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Implementation Of Lean Six Sigma To Improve The Quality Of Service Of A Company In The Restaurant Sector

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Abstract **-** The research proposed to implement Lean Six Sigma in a restaurant company to improve the service quality of Siu Mai snacks delivered via delivery. The study was based on a pre-experimental design with a quantitative approach and evaluating customer perception before and after using the Servqual method. In the initial analysis, lack of employee induction, poor order management and lack of process evaluation were found as causes of low quality. Using DMAIC, processes were improved with BPMN and Kanban to follow the order flow, which optimized processes, reduced waiting times and improved service quality. The results showed that the Servqual score improved from 4.07 to 6.09, while the CP and CPK indicators improved significantly. It was concluded that the implementation of Lean Six Sigma using tools such as VSM, Kanban and SIPOC helped improve service quality and customer satisfaction by optimizing processes, reducing waiting times and improving the ability to respond empathetically to customers.

Keywords**:** Siu Mai appetizers, Chinese cuisine, DMAIC, Lean Six Sigma, Servqual

1. Introduction

The research addressed the application of the Lean Six Sigma methodology to improve service quality in a Chinese food restaurant. Relevant studies by were cited that explored service quality in restaurants and its relationship with customer satisfaction, as well as the adoption of Lean Six Sigma to improve efficiency and reduce waste [1-5].

The objectives of the project included defining the size and type of sampling, measuring service quality with the SERVQUAL method, performing diagnostics using DMAIC and VSM, analyzing the causes that affect service quality, designing proposals with tools such as Kanban and DMAIC, and developing a procedures manual.

Restrictions and limitations of the project were detailed, such as the costly investment of implementing Lean Six Sigma in its entirety, which led to focus on applying these tools only in the service of Siu Mai snacks for delivery. A comparison between current and proposed metrics was presented, as well as the measurement of service quality indicators under Servqual.

Comparative tables of service quality between different types of Asian food restaurants were presented, positioning Chinese food below Japanese food with a score of 5.73 but above Filipino and Malaysian food in terms of service quality. Subsequently, a survey of Bapo Peru restaurant customers was conducted under the Servqual method, resulting in a score of 4.06. Areas for improvement were identified, such as punctuality of delivery, customer service, equipment and personalization of service.

2. Problem

2.1. International level

In the gastronomy industry, considered one of the fastest growing and rapidly expanding sectors, along with the lodging industry, service quality plays a crucial role. Food is an element that connects with the general public, including travelers seeking to explore different countries, which makes service quality management in these businesses increasingly crucial. In developed cities, where fast and safe services are required, food delivery service has become an increasingly used option [6].

In various studies conducted in the region on the restaurant sector, it has been observed that managers and business owners tend to focus on product quality, operations and other factors, neglecting service quality related to customer service. Studies in Taiwan surveyed young adults to determine the factors driving restaurant customer satisfaction. They found that customers valued safety measures and service quality. They found that customers valued safety measures and cleanliness above other factors [7].

2.2. National and local level

On the other hand, in Peru, a country known worldwide for its gastronomy, a study has been carried out in Piura to evaluate the quality of service in growing companies, such as SMEs and small and medium-sized enterprises in the restaurant sector. Deficiencies have been identified in aspects such as transportation, where access becomes a difficulty for customers, and long waiting times affect the customer experience. The Servqual-based evaluation of service quality revealed that responsiveness and reliability are critical areas where diners do not perceive the necessary confidence to return to these establishments [2].

The application of the Lean Six Sigma methodology is presented as an effective solution to optimize time, reduce costs and improve the quality of service in the gastronomic sector. A study conducted in a restaurant in Lima showed that the implementation of Lean Six Sigma significantly reduced waiting times by 58% and increased sales by 38% [8].

Using a cause and effect diagram, the causes affecting the quality of service within Bapo Peru and the Siu Mai snack service via delivery were identified. It was observed that the lack of coordination between delivery personnel and delivery drivers generated delays in deliveries and increased operating costs. In addition, ineffective operations management and a lack of clear indicators to assess service quality were identified as key factors contributing to customer dissatisfaction.

In order to solve the causes of these problems, this work proposes the use of Lean Six Sigma tools to address 70% of the problem, for this purpose it is proposed to use the DMAIC extracted from Six Sigma to improve procedures, in addition to training staff in the improvements made, the Flowchart and VSM extracted from Lean to measure times and chart the procedure. Kanban extracted from Lean Six Sigma was used for order delivery planning. According to Table 1, applying the servqual in the Siu Mai snack service, Bapo Peru obtained an average of 4.06 below the average for Chinese food, which is 5.73. The initial CP and CPK were also calculated using 5 orders per day for 20 days.

Table 1: Initial indicators before implementation

Initial service quality assessment Bapo Peru			**Process indicators**	
Chinese Food	***Bapo Perú***	***Gap***	***CP***	***CPK***
5.73	4.06	-1.67	0.37	0.13

VSM (Value Stream Mapping) was used to analyze the delivery process of Siu Mai snacks. It starts with order management through digital channels such as Whatsapp, where a commercial advisor takes the order from the customer, which takes about 15 minutes. Then, the order is sent to production, where the snacks are prepared in about 10 minutes, using inputs and with the help of two kitchen operators. After preparation, the snacks are cooked and packaged for delivery. A motorized vehicle delivers the order in an average of 50 minutes within the same district, following the shortest route. Once the customer receives the order, he can pay in cash, and then the motorized vehicle returns to the company. The sales manager contacts the customer to confirm receipt of the order, which takes approximately 5 minutes. In case of problems, such as defective products, a return is made. The company bears the cost of fuel, while mobility is the responsibility of the delivery driver.

3. Methodology

3.1. Data collection and evaluation

Studies on Lean Six Sigma (LLS) and the Servqual method have been widely used to improve service quality in various industries, including the gastronomic sector. Authors such as [4] [9] have applied the Servqual method to evaluate service quality in restaurants. Likewise, direct observation has been used for the independent variable Lean Six Sigma, which allowed data to be identified to calculate process indicators.

The instruments used were the questionnaire with 22 questions addressed to 66 clients to know the perception received of the service provided. On the other hand, a record sheet was used to record 5 orders placed daily for 20 days to determine the CP and CPK indicators. This was done in two stages, before and after the improvement applied to compare the results.

3.2. Alternative solutions

The research focused on a pre-experimental case study. For this purpose, techniques were used to collect data that allow allow comparisons before and after the improvement applied under Lean Six Sigma. For the dependent variable being quality of service, the servqual questionnaire with a Likert scale was used to identify the level Bapo Peru was at initially and after the Lean Six Sigma improvement.

3.3. Solution evaluation

Studies on Lean Six Sigma (LLS) and the Servqual method have been widely used to improve service quality in various industries, including the gastronomic sector. Authors such as [4] [9] have applied the Servqual method to evaluate service quality in restaurants, highlighting the importance of understanding the relationship between customer satisfaction and critical factors to improve [10]. Other studies, such as, have extended this approach to accommodation and tourism, using surveys to understand customer perception and its relationship with customer satisfaction [2] [11].

Regarding Lean Six Sigma, authors such as have sought to reduce waste in factory production [5], while studies such as have focused on the application of LLS in the food sector [13]. The DMAIC (Define, Measure, Analyze, Implement and Control) methodology has been commonly used in these studies to develop process improvements [12]. In addition, the combination of Lean and Six Sigma has proven effective in improving business competitiveness, as evidenced in the study by in an electronics company, and in the telecommunications sector [14], where managed to reduce the time to repair breakdowns significantly [15].

The results of these studies demonstrate the effectiveness of Lean Six Sigma in process improvement and customer satisfaction in various industries. For example, the implementation of an LLS framework resulted in increased productivity and improvements in employee quality of life and safety [14]. In the food service sector, process changes and 5S methodology achieved significant reductions in wait times [17]. In addition, responsiveness in restaurants improved with the addition of a second cook, which increased efficiency and customer satisfaction [1]. These results highlight the importance of LLS in continuous process improvement and service quality in different business settings.

In conclusion, the choice of Lean Six Sigma to improve processes at Bapo Peru was supported by ample evidence of its effectiveness in various sectors, including the food industry. Previous studies have shown that the combination of Lean and Six Sigma has led to significant improvements in service quality, customer satisfaction and operational efficiency in different companies. The DMAIC methodology provides a structured and methodological framework to address the specific challenges of the production and delivery processes of Siu Mai snacks, enabling continuous improvement and a data-driven approach to decision making.

3.4. Sample size selection

The study population was the customers who requested Siu Mai snacks via delivery and the times of the order management process. To calculate the sample for the two populations, non-probabilistic sampling was used that allowed the researchers to select a sample according to the specifications. In the case of clients, only those who were able to register within one day and who agreed to participate by filling out the survey were surveyed, which gave a number of 66 clients surveyed. This number was maintained for the comparison of results after the improvement applied. In the case of the processes, five random orders were selected from the 80 daily orders, which allowed 100 average time records to be collected for each order placed for 20 days.

4. Results

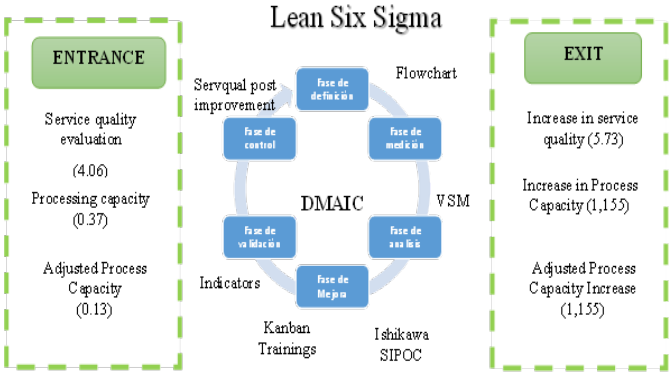

Fig. 1. Lean Six Sigma proposal design

Figure 1 proposes a Lean Six Sigma management model, for which the inputs are the Siu Mai order data, the initial evaluation of the service quality (Servqual method) and the current situation of the organization. Subsequently, through the LLS, the DMAIC will be used, for which in each phase different Lean tools will be used both for the analysis and for the implementation of the improvement. Finally, the process capability indexes and service quality after implementation will be evaluated.

4.1. Definition phase

In the definition phase of the Lean Six Sigma project to improve the processes of a Siu Mai snack company, specific objectives are established, such as improving service quality, process capacity and reducing delivery times. A flow chart was used to visualize the current production and service process, identifying critical areas. The project team, led by Lean Six Sigma experts [18], includes the Administrator as sponsor and multidisciplinary members.

The main objective is to increase service quality, as measured by a score above 5.73 in Servqual, and to improve process capability with a score above 1 in CP and CPK. The team, composed of kitchen, sales and delivery personnel, has key roles such as defining objectives, collecting data, identifying problems and collaborating on the development of the flow chart. Project leadership rests with the researchers [18].

4.2. Measurement phase

In the measurement phase, key indicators were incorporated to evaluate Siu Mai's order delivery process, along with previous metrics of process capability (CP, CPK) and service quality (Servqual). The Average Delivery Time (TEP), calculated at 97.44 minutes, indicates a partial efficiency in deliveries close to the maximum limit of 100 minutes. The possibility of improving by reducing the maximum time to 90 minutes to exceed expectations is highlighted.

Deadline Compliance (CP) of 44% reveals a challenge in delivering within the promised time frame. This suggests inefficiencies in the process, potential broken promises, and the need to improve planning for more efficient distribution. This poor compliance with deadlines could affect customer satisfaction, highlighting the importance of addressing these areas of improvement. This quantitative analysis provides crucial data to optimize the process and improve the overall customer experience.

4.3. Analysis phase

The Analysis phase used tools such as the Ishikawa Diagram and SIPOC to identify root causes, areas of improvement, and optimization opportunities. The Ishikawa diagram, shown in Figure 2, reveals root causes such as errors in order taking, lack of procedural standards, and poor internal communication. Challenges in materials, labor, and machines are also explored, evidencing the need to improve training, equipment maintenance, and time supervision.

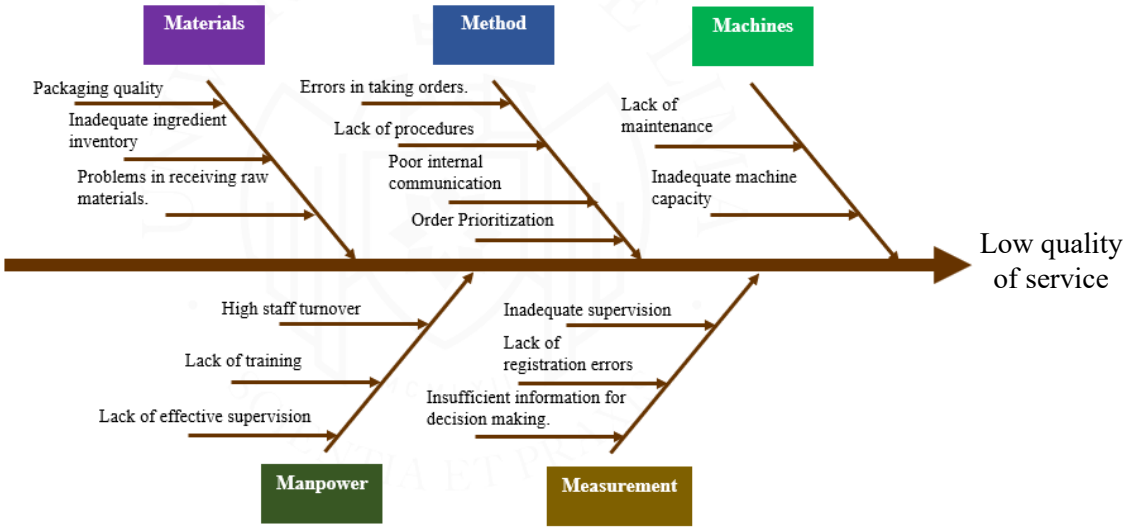

Fig. 2. Cause effect diagram

The SIPOC, which visualizes the workflow from the client's request to delivery, highlights shortcomings in information management between areas and points out the need to reduce process times. Key areas for improvement are identified, such as the lack of error recording and the lack of an efficient system that unites information between areas. This in-depth analysis provides a solid foundation for implementing targeted and effective improvements to Siu Mai's delivery process.

4.3. Improvement phase

For the improvement stage, Bapo Perú seeks to improve the quality and efficiency in the delivery of its Siu Mai snacks through the implementation of Lean Six Sigma and the DMAIC methodology, along with the visual approach of Kanban.

Experimentation Description:

The proposal begins with a detailed evaluation of current processes, identifying critical points. Kanban cards are introduced to manage production, material replacement and order orders. A training program ensures the understanding and correct application of the Kanban system.

Implementation:

In the process of managing orders, accuracy and efficiency are improved using Kanban cards. The production process incorporates Kanban cards to manage materials and improve efficiency. In packaging and transportation, orders are prioritized using Kanban cards for faster delivery. The delivery and post-sales process is optimized with Kanban cards to track progress and improve customer communication.

Monitoring and Adjustment:

Employee surveys show positive results, highlighting improvements in order distribution, production efficiency and time reduction. The images show the successful application of the Kanban system in daily management. The most striking results were that about 33% of the employees consider that the Kanban system has contributed to improve the visibility of orders and their progress status.

Manuals, Procedures or Instructions:

Figure 3 shows the development of the TO BE process flow, detailing each stage of the process such as managing orders, production, packaging and transportation, delivery and after-sales. Kanban cards are presented with specifications for their use, along with a training program covering the fundamentals and components of the system, and practical sessions.

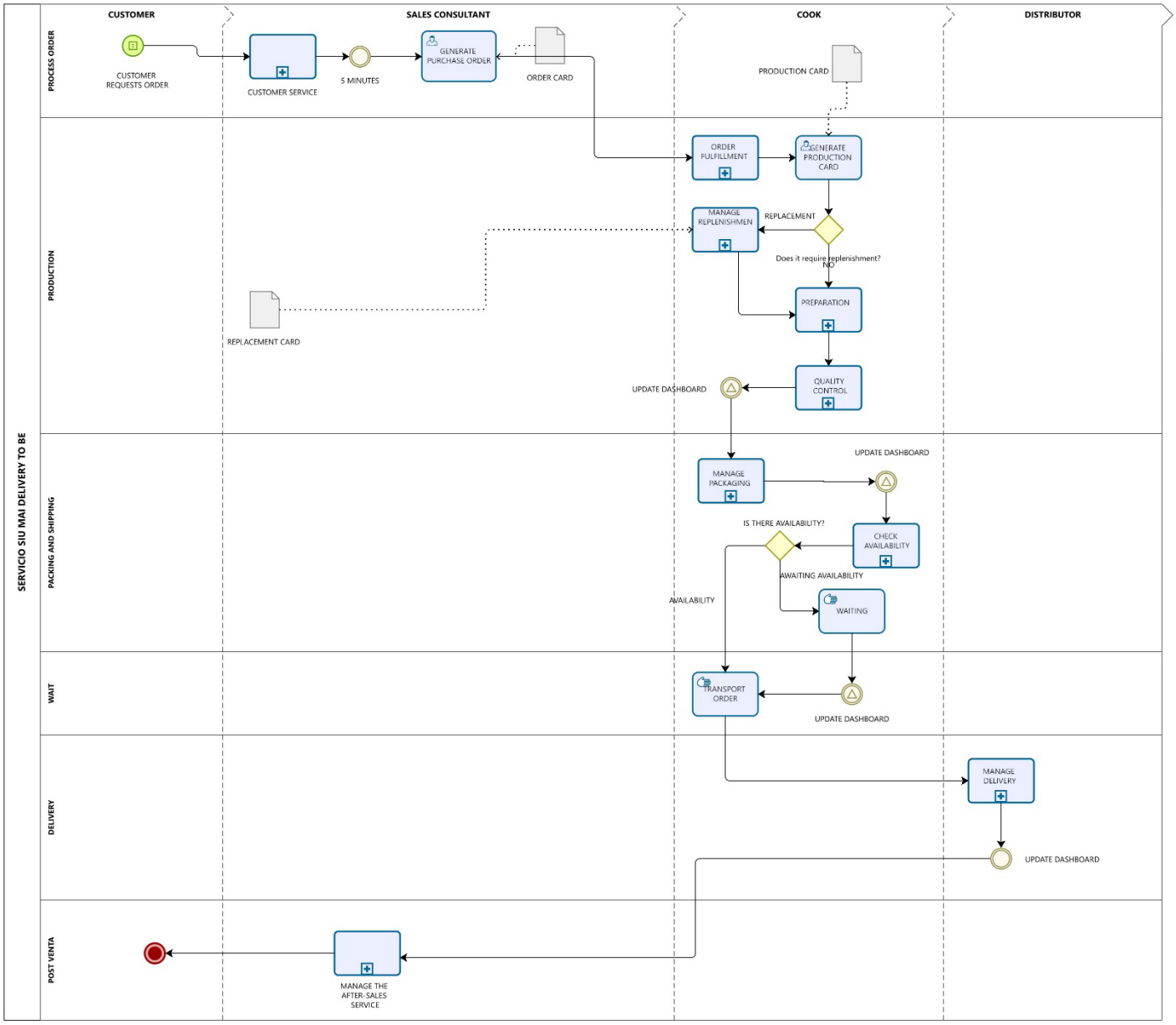

Fig. 3. Siu Mai TO BE Delivery Process Diagram

Following the application of Lean Six Sigma and Kanban on the Siu Mai sandwich order line through to delivery, substantial improvements were observed. The CP and CPK indicators revealed an increase in production capacity, reaching CP 1.08, indicating better control and ability to produce within specifications.However, CPK of 0.89 signals that there are still challenges to fully meeting specifications, highlighting the need for greater consistency in production and reduction in time variability. Regarding the quality of the service evaluated through SERVQUAL, the post-test results indicated a significant improvement. According to Table 2, the dimensions of empathy and responsiveness showed notable increases, demonstrating that the adaptations made to the process led to greater customer satisfaction.

Table 2: Servqual post-improvement evaluation

Service quality evaluation Servqual Bapo Peru					
Reliability	***Safety***	***Tangible elements***	***Responsiveness***	***Empathy***	***Average***
6.01	6.05	5.97	6.20	6.22	6.09
4.004	4.035	3.971	4.093	4.114	4.051

The final average results obtained before and after the application of Lean Six Sigma are shown. Considering that the minimum score is 1 and the maximum score is 7, it can be seen that the post-test result reflects a significant improvement in terms of customer perception based on the service provided (Siu Mai snacks) via delivery. Based on the results shown in Figure 6, there is an improvement of 2.02 in the score which reflects that the improvements had a positive impact especially on poor points such as delivery delays, poor customer service and production capacity.

This result indicates that there is better control in production, which means that the company has the capacity to produce Siu Mai snacks within the required specifications. This result reflects progress, but there are opportunities for improvement, such as reducing the variability of times to generate a better result. Subsequently, a CPK calculation was performed which yielded a score of 0.89. This indicates that the service continues to have some difficulties in meeting specifications and that there is room for improvement. There is a need for greater consistency in production and variability in timelines.

The study evaluated Bapo Peru's service quality using the SERVQUAL method and process capability with a control chart. It was based on previous research, including an improvement framework for warehouses [19] competitiveness in gastronomic destinations [20] and factors influencing customer satisfaction during pandemic [21]. The results indicated that Bapo Peru obtained high ratings in reliability, safety, responsiveness and empathy, although clients perceived a slight deficiency in the tangibles dimension. The company showed an ability to produce Siu Mai within specifications, but there is room for improvement to maintain consistency. Previous research highlights the success of Lean Six Sigma (LSS) in diverse industries, including process improvement in higher education [16] and various industrial sectors [22]. However, both SERVQUAL and LSS have limitations, such as lack of assessment of actual service quality [23] and possible narrow focus on process optimization [13]. Despite their effectiveness, more research is needed to identify limitations and explore alternative approaches. In conclusion, while SERVQUAL and LSS have proven useful in assessing service quality and improving processes, there are always opportunities to improve and adapt these methodologies to specific industry needs.

4. Conclusion

Overall, the use of Lean Six Sigma and Kanban resulted in better production control by increasing the average delivery time of Siu Mai snacks, which allowed to increase the quality of service in the sale of siu mai snacks via delivery. The use of Lean Six Sigma and Kanban resulted in better production control by increasing the average delivery time of Siu Mai snacks. This led to a CP (process capacity) of 1.08 and a CPK (proces capacity index) of 0.89, indicating the need for further improvement. The aforementioned factors have had a significant influence on the improvement in the quality of the service, which has led to a substantial increase in the rating from 4.07 to 6.09. This was the result of the higher level of response and security. This led to a CP (Process Capability) of 1.08 and a CPK (Process Capability Index) of 0.89, which indicates the need for further improvement. The aforementioned factors had a significant influence on the enhancement of service quality, resulting in a substantial increase in the rating from 4.07 to 6.09. This was a result of the enhanced level of responsiveness and safety.

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