

# Model Applied to the Purchasing Area Using Lean Service and Six Sigma to Improve Gross Margin in a Company in the Hotel Sector

Gonzalo Barrera-Ramirez, Jaime Ramirez-Gonzales, Juan Carlos Quiroz-Flores\*, Martin Collao-Diaz, and Alberto Flores-Perez

Facultad de Ingenier í y Arquitectura, Universidad de Lima, Peru

Email: 20170154@aloe.ulima.edu.pe (G.B.-R.); 20171260@aloe.ulima.edu.pe (J.R.-G.); jcquiroz@ulima.edu.pe (J.C.Q.-F.); mcollao@ulima.edu.pe (M.C.-D.); alflores@ulima.edu.pe (A.F.-P.)

\*Corresponding author

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**Abstract**—This research was carried out to determine proposals for improving the gross margin within a company in the hotel sector in Lima, applying the Lean Service and Six Sigma DMAIC methodologies, whose combined approaches provide a global approach to the analysis of the company and helps to extend the improvements to the other areas of this. The area chosen to carry out the DMAIC analysis (Define, Measure, Analyze, Improve and Control) was the purchase one, since this presents a greater number of problems, caused by the low levels of quality offered by suppliers and by the poor management of this, harming the service provided to customers. The techniques chosen for the solution of the root causes of these problems have historically been successfully applied in the manufacturing industry; however, it has not been until recent years that these were also considered for application in companies in the service sector, so the objective of this article is to demonstrate, complementing past research, that these methodologies can have the same success in both sectors.

**Keywords**—lean service, supply chain, sustainability, sustainable practices, gross margin, six sigma, DMAIC, lean six sigma, hotel sector

## I. INTRODUCTION

Sustainability has become a fundamental guide for the development of practices in sustainable organizational [1]. According to [2], there is a very large relationship between sustainability and competitiveness within companies, with those that lead in the Peruvian market those that carry out sustainable practices and in addition, 78% of medium and small companies comply with the standards. One of the service industries with the greatest environmental impact is the hotel industry, since, due to the services it offers, it consumes a significant number of resources [3]. It is therefore beneficial for service companies to be concerned with the sustainability of their practices [4].

Sustainability in companies cannot be achieved unless all the agents that are part of their value chain are considered [5]. In a hotel supply chain, sustainability is based on providing services in a cost-effective way, reaching the long term [6].

The first methodology to use is Lean Service, which helps to find an efficient way to minimize waste and at the same time increase profitability [7]. Another methodology that is useful for companies looking to increase their competitiveness is that of Six Sigma, which is focused on reducing variation in production processes [8]. This methodology is based on the DMAIC principle, which consists of five steps (Define, Measure, Analyze, Improve

and Control).

The papers used contain information about the supply chain and its importance in companies, which is why this research is considered of the utmost importance. Our work will be divided into 5 parts, which are Introduction, Methodology, Results, Discussion and Conclusions.

## II. STATE OF THE ART

### A. Lean Service

Lean Service helps the company to produce value in its activities without generating waste; that is, it helps the organization to identify the failures in the areas that generate the most waste, identify their causes and eliminate them to increase the quality of the service that is delivered to the client [9]. It also helps organizations remove certain waste that prevents the company from improving, helping to reduce costs, increase the quality of customer-facing services, resulting in benefit for the organization [10]. It is defined as the suppression in a system of different waste or worthless tasks due to their disregard for achieving customer satisfaction at the end of the supply chain [11]. As such, it has important applications in the hotel industry, since it needs to efficiently use all the resources required by companies to achieve long-term sustainability based on this practice [12].

### B. Six Sigma

Six Sigma indicates considering the customer as the most important stakeholder in the value chain to repair problems in the areas of the supply chain in an effective way. This methodology helps to analyze the processes within the company following a sequence of steps to reduce errors that make it less efficient, and then improve them in favor of the client and the company [13]. Six sigma is a methodology focused on reducing variation in processes, helping the company in its search for efficiency and effectiveness [14].

Six sigma helps the management of areas of the supply chain to reduce and / or eliminate waste, both tangible and intangible, that affect the company, placing the customer as the most important stakeholder in the value chain to be able to repair problems in the supply chain in an effective way [15].

### C. DMAIC

It's a five-step methodology based on the following steps: Define, Measure, Analyze, Improve and Control [16]. This approach is based on 5 steps which are: Definition of the

problem to be solved, Measurement of the results obtained, Analysis of the impact of the root causes, Improvement proposals to mitigate or eliminate the root causes and the required Control proposals. This methodology helps to identify root causes [17]. As the results obtained in [18] show, the DMAIC methodology helps to identify parts of the process in which is possible to reduce time wasting and increase standardization.

**D. Kanban**

This tool helps to have an overview of the current state of the processes carried out within the company, to optimize them, eliminating the failures in these that generate greater impact in their realization, improving their profitability [19]. Kanban is helpful to improve inventory control, as shown in [20].

Kanban has 3 fundamental principles, which are [21].

- Start with current activities: Kanban allows you to work with current activities to find their respective failures.
- Seek to implement evolutionary and incremental changes.
- Encourage leadership: It is important for leaders to have each of the teams focus on continuous process improvement.

**E. Just in Time**

Just in Time is a system that helps companies eliminate all activities or objects that do not generate value or are unnecessary in the processes, starting from purchases to final distribution. This engineering tool is based on principles aimed at increasing the profitability of the company from the reduction of everything that is not considered essential for the value proposition offered to the client, reducing lead time and batch size, producing high quality products according to the pace of their demand to have the minimum amount of waste. [22]. In order to implement Just in Time in this case study and thus improve delays in the arrival of products and their reception, as well as the management of the purchasing area, 4 steps will be used: layout design, definition of the appropriate storage system, streamlining of the reception and dispatch process and strict inventory control [23].

**III. CONTRIBUTION**

To find the right tools for improvement in the organization, a literature review was carried out, in which the Lean Service and Six Sigma tools suitable for solving the problem were found. The following table shows the relationship of the most important articles selected with the impact they would have on the design of the proposal.

**A. Proposed Model**

The proposed model is based on lean service and six sigma methodologies. For the development of the proposal, it begins by considering the DMAIC methodology, which consists of five steps for its implementation. First, the problem and the objective of the research are defined. Secondly, once the problem is defined, we proceed to define the indicators to be used for the measurement of the process. Thirdly, the data and indicators collected should be analyzed to identify the main causes. Fourthly, the improvement will

be implemented with the aim of improving the indicators and comparing them with those obtained previously. Finally, the implemented improvement will be monitored and controlled. (see Table 1)

Table 1. Comparison matrix of the causes of this research vs the state of the art

Scientific articles	Inefficient management of the purchasing area	Non-compliance by suppliers	Environmental commitment of suppliers
Kotlyarova, E., Mekhantseva, K., Markin, L., & Otrishko, M. (2021)	Kanban		Lean Six Sigma
Rauch, E., Matt, D., & Linder, C. (2020)			
Farrington, T., Antony, J., & O’Gorman, K (2017).	Kanban	Just in time	
De-Pablos-He redero, C., Fernández-Va lero, G., & Blanco-Callej o, M. (2017)			Supplier Approval
<b>Proposal</b>	Kanban	Just in Time	Supplier Approval

**B. Model Components**

**1) Phase 1: Definition of the problem**

This stage consists of the the definition of the problem identified with the help of the diagnosis. For this, the Value Stream Map (VSM) tools and the SIPOC diagram will be used, as this tells us whether an activity adds value for a client, whether external or internal. VSM is used to eliminate waste in processes. It is done by creating a map that allows to visualize the flow of the products throughout the process of value creation, their corresponding added value, the time of each activity and the relationship of these with the economic agents. The SIPOC diagram helps to have a simple perspective of a company activity by identifying its parts, which are: the supplier, the resources, the process, and the customer. In this case study, the supplier is the company that delivers the products (amenities), which would be the resources, the process of purchasing these and the customer of this activity the warehouse area, which is responsible for preparing these packages for distribution at the time it is required.

**2) Phase 2: Measure**

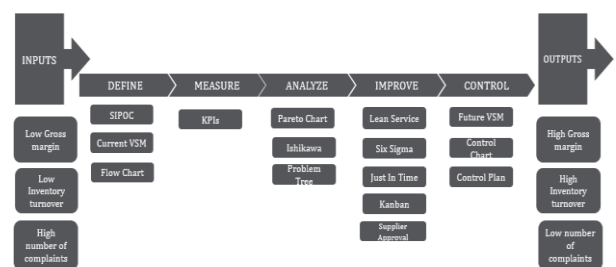


Fig. 1. DMAIC.

In the second phase, the data collected will be studied to define the appropriate indicators according to the problem encountered (see Fig. 1). This step is important to be able to numerically observe the current state of the company and its variation with respect to improvement.

3) Phase 3: Analyze

In this phase, the indicators and the information collected in the two previous phases are analyzed to identify the main causes of the problem. Tools such as the Ishikawa and Pareto Charts will be used to perform this analysis. The main problem found within the purchasing area of the company is caused by failures in the delivery of products by suppliers, which generates problems and delays in different areas of the supply chain. It should be noted that these failures do not originate only from suppliers, but also from poor management of purchase orders. In addition, the absence of sustainable practices on the part of suppliers makes it difficult to comply with the company's environmental commitment.

4) Phase 4: Analyze

In this phase, lean service and six sigma methodologies will be implemented with the aim of improving the measured indicators and standardizing the process. Techniques such as Just in time and tools such as Kanban and supplier approval will be used.

5) Phase 5: Control

The last phase of this model is to control that the proposed improvement is a solution that can be sustained over time. For this, a Value Stream Map (VSM) will be made again where the new state of the indicators will be identified. Thanks to the best management of purchase orders, it is expected to be able to receive all the amenities; that is, the 5460 units, in a single trip instead of three, saving the company a day of waiting and 0.06 minutes of cycle time. In the process of forming packs, having all the amenities at hand to be able to form the packs, eliminating unnecessary waits, the cycle time will be reduced by half a minute and its waiting time in one day, this due to the fluidity that these improvements are expected to provide. Finally, for the distribution of the packs of amenities to the rooms, it is planned to reduce by half the time invested in the room; that is, 2 minutes, thanks to the shorter waiting time by those in charge by having in the warehouses the exact amount that is required to meet the daily demand.

C. Indicators

3 indicators will be used to measure the impact of the proposed improvement.

**Number of monthly complaints:** With this indicator, the complaints made by customers are measured when they do not have at their disposal a package of amenities when they require it. The objective is to reduce this amount by 50%.

**Gross Margin:** This indicator measures the profitability of purchases made in the year. The objective is to increase this indicator by 40%

$$Gross\ Margin = \frac{Gross\ profit}{Total\ sales\ of\ the\ period}$$

**Number of inventory turnover:** This indicator helps to measure the number of times all the existing merchandise is

sold in the company's warehouses. A high value for the hotel indicates that it is having smooth sales and stocks are coming out quickly. The objective is to increase this indicator by 30%

$$Inventory\ turns = \frac{Cost\ of\ Goods\ Sold}{Inventory\ cost}$$

IV. VALIDATION

A. Initial Diagnosis

When studying the situation of the company at the beginning, the main problem is the large magnitude of operating expenses, which represent 80.9% with respect to annual sales. The main causes of this problem are the inefficient management of the purchasing area, non-compliance by suppliers and lack of homologation to them.

The calculation of the amount of the optimal replications so that the values obtained are significant was carried out through the output analyzer.

B. Initial Diagnosis of the Case Study

According to the proposed model, the initial variables of this were first analyzed, such as the number of workers, packages to be formed, rooms to be distributed and working hours. With the implementation of lean service and six sigma methodologies and Kanban, JIT, and homologation tools, it is possible to reduce the cycle time of the process of assembling the amenities, also evidencing the reduction in the times taken by the drafting, and sending of an order and the cleaning of the rooms.

C. Validation Design

To implement the proposed model, the Arena simulation software was used. For this, it began by calculating the distributions of the times that were previously measured by the company. Using the formula to calculate the sample size via output analyzer, an optimal number of runs of 320 was reached. The following Table 2 presents the current, the expected and the actual results obtained after the simulation.

Table 2. Comparison matrix of the current situation, expectations and the simulations results

Indicator	Current	Expectation	Simulation
Gross margin	56%	70%	70%
Inventory rotation	4 times	6 times	8 times
Number of monthly complaints	15	9	2

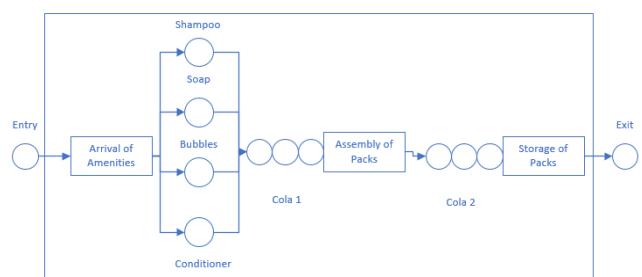


Fig. 2. System representations.

By eliminating the waiting times generated by the failures in the orders and the poor management of the purchasing area,

it managed to considerably reduce the number of monthly complaints, which occur when a customer does not find the package of amenities in his room at the time it requires. In addition, the number of times the inventory rotates was also increased, thus also increasing the gross margin. (see Fig. 2)

## V. CONCLUSIONS

This study helped to better understand the relevance of good purchasing management in a company in the hotel sector in Peru. According to the results obtained, an evident improvement can be observed in the indicators raised at the beginning of the research. Below, the rescued conclusions will be detailed.

- The implementation of lean service and six sigma methodologies with Just in Time and Kanban tools eliminated order failures, resulting in delays throughout the process. This is because, thanks to these improvements, there was a better order and standard for the formulation of these.
- The improvements implemented in the purchasing area can be replicated in other parts of the supply chain of service companies to reduce waiting times, errors that trigger reprocesses and to establish standard work procedures where they do not exist.
- It was possible to observe and highlight the importance of the homologation of suppliers as a stage prior to the selection of these to ensure the alignment of the principles of both the service company and the supplier.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## AUTHOR CONTRIBUTIONS

Juan Quiroz-Flores, Mart ín Collao-Diaz, and Alberto Flores-Perez provided the conceptual and theoretical parameters for the research and writing. Gonzalo Barrera-Ramirez and Jaime Ramirez-Gonzales proposed the topic and the sector to analyze, conducted the research, analyzed the data, came up with the model design, calculates the indicators, and ran the simulations together. All authors had approved the final version.

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