

Improvement Model Based on Lean Warehousing, Kanban and BMP to Increase the Level of Service of A Lighting Fixtures Retailer

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Abstract

The commercial sector in Peru is one of the most influential sectors in its economy, representing a percentage of 17.8% of GDP. Although this sector has a lot of influence, it also has a big problem, which is its level of service, which greatly affects companies, economically and their customers. One of the causes of this problem is the inadequate management of inventories in the warehouses of the companies, causing non-fulfillment of orders, reorders, among other things. Therefore, the objective of this research is to demonstrate that the implementation of Lean Warehousing, Kanban and BPM tools are useful to increase the level of service of trading companies, minimizing the number of reorders, the time to search for products in the warehouse, improving inventory management in the warehouse. In addition, in order to validate this proposal, the BPM tool was simulated, using the Arena software, in the warehouse area, which resulted in an increase in the availability of the operators, from 65% to 90%.

Keywords

BPM, Lean Warehousing, Kanban, 5'S and Warehousing.

1. Introduction

The commercial sector refers to the commercialization of goods, which can be domestic or imported, which will be offered in various distribution channels (*INEI, 2022*). The commercial sector represents 17.8% of the national GDP (*BCR, 2022*). In June 2021, the total volume of imports increased by 53.4%, explained by higher imports of consumer goods (26.8%) (*INEI, 2015*). Imports of lamps and other lighting equipment in 2021 amounted to US\$ 3.2 million (Hu & Chuang, 2022).

The commercial performance of a company is measured according to the level of service. In the case of small and medium-sized enterprises (SMEs), this is directly associated with adequate inventory and warehouse management (Sugito et al., 2021). In a company in the commercial sector in Peru, which had a service level of 81.98%, generating unearned income of 98,780 soles, this was due to the shortage of materials, long cycle times and stock rupture (Pyroh et al., 2021). Another mechanical spare parts trading company reported a service level below 80% this was due to dissatisfaction of purchase order delivery and missed dates (Chams-Anturi et al., 2022). In addition to this, a trading company in Peru, obtained a service level of 87.31%, the main causes were the number of orders delivered incompletely and orders rejected by customers, generating an economic impact of 89 594 soles, representing 11.04% of the annual turnover (Castro et al., 2019).

A case study was chosen to reflect the problem identified in the sector, the low level of service in the company to be analysed is due to the quality of the products and the delivery time of these, which increases due to inadequate warehouse management, causing an economic impact of US \$17,078.00, to improve the problem an improvement model will be created using the tools Lean Warehousing, Kanban and BPM.

In order to present this scientific article, it was divided into the state of the art, in which the background of the problem is presented with the help of research by different authors, a contribution where the theoretical foundation is analysed, as well as the case study model and its indicators.

1.1 Objectives

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2. Literature Review

2.1. Kanban

The Kanban tool is a visual system which can be used from cards or boards to visual and electronic signs to manage information flow and workload, as well as to increase and improve communication between processes and work centers (Castellano Lendínez, 2019). Kanban cards help to have a simple but effective visual management system in warehouses where there is a large set of fast-moving goods (Marques et al., 2022).

2.2. Lean Warehousing

In order to ensure a good level of service in SME marketers, it is necessary to maintain an adequate supply chain management, which in turn, has generated the need for adequate warehouse management (Camacho-Obregón et al., 2022), (Castro et al., 2019), (Figuroa-Rivera et al., 2022), (Fahad et al., 2017), (Viriyasitavat et al., 2020) and (Abhishek P.G. & Pratap, 2020). Warehousing is the largest operating cost in an organization's supply chain (REQUEJO PAZ, 2020). In order to maintain an adequate warehouse management in SMEs, it is suggested to use the Lean Warehousing tool, which uses the Lean Manufacturing philosophy to be able to increase the productivity of warehouses, this tool aims to reduce logistics costs in the warehouse, eliminating activities that do not generate value (Camacho-Obregón et al., 2022) , (REQUEJO PAZ, 2020), (Viriyasitavat et al., 2020) and (Castro et al., 2019). In addition to this, it is important to maintain an established order in the warehouses, in order to reduce the picking time of the products, so it is necessary to perform a good inventory control (Camacho-Obregón et al., 2022) and (Abad-Morán et al., 2021). Because of this, the Lean Warehousing tool is used in conjunction with the 5'S and ABC tools (Camacho-Obregón et al., 2022) and (Sugito et al., 2021).

2.3. Management of Business Processes (BPM)

SMEs face the great challenge of optimizing and innovating their business processes so that they can gain business advantages in a highly competitive market (Aversano et al., 2016), (Castellano Lendínez, 2019) and (Viriyasitavat & Hoonsopon, 2019). BPM uses design tools, techniques and management methods to identify, analyze, execute and nurture processes, increasing the service level of SMEs (Figuroa-Rivera et al., 2022), (Sugito et al., 2021), (Castro et al., 2019) and (Villacrez-Zelada et al., 2022). In addition, to ensure a good optimization of processes, the digitization of inventories is used to automate them in a technological way (Molnár et al., 2021), (Castro et al., 2019) and (Viriyasitavat & Hoonsopon, 2019).

3. Methods

The purpose of this research is to create a value proposition, using the various tools that have been proposed and evaluated in the previous chapter, the state of the art for this service model. The proposed tools are intended to mitigate the root problem of this case study, the main objective of this study is to increase the level of service in a trading company. Considering the current context, we proceeded to investigate different models, tools and methodologies to support the mitigation of the main causes that affect the service level. It was possible to determine the Lean Warehousing tools for the problem of warehouse management; in addition, it was identified that Kanban for problems in the management of workflow and workload; as well as the Business Process Management (BPM) tool which is very useful to achieve a standardization of the inventory storage process.

Based on the research conducted and the articles reviewed, the proposed model has the Lean Warehousing, Kanban and BPM tools which will increase the level of service in a company that sells lighting fixtures. This model is made up of 3 components. Figure 1. Shows the suggested approach for the elaboration of the implementation proposal.

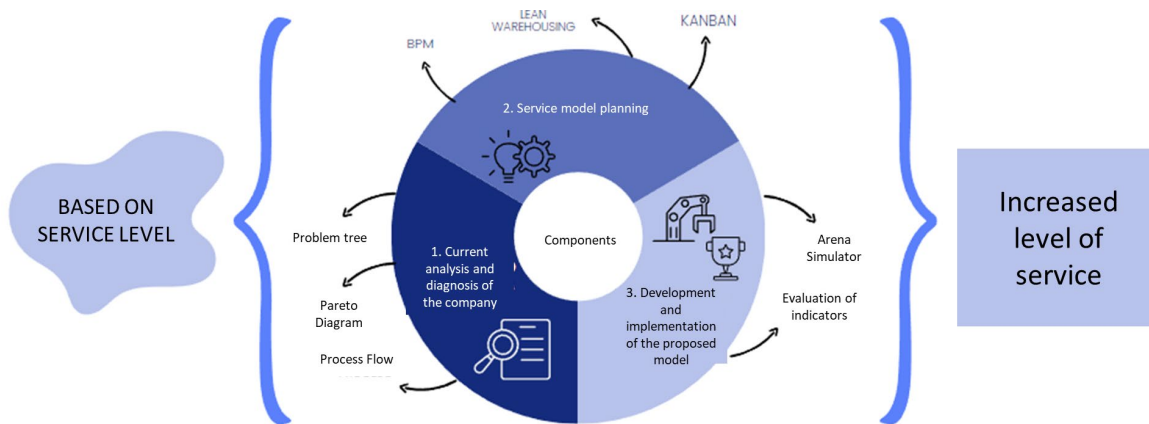


Figure 1. Proposed model

3.1. Information on the study process

The order collection, packaging and dispatch process is crucial since customer satisfaction depends on it, which can be affected by the quality of the product, the quantity of the product and the delivery time.

4. Data collection

For data collection, interviews and surveys were used with workers and area managers to obtain detailed information on how the collection and dispatch area is managed and to analyse the process in order to determine opportunities for improvement or possible problems. With the help of the Pareto tool we were able to determine the most critical problems in the area and with the use of the problem tree we were able to determine the main causes of these problems. After finding the critical problems and their causes we went on to choose the most appropriate tools to solve them, the tools Lean Warehousing, Kanban and BPM were chosen to solve the problems of organization in the warehouse, standardization of processes and communication between areas. See Figure 2.

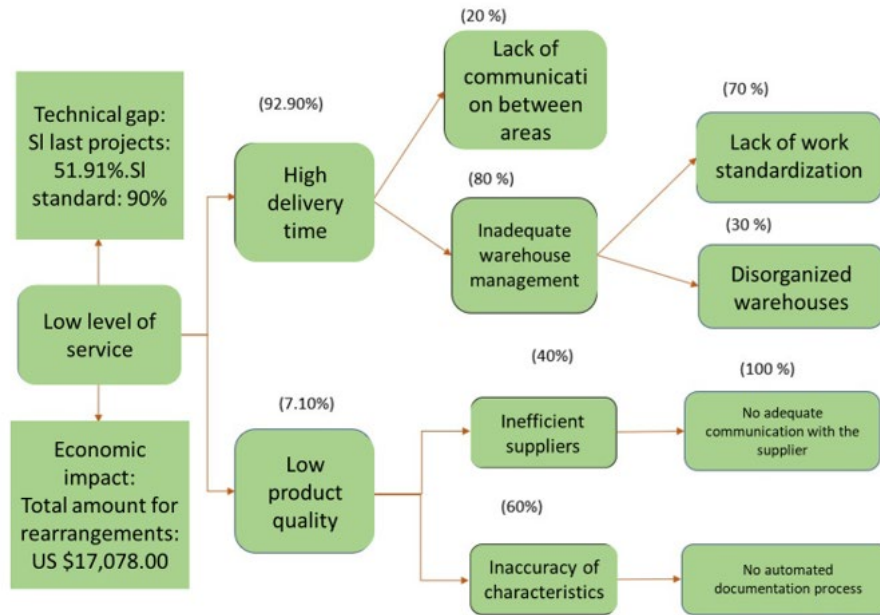


Figure 2. Problem tree

4.1. Implementation of Lean Warehousing, Kanban and BPM

The tool we will use is Lean Warehousing because this tool focuses on putting the warehouse in order using the 5'S tool. In order to implement this tool, it must be implemented in 5 phases: Sort, set in order, shine, standardize, sustain. For the execution of the fourth phase of standardizing, the BPM tool will also be used to eliminate repetitive activities and reduce work time. The Kanban tool will also be used in the last phase so that the information flows more effectively among the workers.

- Sort: With the help of a control card, the tools and EPPS found in the warehouse were classified according to their condition and divided into three categories: tools with recoverable damage, unnecessary materials and unusable materials. The types of products in the warehouse were also identified, the most frequent being LED lights, LED panels and spotlights.
- Set in order: the materials were ordered according to their frequency of use. The warehouse had two aisles and a special area to carry out modifications if is necessary. In the case of the first area, the aisles that were full of boxes were freed so that mobility would be more fluid and the places on the shelves where the products would go were marked, and in the modification area, the different extra accessories that are usually used for this activity were catalogued and divided.
- Shine: warehouse personnel were trained on the benefits of keeping the area clean and how this would be beneficial to their comfort and work efficiency. In addition, the warehouse was cleaned, as well as the materials that were there. After that, a calendar of activities was drawn up, detailing the actions to be performed by each person and the day on which they should do it.
- Standardize: The inspections carried out at the site were followed up to ensure that the materials were in their respective places. After this, a poster was made with the rules established to maintain cleanliness, which was placed on the door, since it is an area where warehouse operators can see it clearly and quickly.

based on the data collected from the activities, a process flow was made to recognize which activities can be combined or eliminated to reduce work time. With the use of the BPM tool it was possible to determine the activities that should be standardized to reduce the time of the activities that make up the process.

- e. Sustain: a reminder was given to the operators about the importance of the 5'S, its phases and what they must do to achieve the established objectives. Images were placed referring to the phases of the 5'S and their philosophy.

In this phase we also used the Kanban tool which is used to determine the flow of all the activities that are carried out at the time of making the sale, with this phase you can have a better notion of the work being done and thus be able to control it.

5. Results and discussion

The application of the pilot test for the improvement of the level of service was given during 1 month in which training was given to the personnel about the 5's philosophy as well as guidelines so that the Kanban tool could be used in an efficient way, not only to improve the service level, but also to improve the quality of the service. In the results of the pilot test and the simulation that was used to validate the BPM tool, the number of reorder errors was reduced to only 10% when in the situation before the implementation of the improvements it was an error percentage of 40%, the availability of the operators was increased by 25% allowing the workload to decrease.

The data show an improvement in the times of the activities that affected the level of service of the company, such as the number of reorders which increased the delivery time, in the verification activity the error decreased from 60% to 90% which contributed to the fact that the months of waiting for reordering products, in this case 3 months, no longer affected the total delivery time of the order.

It was also observed that the time of use of the operators decreased since now the activities are separated and automated, resulting in less workload for the rest of the operators, the permanence of the orders decreased to 262.43 minutes.

In this case, it can be determined that there was a favourable change in the company studied, given that the product search time indicator was reduced, this is a key indicator to be able to implement the improvement implementation, since it is related to the main problem of the company. The reduction of this indicator was due to the good order and classification of the products and their tools, starting with a product search time of 15 minutes per product and ending with a search time of 5 minutes per product. Likewise, the other indicator selected was the 5's audit, which increased its score, showing that the operators internalized the 5's philosophy and perform it correctly and continuously. Starting with an average of 4.6 and ending with an 8.8. Show in Table 1 and Figure 3.

Table 1. Indicator of 5'S

Indicator	Before the upgrade	With the improvement
Product search time	15	5
Average of 5's audit indicator	4.6	8.8
Sort	6	9
Set in order	2	9
Shine	2	9
Standardize	6	8
Sustain	7	9

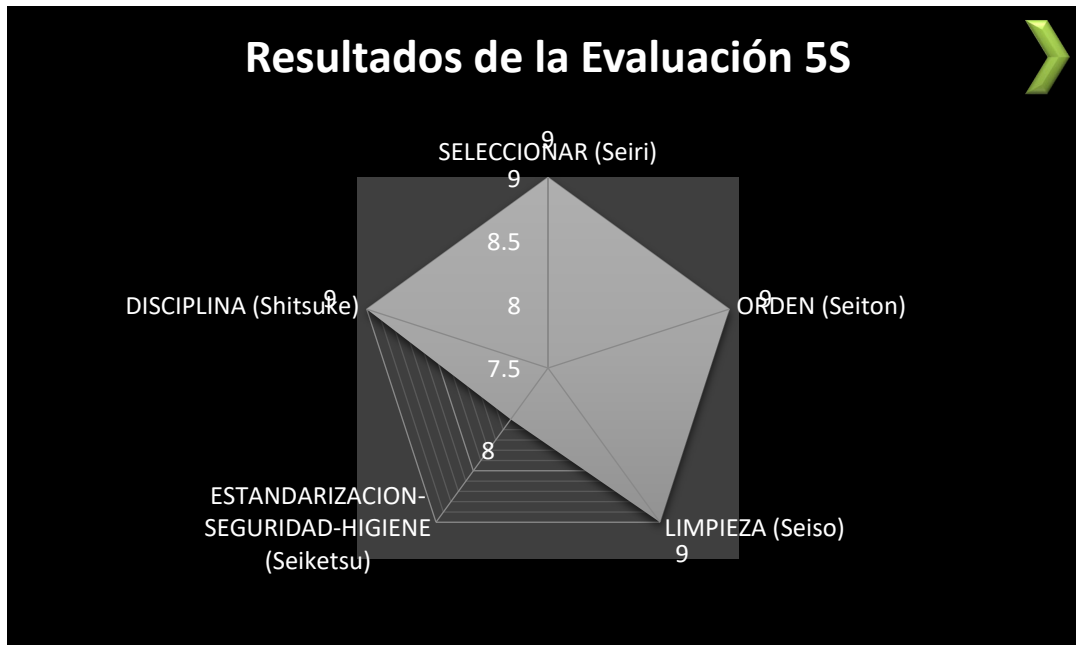


Figure 3. Assessment of the 5's

5.1. Cost analysis

At this point, the budget that would be required to carry out the improvement model in the company will be presented. Show Table 2

Table 2. Cost for cleaning

Resource	Quantity	Unit	Unit Cost (S./)	Total Cost (S./)
Office supplies	2	kit	50	100
Organizing trays	1	unit	99	99
Cleaning kit	1	kit	50	50
Cleaning products	2	unit	11	22
Trash garbage can	1	unit	18	18
Recycling garbage can	1	unit	18	18
Total cost				307

For the implementation of the best BPM, a person was hired to be in charge of inventories, this worker can be either a new employee hired and trained or can already be part of the organization and be promoted to this position after training which would cost S./1,875.00

5.2. Validation

The improvement model was validated through a pilot test that lasted 1 month and through a simulation made in the arena simulator. With the data obtained, the indicators used to determine if the improvements helped to increase the level of service were compared. Show in Table 3.

Table 3. Comparison of indicators between scenarios

Problem	Actual	Objective	Improved	Causes	Indicator	Actual	Objective	Improved
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Low level of service	52%	90%	87%	Lack of standardization	Availability of operators	65.33%	85%	90%
				disorganized warehouses	order cycle time	3 meses	2 mes	1 mes y medio
				Lack of communication between areas	% of orders with error	40%	20%	10%

The correct implementation of the 5's and Kanban managed to reduce the number of order errors, reaching only 10% when in the situation before the implementation of the improvements it was an error rate of 40%.

The use of the BPM tool improves the availability of the operators since it manages to standardize the activities and it is possible to increase availability by 25%, allowing the workload to decrease.

With the implementation of BPM, 5'S and Kanban, it was possible to reduce the order delivery time from 3 months to 1 month and a half, which led to an increase in the service level to 87%.

6. Conclusions

The proposed model achieved the proposed objectives in the 4 weeks that the pilot test of the tools was carried out. The indicator of the number of reorders and the product search time were some of the most important indicators, since with these indicators we can see if the model works correctly.

Taking into account the results obtained from the implementation of the proposed model, we can conclude that the company's service level has increased, this is due to the fact that the fewer reorders that have been made, the less time it takes to replenish the warehouses with the necessary products to meet the demand of its customers within the established deadline.

The commitment to continuous improvement starts from the management level down to the workers. It is essential to integrate the entire work team to become a more competitive company.

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