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Improvement to Reduce Delivery Times Using 5S, Kanban and Standardized Work in a Plastic Company: A Peruvian Empirical Review

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Abstract

The objective of this research was to propose a solution to the delay in order delivery in a Peruvian SME dedicated to the production of plastic containers, using lean tools such as 5S, Kanban, and standardized work. The 5S methodology was used to organize and organize the area, Kanban to control and improve the pace of work, and standardized work to ensure that everyone follows the same method. Through a pilot test, it was validated that this solution reduces the delivery time of generated orders to competitive levels in the industry. Furthermore, the pilot test resulted in a 45.5% reduction in delivery time.

Keywords
Delivery time, Lean Manufacturing, 5S, Kanban, Standardized work, Plastic sector.

1. Introduction
In Peru, micro, small, and medium-sized enterprises (MSMEs) represent 99.6% of formal businesses and account for approximately 59% of the economically active population (EAP) (MSME Statistics, 2019). Within this universe, 7.4% of national companies belong to the plastics manufacturing sector, and in Metropolitan Lima this sector represents 18.9% of all manufacturing companies (Institute of Economic and Social Studies, 2021, p.2). Although the manufacturing sector contributes 13% to the national Gross Domestic Product (GDP), the manufacture of plastic containers represents only 0.1% according to Instituto Nacional de Estadística e Informática (INEI, 2019).

In this context, the competitiveness of the plastics manufacturing sector, especially in packaging, faces significant challenges in terms of operational efficiency and process optimization. Therefore, the application of Lean Manufacturing tools, such as Kanban, 5S, standardized work, and the reduction of waiting times, is key to improving the productivity and sustainability of these companies. This article focuses on analyzing the implementation of these tools in the plastics sector in Peru, with the aim of identifying their impact on operational efficiency and production process management. The Socioeconomic Research Institute (2019) noted that during 2018, the national plastic packaging industry declined by 17% due to low incomes and other reasons. According to Guillen et al. (2018), the main problems observed in plastics manufacturing in Peru are linked to inefficient production processes and systems. This leads to delays in manufacturing schedules and failures to deliver orders.

The delivery of finished products is essential for the manufacturing industry (Birkie & Trucco, 2016) and should be the main purpose of the company (Lefcovich, 2009). Likewise, the best way to provide reliability and optimal quality services directly to customers/buyers is by meeting estimated delivery times, increasing the level of efficiency in production processes, and taking occupational health and safety into consideration. In this way, demand uncertainty is satisfied, and greater profits can be earned (Hoque et al. 2020).

Conversely, delays in order deliveries reveal problems in production processes due to poor management. As a result, associated costs arise, ranging from fines or payment discounts to the loss of customers and consumption (Jebaraj et al. 2013). In this context, it is necessary for SMEs in the plastics sector to be more efficient with order delivery times. To this end, this case study addressed the problem of not having optimal management of finished product supply and lacking contingency measures or action plans due to the absence of standardized processes. Thus, the application of Lean methodologies such as 5S, Kanban, and standardized work is proposed with the aim of meeting estimated delivery times by 45,5%.
This scientific article is divided into five parts: Introduction, State of the Art, Contribution and Validation, Discussion, and References.

1.1 Objectives
The main objective of this research article is to achieve a 45.5% reduction in order delivery time in a small and medium-sized enterprise (SME) dedicated to the production of plastic packaging using 5S tools, Kanban, and Standardized Work. Specific objectives were also proposed, specifically aimed at increasing delivery compliance to 95% and inventory turnover to 11 shifts.

2. State of the art
2.1 Kanban
The Kanban methodology was designed for the visual optimization of procedures, and its development is based on the concept of reducing activities that cause delays and/or waste (Leksic et al., 2020). This tool facilitates the efficient management of spare parts, as it allows us to organize ourselves in a more dynamic way based on actual demand. Furthermore, in the context of planning finished products in a warehouse, using Kanban streamlines task coordination, ensures accurate inventory tracking, and facilitates the replacement of required spare parts, reducing downtime and optimizing service conditions. Antony et al. (2019). According to Poma (2023), Kanban proved its effectiveness in reducing order delivery times by 60.68% in a mining company by facilitating the efficient planning and supply of necessary components.

2.2 Delivery time
Delivery time in a company is one of the variables that will directly affect customer satisfaction and the company's service level. The need to reduce service times is evident because users seek speed and convenience in customer service. Even when faced with a quality product at a good price, delivery time stands out and prevails. If a consumer waits longer than they should, their satisfaction with the overall experience is reduced by 18% (Zendesk, 2023). This research demonstrates the lack of visibility in the logistics chain and the omission of strategic planning, which are the main elements that cause delays.

2.3 5S
The 5S methodology should not be conceived solely as a process of selection, order, and cleaning. On the contrary, all tools, methodologies, and techniques that contribute to identifying and eliminating elements that do not add value will be crucial to designing a new work standard. This, in turn, will enhance and simplify the implementation of 5S, as well as maintain it in a sustainable manner over time (Tapia, 2024). Tools, equipment, and supplies must be strategically organized for more convenient and efficient access. Therefore, this challenge is handled with the goal of reducing the number of movements a worker must make during an operation (Shahriar et al., 2022).

According to Gupta and Chandna (2020) in a scientific equipment manufacturing company, they showed that after 24 weeks of applying 5S, the audit score improved from 6 to 72. According to Shahriar et al. (2022), the average block search time was reduced from 437 seconds to 210 seconds (66.66%), and the total operating time decreased by 18%, from 1256 seconds to 1029 seconds.

2.4 Standardized work
According to Abdul Halim et al. (2015), there are three elements that are identified as work time, standard cycle time, and work sequence, where their main function is to establish the most efficient and reliable work practices and sequences for each process, machine, and operator. Araujo et al. (2017) point out that work measurement is a lean manufacturing methodology that seeks primarily to generate processes and standards for creating value for the company and its customers, which consists of a numerical value that quantifies the content of the work during an operation according to the study method. In the study conducted by Dos Santos et al. (2021), standardized work was

used and operating times were reduced by approximately 8 seconds per box, representing a total savings of 49.5 minutes per day and around 18 hours per month.

3. Contribution

An exhaustive search was conducted of different studies addressing the same problem that arises in companies in the plastics sector: delays in order delivery. This made it possible to identify possible tools that could mitigate the causes associated with staff disorganization and disorder in a company's warehouse. In this context, the contribution of the model lies in its implementation to reduce delivery times and thereby improve the management of SMEs. Table 1 presents a comparative matrix of the different solution tools identified in the articles by different authors (Table 1).

Table 1. Comparative Matrix.

Causes or Objectives / Scientific Articles	Order and cleanliness of the area	Disorganization of personnel	Process improvement
Patel & Thakkar (2021)	5S	5S	5S
Kumar & Ganguly (2021)			ABC
Pérez, & Soto (2021)			Standardized work
Realyvásquez et al., (2019)		Standardized work	Standardized work
Cárdenas & Cerveleón (2021)		Kanban	
Drickhamer (2005)		Kanban	
Proposal	**5 S**	**Kanban and standardized work**	**Standardized work**

3.1 Proposed model

The proposed model is based on the use of lean manufacturing tools such as 5S with the aim of establishing a system of order and cleanliness in the company, which translates into significant progress in organizational productivity. (Morocho & Vinicio, 2020). In addition, it must be maintained and improved over time in order to optimize customer satisfaction, reduce response time, and maximize space in the warehouse area. Kanban tools and standardized work were included, which allow the flow of materials and the assignment of tasks to be managed visually and efficiently, reducing waste, avoiding bottlenecks, and ensuring that activities are carried out under uniform quality parameters (Canales-Jeri et al. 2022). These practices promote continuous improvement and operational flexibility, contributing to a more agile value chain that is aligned with the organization's strategic objectives.

For this reason, it is essential to calculate indicators before and after implementing the improvement proposal in order to obtain the desired results. The proposed model will be developed in three stages, which are detailed below in a graph (Figure 1).

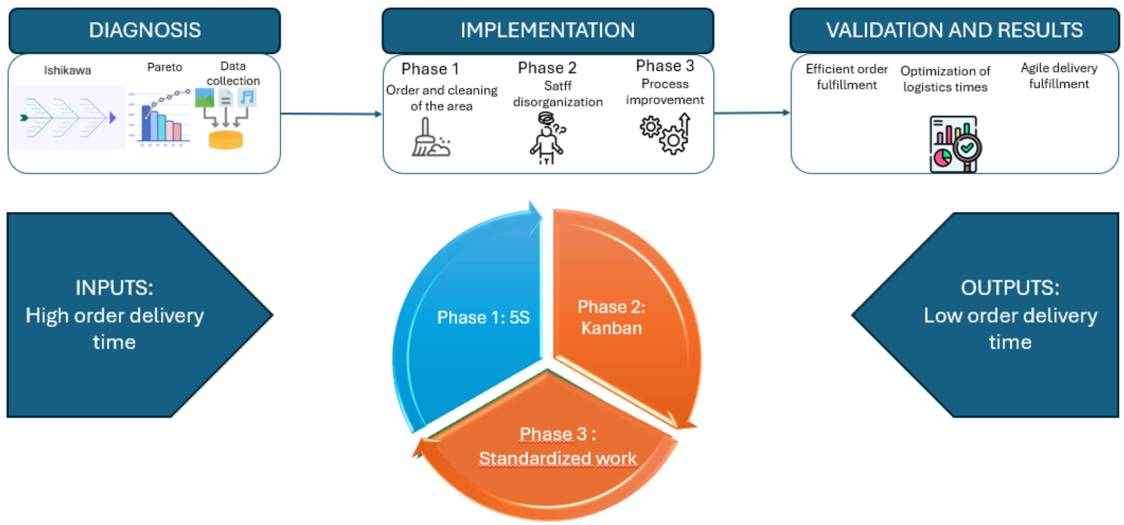

Figure 1. Proposed model.

3.2 Model components

3.2.1 Component 1: Diagnosis of the current situation

The first step was to investigate the daily activities of a micro and small enterprise (MSME) in the plastics sector to identify gaps, the most common problems and their causes, and areas for improvement. To this end, data was collected from the company through visits to its premises, as well as from repositories provided to us to learn about the indicators they use. Based on the above, scientific articles with similar conditions in other companies were examined to compare processes and characteristics in order to improve performance. With the help of the problem tree, Pareto diagram, and Ishikawa diagram, the main problems affecting companies were identified, thus presenting an overview that identified the causes to be addressed directly and proposals for improvement.

3.2.2 Component 2: Model Implementation

To address the main problems identified in the operation, Lean Manufacturing tools were selected that fit the specific needs of the process. The 5S tool made it possible to organize the work area, eliminating unnecessary materials, relocating tools, and standardizing cleaning routines. As a result, the time spent searching for supplies was reduced and the detection of equipment anomalies was improved, which contributed to a decrease in unplanned downtime and fostered greater operational discipline among workers. The second tool, Kanban, was used to visually control the flow of materials and supplies between stations. This made it possible to identify bottlenecks in real time and avoid work overload, as well as improve coordination between the production and supply areas. Thanks to this implementation, order tracking was improved and waiting times were significantly reduced. Finally, work standardization (WS) was used to clearly define the optimal methods and sequences for each operation. This prevented operators from performing tasks randomly, reducing process variability and facilitating the training of new workers. In addition, unnecessary steps were identified and eliminated, shortening cycle times and increasing productivity without compromising product quality.

When applying the model, it was essential to provide training on the tools to be used so that company personnel would be aligned and familiar with the procedures.

The implementation was carried out in three main phases. During the first phase, the 5S methodology was applied to organize inventory, organize personnel, and streamline the processes carried out in the warehouse. After it was up and running, the second tool was implemented: Kanban. Finally, in the third phase, Standardized Work was implemented. It should be noted that phase 1 did not end with the start of phases 2 and 3; rather, they ran simultaneously. Once phase 3 was completed and functioning properly, both phases were integrated to establish three tools, each with the objective of mitigating different aspects in the factory warehouse but directed towards the same common goal of meeting estimated delivery times and reducing order rejections by 15%.

The following indicators were considered appropriate for measuring the effectiveness of the proposed solution. Their descriptions and algorithm are detailed below:

3.2.2.1 Indicators
Indicator 1: Order delivery time
Total order time (in days)
Interpretation: Measures the time from when the order is generated until it is delivered to the customer.
The goal is to reduce order delivery time to 6 days

$$Total\ order\ delivery\ time\ (days)$$

Indicator 2: % Delivery fulfillment
Interpretation: This indicator is considered the most important because it is the primary problem to be solved in the company. It measures the percentage of order deliveries that are fulfilled on time.
The goal is to improve delivery fulfillment to 97%.

$$Delivery\ fulfillment = \frac{Number\ of\ deliveries\ fulfilled\ on\ time}{(Number\ of\ orders\ generated} x100$$

Indicator 3: Inventory Turnover
Interpretation: Measures how many times inventory is renewed in a 6-month period.
The goal is to increase inventory turnover to 10 times (turns) in 6 months.

$$Inventory\ Turnover = \frac{Cost\ of\ Goods\ Sold\ (COGS)}{Average\ Inventory}$$

3.2.3 Component 3: Validation and Results:

3.2.3.1. Start of the pilot test:

The validation consisted of an 8-week pilot test carried out by the supervisor in coordination with the authors, with a frequency of 5 hours per day, Monday through Friday, during the day shift from 8:00 a.m. to 1:00 p.m. The product selected for the pilot test was a plastic container PL105 due to its high turnover from storage to dispatch.

3.2.3.2 Development of the pilot test

First, the 5S methodology was applied, which began with coordination with the warehouse supervisor and proceeded to organize the inventory on each of the racks for routine work. Specific locations were established for each of the racks in order to facilitate their location. Next, one of the facilities was cleaned for two hours (6:00 a.m. to 8:00 a.m.). The staff followed the rules and standards established to keep the workplace clean and in excellent condition. Finally, the time required to transport and search for these accessories was reduced from 10.5 minutes to 4.7 minutes. (decimales)

Secondly, Kanban was applied, which made it possible to clearly determine the flow of incoming orders, their status, and their priority. The time required to replenish materials was reduced from 20.3 minutes to 16.8 minutes. To achieve this, labels were placed at key points in the process to reduce confusion and ensure timely replenishment.

Finally, as part of the pilot phase, standardized work was implemented and a clear, stable, and non-variable work plan was defined with the aim of avoiding randomness in operations. During this stage, staff were trained in the use of the new tools, procedures, and routines, reducing the average time per task from 25.4 minutes to 17.8 minutes, with a 37.6 % decrease in errors compared to previous records.

4. Results

To organize and clean up the factory's inventory area, 5S and Kanban were used to track incoming orders and their status, and Standardized Work was used to create a standard work plan that avoids randomness.

Table 2. Summary of indicators from the original and improved system

Cause	Indicator	Original	Objective	Improved
Poor on-time delivery of orders	Delay in order delivery (days)	11 days	6 days	5 days
Poor compliance with final product delivery	% Delivery Compliance	85%	97%	95%
Inventory turnover	Inventory turnover	8 turns	10 turns	11 turns

According to Table 2, the number of days of delays in order deliveries decreased to 5 days, exceeding the estimated 6 days. With regard to order delivery compliance, 95% was achieved; although the target was not met, there was an improvement compared to the original figure. Finally, inventory turnover increased to 11 turns in 6 months

4.1 Completion of the test

The pilot test was set to end after 8 weeks, which was considered the optimal period for evaluating the performance of the variables under study. The standard deviation of the measurements between weeks 6 and 8 was 0.32, which showed greater stability in delivery times, justifying the end of the pilot test in the eighth week. Extending the validation would have introduced external variations, such as fluctuations in demand or staff turnover, which would have made it difficult to accurately interpret the findings.

This time interval allowed representative data to be collected under real operating conditions in the warehouse, minimizing the risk of introducing additional variations that could affect the consistency of the results

5. Discussion

The 5S methodology significantly reduced the time spent searching for and transporting materials within the warehouse, which is consistent with the findings of Shahriar et al. (2022), who showed that reorganizing and standardizing the workspace reduces unproductive time by up to 66%. In the case analyzed, search time was reduced from 10.5 to 4.7 minutes, which validates the importance of maintaining an orderly and clean environment as a basis for continuous improvement.

The implementation of Kanban contributed to streamlining the replenishment of materials and providing greater visibility of the order flow, reducing replenishment times from 20.3 to 16.8 minutes. This finding coincides with Leksic et al. (2020) and Antony et al. (2019), who highlight that the Kanban system facilitates coordination between areas, reduces downtime, and prevents bottlenecks. However, it was identified that during weeks 6 and 8 there were occasional delays due to a lack of discipline in updating cards, demonstrating that the effectiveness of the tool depends largely on staff commitment. It is worth mentioning that a fundamental element in the implementation of this system [Kanban] was the training and education of staff. A deficiency in these circumstances jeopardizes the success not only of projects such as this one, but of any project in general (Medrano, 2023).

Standardized work reduced variability in operations and decreased errors in assigned tasks. Although the 97% delivery compliance target was not fully achieved, an improvement from 85% to 95% was achieved, demonstrating substantial progress compared to the initial situation. Moreover, order delivery times were reduced by 54.5%, exceeding the initial target. These results are in line with those described by Vidal, S. et al. (2014), who demonstrated that process standardization improves warehouse operations performance, reducing delivery times and increasing efficiency.

Although inventory turnover increased to 11 turns, reaching the target set, there are still areas of opportunity in terms of integrating the three tools more robustly and generating real-time monitoring indicators. It is crucial that the company take measures to improve its inventory management and ensure more effective control of its processes, as well as take into account how its employees are working and providing training so that they can successfully perform their work. It should be emphasized that it is important for the company to offer adequate, high-quality resources and tools to carry out a good inventory process in accounting (Checa Calderón, 2024).

There were some limitations in the development of the pilot for this research, which were related to the assignment of shifts for the pilot. We believe that if there had been more than one shift and a larger number of employees, the results would have been even more successful. It is recommended that similar work be carried out using the Kaizen tool, as it was found in multiple studies in the literature review for this research; however, our research did not address it.

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