importance of MSMEs in the capital of Cauca, Popayán. These tools can help improve company efficiency and productivity, reducing costs and increasing customer satisfaction.

To carry out said implementation, it is necessary to take into account these processes in which it allows companies to identify and visualize the methods that are carried out in the company. Resulting in the discovery of inefficient processes and bottlenecks, in order to eliminate or improve them.

There are multiple control tools that allow companies to control inventory levels and minimize waste, such as Kanban. By using this tool, MSMEs can improve efficiency and reduce costs associated with excess inventory. Within this implementation is the 5S tool, since it is used to improve organization and cleanliness in the workplace.
This tool focuses on eliminating clutter, improving efficiency, and reducing errors in production processes.

Tools like Just in Time focus on producing and delivering products just in time. By using this tool, MSMEs can reduce costs associated with storage and inventory management, and improve the efficiency of production processes. It is important to keep in mind that the implementation of Lean Manufacturing tools in Popayán MSMEs must be adapted to the specific needs and characteristics of each company. Furthermore, the implementation of these tools must be accompanied by a culture of continuous improvement and constant training to ensure their long-term success.

It is true that the implementation of engineering tools and the improvement of production processes can have a very positive impact on SMEs and MSMEs in the city of Popayán. In many cases, these companies may be operating with limited resources and inefficient processes, which can hinder their ability to compete with other larger, more established companies. Implementing process improvement tools can help these companies identify and eliminate waste in their production processes, increasing efficiency and reducing costs. This, in turn, can lead to an improvement in the quality of your products and services, which can help attract and retain customers. Furthermore, as should be taken into account, there are a large number of SMEs and MSMEs in Popayán, so an improvement in the efficiency and production capacity of these companies can have a positive impact on the local economy. By helping these companies stay competitive and grow, they can create more employment opportunities and help drive the economic development of the city.

5.4 Validation

Lean Manufacturing

Lean Manufacturing is a production methodology that focuses on eliminating waste and optimizing processes to increase efficiency, quality and customer satisfaction. It originated in the automotive industry in Japan in the 1950s and 1960s, and has since spread to many other industries and countries.

The term "muda" refers to any activity in a production process that does not add value to the customer. These activities can include everything from unnecessary waiting to excessive movements or defects in the final product. By eliminating or reducing these wastes, companies can improve their efficiency and reduce their costs.

To achieve this, Lean Manufacturing uses tools and techniques such as Kaizen (continuous improvement), Kanban (inventory control system), Just-in-Time (just-in-time production), Poka-yoke (error prevention), and further. These tools focus on identifying and addressing the root causes of shedding in a production process.

The methodology described in the text focuses on identifying the most important change in a production process and selecting the most appropriate Lean Manufacturing tool to address it. However, it is important to remember that molts are interconnected and removing one can have an impact on other areas of the process.

Thanks to this powerful Lean Manufacturing methodology, it can be used to improve efficiency and reduce costs in production. Identification and removal of molts is a key component of this methodology, and there are many tools and techniques available to achieve this goal.

- **(creation or development of the dimaf tool prototype)**

The DIMAF tool is an application software in Excel. It was created through the relationship that exists between lean manufacturing and six sigma. It is made up of 7 variables and 47 productivity factors, which are related through a series of questions to understand waste. most outstanding of each organization. The following phases were taken to develop the prototype:

1. Determination of seedlings and identification of productivity factors.
2. Preparation of the questions.
3. Prototype development.

- **Determination of molts.**

The process begins by identifying the seven seedlings and their productivity factors, developing questions related to each of these factors. Then, a quantitative and qualitative evaluation of each question is carried out to give weight to the quantitative results and determine which is the change that most affects the company.
Once the most important change is identified, Lean Manufacturing tool options are offered that can be used to increase productivity in relation to that change. These tools can include Kanban techniques, Just-in-Time, Poka-yoke, and more.

To carry out the implementation of said management tool, as a research study method, a pilot test was developed where the methodology was implemented to identify and address the "seven seedlings" or waste, in a production process through the application of Lean Manufacturing tools. These seven changes are: overproduction, waiting time, transportation, unnecessary processing, excessive inventory, unnecessary movement and defects.

Finally, a final diagnosis is carried out where the questions are answered again after the implementation of the selected tool, to evaluate the impact and effectiveness of the implemented solution. This methodology is a systematic and structured way to identify and address waste in a production process, using Lean Manufacturing tools to increase efficiency and reduce costs.

6. Conclusion

- The implementation of the different engineering tools, and the making of proposals to achieve an improvement, will positively impact the SMEs and MSMEs of the city of Popayán, since they will be able to obtain a base and different options that they can implement to achieve their goals. objectives and goals. In addition, the capacity to produce and deliver their products more efficiently will be developed, bringing each of the institutions closer to satisfying the needs of their clients.

- It should be noted that the percentage of micro, small and medium-sized companies in the city is high, so by implementing mechanisms that promote an improvement in their production processes, the company will be able to remain in the market for a long time. Generating with this a maintenance and reduction of unemployment rates and a boost to the Payanesa economy.

- The implementation of engineering tools and the improvement of production processes can be very beneficial for SMEs and MSMEs in Popayán, which can help improve the quality of products and services, increase efficiency and reduce costs, and contribute to development. economic and the reduction of unemployment in the city.

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