

Application of PDCA Methodology in the Automotive Industry for the Reduction of Warranty Claims by the Client / Aplicación de la Metodología PDCA en la Industria Automotriz para la Reducción de Reclamos de Garantía por parte del Cliente

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Resumen:

Hoy en día, la industria automotriz es uno de los sectores más exigentes en el mercado global, es un sector enfocado en la satisfacción del cliente y requiere un aumento sistemático de la productividad y la competitividad, así como una reducción de costos. La presente investigación muestra un estudio de caso que aborda la filosofía de Lean Manufacturing dentro de la industria automotriz, el objetivo es reducir en un 90% los reclamos de garantía reportados por el cliente, así como impactar la reducción de costos debido a la generación de Scrap durante el proceso de producción. El presente artículo se basa en la aplicación de la metodología del ciclo Planear-Hacer-Verificar-Actuar (PDCA) o también conocido como el ciclo Deming, una vez realizada la aplicación, los objetivos se alcanzaron satisfactoriamente, los reclamos de garantía disminuyeron en un 90% y hubo un impacto financiero debido a la reducción en el costo del Scrap en el producto analizado, lo que representa un ahorro anual de 132 K USD para la empresa, por lo tanto, se concluye que la implementación de herramientas de Lean Manufacturing es de suma importancia para la mejora de los resultados de los indicadores clave de desempeño (KPI) dentro de las organizaciones del sector automotriz.

Palabras Claves: Lean Manufacturing, Metodología PDCA, Industria Automotriz, Ahorros.

Abstract:

Nowadays, the automotive industry is one of the most demanding sectors in the global market, it is a sector focused on customer satisfaction, and requires a systematic increase in productivity and competitiveness, as well as a cost reduction. The present research shows a case study that addresses the Lean Manufacturing philosophy within the automotive industry, the objective is to reduce by 90% the warranty claims reported by the client, as well as affecting the reduction of costs due to the generation of scrap during the production process. The present paper is based on the application of

the methodology of the Plan-Do-Verify-Act (PDCA) cycle or also known as the Deming cycle, once the application was done, the objectives were satisfactorily achieved, warranty claims decreased by 90 % and there was a financial impact due to the reduction in the cost of scrap in the analyzed product, which represents an annual saving of 132 K USD for the company, therefore, it is concluded that the implementation of Lean Manufacturing tools is of the utmost importance for the improvement of the results of the key performance indicators (KPI) within the automotive sector organizations.

Keywords: Lean Manufacturing, PDCA Methodology, Automotive Industry, Savings.

1. Introduction

According to (Suzaki, 1987) Lean thinking is a production strategy that aims to increase profit, with limited resources (p.255). Just-in-time (JIT) practices, waste reduction (M.K. & Mrugalska, 2017, págs. 780-785), improvement strategies, defect-free production and work standardization are the principal characteristics of lean thinking. The primary goal of lean production is to reduce costs and increase productivity by eliminating waste. Anything other than the minimum amount of equipment, materials, parts, space and employee time necessary to produce the required products is waste.

This philosophy was developed in the Toyota Production System and rapidly it was established in the manufacturing industry around the world (Botti, Mora, & Regattieri, 2017). According with (Marodin, Frank, Tortorella, & Netland, 2018) y (Womack, Jones, & Roos, 1990) the companies that implement lean manufacturing seek to improve effectiveness and efficiency of their production process (Prashar, 2017), Womack mentions that they get more effective by increasing product quality and value from the customer perspective, also they get more efficient by minimizing internal and external variability and with waste reduction in the process.

Manufacturing companies transform the raw materials assembling them to obtain a finished product, which must be delivered to the customer at time and without defect (Guirras, Turki, Rezg, & Dolgui, 2018) However, according with (Sreedharan, Rajasekar, Kannan, Arunprasad, & Rajeev, 2018) defective parts in manufacturing is a serious issue that industries are facing, even after proper care in design, material selection and manufacturing of product.

In the present article addresses, the problem mentioned in terms of quality within the manufacturing processes of transmission rear axles for the automotive sector. The process under study consists of two assembly lines that transform the raw material into a finished product, as of consecutive operations that eventually suffer inconsistencies and as a consequence products without quality are generated, that is, out of specification.

According with (Neves, Silva, Ferreira, & Pereira, 2018) and (Jagusiak-Kocik, 2017), the requirements regarding quality assurance require the implementation of continuous improvement methodologies and lean manufacturing, in order to maintain the company's levels of competitiveness and satisfaction for its customers in terms of quality. For this reason, an application of the PDCA methodology is presented which is one of the tools of

Lean Manufacturing, and according to (De Queiroz Albuquerque, 2015) and Silva (Silva, C.F., & R.K, 2017), it is characterized by its focus on continuous improvement, that is, a continuous search for the best methods to improve products and processes.

The main objective of the research was to reduce the warranty claims by the client by 90%, as well as a reduction of costs generated during the process, in advanced, it can be mentioned that the objective was achieved after the implementation of the PDCA methodology.

Researches has been conducted where are proven the benefits of carrying out implementations of Lean Manufacturing methodologies in the automotive sector, among them the PDCA methodology stands out. In the work presented by (Conceição, Silva, & Ferreira, 2017) an improvement application was carried out in the automotive industry. The study was developed in order to improve the assembly lines of steel cables used to control basic functions of cars, such as the lifting of windows on doors. By applying the Lean and PDCA methodologies based on an action plan, it was possible to guarantee the systematic implementation of the proposed and developed solutions.

The research carried out by (Santos, Pereira, & F, 2018) shows an application of the PDCA methodology focused on the analysis of quality costs in the automotive industry, specifically in a bus manufacturing company, the article proposes several key performance indicators to support the decision making and a graphic indicator to show the general balance between quality costs and non-quality costs.

In (Conceição, Silva, Pinto, Pereira, & Gouveia, 2018), is presented a study aimed at optimizing a control cable assembly line for the automotive industry based on the PDCA methodology. Through the use of Lean tools and methodologies, viable solutions were found, which resulted in a significant increase in productivity (43%). In the work developed by (Darmawan, Hasibuan, & Purba, 2018) is shown an application of the PDCA and KAIZEN methodology in a production system focused on the manufacture of automotive batteries, the implementation managed to reduce the defect rate by 38%.

The present study focuses on solving a problem of warranties with the customer or final user of a product manufactured in an automotive industry; these products are rear axles, which are assembled in different truck applications. The client reports a series of events and causes that originate the problem at the point of use, thus, it is necessary to know the root cause that generate the problem, the scope of this investigation is limited to analyzing the axle model with the greatest impact in warranty claims and the main defect reported by the client and thus focus the study to eliminate the cause that originate the problem through the implementation of Lean tools. Therefore, the aim of the project is to reduce the number of customer claims for the condition analyzed and thus increase the quality of the product, as well as generate a favorable financial impact on the company in which they are manufactured. The methodology adopted to undertake this study considers the Quality Management System of the company where the study is carried out, which indicates that one of the methodologies for problem solving for the improvement of the indicators is the PDCA (Plan-Do-Check - Act). As of this consideration, the first phase consisted of a review of literature and scientific articles published in recent years with studies similar to this research to support this

application. The next phase as such is the development of the project (case study), in which the analysis and tools used in each stage of the PDCA are presented: Plan-Do-Verify and Act, as well as the analysis of the results obtained and finally conclusions and recommendations.

Additionally, it should be considered that for reasons of information security of the company where the methodology was applied, the identification of the organization and part of the data were not authorized to be displayed.

2. Methodology

As mentioned earlier, the methodology used for the present case study is the PDCA cycle, which is integrated by 4 phases: Plan, Do, Check and Act, the following section will describe the application of each phase in this project.

2.1 Phase 1: Plan

As a first step for the planning phase, it is identified the team of people who will be working on the problem analysis and implementation of the corrective actions in order to eliminate the root cause that originates it, the multidisciplinary team is integrated by the following representatives of each area: Sponsor, manufacturing supervisor, who is the team leader, manufacturing operator, materials engineer, industrial engineer, maintenance engineer, quality engineer and safety engineer.

The current costumers of the organization are Nissan, General Motors and FCA Chrysler, during 2017 there was a major impact on the warranties indicator by the FCA client, therefore, it is initiate the present study focused on this client.

The next step is to define and analyze the problem as a team, the problem to be analyzed is within the production process of assembly lines, this study focuses on 2 processes called: 3rd member assembly line which is integrated from start to finish by 26 operations and the operation under this study is the station 90 of pressing of components, and the final assembly line consisting of 30 operations, the operation analyzed in this process is the leak tester station 140; in the line where the present study is carried out, several types of products are assembled, which include the Nissan client and FCA Chrysler, each family has different derivative models, the present study is limited to the product of the FCA customer family, which is a rear axle model 11.5.

For the problem definition is considered as part of the analysis the monthly registration and monitoring for the warranties indicator, for which there is a record of the number of claims, causes and models reported by the client.

The report is generated based on a standard period by the client, which includes from August to August of each year; during the month closing of August 2017, the report of the causes of the customer claims was generated as the first step of the data analysis, in Figure 1 the TOP

5 of main causes is shown, which includes the number of events reported for each condition and which represent 60% of customer claims.

Next, the reported causes are listed, as can be seen in Figure 1, the affectation with more recidivism are the “Pinion seal leaks” with 209 reported events.

- Rear Axle Pinion Seal Leaks
- Actuator
- Rear Axle Ring Gear & Pinion
- Rear Axle Hub Seal
- ABS Wheel Sensor

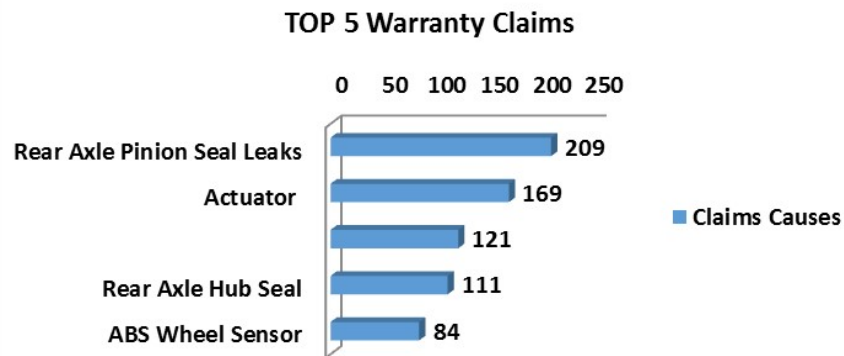


Figure 1. TOP 5 Warranty Claims

The Figure 2, shows its contribution percentage by type of event, this study focuses on the highest contribution of customer claims, the characteristic is defined as “Pinion seal leaks ” and represents 30% in the TOP 5 of reported events.

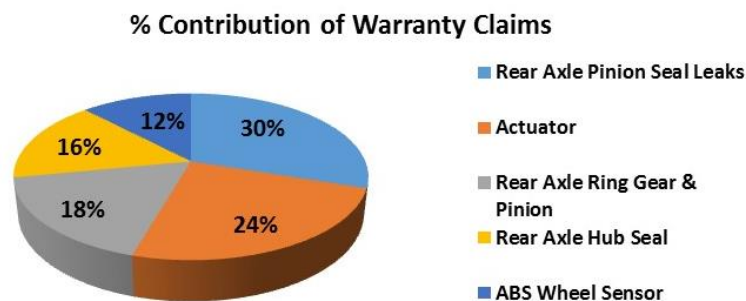


Figure 2. % Contribution of Warranty Claims

The next step is to analyze the condition reported in the different models, the results show a contribution of 85% for the 11.5 model with greater recidivism, 10% for the 11.8 model and 5% for the 9.25 model as shown in the Figure 3.

% Contribution by model

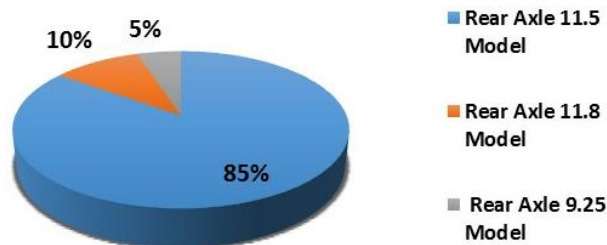


Figure 3. % Contribution by model

The above mentioned, the definition of the problem is as follows: "Warranty claims by the FCA customer for Pinion Seal Leaks on Rear Axles 11.5".

For the root cause analysis of this problem, there is the following record of cases of warranties reported by this condition, Figure 4 shows the monitoring of events, trends and affectionation in the indicator during the period from August 2016 to July 2017 with a total of 209 events reported, previously analyzed in the TOP 5 of customer complaints.

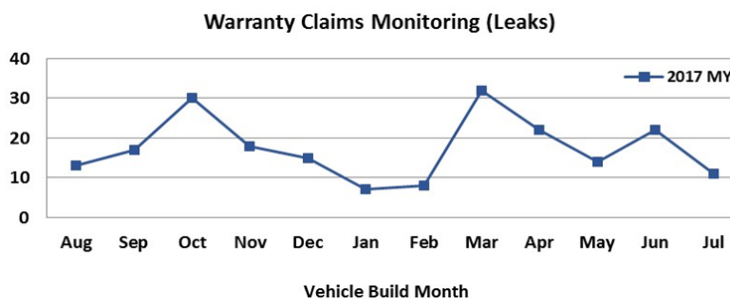


Figure 4. Warranty Claims Monitoring (Leaks)

As of the definition of the problem, a root cause analysis is performed to identify the potential causes of the event studied, the above, with the support of the Ishikawa Diagram tool as looks in Figure 5, finding as the main cause the misalignment generated in the component pressing operation 90, in which pressing of seal, bearing and flange is performed (Hydraulic Press), it is identified that this operation is not being carried out according to the specifications required by the misalignment generated in the pressing, which is why there is the problem of pinion seal leak on the rear axle.

In addition to this variable, there is a second operation that has a contribution to the reported condition, which is the leak tester, is located in the final assembly process (Operation 140), as its name indicates is responsible for carrying out the leak test on the rear axle, this operation is an indispensable part of the process since it is the operation that is responsible for detecting the problem and the condition that originates it, an obsolescence was found in the equipment so it is important to make a version change.

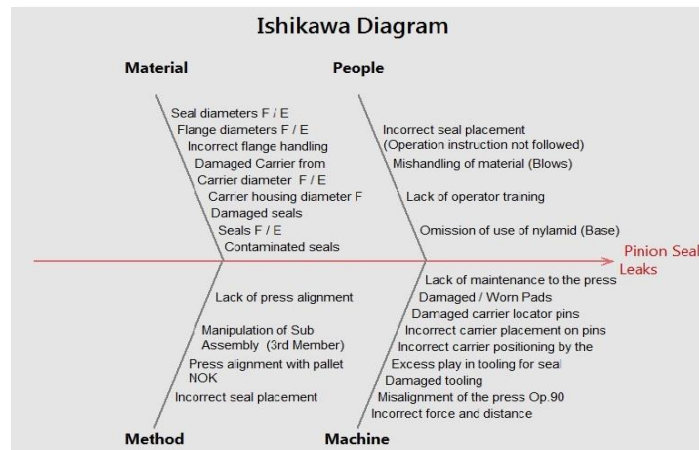


Figure 5. Ishikawa Diagram

As of this analysis, different actions are determined to be implemented to eliminate the condition that causes the problem of press misalignment in operation 90 and improve the current condition in operation 140 of the final assembly process.

2.2 Phase 2: Do

During this phase, the implementation of corrective actions is carried out, according to the analysis done in phase 1. The actions implemented are listed below:

1. Alignment pallet implementation (Operation 90).

The design of an alignment pallet was developed, which is shown in Figure 5, this device allows to validate and ensure the correct alignment of the press with the carrier when performing the operation.



Figure 6. Alignment pallet design

Which has a laser light reference to validate the correct alignment at the time of pressing, Figure 6 shows the NOK and OK condition.

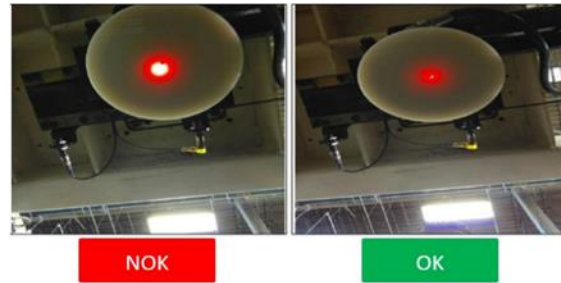


Figure 7. Alignment validation

The Figure 8, shows the alignment pallet implemented in the process.

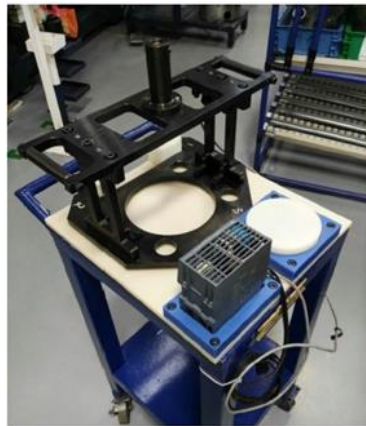


Figure 8. Alignment pallet implementation

2. Leak tester implementation (Operation 140)

The leak tester was changed with the client's authorization, considering now to use the latest version in the model and to cover the necessary requirements and specifications in the final assembly process, Figure 9 shows the previous version of the leak tester and the new version implemented.



Figure 9. Op.140 Leak tester implementation

3. Servo press implementation

Another activity was to replace the hydraulic press with a servo press, which has the necessary process characteristics and meets the requirements of the customer, the change generates various benefits for the operation, including the integration of new insertion tools that perform the pressing of pinion seal, bearing and flange in 3 steps, thus avoiding the problem of misalignment of the pinion seal.

With the servo press there is the possibility to measure and monitor the result of "force and distance" and evaluate the misalignment and correct pressing, as well as a quick alignment with validation pallet, thus it will allow to control and improve the necessary conditions in the operation. The previous hydraulic press and the new servo press installed in operation 90 are shown in Figure 10.

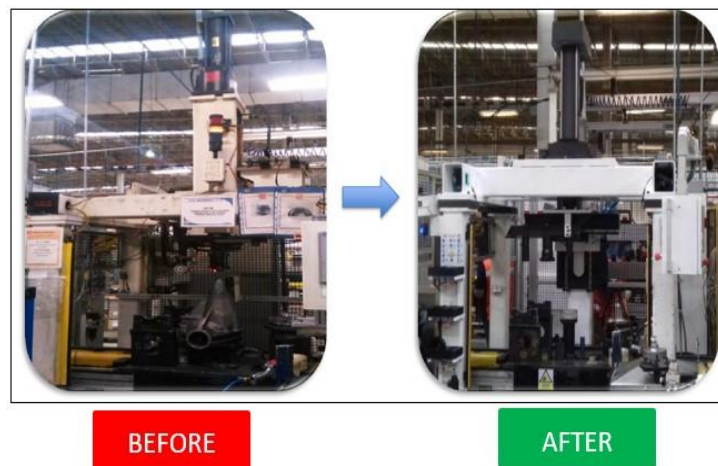


Figure 10. Op. 90 – Servo press implementation

2.3 Phase 3: Check

For this phase, the results obtained after implementing the improvement actions are monitored and verified. The trend of leaks defects by pinion seal in the assembly line is analyzed, as well as the scrap generated by this condition, in order to determine the economic benefit of this project.

In the same way the warranty claims by the customer are kept under monitoring to validate the improvement obtained after the implementation of the corrective actions to ensure that the client's claim does not recur, the data of the year 2018 was collected to make the analysis of results. Figure 11 shows the results obtained in comparison with the previous year.

As shown in the graph, the results reported during August 2017 to July 2018 have a significant improvement against what was reported during August 2016 to July 2017, the number of claims decreased from 209 to 20 reported events, that is, a reduction of 90% in the customer's claims for the condition of leaks by pinion seal in the 11.5 model of the FCA client.

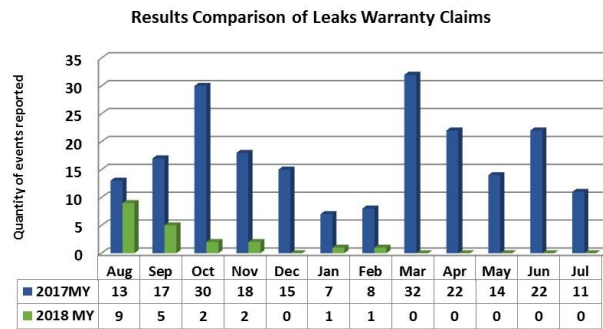


Figure 11. Results Comparison of Leaks Warranty Claims

Additionally, for the validation of the process, a study of the capacity of the installed servo press was carried out, data of pinion seal pressing force, bearing pressing distance and flange pressing distance were obtained. The sample taken for the capacity analysis conforms to a normal distribution according to Anderson Darling's normality test. The results of the Cp analysis of the pinion seal pressing force are shown in Figure 12.

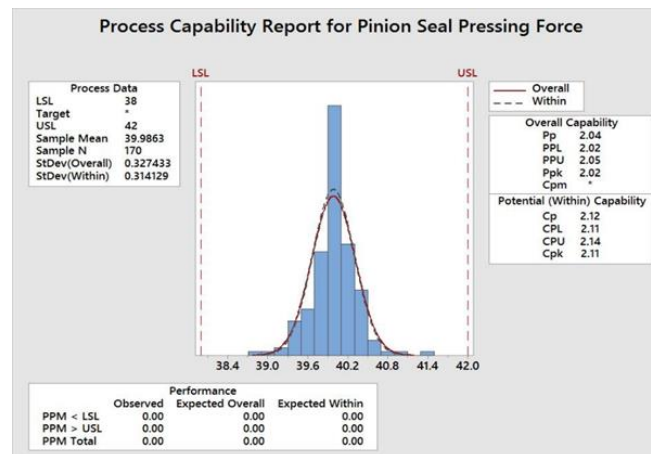


Figure 12. Pinion Seal Pressing Force

According to the results obtained, it can be seen that the process has the capacity to meet with the requirements established by the customer with a result of Cp of 2.12 and Cpk of 2.11, See Table 1.

Pressing Force		
	Cp	Cpk
Pinion Seal	Cp= 2.12	Cpk= 2.11

Table 1. Pressing Force Result

In the same way, the analysis was performed for the bearing press distance and flange pressing distance characteristics, see Figure 13 and 14.

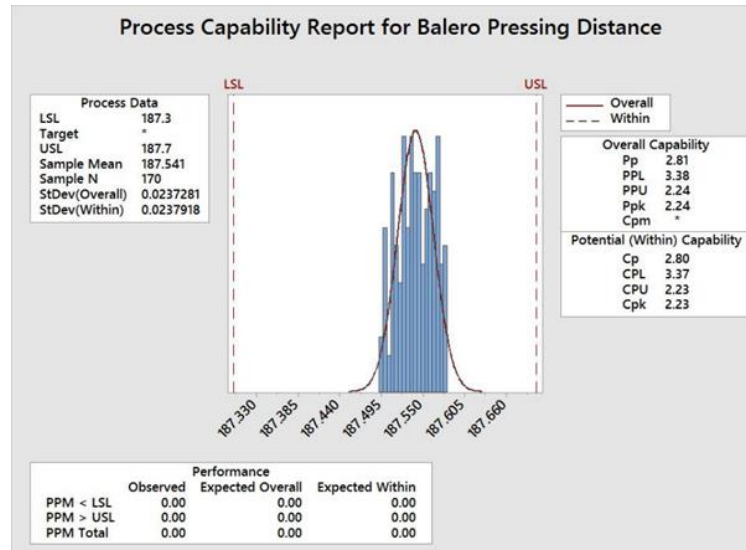


Figure 13. Bearing Pressing Distance

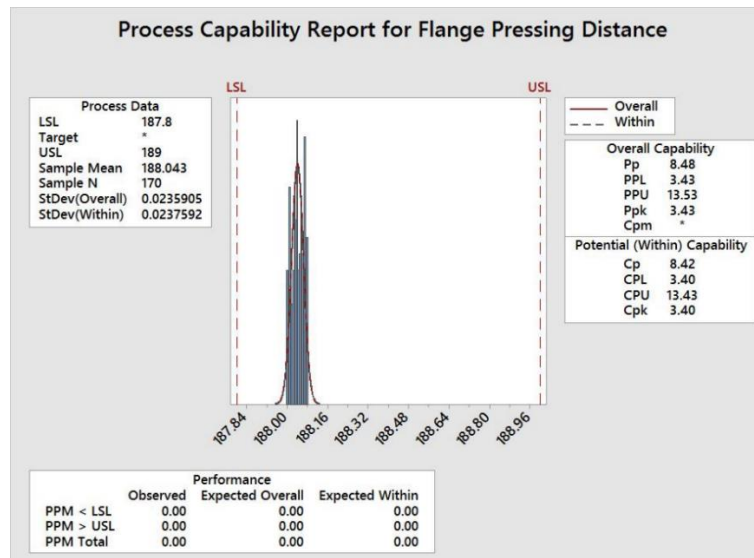


Figure 14. Flange Pressing Distance

The Table 2 shows the Cp and Cpk results calculated for each characteristic, this confirms the capacity of the process with $Cpk > 1.33$.

Pressing Distance		
	Cp	Cpk
Bearing	Cp= 2.80	Cpk= 2.23
Flange	Cp= 8.42	Cpk= 3.40

Table 2. Pressing Distance Result

During this phase the standardization of the improvements implemented according to the Quality Management System (SGC) applied in the organization is carried out, part of the process standardization was the update of the Operation Instruction (IO), it includes the step to step of the activities to be developed for each operation of the process, the corresponding to operation 90 is updated by the change made of the servo press.

Another document that is part of the SGC is the process release sheet, in the same way this document was updated with the changes of operation 90 as part of the standardization.

3. Discusión y análisis de resultados

According to the results in the present project, it can be affirmed that the results obtained are correct, considering that the case studies presented in the literature review showed that it is a method used for problem solving analysis, it is used for the performance indicators improvement of the organizations, product quality and with its correct application allows to generate a financial impact in the organization.

In the present case study, the results indicated a reduction of 209 to 20 events reported by the client, thus, a significant reduction of 90% in claims for the condition of pinion seal leaks in the Model 11.5 of the FCA customer, therefore, means that the root cause of the problem was eliminated, the improvement made was standardized, product quality was improved, as well as customer satisfaction, and finally a financial impact was achieved due to that the actions implemented contributed to the improvement of the scrap indicator, one of the main waste within the company and that it was affected by the same condition analyzed in this project.

A control and monitoring of the scrap indicator was performed to financially validate the improvement obtained after the implementation of the corrective actions and a significant improvement was demonstrated in this indicator, this improvement means an annual saving of \$132,000 USD, this represents a financial impact for the company, therefore, these results prove that the application of the PDCA methodology was correct.

It is verified that the application of this methodology can be used in the automotive sector, and in the same way in different sectors, such as: food, health, education, environmental management, among others

4. Conclusions

To conclude this study, in general terms it is concluded that the PDCA methodology is a Lean Manufacturing tool that through its application allows to define and analyze a problem, as well as identify the root cause that originates it, suggests an implementation plan of corrective actions and with the support of continuous monitoring allows validating the effectiveness of the actions implemented in order to ensure the results obtained.

Regarding to the objective established in this project, it is concluded that it was satisfactorily achieved, since the number of warranty events reported by the client was reduced by 90% through the application of the PDCA methodology, additional to this result, It was possible to generate significant annual savings for the company, which represents a financial impact in pro of the competitiveness of the organization.

According to the above, it is proven that the application of this methodology supports the Automotive Industry to improve competitiveness, customer satisfaction and generate a financial impact as shown in the present application case study.

Additionally, it is important to mention that this type of Continuous Improvement process requires a commitment and support from the company's Management (Alefari, Salonitis, & Y, 2017), (Dombrowski & Mielke, 2013), the leadership of the organization has a considerable influence on the success of the implementations of Lean Manufacturing, it is a key factor that will provide support, resources, training and investment necessary to achieve the implementation of the methodology in a timely manner.

Finally, considering the results of this case study, it is recommended to apply this PDCA methodology in the same way for the different causes of warranty events reported by the costumer and for the rest of the costumers according to the needs of the organization.

Bibliography

Alefari, M., Salonitis, K., & Y, X. (2017). *The role of leadership in implementing lean manufacturing*. Procedia CIRP, 756-761.

Botti, L., Mora, C., & Regattieri, A. (2017). *Integrating ergonomics and lean manufacturing principles in a hybrid assembly line*. Comput. Ind. Eng, 111,481-491.

Conceição, R., Silva, F., & Ferreira, L. (2017). *Improving the quality and productivity of steel wire-rope assembly lines for the automotive industry*. Procedia Manufacturing, 1035.

Conceição, R., Silva, F., Pinto, L., Pereira, T., & Gouveia, R. (2018). *Establishing Standard Methodologies To Improve The Production Rate Of Assembly Lines Used For Low Added-Value Products*. Procedia Manufacturing, 555-562.

Darmawan, H., Hasibuan, S., & Purba, H. (2018). *Application of Kaizen Concept with 8 Steps PDCA to Reduce in Line Defect at Pasting Process: A Case Study in Automotive Battery*. International Journal of Advances in Scientific Research and Engineering, 97-107.

De Queiroz Albuquerque, A. (2015). *Evaluation of the Application of the PDCA Cycle in Decision-Making in Industrial Processes*. Belém: Federal University of Pará.

Dombrowski, U., & Mielke, T. (2013). *Lean Leadership fundamental principles and their application*. Procedia CIRP, 569-574.

Guiras, Z., Turki, S., Rezg, N., & Dolgui, A. (2018). *Optimization of Two-Level Disassembly/Remanufacturing/Assembly System with an Integrated Maintenance Strategy*. Appl. Sci, 266.

Jagusiak-Kocik, M. (2017). *PDCA cycle as a part of continuous improvement in the production company - a case study*. Production engineering archives, 19-22.

M.K., W., & Mrugalska, B. (2017). *Mirages of Lean Manufacturing in Practice*. Procedia Engineering, 182, 780-785.

Marodin, G., Frank, A., Tortorella, G., & Netland, T. (2018). *Lean product development and lean manufacturing: Testing moderation effects*. Int. J. Prod. Econ, 301-310.

Neves, P., Silva, F., Ferreira, L., & Pereira, T. (2018). *Implementing Lean Tools in the Manufacturing Process of Trimmings Products*. Procedia Manufacturing, 696-704.

Prashar, A. (2017). *Adopting PDCA (Plan-Do-Check-Act) cycle for energy optimization in energy-intensive SMEs*. Journal of Cleaner Production, 277-293.

Santos, H., Pereira, M., & F, S. (2018). *A Novel Rework Costing Methodology Applied To a Bus Manufacturing Company*. Procedia Manufacturing, 631-639.

Silva, A., C.F., M., & R.K, V. (2017). *Cleaner Production and PDCA cycle: Practical application for reducing the Cans Loss Index in a beverage company*. Journal of Cleaner Production, 324-338.

Sreedharan, V., Rajasekar, S., Kannan, S., Arunprasad, P., & Rajeev, T. (2018). *Defect reduction in an electrical parts manufacturer: A case study*. TQM J, 650-678.

Suzaki, K. (1987). *The new manufacturing challenge: techniques for continuous improvement*. New York: Free Press.

Womack, J., Jones, D., & Roos, D. (1990). *The Machine that Changed the World: The Story of Lean Production*. New York: Harper Perennial.

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