Improvement Proposal Applying Standardized Work and 5'S to Reduce the Rate of Returned Orders of a Poultry Company Under the PDCA Cycle

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Abstract

Over the last few years, the poultry sector has positioned itself advantageously in the Peruvian market since it contributes 56% of the animal protein consumption demanded by the population. This represents annual sales of around 11,000 million soles, which corresponds to 29% of the agricultural GDP. Based on the above, companies in this sector must be at the forefront to satisfy the growing demand of this product and avoiding customer dissatisfaction, since this reduces the profitability indexes generating economic loses. Part of these considerations is to reduce the 8.99% rate of order returns of a poultry company located in the south of Peru through a proposal that uses 5S tools and work standardization structured under the PDCA cycle. After the annual simulation of both models through the Arena software, the average error rate of the orders was reduced by 55.71%, the documentation search time by 44.04% and the order cycle time by 77.90%, all of them compared to their initial value. Resulting in a significant reduction to 4.95% of the order return rate.

Keywords
Standardized Work, 5S, PDCA Cycle, Rate of return Orders, Cycle time.

1. Introduction
On a worldwide level, the Food and Agriculture Organization of the United Nations (FAO) (FAO, 2020), reported an increase in poultry meat production reaching up to 132 million tons in 2019. According to the Peruvian Poultry Association (APA) (APA, 2021), 56% of the protein consumed by the population comes from chicken meat. This reveals the existing demand that poultry companies must satisfy in order to maintain an advantageous position in the market. The national poultry industry is important because it has an impact on the country's economic activity, representing 28.5% of the gross domestic production value of Peru's agricultural sector. However, statistical studies have shown a decrease in sales and an increase in returns in December 2020. This was due to the pandemic caused by Covid-19, which put many companies in jeopardy because of the impositions to operate and the new changes in demand and population consumption. (Inoñan y León, 2020).

As can be appreciated, the problem lies in the increase in the rate of product returns. Not complying with customer specifications denotes deficiencies such as dissonance of information, disorganization in methods and inefficient processes within the organization (Hernández et al., 2018). In this context, it is pertinent to investigate how to mitigate this problem by applying industrial solutions.

A case study was chosen to reflect the problems faced by the poultry sector. In this sense, an improvement model was developed considering the implementation of Lean manufacturing tools in organizations. The 5S tools and work standardization were combined under the PDCA Cycle methodology to attack the described problem (Favela et al.,2019). Since the poultry sector is not frequently explored and few case studies are available, this study included successful cases that address similar problems related to the return of orders.

This article will be divided into six parts, which are Introduction, Literature Review, Methods, Data Collection, Results and Discussion and Conclusions.

1.1 Objectives

- Use the model based on Lean Manufacturing tools to carry out the proposed implementation.
- Reduce the rate of order returns, increasing the company's profitability with respect to chicken line sales.
- Reduce order errors in the sales area of a poultry company through standardized work.
- Reduce order cycle time in the warehouse through the 5'S tool and standardized work.

2. Literature Review

2.1 Lean Manufacturing

The term lean manufacturing is widely used as an alternative to increase productivity and develop skills within an organization (Favela et al.,2019). There are many systematic reviews of this term in the food industry. All agree that there are palpable and measurable impacts that fall on the elimination of waste, reduction of cycle and unproductive times as well as an increase in performance, continuity, and quality of the processes. Specifically, a reduction in operating time in 50%, costs in 80%, saves production space in 30% and finally increases productivity in 30%. (Nyguyen, 2015)

2.2 Standardized Work

Standardization is defined as a specific methodology focused on the operator working in the same way in order to obtain the best results (Bragança y Costa, 2015). In one case study, excess steps and non-standardized work must be eliminated and/or modified in order to reduce cycle time by 16% and increase efficiency in activities such as coil set-up Puvanasvaran et al. (2018). Another case study related to chassis manufacturing shows that, by applying standardization, the times were reduced by up to 44% and presented improvements in efficiency of up to 51% in the execution of the task (Raed y Zeaiter, 2015). Another aspect to consider is that the introduction of formatted documents reduces the variability of the operators' work in the automotive exhaust manufacturing process. Also, that it reduces the error rate by 76.35% and improves cycle time by 63.15%. (Martínez, 2018)

1.3 5S in manufacturing companies

It is a Japanese methodology applied worldwide by several companies since they contemplate improvements in the processes and control parameters regarding quality and food safety. By implementing this tool, positive results were obtained, going from 66% compliance to 81% with respect to quality (Chero y Panchana, 2019). This tool increases the adequate use of space in work areas by 25%-50%. This has an impact on distance indicators, downtime due to unnecessary searches and, therefore, on costs. (Herrera et al.., 2019). The results of the application of this methodology in a spare parts warehouse show a 20% decrease in item search times, a 55% decrease in equipment identification, a 30% decrease in cleaning, and a 43% increase in activity scheduling (Medrano et al., 2019) Another point to consider is that the integration of the 5'S improved process efficiency by 57% to 86%, eliminating possible quality failures (Raed y Zeaiter, 2015).

1.4 PDCA Cycle

Optimal process management is achieved thanks to this tool since it is based on continuous improvement and, as it is a simple management approach, it helps to suggest changes in the processes or provide solutions. The acronyms of this cycle are phases comprised by: Plan, Do, Check and Act. These phases are closely linked to planning, implementation, control, and improvement, thereby streamlining the relationship between the operator and the process based on efficient controls (Moser et al., 2020) It is emphasized that this methodology aids in the execution of tasks and is frequently used as a determining factor for improvement. This premise is supported in a case of study of the gas inventory area in Mexico, increasing storage efficiencies from 2.64% to 4.04% between 2016-2018, respectively. Several authors agree that the advantages lie in fast visible results, cost reduction, increases in productivity and elimination of repetitive processes. (Montesinos et al., 2020).

3. Methods

The method used was based on data collection. The authors used to design the model provide quantitative and success results implemented in case studies asshown in table 1. This was a guide to estimate the improvements proposed in the research itself in a numerical and percentage way.

Table 1. Comparison table of the Proposal Components vs State of Art

Scientific articles	**Lean Manufacturing Tools**	
	Standardized work	***5´S***
Puvanasvaran, A., Hamid, M. & Yoong, S. (2018)	Reduces task repetitiveness. Reduce cycle time by 16%.	
Martínez (2018)	Reduction of errors and duplicity by76.35%.	
Realyvásquez, A., Flor, F.,Blanco, J., Sandoval, J., Jiménez, E. & García, J. (2019). Jaffar, A., Abdul, N. &Yusoff, N. (2012)	Reduction in cycle time by 20.55%.	
Medrano, F., Hinojosa, V.,Basilio, B. & Becerril, I. (2019)	Improved task execution from 48% to 93%.	Decrease in search time by 80%.
Santoyo, F., Murguia, D.,López, A., & Santoyo, E.(2013).		Reduction of 20% in documentation search time and space savings of 27%.
Rizkya, I., Hidayati, N., Sari, R. M., & Tarigan, U. (2019).		Minimizes search activity by 18.75% and space occupation by 11.20%.

3.1 Proposed Model

The proposed model is based on the use of techniques such as the 5'S and work standardization, structured under the PDCA cycle and framed in a Lean Manufacturing environment. The main problem derived from the high rate of order returns is approached through the use of indicators gathered from the problem analysis. In the deployment of the implementation proposal, an improved model is presented which, along with the current model, are submitted to a simulation using arena software to contrast the main indicators (Figure 1).

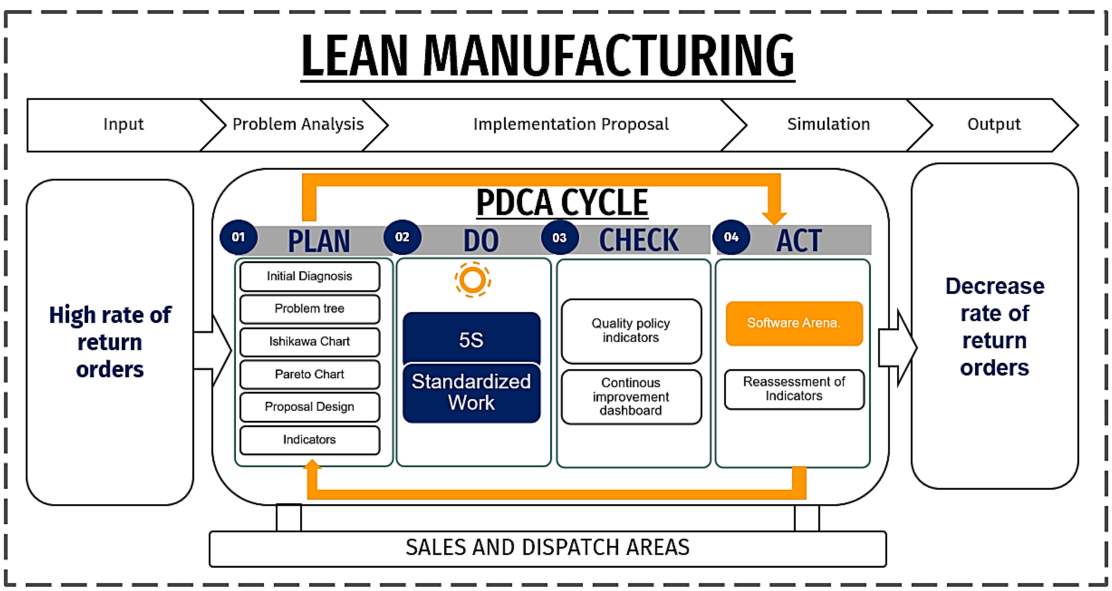

Figure 1. Proposed Model.

As previously mentioned, the phases of the model are organized under the PDCA cycle in order to give a structure to the proposal.

3.1.1 Phase 1: Plan
In this phase, an initial diagnosis was established through a problem tree, Ishikawa and Pareto charts to determine the causes of the main problem. Once the causes of the increase in the error rate and order cycle time have been identified, the proposal was designed. The implementation of 5'S in the dispatch area and standardized work for both areas were folded in detail. Based on the above, parametric and non-parametric indicators to be used were established.

3.1.2 Phase 2: Do
In this second phase, the 5s tool was first applied, the purpose of which is to reduce the time spent searching for documents and information. Red cards were used to eliminate unnecessary items, visual controls for the correct location of items, a checklist for cleaning compliance, 3S evaluation forms, and activities to encourage workers' self-discipline. Then standardization work was applied in order to establish the same methodology for all workers and eliminate activities that do not add value. A procedures manual was established, as well as record formats, standard worksheets and documents to optimize the process and reduce cycle time. Finally, a series of training programs were proposed for the employees on the suggested formats and a series of steps to be followed in both areas.

3.1.3 Phase 3: Check
In the third phase, quality policy indicators, a continuous improvement dashboard, and audits were established to ensure the implementation of the tools.

3.1.4 Phase 4: Act
In this last phase, the simulation was carried out in the Arena software, schematizing the sales and dispatch process. The data obtained was placed in the input analyzer to determine the distributions of each activity, and then proceeded to assemble both models in the software. In order to analyze the proposed improvements to the current model, 4 parametric indicators and 3 non-parametric indicators were studied (Table 2 and table 3).

Tables 2. Parametric indicators

Indicators
Orders placed without error
Archived Order
Orders not returned
Dispatched orders

Table 3. Non-parametric indicators

Indicators	Algorithm	Use
Average search time	$AST = Time\ spent\ searching\ for\ documents$	The amount of time required for the operator to search the proper documentation for dispatch.
Average order error rate	$AOER = \frac{Number\ of\ orders\ with\ errors}{Total\ incoming\ orders}$	Allows to know the percentage of errors in the orders regarding the incoming orders.
Cycle time of order	$CTO = Entry\ time + Return\ time$	Time lapse since a call is received to the time it returns to determine whether or not the order is returned.

4. Data Collection
In order to obtain the data, first a initial diagnosis was carried out, which the following results were obtained: The proposed model is based on the study of a poultry company located in the south of Peru. The product lineof processed chicken was chosen because it has a participation percentage of 69% in comparison with other product lines. The average annual return rate of three leading poultry companies in the sector was taken averaging approximately 5%. For this case study, the 2020 period were analyzed, and it was found that on average 8.99% of the TN of processed chicken per year was returned, equivalent to 59,426,760 PEN. In the current situation, this represents 13.26% of the

income generated exclusively from the processed chicken line.This percentage implies the existence of deficiencies and problems that have an impact on the increase in therate of returned orders.

For the validation, a confidence interval under parametric statistics is needed to demonstrate that there is a significant difference between the current model and the proposed model. For this purpose, 5 relevant indicators were taken. The optimal number of iterations is calculated empirically by applying a precision of +-0.26% to each of the relevant indicators of the work with 95% confidence (Table 4).

Table 4. Calculation of number of replicates for each indicator

Indicador	n	Initial amplitude (h_0)	Desired amplitude (h)	Initial number of replicates (n_0)
Orders placed without error	39	39.26 orders	20 orders	10
Archived order	18	26.41 orders	20 orders	10
Orders not returned	2	7.30 orders	4 orders	10
Dispatched orders	18	26.55 orders	20 orders	10
Average search time	33	0.72 min	0.4 min	10

Once the 39 replications have been carried out, the averages previously written in the initial amplitude change and the following ranges were obtained (table 5):

Table 5. Intervals for each indicator

Indicador	Actual	Improvement
Orders placed without error	7562 +/- 14.66 = [7547.34, 7576.66] orders	7749.13 +/- 9.86 = [7739.27, 7758.99] orders
Archived order	8416.72 +/- 9.47 = [8407.25, 8426.19] orders	8114.23 +/- 7.96 = [8106.27, 8122.19] orders
Orders not returned	7653.56 +/- 3.96 = [7649.6, 7657.52] orders	7700.79 +/- 3.23 = [7697.56, 77042] orders
Dispatched orders	8397.79 +/- 9.48 = [8388.31, 8407.27] orders	8102.67 +/- 7.90 = [8094.77, 8110.57] orders
Average search time	230.26 +/- 0.32 = [229.94, 230.58] minutes	1014 +/- 0.16 = [100.88,101.2] minutes

5. Results and Discussion

5.1 Numerical Results

In this chapter, the improvements are presented in a numerical way. The following tables 6 and 7 compare the parametric and non-parametric indicators between the two scenarios. It should be noted that the parametric indicators follow a normal distribution that allows the software to compare the scenarios and determine if there are differences that are statistically significant, while the other indicators are ruled by a non-parametric estimation, therefore they cannot be worked with the software's average +- since it assumes normality in the mean width of the data; hence the proposed indicators cannot be validated using a statistical comparison with confidence intervals. However, they were analyzed using the average once the 39 replications had been completed and the results obtained were commented on. As for the results after running the software, there is no overlap between the indicators and therefore it is notnecessary to submit them to the output analyzer since there are significant differences between the two models.

Table 6. Parametric indicators between scenarios

Indicators	Initial situation	Improvement situation
Orders placed without error	76.58%	78.47%
Archived order	85.23%	82.17%

Orders not returned	77.50%	77.98%
Dispatched orders	85.4%	82.5%

Table 7. Comparison of non-parametric indicators between scenarios

Indicators	Initial situation	Objetive	Improved situation	Authors
Average search time	230.26 min	184.21 min	101.4 min	Minimized documentation search by 20% of the current percentage. (Santoyo et al., 2013) (Rizkya et al., 2019)
Average order error rate	10.16%	3.56%	4.50%	A reduction of approximately errors to 75% of the current percentage. (Martinez, 2018)
Order cycle time	620.03 min	492.61 min	483.23 min	An average reduction in cycle time by 20.55%. (Realyvásquez et al., 2019) (Jaffar et al., 2012)

5.2 Graphical Results

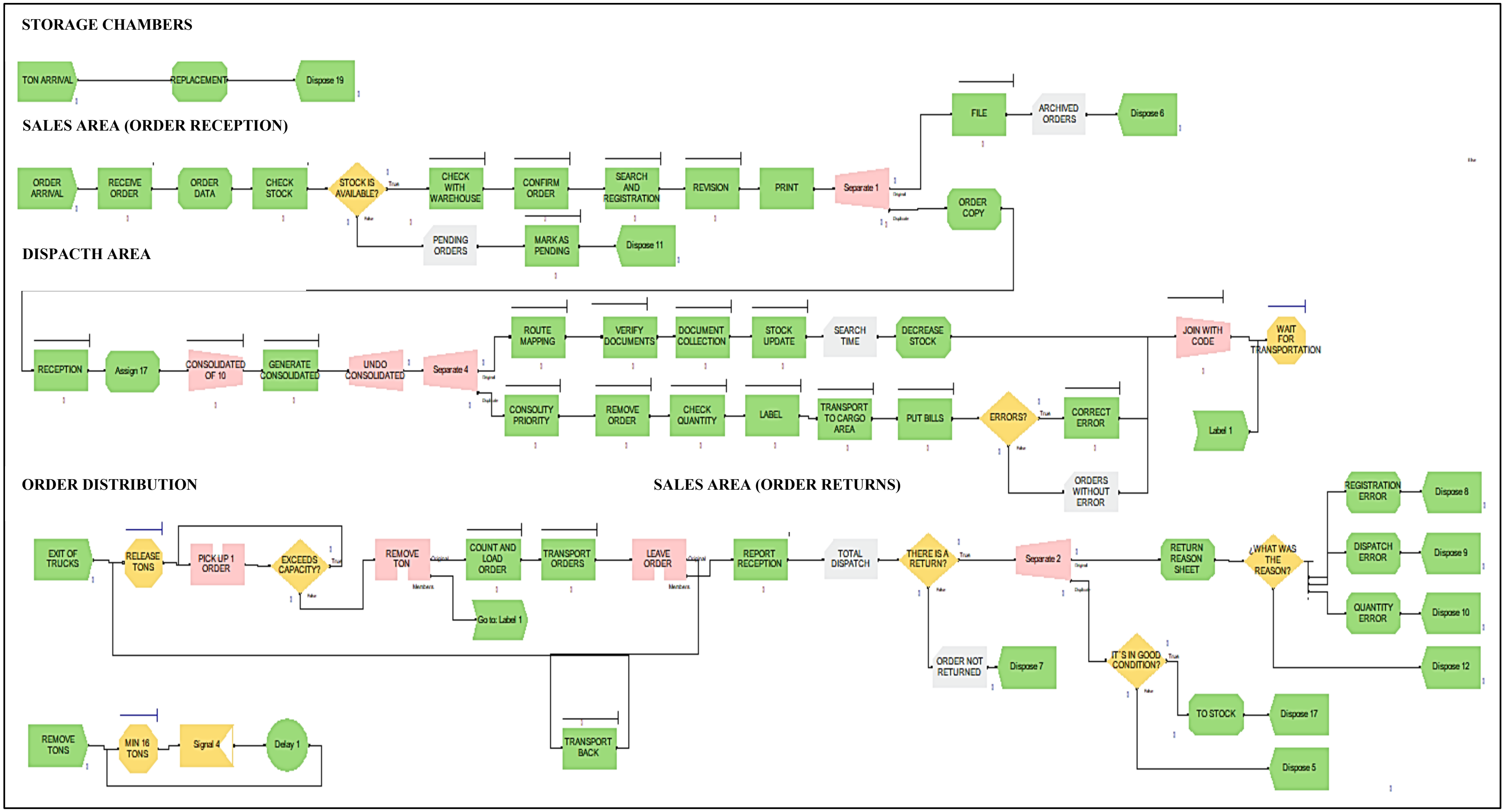

Figure 2. Initial Model in Arena

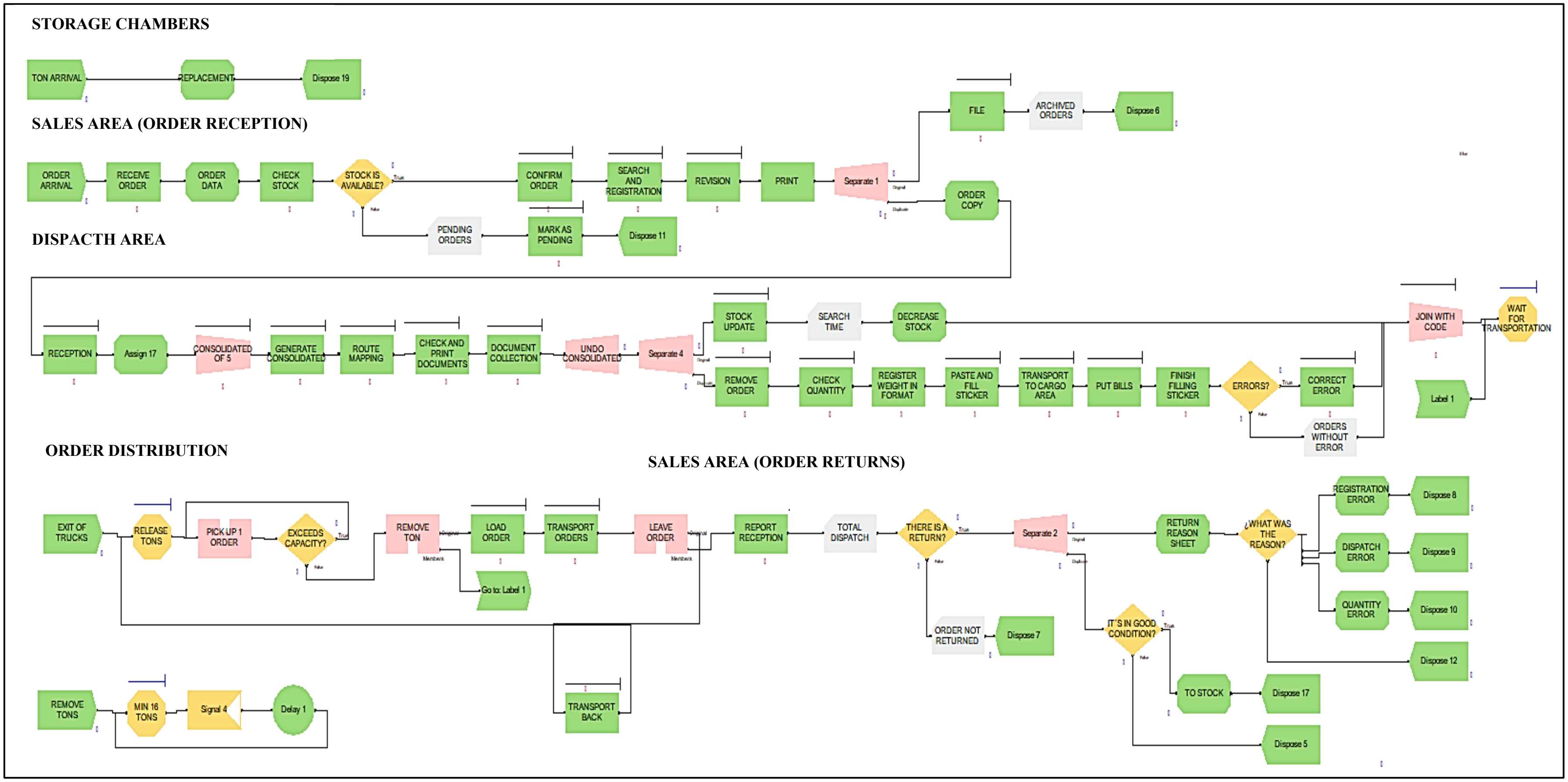

Figure 3. Proposed Model in Arena

5.3 Proposed Improvement

The validation of the model followed the four phases previously mentioned. In phase 1, the relevant data for the year 2020 was collected in order to determine the critical areas that had an impact on the increase in the rate of returned orders. From the diagnosis and the elaboration of charts, it was found that the sales and dispatch areas were the ones with the highest incidence, so they were selected to design the improvement proposal andenter their data into the Arena professional software. In phase 2, the tools were displayed using scientific articles that provided quantitative and successful results implemented in case studies. In phase 3 the controls were established to maintain the proposals and in phase 4 is where the simulation was performed. In the sales area, the use of standardized formats was proposed to reduce errors, and tasks that did not add value to the process, such as queries, were eliminated, since they were repetitive and only consumed time. Activities were also added, 5S was applied to the dispatch area to reduce search times and the order of the dispatch documentation branch was changed, which had a significant impact when the model was run. (Figure 2 and figure 3)

Running the simulation in the software, 16 effective working hours per day were used, 288 days were considered as a year and the number of iterations to which both models were subjected was 39 replications. The scope of the system simulates the process of receiving orders (sales area), dispatching orders and receiving returns. Private information provided by the company was used to simulate the initial situation. It should be noted that, being approximations of times, similar random numbers were taken in order to have an appropriate sample size for each activity. The purpose of the sample is to be submitted to the input analyzer to validate the data and obtain the distributions to build the current model. To run the simulation, the sample size was previously calculated for the current and improved model with a 95% confidence level, the distributions for each activity, the entities and attributes of the system were established, as well as the number of replications to be performed. A reduction in the order rate from 8.99% to 4.95% was obtained.

5.4 Validation

The problem of this paper focuses on the high rate of returns of orders expressed in tons of poultry meat per year, the current value is 8.99% belonging only to the line of processed chicken meat. The objective is to reduceit to an average rate of 5%. With the proposed implementation of 5S and standardized work in the sales and dispatch area, it was reduced to 4.95%. This reduction would have an impact on the reduction of return costs to 32,721,074.93 PEN per year. As for the parametric estimation indicators for the same requirement of incoming calls, a statistically significant higher number of orders are being delivered without error, the current model presents 76.88% and the improved one 78.47%. The indicator for orders not returned goes from 77.50%to 77.98%, which increases the efficiency of the process. However, it is noted that both orders on file and totaldispatches decrease by 85.23% to 82.17% and 85.4% to 82.5%, respectively. This is due to the increase in pending orders conditioned by the availability of stock. This limitation concerns the production area and not the areas treated in this paper, which becomes a restriction in the improvement model.

As for the non-parametric estimation, the first indicator addressed was the average documentation search time in the dispatch area. The current value was 230.26 min, the objective was to reduce this time to 170.39 min (Santoyo et al., 2013) (Rizkya et al., 2019), the simulation shows a reduction of 101.4 min. This represents an improvement of up to 44.04%with respect to the current value. The second indicator was average error rate of orders. The current value is 10.16%, the objective was to reduce it to 3.56% (Martinez, 2018), and through the simulation 4.50% was obtained, althoughthe objective was not reached, it was reduced to 55.71% of the current value. Finally, the cycle time indicator presents a current value of 620.3 min, the objective was to reduce it to 492.61 min (Realyvásquez et al., 2019) (Jaffar et al., 2012), with the simulationand the proposed changes, 483.23 min was obtained, which complies to a great extent with this objective and with the premise that, by applying standardized work, the efficiency in the task execution is improved (Fazinga et al., 2019).

6. Conclusion

The methodology framed in the proposed model using Lean tools such as 5S and standardised work structured under the PDCA cycle, achieved the objective of reducing the rate of order returns from 8.99% to 4.95%. Parametric and non-parametric indicators were used to justify how this proposal would mitigate the economic losses that affect the company's profitability by reducing costs from 13.26% to 7.30% of the income from chicken.

It was possible to apply the literature based on successful case studies to the proposed indicators. Although the authors used addressed sectors focused on the production area, they served as a basis for the numerical and percentage estimates to address the sales and dispatch area of this article. Indicators such as order error rate went from 10.16% to 4.50%, documentation search time was reduced to 44.04% and order cycle time presented a reduction of 77.94%, both with respect to the current value. Finally, this proposal could be used as a reference for a preliminary guide in different sectors, but especially oriented to the poultry industry since the scarce information applied to these companies was one of the reasons that motivated this research. However, this should be evaluated according to the model of each industry so that they can adapt their objectives to the Lean Manufacturing tools.

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