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Methodology For The Application Of Six Sigma In Smes In Guanajuato

Methodological Approach

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***Abstract*— Six Sigma is a methodology based on the analysis of data and metrics that studies the iterative processes of companies and aims to bring quality to a level close to perfection, minimizing errors. This method has been very popular in large companies because it generates significant changes in production costs and product quality. The application of this methodology in SMEs has not represented a great benefit since they find a series of restrictions and limitations that hinder their effective implementation. This paper shows a methodology to follow for the implementation of Six Sigma in SMEs, adapting to the needs and characteristics of this type of companies in the state of Guanajuato.**

Keywords*— *Six Sigma, SMEs, costs, quality, methodology

I. INTRODUCTION

Companies are now required to develop and implement innovation-based strategies and increase productivity levels, quality and resource efficiency to remain competitive [1]. Due to their size, SMEs face a number of significant challenges, such as growth and scalability. For this reason, they are very sensitive to sudden changes in the economy, since the slightest change in the market can slow down their growth and negatively affect sales [2]. This problem arises from the lack of commitment to leadership, as well as financial and human resource limitations, lack of a culture of continuous improvement, lack of understanding of the importance of methods and lack of commitment to the execution of the process [3]. In recent years, Mexico has witnessed the development and growth of small and medium-sized enterprises (SMEs), has experienced a great boom thanks to government support and the growth of new policies for small and medium-sized enterprises with up to 250 employees and at least 15 to promote the growth of new companies and promote economic growth and reduce poverty in Mexico [4]. According to the National Statistical Directory of Economic Units (DENUE), of the INEGI, in its respective report for November 2021, in Guanajuato there are 272 thousand 559 companies [5]. This is why Guanajuato has become one of the key factors in the country's economic development by developing trade relations and encouraging foreign investment [6]. The application of the Six sigma methodology allows to improve the production capacity and provides stability in the processes, through the monitoring and control of daily activities, reducing the variability of resources and waste, seeking customer satisfaction [7]. According to the above there is a large area of opportunity for the implementation of strategies that help improve competitiveness and operational performance, In this work we want to propose a methodological approach that allows the effective development of the six Sigma methodology in SMEs in Guanajuato, based on the DMAIC process that consists of Define, Measure, Analyze, Improve and Control, This method, by correctly generating and analyzing data, allows companies to make decisions not only based on intuition or feelings, but also on facts arising from data analysis. It should be noted that the Six Sigma quality level is not necessarily achieved in all processes of an organization, as there may be products or processes that do not have a significant impact on customer satisfaction and acceptable performance levels [8].

II. THEORETICAL FRAMEWORK

Through a literature review we were able to show that there are not many applications of the six sigma methodology in small and medium-sized companies; and mainly we do not find many focused on the state of Guanajuato. However, the literature review allows us to identify the steps to follow for the implementation of this methodology to small and medium-sized enterprises. We find some authors who have worked with the same methodology showing a series of steps to follow for the implementation of Six Sigma in SMEs, taking into account the barriers that arise for the implementation of this methodology in these types of companies [9]. [3] Proposes a methodology for the implementation of an integrated approach validated in an SME dedicated to the manufacture of wooden furniture, adapting to the needs and characteristics of this, the methodology to be applied consists of four phases: where the first establishes the key factors in which SMEs must prepare to implement LSS; secondly, the identification of areas for improvement and definition of a portfolio of projects is proposed; thirdly, the implementation of prioritized projects; and finally, the evaluation of the results obtained. According to [10], to identify the problems of SMEs, they must be classified into two approaches: the external approach that are of the macroeconomic type and where the SME has no influence on their solution; and the internal approach, problems derived from the management of the business. To successfully implement the Six Sigma technique, it is

necessary that all workers involved in the process are well trained and possess the appropriate knowledge. Thus, implementation is carried out from top to bottom [11]. Methodologies such as Lean and Six Sigma have granted important benefits to large companies, the first through a gradual reduction of activities and elements that do not add value to the organization and the second as a way to make projects that improve quality and reduce costs [12]. In the studies to identify the problems of SMEs, these are classified into two approaches: the external approach that are of the macroeconomic type and where the SME has no influence on their solution; and the internal approach, problems derived from the management of the business. Some authors have developed a framework or guide to follow for the implementation of Six Sigma in SMEs, the implementation of Six Sigma throughout a company can take place through five phases, starting with the evaluation of the readiness for implementation until the sustainability of the benefits achieved [13].

After identifying various approaches, a fundamental method has been developed for a successful implementation of Six Sigma in SMEs. By applying DMAIC it starts with the identification of the problem, followed by the measurement of the process performance. These target variables are identified and, using appropriate analytical tools, a plan based on potential predictors is created to identify adjustments to the improvement process and finally process improvement operations are supported by the implementation of effective control plans.

III. METHODOLOGY

The proposed methodology for the implementation of Six Sigma in SMEs in Guanajuato consists of a series of consecutive steps, illustrated in Figure 1.

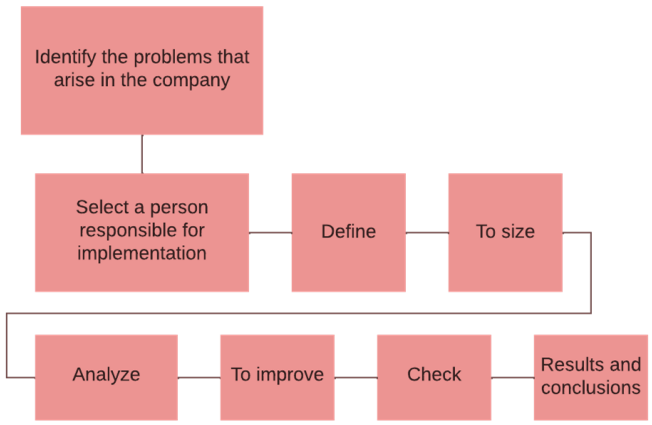

Figure 1. Methodology for applying Six Sigma

In the first stage the identification of the problems that arise in the company is carried out, by detecting the problem we find processes to improve we can also have a retrospective of each of the processes that are carried out, this leads to the optimization of the processes. In the second stage, a person must be selected who will be responsible for implementing and ensuring the proper application of the methodology, this is defined by the fact that the Six Sigma approach is rigorous and requires a commitment to leadership throughout the organization. In the following stages the methodology is applied the deployment of the DMAIC method is carried out. Each stage of the process will undergo the necessary adaptations for its implementation in the SME. The process begins with the definition of a problem, followed by the measurement of the company's performance, the analysis of the data, the improvement and finally the taking of control actions that allow to sustain the improvement.

At the definition stage, potential Six Sigma projects are identified, which must be evaluated by management to avoid underutilization of resources. Once the project is selected, its mission is prepared and the most appropriate team is selected, assigning it the necessary priority. The measurement stage consists of the characterization of the process by identifying the key requirements of the customers, the key characteristics of the product (or variables of the result) and the parameters (input variables) that affect the operation of the process and the characteristics or key variables. From this characterization, the measurement system is defined and the capacity of the process is measured. In the third stage of analysis, current and historical results data are analyzed. Hypotheses about possible cause-effect relationships are developed and tested using relevant statistical tools. In this way, they can confirm the determinants of the process, that is, the key input variables or "vital few" that affect the response variables of the process. In the improvement stage, the team tries to determine the cause-effect relationship (mathematical relationship between the input variables and the response variable of interest), to predict, improve and optimize the operation of the process. Finally, the operational range of the process input parameters or variables is determined. The final stage, control, consists of designing and documenting the necessary controls to ensure that what has been achieved through the Six Sigma project is maintained once the changes have been implemented [14]. To finish the methodology we have the output of the results the conclusions that allow comparisons between the before and after the implementation of the methodology. At the end of the DMAIC process, once the results are achieved, the challenge is to maintain the improvement in the results achieved.

IV. CONCLUSION

Small businesses, because of their relative informality and ease of communication, can sometimes implement change programs here and there according to their needs. If we take into account that the objective of every Company is to find, among others, the path to "0 Defects", that quality every day is the focus of customers, we have to move forward to achieve their expectations, and even exceed them. The Six Sigma method is becoming the culture of many successful companies because, through the statistical tools offered by this method, they are able to achieve the highest quality and profitability of their products [15]. This paper presents a methodology that can be adapted to the needs of small and medium-sized enterprises in Guanajuato as a fundamental part of the improvement approach.

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