Proposal to Improve Storage Management to Reduce Stock-Outs Through the Use of the Reorder Point, Safety Stock and 5S in the Plastic Sector

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Abstract: In warehouse management lies mainly the absence of spare parts when they are needed for maintenance of machinery or because a fault arose, and it is necessary to replace the parts. This cause must be reduced as it generates a huge downtime of the machinery. In the present case study, the ABC was used to separate the most important spare parts families, in addition, using the EOQ together with the reorder point was able to efficiently supply the spare parts stores, to reduce stock breakages and, Also, the security stock was used. Then, from implementing the improvement tools in the sourcing process, 5S and ABC methods were used to organize the warehouses, obtaining in this way a considerable decrease in the stock break of approximately 42% and a reduction of the purchase orders by 58%.

1 INTRODUCTION

In Peru, the plastic industry contributes well, accounting for 4% of Gross Domestic Product and generating 200,000 jobs (Sociedad Nacional de Industrias, 2019b). This is a good indicator as the industry grows annually at a rate of 3.2% (Sociedad Nacional de Industrias, 2019b), this is due to the reactivation of the construction sector and the demand for packaging for the agro-industry sector. Added to this the plastics industry sector has a growing trend, this is evidenced by the fact that the global plastic production in volume of 2017 exceeded by 3.8% to the production of 2016 (Sociedad Nacional de Industrias, 2019a). However, this trend of growth in production is affected by various problems, affecting several products, this is mainly reflected in single-use plastics as they are (Sociedad Nacional de Industrias, 2019a), that is why there is a tendency to reduce the amount of plastics consumed, as evidence of this trend are taxes and various restrictions, in the national case, we have the law 30884 that estimates to reach a reduction of 30% of plastics in the first year of validity (Sistema Nacional de Información Ambiental, 2019)

The above shows that companies in the plastic sector, although they have global growth trends, also have problems so it is sought to propose new solutions, Part of these solutions focused on innovation in creating new types of products such as 100% recyclable packaging and thereby promoting a cycle of use and disuse.

It was identified that there are different factors that affect the problem, such as the mean time between breakdowns in each machine, stock breakage and inefficient management in the supply plans, significantly affecting the performance of the injection molding machines and therefore production, which is the reason for the increase in costs, generated by an inadequate stock (Conceição et al., 2021).

With this established, the following structure is presented for this article, which is divided into five important parts which are: introduction, state of the art, contribution, validation, and conclusions.

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2 STATE OF THE ART

2.1 5S Methodology (5S) -Activity Basic Costing in the Stores (ABC)

Based on the improvement in the warehouses, it was found in the various case studies that the main flaws are the lack of controls and the standardization of processes, in addition to that only 5% of the activities add value and 60% only add partial value (Marmolejo et al., 2016), this means that many of the activities are underutilized when adding value, and that there are usually activities that do not generate value and these should be eliminated since they only generate costs that will not be paid by customers(Shahriar et al., 2022).

The implementation of the 5S means that everything that is considered waste is eliminated (Sukdeo et al., 2020), but to start implementing the 5S you first need to establish a language that everyone can understand (Gupta & Jain, 2015), in order to avoid confusion.

Because when properly implemented it not only helps productivity, but also keeps the place clean and organized (SOROOSHIAN & MAD ALI, 2017), it helps to make working conditions better, improves the usability of spaces and reduces downtime (SOROOSHIAN & MAD ALI, 2017).

Another problem is the lack of organization in the warehouses, where we find that the big mistake that is made is to give all items the same treatment (Conceição et al., 2021), to solve this applies the order based on the ABC, which serves to separate the items that are stored, based on which have greater financial relevance (Conceição et al., 2021).

2.2 Reorder Point – Economic Order Quantity (EOQ)

Due to the uncertainty of demand, the application of the reorder point and the EOQ for forecasts were found in different case studies. Based on different market conditions, companies face a demand that cannot be accurately predicted(Sorooshian & Jadidi, 2021). In addition, the security stock must be used when sales are greater than the sales planned to fulfill the customer's orders.

Based on actual demand, the moving average forecast was made for the last three periods. The EOQ was then calculated to determine the lot size and reduce inventory-related costs(Rodríguez et al., 2020), taking a fixed cost and the annual maintenance cost per unit. Finally, taking the lead time of the supplier proceeds to calculate the reorder point, which is important since this is the time to order the material, to have them at the optimal time(Conceição et al., 2021).

However, because of the oscillating demand, it is necessary to have a safety stock, since stocks are required to deal with unplanned situations(Rusman et al., 2019).

2.3 Inventory Control- Stock Safety (SS)

To reduce the costs of a company, the management of its warehouses is one of the necessary activities (Salee & Chutima, 2021). For the proper management of inventories, it should be taken into account that the main objective is to maximise profitability by reducing storage costs (Kheireddine & Bouchelaghem, 2020) , in addition to this it should be taken into account that poor management produces negative effects such as material shortages (Rodríguez et al., 2020) , this is why a good inventory policy must be chosen that can respond to demand, without breaking stock and reducing costs to the maximum (Paredes Rodriguez et al., 2019). For this to happen, it must be accompanied by a safety stock, which will be responsible for anticipating the uncertainties of the future as there may be delays and thereby reduce the risk (Conceição et al., 2021)

3 CONTRIBUTION

3.1 Fundamentals of the Model

For the development of our improved inventory management, we took into account various types of papers that were especially related to the safety stock, reorder point, EOQ, ABC and 5S. These articles provided the necessary knowledge for implementation and possible outcomes. As for the differentiation with other jobs of this type is the implementation of the ABC tool as a complement to the 5S, since it was seen that not only enough with the organization of the warehouses but also, the time lost in the search for spare parts must be minimised, however, the importance of this work lies in the combination of the various tools already mentioned and their adaptation for use in a company in the plastic sector, achieving a significant improvement in the supply of spare parts needed by the company, being the most outstanding tools the reorder point which is the level of spare parts calculated to request another multiorder to the supplier based on its lead time and the safety stock that will ensure us keep the necessary stocks for the machines to continue functioning.

3.2 Basis

The proposed model is developed based on the following tools: 5S and ABC for the order of warehouses and the distribution of spare parts, with the ABC tool in charge of distributing the various types of spare parts, this will depend on the frequency of use of the spare parts.

Supply and control of warehouses spare parts, the reorder point tools, safety stock and EOQ were used, these tools being responsible for determining when the next order must

Table 1: Comparative matrix of cause VS State of art.

Authors	Inventory planning	Improvement in inventory management	Warehouse disorder
D. Sobyaa, S. Nallusamyb, and Partha Sarathi Chakraborty (2021)			5S, Line Balancing
R Hanafi, F Mardin, S Asmal, I Setiawan and S Wijaya (2019)	EOQ	SS, Reorder Point	ABC
M Rusman, S Mangengenre, SM Parenreng, I Setiawan y A Pertiwi (2019)	Normal Distribution, SS	EOQ, Reorder point	
A.M. Paredes-Rodríguez;V. L. Chud-Pantoja; J.C. Osorio E (2019)	Inventory control	System of inventories, Q	
Proposal	Inventory Control & SS	EOQ & Reorder Point	5S & ABC.

3.3 Proposed Model

The proposed model is developed based on the following tools: 5S and ABC for the order of warehouses and the distribution of spare parts, with the ABC tool in charge of distributing the various types of spare parts, this will depend on the frequency of use of the spare parts.

Supply and control of warehouses spare parts, the reorder point tools, safety stock and EOQ were used, these tools being responsible for determining when the next order must be made and the concrete quantity to be able to supply the warehouse s, without having to fall into a cost overrun caused by parts that are never used.

3.4 Components of Model

3.4.1 Component 1: Analysis of the Problem

At this point we analyzed the current situation of the company and how the stock breaks arise, so that we could determine why these values are so high.

In order to detect the existing stock break, the number of times the spare parts needed for the machines could not be properly supplied was taken. With this it was determined, the techniques to use to solve it, in the case of our improvement were used the inventory control, the stock of safety and the point of reorder, in order to reduce the times that the warehouse is left without spare parts. And the 5S and ABC tools will be used for the reduction of disorder, elimination of unnecessary processes, for the distribution of places for the various types of spare parts and for the standardization of all these processes

3.4.2 Component 2: Intervention

In this component, the application of tools to solve the problem that was analyzed in the diagnosis is given. First, the 5S will be used to start with a clean, organized, and standardized environment, along with the ABC to classify the resistance family according to its rotation. Secondly, the safety stock will be calculated to have a spare parts stock in any emergency. Thirdly, we will proceed to calculate the EOQ to know the optimal lot of purchase. Finally, the reorder point will be calculated, which will be the notice to make the purchase during the lead time of the supplier to deliver the order.

3.4.3 Component 3: Implementation and Development of the Intervention

This last part is the implementation of the improvement, for this you will have to use the ARENA simulator, which seeks to observe the improvements obtained after the implementation of the entire improvement plan in the company, this will require a comparison of indicators before and after improvements.

3.5 Indicators

The following indicators were used to evaluate the performance of the improvements made

- Stock out: Measure the quantity of unsolicited spare parts ordered over the total spare parts supplied. Target: Reduce stock break to 5%

$$= \frac{Spare\ parts\ ordered\ but\ not\ delivered}{Spare\ parts\ supplied}$$

- Number of orders served: Determines the fulfillment of orders placed by technicians Target: Orders served increased to 98%

$$\%\ Orders\ fulfilled = \frac{N°\ orders\ delivered}{N°\ orders\ places}$$

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4 VALIDATION

4.1 Diagnosis Inicial

To begin with, it must be understood that the reorder point is the main tool and the safety stock a complement and as established from the beginning, the main objective is the reduction of stock break to acceptable levels, for the plastics production sector.

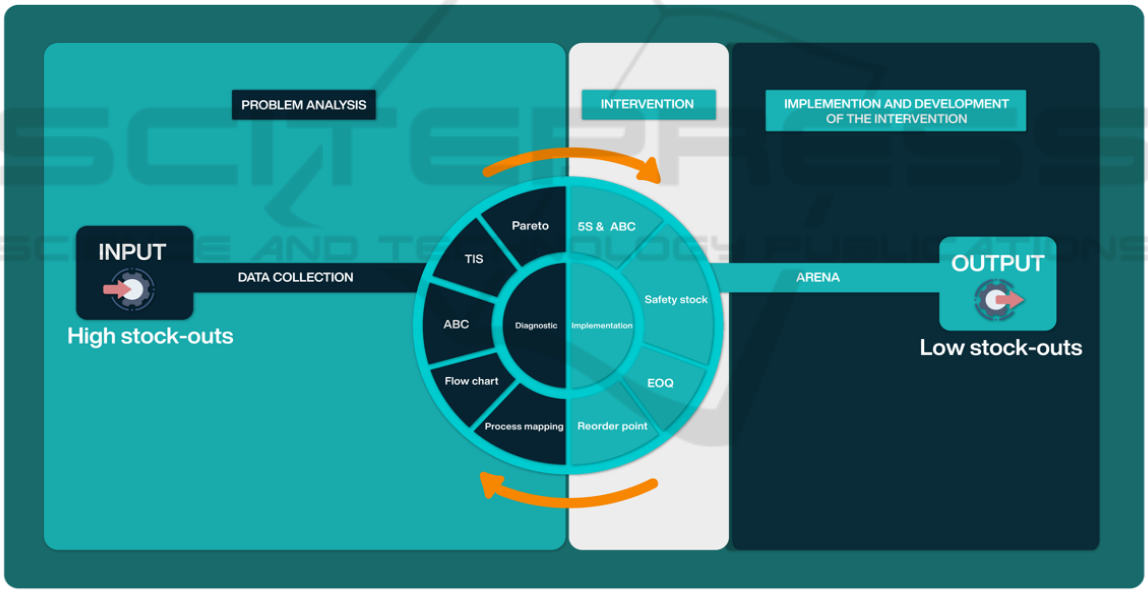

Figure 1: Management Model

But, to achieve this must take into account various factors such as whether the company applies policies of inventories suitable for its type of demand, in the case of this company was opted for the creation of a new policy of stock of safety and a policy of point of reorder, this was intended to significantly reduce stock breakage and the costs of not owning the right types of spare parts when breakdowns occur. This was established after analyzing the company and understanding that the biggest of its problems was the policy of acting in a corrective manner generating a lack of policies of replenishment of spare parts

4.2 Design Validation and Comparison with Diagnostics

For this segment the sand software was used, in which the initial form of the company was modeled and then another where the corresponding improvements were

applied, managing to obtain data for the validation of the system.

For the first simulation, the necessary information was collected to establish the initial indicators and the conditions with which they were obtained, this served us for the subsequent analysis and comparison with the data collected in the second scenario, in which it is evidenced the enormous importance of having a policy of rearrangement point and complement with the stock of security, with this reduce the number of times that happen the breaks and reach a value less than 5% of break.

4.3 Enhancement- Simulation of Improvement

As specified in the previous point the simulation was done with the Arena software, in which the first scenario is the model without improvement, is the model that the company used and in the second scenario, the proposed improvements were established, some 212 simulations were made, of about 24 hours a day in the span of one year in order to have a truthful simulation.

Taking into account that the main variables are the number of orders placed and the demand for spare parts for each order made.

With these data, the following table was established showing a comparison of the pre-improvement situation vs the improved situation using the KPIs or the indicators proposed above, this in order to establish a numerical sample in the improvements obtained after the simulation.

Once the table has been made and analyzed, it is possible to observe a considerable improvement in the main indicator after the improvements were applied in the spare parts warehouse, achieving in this way to have a breaking percentage of 2.13% being considerably lower than the current break of 48.52%, likewise it was found that this decrease in stock break increased the orders requested by technicians by 90.11%.

Table 2: Current simulation against the improved situation

Process	Current	Improved	%
Stock Outs	48.52%	2.13%	-95.61%
Orders served	51.48%	97.87%	90.11%

5 CONCLUSIONS

The aim of the present investigation was to reduce stock breakages in a spare parts warehouse for injectors. Based on a quantitative and qualitative analysis of the company's demand and case studies, it was calculated that the company had 48.52% of orders not delivered to the maintenance area and after applying the improvements was able to reduce the stock break to 2.13%. Achieving in this way meet the main objective of reducing at least 5% of stock break.

Another of the improvements achieved, along with the improvement of the reduction of stock breakage there is an improvement in the decrease of orders made purchases, where in the pre-improvement was had 37 purchase orders and after the improvements applied was had 16 purchase orders, thus obtaining a reduction of 58.33% in terms of the orders made.

This research was applied in a plastic sector company, and it was possible to demonstrate the great synergy that the tools of the reorder point have with that of the stock of security, because as seen in the scenarios of the discussion, no single one can reach to eliminate stock breakage since while the reorder point tries to avoid stock breakage through orders, the security stock serves as an additional insurance.

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