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Process Optimization and Its Impact on Customer Satisfaction in an Automotive After-Sales Service Department

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ABSTRACT

An automotive dealership conducted a study after experiencing a 19% decrease in customer satisfaction over a three-month period. The problem was analyzed using a Pareto diagram, which identified the after-sales service process as the primary source of dissatisfaction, mainly due to excessive waiting times. A quasi-experimental pretest–posttest design was applied to evaluate the impact of the intervention. The study sample consisted of services performed on an average of 30 vehicles per month. To address the problem, the PDCA and SMART methodologies were implemented and complemented with a continuous time-and-motion study, which revealed a bottleneck in the vehicle washing stage. As corrective actions, follow-up procedures were standardized through an APS monitoring format, schedules were reorganized, personnel performance was evaluated through key performance indicators (KPIs), and an additional washer was hired. As a result, waiting times were significantly reduced, productivity in the washing process doubled, and the Customer Satisfaction Index (CSI) increased from 77.8% in January to 95.6% during the following quarter. These results demonstrate that process optimization and systematic monitoring can significantly enhance operational efficiency and customer satisfaction in automotive service departments.

Keywords: Customer satisfaction, productivity, time management, process optimization, time and motion study

Optimización de procesos y su impacto en la satisfacción del cliente en un departamento de servicio posventa automotriz

RESUMEN

Un concesionario automotriz realizó un estudio tras experimentar una disminución del 19 % en la satisfacción del cliente durante un período de tres meses. El problema fue analizado mediante un diagrama de Pareto, el cual identificó el proceso de servicio posventa como la principal fuente de insatisfacción, principalmente debido a tiempos de espera excesivos. Se aplicó un diseño cuasi experimental de pretest–postest para evaluar el impacto de la intervención. La muestra del estudio estuvo conformada por servicios realizados a un promedio de 30 vehículos por mes. Para abordar el problema, se implementaron las metodologías PDCA y SMART, complementadas con un estudio continuo de tiempos y movimientos, el cual reveló un cuello de botella en la etapa de lavado de vehículos. Como acciones correctivas, se estandarizaron los procedimientos de seguimiento mediante un formato de monitoreo APS, se reorganizaron los horarios, se evaluó el desempeño del personal a través de indicadores clave de desempeño (KPI) y se contrató un lavador adicional. Como resultado, los tiempos de espera se redujeron significativamente, la productividad en el proceso de lavado se duplicó y el Índice de Satisfacción del Cliente (CSI) aumentó de 77.8 % en enero a 95.6 % durante el trimestre siguiente. Estos resultados demuestran que la optimización de procesos y el monitoreo sistemático pueden mejorar significativamente la eficiencia operativa y la satisfacción del cliente en los departamentos de servicio automotriz.

Palabras clave: satisfacción del cliente, productividad, gestión del tiempo, optimización de procesos, estudio de tiempos y movimientos

INTRODUCTION

The quality of repair, maintenance, and after-sales services can be considered one of the fundamental pillars for achieving customer loyalty in the automotive sector, whether in a dealership or in an independent repair shop. In a highly competitive environment in which different companies offer products with similar technological features and performance, differentiation and customer preference are increasingly determined by customer experience, both during the purchase process and during the provision of maintenance or repair services.

For this reason, after-sales service, which includes preventive maintenance, corrective repairs, and warranty claims—has become an essential component of the overall value offered by automotive companies. These services contribute directly to customer satisfaction and loyalty by providing a support experience that differentiates the company from its competitors and promotes long-term customer relationships (Kotler & Keller, 2016).

Specialized literature in quality management has consistently demonstrated that customer satisfaction is a critical indicator of organizational performance and long-term success (Hernandez, 2025). According to Parasuraman et al. (1998), service quality can be defined as the gap between customer expectations and their perception of the service received. In automotive service environments, this gap tends to increase when communication between service providers and customers is inadequate, particularly with regard to delivery times and service progress.

A realistic delivery commitment must therefore be established while considering all operational factors that may affect service completion, as well as any potential additional repairs that could generate extra costs for the customer. Consequently, customer experience management involves not only the technical execution of mechanical work but also the coordination of all operational stages, from vehicle reception to final delivery, ensuring transparency and reliability throughout the entire service process.

From a theoretical perspective, this study is framed within the philosophy of Total Quality Management (TQM), which emphasizes the importance of involving all organizational personnel in continuous process improvement. According to Oakland (2014), individual actions within an organization directly influence the overall performance of products and services. TQM integrates three fundamental principles: customer focus, continuous improvement, and employee involvement. Applying these principles to the after-sales service area aims to transform organizational culture from a reactive approach to a proactive system in which each employee assumes responsibility for the quality of service delivered.

This research also incorporates elements of the Lean Service approach derived from the Toyota Production System, which focuses on eliminating waste and reducing activities that do not add value to the customer. In practical terms, this approach involves minimizing idle time, rework, and delays caused by insufficient coordination among operational areas. For this reason, one of the specific objectives of this study was to analyze the distribution of operational time across the different stages of the service process, including vehicle reception, mechanical work, washing, and detailing, in order to identify opportunities for process improvement.

In the automotive industry, particularly in Mexico, customer satisfaction has become a critical performance indicator required by automotive manufacturers and corporate standards. Dealerships are therefore required not only to meet operational targets related to vehicle sales or service profitability but also to maintain specific satisfaction indicators such as the Customer Satisfaction Index (CSI) for service operations and the Sales Satisfaction Index (SSI) for vehicle purchases. These indicators are periodically evaluated to determine whether dealerships qualify for incentives, performance bonuses, or certification programs.

Within this context, the automotive dealership analyzed in this study, located in Tulancingo de Bravo, Hidalgo, experienced a 19% decrease in the Customer Satisfaction Index (CSI) during the October 2024 to January 2025 period. This decline directly affected the dealership's ability to achieve the performance objectives established by the automotive brand. The reduction in customer satisfaction not only compromises operational performance indicators but also increases the risk of losing repeat customers and limits the acquisition of new clients, generating estimated economic losses exceeding 50,000 Mexican pesos.

Addressing this issue is particularly important because after-sales services represent not only a significant source of revenue for automotive dealerships but also a key element in building long-term customer loyalty. According to Heskett, Sasser, and Schlesinger (2008), the service-profit chain establishes a direct relationship between customer satisfaction and organizational profitability, as satisfied customers are more likely to make repeat purchases, recommend the company to others, and contribute to business stability.

The main objective of this study is to evaluate the effect of optimizing the after-sales service process on improving the Customer Satisfaction Index (CSI) in an automotive dealership through the implementation of continuous improvement methodologies.

To achieve this objective, the following specific goals were established:

- To analyze the operational performance of the after-sales service process through a time-and-motion study to identify operational bottlenecks.
- To implement improvement strategies based on the PDCA and SMART methodologies, as well as additional quality tools aimed at reducing waiting times.
- To compare customer satisfaction indicators and operational process times before and after the intervention in order to determine the impact of the implemented actions.

Despite the importance of after-sales service in the automotive industry, many dealerships face operational inefficiencies that negatively affect customer satisfaction levels, so this article presents the methodologies applied to address the identified problem. Using time-and-motion analysis and quality management tools, several internal operational factors that negatively affected customer satisfaction were identified. The relevance of this research lies in the replicability of the proposed solution, as it addresses systemic operational issues commonly observed in after-sales service processes across multiple automotive dealerships with similar organizational structures.

The objective of this study is to evaluate the impact of process optimization strategies on customer satisfaction in the after-sales service department of an automotive dealership. As a result, this study provides a dual contribution. On the one hand, it offers empirical evidence regarding the effectiveness of quality management tools in the automotive service sector. On the other hand, it proposes a replicable operational improvement model that may be applied in other dealerships facing similar service management challenges. Improving customer satisfaction not only enhances operational performance indicators but also strengthens the perceived value of the brand and supports the long-term sustainability of the dealership as a business organization.

METHODOLOGY

The study was conducted using a quantitative applied research approach, complemented by descriptive qualitative elements aimed at optimizing processes within the automotive after-sales service area. The quantitative approach enabled the measurement of operational times and movements within the service process, the establishment of performance indicators, and the evaluation of the impact of the corrective actions implemented. The qualitative component allowed for the analysis of customer and employee perceptions, as well as cultural and organizational factors that influence service delivery.

The methodological framework of this research is based on the application of quality management tools and continuous improvement methodologies that have proven effective in both industrial and service environments. Among these tools, the time-and-motion study, process simulation, Ishikawa cause-and-effect analysis, and the PDCA cycle (Plan, Do, Check, Act) proposed by Deming played a particularly important role. These tools facilitated the identification of operational bottlenecks, the optimization of resources, and the establishment of process controls aimed at improving customer satisfaction.

The research design followed a quasi-experimental pretest–posttest structure without a control group, in which operational results and satisfaction indicators were evaluated before and after the implementation of improvement strategies. This design allowed for the observation of changes in operational performance and customer satisfaction without the need for a separate control group. Because the intervention affected the entire operational system, the unit of analysis was organizational rather than individual.

The population consisted of all vehicles serviced within the dealership's after-sales department during the study period. Prior to the intervention, the service department processed an average of 10 to 14 vehicles per day. After the implementation of the optimization strategies, the average increased to 21 vehicles per day.

For the measurement of customer satisfaction, monthly averages of the Customer Satisfaction Index (CSI) were calculated based on a sample of 30 surveys administered to customers who received service. For the comparative analysis, three monthly measurements were considered prior to the intervention (November, December, and January) and three measurements after the intervention (February, March, and April), forming two temporal groups ($n_1 = 3$; $n_2 = 3$).

With regard to personnel, the operational sample included four mechanical technicians, two washers, and three Professional Service Advisors (APS), who participated in diagnostic activities, service follow-up, and the implementation of improvement strategies. This selection followed a purposive sampling approach, since the individuals involved were directly responsible for the operational processes under analysis.

The independent variables of the study consisted of the implementation of washing process optimization strategies, the PDCA improvement cycle, SMART goal planning, the redistribution of operational workloads, and the standardization of service procedures. The primary dependent variable was the monthly average of the Customer Satisfaction Index (CSI), expressed as a percentage. Secondary dependent variables included the average number of vehicles serviced per day and the operational processing times within the service workflow.

Finally, descriptive statistics (mean and standard deviation) were used to summarize the monthly CSI averages for both the pre- and post-intervention periods. To evaluate the difference between the two groups, an independent samples Student's T-test was applied using a significance level of $\alpha = 0.05$. This analysis made it possible to determine whether the increase in CSI observed after process optimization was statistically significant.

RESULTS AND DISCUSSION

General Results

The initial diagnosis showed that the main factors associated with customer dissatisfaction were delays in delivery times and the lack of effective communication during the service process. Through the time and motion study conducted between January 30 and February 6, it was identified that the greatest delays occurred in the washing and detailing stages, where accumulated waiting times exceeded 60 minutes per vehicle. This created a chain of delays that affected the final delivery to the customer.

The records indicated that the total average service time, from reception to delivery, exceeded 6 hours, while the brand standard established a maximum of 4 hours and 30 minutes. This deviation had a direct impact on customer satisfaction, as the surveys reflected dissatisfaction regarding the failure to meet the promised delivery time and the lack of timely information during the process.

It was also observed that the washing and detailing staff began their activities one hour after the workshop opened, which created a bottleneck between 8:00 and 9:00 a.m., precisely when the service advisors were starting to bring vehicles into the technical area. The workload analysis revealed that an average of 16 to 19 vehicles were serviced per day, which required a more efficient redistribution of schedules and personnel.

Deming Cycle (PDCA)

The methodological structure of the study was organized into four main phases aligned with the PDCA continuous improvement cycle (Plan, Do, Check, Act) proposed by Deming (1986).

Plan (Process Diagnosis)

As a starting point for this phase, improvement objectives were established using the SMART methodology. According to Doran (1981), this method provides an effective framework for defining goals by ensuring they are Specific, Measurable, Achievable, Relevant, and Time-bound. Based on this framework, the after-sales area was defined as the specific focus, with the goal of increasing customer satisfaction and survey response rate by 15 percent. The objective was considered achievable through the application of specific strategies, relevant because of its alignment with brand objectives, and time-bound to a one-month period. Based on the above, the main objective formulated was as follows: "Increase customer satisfaction and survey response rate in the after-sales area by 15 percent within a one-month period, complying with the established brand standards."

Once the SMART objective of the study was established, an analysis of customer complaints and service performance was conducted in order to describe the problem. The results obtained are presented in Table 1.

Table 1. Customer satisfaction and response rate Oct-24 to Jan-25

Indicators	Monthly			
	Oct	*Nov*	*Dec*	*Jan*
Satisfaction CSI (NPS)	94.3%	85.7%	87.5%	77.8%
Response Rate	21.9%	21.9%	16.9%	16.0%

With the information obtained, it was found that over the last three months customer satisfaction and response rate have decreased by 19 percent at the branch located in the municipality of Tulancingo, Hidalgo. During the period from October 2024 to January 2025, fifteen dissatisfaction surveys were received, in which two customers stated that they would not return to have their service performed at the dealership.

This raises the question: what problem does the customers' decision not to return actually represent? According to the data collected in Table 2, it was projected that for the year 2025 the economic losses could increase up to 53,913.60 pesos if the issue is not addressed. As mentioned previously, a satisfied customer represents a network of potential new customers, while dissatisfied customers not only choose not to return but also reduce the possibility of attracting new clients.

Table 2.- Annual economic loss in 2024

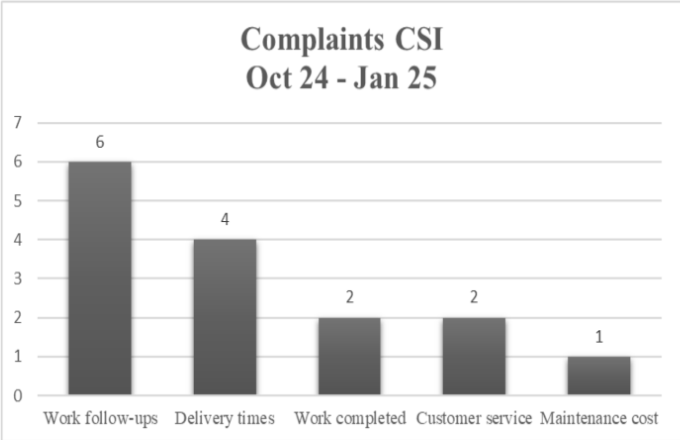
No Back	Average cost	Losses 2024
12	$ 1,248.00	$ 14,976.00
Times per year 1.8	**Average cost**	**Actual annual loss**
21.6	$ 1,248.00	$ 26,956.80

Loss forecast 2025	$ 53,913.60
Loss forecast 2026	$ 80,870.40

*Considering the requested annual growth of 20%

To identify the root cause of the problem, a feedback strategy was implemented through satisfaction surveys administered at the end of each service. During the period from October 2024 to January 2025, fifteen satisfaction surveys were collected. The results revealed five distinct types of complaints: work follow-up, delivery times, work performed, customer service, and maintenance cost.

Figure 1.- Complains during period



Once the results were collected, a Pareto Chart was used to prioritize the complaints with the greatest impact on customer satisfaction. The analysis determined that both follow-up and delivery times accounted for approximately 20 percent of the causes responsible for 80 percent of the recorded dissatisfaction.

Do (Implementation of Improvement Strategies)

With the problem identified and the causes defined, the study proceeded to the next stage of the PDCA cycle. Corrective measures were proposed for the two complaints with the highest impact, and as shown in Figure 1, the most frequent complaint was related to work follow-up, so efforts focused on mitigating this issue.

To begin reducing this complaint, an internal follow-up form was implemented, which the Service Advisors (APS) were required to complete. This form served as a means of standardizing the process. The structure of the form is illustrated in Figure 2.

Figure 2.- Follow-up form for APS

<table>
<tr><td>ASP:</td><td colspan="8"></td></tr>
<tr><td>Customer:</td><td colspan="8"></td></tr>
<tr><td>No. Order</td><td colspan="2">Vehicle</td><td colspan="2">Tower</td><td colspan="2">Service (Km)</td><td colspan="2">Delivery time</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="3">Mechanics
Status</td><td colspan="3">Alignment and balancing
Status</td><td colspan="3">Washing
Status</td></tr>
<tr><td>Completed</td><td>Pending</td><td>No</td><td>Completed</td><td>Pending</td><td>No</td><td>Completed</td><td>Pending</td><td>No</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Follow-up calls</td><td colspan="2">Time</td><td colspan="2">Time</td><td colspan="2">Time</td><td colspan="2">Additional budget</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td>YES</td><td>NO</td></tr>
<tr><td colspan="6">ADDITIONAL COMMENTS</td><td colspan="3">Signature</td></tr>
</table>

To address the issue related to the complaints received regarding delivery times, a procedure divided into three stages was implemented: 1. A time and motion study of the service process. 2. Simulation of three possible scenarios. 3.Follow-up on surveys and reminder messages for customers

In the first stage, a study of the general service process was carried out between January 30 and February 6, 2025. The average times obtained are described in Table 3.

Table 3.- Execution times for the general service process

Process	Activity Time (h)	Waiting Time (h)
Unit Arrival	07:50 - 10:40	00:08:31
Service Reception	08:58:00	01:17:16
Mechanical work	01:00:04	01:12:55
Washing	01:00:12	
Detailing	00:07:16	00:08:06
QC Inspection	00:05:34	

According to Table 3, which presents the record of one of the samples used in this study, an estimate of the average times of the general service process before the improvement actions were implemented can be observed. The table also shows that vehicle reception took place between 07:50 and 10:40 a.m., with the analyzed vehicle arriving at 08:58 a.m. and experiencing a waiting time of 8 minutes and 31 seconds due to the constant flow of vehicles during that period.

Afterward, the unit remained in the waiting line to enter the mechanical area for approximately 1 hour and 17 minutes, a duration that reflects process saturation and the need for improved operational scheduling. The mechanical work lasted 1 hour, which corresponds to a standard service from the program known as the Gold Service, a more complete and detailed maintenance procedure.

Once this stage was completed, the vehicle was moved to the washing area, where a waiting time of more than 3 hours was recorded. This delay was caused by the imbalance between the number of technicians (4) and washers (2) available at the time. The washing activity lasted approximately 1 hour, followed by the detailing stage, which took an average of 7 minutes. Finally, the ICC staff performed the quality inspection to verify the final condition of the vehicle and authorize its delivery to the customer.

Taken together, these times reflect the presence of significant bottlenecks in the operational flow prior to the implementation of the improvement strategies, particularly in the washing waiting stage, which directly affects customer satisfaction and the dealership's ability to meet promised delivery times.

Various corrective actions were implemented, including adjustments to schedules and rest days for the washing staff while respecting their rights and modifying shifts only with their approval to avoid conflicts; standardization of a digital follow-up form for the Service Advisors (APS); development of a skills matrix for technical personnel; and the addition of a new team member to the washing area. All this information is presented in Table 4.

Table 4.- Times with 4 Technicians and 2 Washers

Monday - Friday (9:00 - 19:00 h)							
Service No.	Reception Time	Delivery time	1st follow-up	Mechanical Times	Washing	Car Finished	Previous Appointments
1	08:00	13:30	09:30	09:30	10:00	11:00	09:00-10:00
2	08:00	13:30	09:30	09:30	10:00	11:00	2
3	08:20	14:30	09:30	09:30	11:00	12:00	
4	08:20	14:30	09:30	09:30	11:00	12:00	
5	08:40	15:00	11:30	11:30	12:00	13:00	
6	08:40	15:00	11:30	11:30	12:00	13:00	
7	09:00	15:30	11:30	11:30	13:00	14:00	
8	09:00	15:30	11:30	11:30	13:00	14:00	
9	09:20	16:00	13:30	13:30	14:00	15:00	
10	09:20	16:30	13:30	13:30	15:00	16:00	
11	09:40	17:00	13:30	13:30	16:00	17:00	
12	09:40	17:30	13:30	13:30	16:00	17:00	
13	10:00				17:00	18:00	
14	10:00						
15	10:20						
16	10:20						
17	10:40						
18	10:40						
Saturday (9:00 - 14:00 h)							
Service No.	Reception Time	Delivery time	1st follow-up	Mechanical Times	Washing	Car Finished	Previous Appointments
1	08:00	13:30	09:30	09:30	10:00	11:00	09:00-10:00
2	08:00	13:30	09:30	09:30	10:00	11:00	2
3	08:20	14:30	09:30	09:30	11:00	12:00	
4	08:20	14:30	09:30	09:30	11:00	12:00	
5	08:40	15:00	11:30	11:30	12:00	13:00	
6	08:40	15:00	11:30	11:30	12:00	13:00	
7	09:00	15:30	11:30	11:30	13:00	14:00	
8	09:00	15:30	11:30	11:30	13:00	14:00	

A time study was then conducted on different days under different scenarios, such as the case with 4 technicians and 2 washers, which was the most common scenario in the dealership given the number of employees. Under this configuration, a maximum of 12 service units and 2 previous appointments were handled per day, for a total of 14 units from Monday to Friday. This resulted in leftover units being carried over to the next day, creating a bottleneck. On Saturdays, a total of 8 service units and 2 previous appointments were washed, for a total of 10 units. Additional scenarios were then analyzed, such as 3 technicians and 3 washers, as well as 4 technicians and 3 washers. The latter proved to be the best scenario due to the increase in the number of units washed, as shown in Table 5.

Table 5.- Times with 4 Technicians and 3 Wahers

Monday - Friday (9:00 - 19:00 h)							
Service No.	Reception Time	Delivery time	1st follow-up	Mechanical Times	Washing	Car Finished	Previous Appointments
1	08:00	13:00	09:30	09:30	10:00	11:00	09:00-10:00
2	08:00	13:00	09:30	09:30	10:00	11:00	3
3	08:20	13:30	09:30	09:30	10:00	11:00	
4	08:20	13:30	09:30	09:30	11:00	12:00	
5	08:40	14:00	11:30	11:30	11:00	12:00	
6	08:40	14:00	11:30	11:30	11:00	12:00	
7	09:00	14:30	11:30	11:30	12:00	13:00	
8	09:00	14:30	11:30	11:30	12:00	13:00	13:00-14:00
9	09:20	15:30	13:30	13:30	14:00	15:00	1
10	09:20	15:30	13:30	13:30	14:00	15:00	
11	09:40	16:30	13:30	13:30	15:00	16:00	15:00-16:00
12	09:40	17:30	15:30	15:30	16:00	17:00	1
13	10:00	17:30	15:30	15:30	16:00	17:00	
14	10:00	18:00	15:30	15:30	16:00	17:00	
15	10:20	19:30	17:30	17:30	18:00	19:00	
16	10:20	19:30	17:30	17:30	18:00	19:00	

Saturday (9:00 - 14:00 h)							
Service No.	Reception Time	Delivery time	1st follow-up	Mechanical Times	Washing	Car Finished	Previous Appointments
1	08:00	13:00	09:30	09:30	10:00	11:00	09:00-10:00
2	08:00	13:00	09:30	09:30	10:00	11:00	3
3	08:20	13:30	09:30	09:30	10:00	11:00	
4	08:20	13:30	09:30	09:30	11:00	12:00	11:00-12:00
5	08:40	14:00	11:30	11:30	12:00	13:00	2
6	08:40	14:00	11:30	11:30	12:00	13:00	
7	09:00	14:30	11:30	11:30	12:00	13:00	
8	09:00	14:30	11:30	11:30	13:00	14:00	13:00-14:00
9	09:20	15:30	13:30	13:30	14:00	15:00	2
10	09:20	15:30	13:30	13:30	14:00	15:00	
11	09:40	16:00	13:30	13:30	14:00	15:00	
12	09:40	16:30	13:30	13:30	15:00	16:00	

In Table 5, the increase in washed units can be clearly observed. In a single day, 16 service units and 5 previous appointments were handled, for a total of 21 units from Monday to Friday. On Saturdays, 12 service units and 7 previous appointments were handled. Additionally, a 15 percent buffer time was available for the washing process, allowing the reception of more units or enabling team members to assist each other when a vehicle required extra cleaning due to its condition, without exceeding the expected time.

Table 6.- Tracking

PHONE	E-MAIL	RECEPTIONIST	RECEPTION TIME	ADDITIONAL SERVICES CALL TIME	ADDITIONAL SERVICES
5622117***	impuesto.consultoriafbm.com.mx	JONATHAN SALAZAR HERNÁNDEZ	08:07	0:45 DOES NOT AUTHORIZE	THEY STILL DO NOT AUTHORIZE THE
7752045***	floralesiasaleflorquimamaz@gmail.com	FRANCISCO JAVIER OLIVER MEZA	11:15		
2213014***	recepcionista_ozmas@hotmail.com	JONATHAN SALAZAR HERNÁNDEZ	08:40	11:10 FRONT BRAKE PADS	ONLY THE SERVICE
7715413***	mae_796live.com	FRANCISCO JAVIER OLIVER MEZA	08:40		
7758534***	colomerfabrica@colomer.mx	JONATHAN SALAZAR HERNÁNDEZ	09:50		NO ADDITIONAL SERVICES REQUIRED
7778748***	miguel215@yahoo.com.mx	FRANCISCO JAVIER OLIVER MEZA	09:06		IT RINGS BUT NO ANSWER

As an additional action, more frequent follow-ups were carried out on customers' vehicles through a database (Excel) that was constantly updated with the technicians' comments. This was done by the controller, who is responsible for assigning jobs to the technicians, and then reviewed by the Service Advisors (APS), who informed customers if their vehicles required anything beyond the scheduled maintenance service. It was then up to the customer to decide whether to authorize the additional work.

Verify (Evaluation of Results)

The monthly averages of the Customer Satisfaction Index (CSI) corresponding to the period from November to January (Table 2) were analyzed and compared with the averages obtained during the period from February to April presented in Table 7, following the implementation of the after-sales washing process optimization. The data was obtained directly from the corporate platform exclusively available to dealerships and provided by the Nissan brand, which consolidates the official CSI results.

Table 7.- Overall Satisfaction Indicator

	Monthly			
Responses	Feb	Mar	Apr	3MA
Satisfaction CSI (NPS)	93.90%	95.00%	97.60%	95.60%
Satisfied (9 and 10)	32	38	40	110
Neutral (7 and 8)	0	2	1	3
Dissatisfied (0-6)	1	0	0	1
Surveys Withdrawn	2	1	0	3
Work Orders (ODTs)	2	1	0	3
NMEX Withdrawal	0	0	0	0
Tickets Closed at Level 1	100.00%	100.00%	N/A	100.00%

The pre-intervention monthly average was 83.67 percent (SD = 5.16), while the post-intervention average was 95.50 percent (SD = 1.90), reflecting an absolute increase of 11.83 percentage points, equivalent to a relative increase of 14.14 percent. An independent samples Student's t-test indicated that the difference between periods was statistically significant ($t = 3.73$; $df = 4$; $p < 0.05$), confirming that the intervention had a positive effect on customer satisfaction levels.

Additionally, operational productivity showed an increase in the average number of vehicles serviced per day, rising from 10 to 14 units before the intervention to 21 units after process optimization

As previously mentioned, the project implemented a digital follow-up form for the Service Advisors (APS), which made it possible to establish a more transparent and efficient communication channel. This tool allowed customers to be informed about the progress of their vehicle as well as any issues, such as required parts or other considerations. The correct completion of these forms was verified daily, generating a digital record with the collected information. This record included: customer contact details, the vehicle entered for service, the names of the staff who attended to the customer, the entry time for each stage of the general service process, and any additional comments.

Subsequently, the delivery time and customer satisfaction indicators were compared before and after the implementation of the improvements, using operational risk analyses and service surveys. The comparative analysis of the service process, conducted before and after the implementation of the APS format, revealed the need to establish a skills matrix for the staff involved, which is described in the following stage.

Act (Standardization and Follow-up*)*

As indicated in Deming's methodology (1987), the "Act" stage presents two possible paths. If the results are partial or insufficient, the process must return to the "Plan" stage with the newly acquired feedback. This was not the case here. The goals were achieved as expected after implementing the APS format. However, it was still necessary to standardize the changes, update the procedure, and establish controls that promote a culture of continuous improvement. In this context, a skills matrix was implemented as an evaluation tool for personnel involved in the general service process, and KPIs were established to support the assessment.

The skills matrix integrated the key competencies required for operational excellence in the after-sales service and, consequently, for improved customer satisfaction. It was structured into the following phases:

- Process follow-up: Aligned with the Voice of the Customer (VOC) and the Customer Satisfaction Index (CSI), ensuring compliance with the standards defined through customer feedback. Responsibilities for each position were verified to ensure proper execution of assigned tasks.
- Customer service: Focused on service sales and identifying opportunities for additional sales, with the aim of optimizing both customer experience and business performance.
- Profitability: Considered as a cross-functional element in all activities related to service or additional sales. The team's actions were compared with their economic efficiency and financial impact.
- Attitude: Based on two core values within after-sales service. Empathy, defined as the ability to fully understand the customer to provide genuine service and respect, which promotes courteous and considerate treatment of all individuals while adapting sales methods within a professional framework.

Finally, adjustments were made to the methods previously proposed to address complaints related to delivery times. The new times obtained are presented in Table 8.

Table 8.- Time results after improvement

Process	Activity Time (h)	Waiting Time (h)
Unit Arrival	07:50 - 10:40	00:05:57
Service Reception	08:27	00:54:19
Mechanical work	00:49:14	01:12:55
Washing	00:51:48	
Detailing	00:06:14	00:07:12
QC Inspection	00:05:51	

The comparative analysis between Table 3 and Table 8 shows a significant reduction in waiting time between the mechanical and washing stages, decreasing from 3 hours and 3 minutes to 1 hour and 12 minutes, which represents a reduction of 61 percent. This improvement resulted from the integrated application of the strategies designed within the PDCA cycle, the implementation of quality methodologies such as SMART and 5S, and the use of operational control tools. Overall, the most relevant actions included rescheduling the washers' working hours, adjusting their days off according to peak demand, optimizing workflow between the mechanical and washing areas, and standardizing processes through the order and discipline promoted by 5S. These measures helped balance the workload, reduce idle times, and ensure a continuous flow of vehicles, contributing directly to meeting promised delivery times and increasing customer satisfaction, as reflected in Table 7.

Theoretical discussion

The results obtained are in line with the approaches of Deming (1986) and Ishikawa (1989), who highlight the importance of process control and staff participation as pillars of continuous improvement. In this case, the application of the PDCA cycle allowed for a systematic approach to diagnosis, action, and control, while the SMART methodology facilitated the management of achievable and measurable objectives.

Similarly, the findings confirm Kotler and Keller's (2016) assertion that customer satisfaction depends not only on the functional fulfillment of the service, but also on the emotional perception of support and communication. The standardization of follow-up by APS strengthened this aspect, creating a more reliable service experience.

On the other hand, the combination of tools such as flowcharts, Ishikawa diagrams, the 5S methodology, and KPIs reflects an effective integration of quantitative and qualitative methods. This synergy not only reduced time but also improved staff morale and discipline, which are essential components for total quality sustainability (Oakland, 2014: Ham, 2025).

Finally, internal controls were established through weekly monitoring and evaluation, with the aim of ensuring the sustainability of results and preventing setbacks in performance indicators. In addition, interdepartmental coordination was strengthened, especially with the new vehicle area, respecting internal agreements that establish that washers must service a maximum of four new units per day for delivery to customers. This inter-area commitment made it possible to maintain operational balance without affecting the efficiency or quality standards of the after-sales area.

However, the study presents several limitations that must be considered when interpreting the results. First, the statistical analysis was conducted based on aggregated monthly averages, which reduced the sample size for inferential testing and limited the possibility of analyzing variability at the individual survey level. Furthermore, the research was carried out in a single automotive dealership, which restricts the generalizability of the findings to other organizational contexts with different operational dynamics. Likewise, the post-intervention observation period was relatively short, preventing the evaluation of seasonal effects or long-term fluctuations in service demand.

Regarding the sustainability of the results, there are potential risks associated with staff turnover, variations in workload, changes in corporate guidelines, or a decrease in adherence to the implemented controls. The absence of continuous supervision or a decline in operational discipline could lead to regression toward previous practices, thereby affecting the achieved level of customer satisfaction. Therefore, the institutionalization of standardized procedures and the continuous monitoring of key performance indicators are essential to preserve the benefits obtained over time.

CONCLUSIONS

The implementation of PDCA, SMART, and 5S methodologies in the automotive after-sales area yielded significant results in key operational and customer satisfaction indicators. Comparative records show a 61% reduction in waiting time between the mechanical and washing stages, from 3:03:42 hours to 1:12:55 hours, demonstrating effective workflow optimization and better coordination between areas.

Similarly, satisfaction indicators showed a notable recovery: the CSI index rose from an average of 77.8% in January to 95.6% in the following quarter, accompanied by an increase in the survey response rate. These improvements were achieved through the reconfiguration of schedules, the redistribution of workloads, systematic customer follow-up, and the standardization of the work environment under the principles of 5S.

The results obtained demonstrate that the disciplined application of quality tools can generate measurable impacts on productivity and service perception, strengthening process reliability and end-user satisfaction. From an industrial and process engineering perspective, this case reaffirms that management based on continuous improvement methodologies allows operational data to be transformed into effective decisions, consolidating more efficient, secure, and customer-oriented systems.

Consequently, this study provides practical evidence of how engineering applied to service management can integrate technical analysis with organizational improvement, contributing to the development of sustainable models of quality and efficiency in the automotive industry. The findings confirm that the integration of PDCA methodology and time-motion analysis can effectively improve operational efficiency and customer satisfaction in automotive after-sales services.

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