5th South American Conference on Industrial Engineering and Operations Management
Bogota, Colombia, May 7-9, 2024
Publisher: IEOM Society International, USA DOI: 10.46254/SA05.20240020
Published: May 9, 2024

Improvement Proposal for the Reduction of Time in Reception and Picking Processes through Systematization in a Logistics Operator

Diego Zavaleta Leon and Mateo Zuloeta Ortiz
Students of engineering, Industrial Engineering Department
University of Lima
20193698@aloe.ulima.edu.pe, 20192205@aloe.ulima.edu.pe

Paul Angello Sanchez Soto
Master's degree in supply chain management
University of Lima
pasanche@ulima.edu.pe

Abstract

In the supply chain, every logistic process is important, from the beginning of the production process until the product reaches the final customer, but one of the most relevant is the storage of these products, because if there is not an adequate storage or an inadequate control of SKUs, this can generate a very large loss at an economic level in the company. In this scientific article a diagnosis of a logistics operator which distributes and stores pharmaceutical products was made, in this diagnosis it was detected that there were certain deficiencies in the processes of receiving and picking and could be made an implementation of tools to optimize these same within the operator. The selected tools were a WMS, barcode, HandHeld and ringscanner; with these tools the times in the logistics activities mentioned above improved significantly, increasing productivity in time and giving the company greater responsiveness in orders and control of all SKUs, evidenced by a simulation in the software "Arena".

Keywords
WMS, Bar codes, HandHeld, Picking and Reception

1. Introduction
1.1 Objectives
General objective: To make an improvement proposal to reduce logistics process times by systematizing the warehouse in a logistics operator.
Specific objectives:
- Objective 1: Develop the background and state of the art of a logistics operator to improve times in receiving and picking.
- Objective 2: To develop a diagnosis of the problem by means of a Pareto diagram.
- Objective 3: Design and develop a proposed solution based on the systematization of the warehouse.
- Objective 4: Validate the solution in terms of time reduction in reception and picking processes, economic viability, and its impact on workers.

2. Literature Review
For article selection, searches were conducted in English, using the keywords "Inventory AND warehouse," "Picking," "Reception," "Reduce AND Time," and "systematization." All articles were sourced from the SCOPUS and EBSCO

databases. The criteria considered for selection were that the articles were in English, published from 2017 onwards, freely accessible, categorized as Q1, Q2, or Q3, and classified as Journal Articles. Once all the articles deemed valid for the research were selected, we proceeded to categorize them based on the optimization model applied in each article for the picking and reception processes. Consequently, we obtained three groups: RFID, barcode, and ERP with WMS. Below is a bar chart detailing the number of items we were able to find for each proposed model (Figure 1).

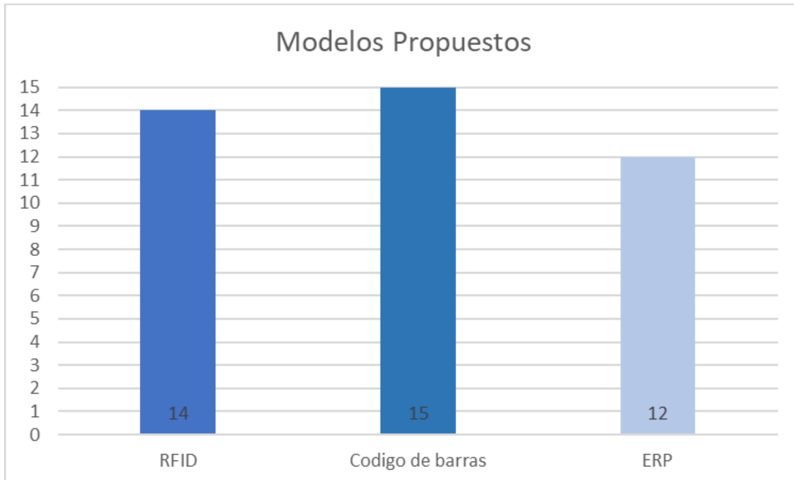

Figure 1. Proposed Models

For the research, the results were classified into two main groups: 30 case studies contributing to the methodology and tools, and 10 describing algorithms for inventory optimization. The following graph shows the number of items found per year and indicates that the following items were considered (Figure 2).

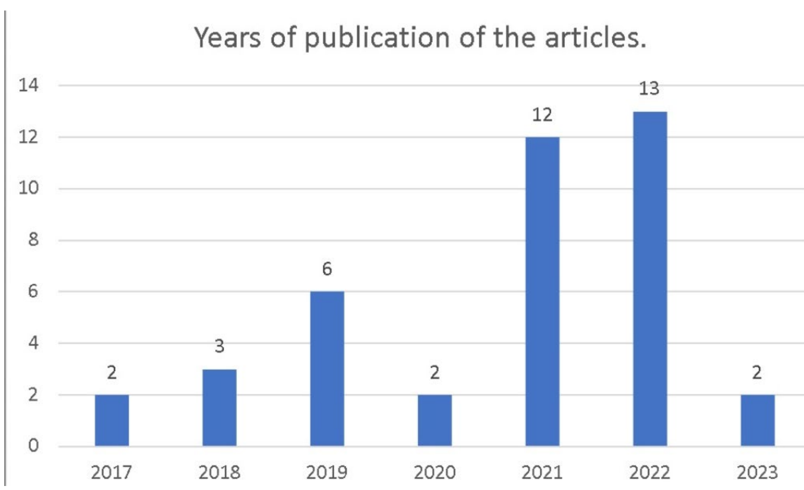

Figure 2. Years of publication of articles

Furthermore, this comparative table is presented, in which we classify the types of articles used in this research. It highlights predominantly the case study type, as it closely resembles the research type we are conducting (Table 1).

Table 1. Classification of articles according to the type found.

Case Study	Descriptive
30	10

Below, articles will be presented to support the rationale of the research and the context of the problem being addressed therein.

Traditional warehouses are warehouses that do not operate efficiently and perform many manual tasks that cause inefficiencies (Kamali 2019) and affects the efficient of the warehouse and according with Zernov (2017) in the supply chain helps shorten time and offers value-added processes. In terms of production and purchasing, economies of scale are achieved, and transportation costs are reduced through product consolidation and all of these factors can affect inventories, and inventories are defined as follows as set of ordered things and other valuable items that belong to a company and are made available when required (Salas 2022). Based on this definition, we can say that inventories are a fundamental part with a strong impact on the company, but this wasn't always the case as Trujillo et al. (2017) indicate. In the past, they were a necessary evil to ensure production continuity; however, current business management requires proper inventory management, where the criterion of maintaining the minimum necessary quantities to ensure continuity of the entire flow in the logistics chain should prevail, allowing for the absorption of the impact of variability and uncertainty associated with operations, ensuring maximum customer satisfaction. With these concepts clear, it can be said that inventories are a fundamental part of a company, as Céspedes (2014) stated in his research work. 75% believe that profitability has improved in their companies, while 25% stated that the profitability of their companies has decreased in the period mentioned, referring to inventory control. Therefore, it can be said that some companies still do not consider having better control of their inventories, which could have negative effects such as not having control of stocks in their warehouses or being able to meet their estimated demands and as it mentions Zinchenko (2017) technology implementation is required for companies with intensive turnover processes (Table 2).

Table 2. Comparison: Manual Data Entry vs Barcode Scanning

<table>
<tr><th>CHARACTERISTICS</th><th>MANUAL INPUT</th><th>BAR CODE</th></tr>
<tr><td>Speed</td><td>6 seconds</td><td>0.3 to 2 seconds</td></tr>
<tr><td>Substitution error rate</td><td>1 error character for every 300 characters entered</td><td>1 character error between fifteen thousand to thirty-six trillion characters</td></tr>
<tr><td>Coding costs</td><td>High</td><td>Low</td></tr>
<tr><td>Reading costs</td><td>Low</td><td>Low</td></tr>
<tr><td rowspan="3">Benefits</td><td rowspan="3">Humans</td><td>Low error rate</td></tr>
<tr><td>Low cost / High Speed</td></tr>
<tr><td>Can be read from a distance</td></tr>
<tr><td rowspan="4">Disadvantages</td><td>Humans</td><td rowspan="2">Requires education of the user community</td></tr>
<tr><td>High costs</td></tr>
<tr><td>High error rate</td><td>Equipment costs</td></tr>
<tr><td>Low speed</td><td>Dealing with lost or damaged images</td></tr>
</table>

The WMS is a tool that will be used for the implementation of this research. The logistics operator has an ERP in their warehouse but lacks a WMS complement, resulting in no localization system. Tong et al. (2020) indicates that the implementation of WMS working in conjunction with ERP positively affects the warehouse. Products are organized better, and solutions are provided to expedite logistical processes. One such solution is product localization to speed up the picking route and increase productivity. With this tool's implementation, the response ratio is 0.1 seconds, error ratio is 0.1%, and the number of operators is reduced to 5 from the previous 15 (Table 3).

Table 3. Effects of WMS implementation

Category	Unit	Traditional Storage	Storage with WMS
Response	Seconds	10	0.1
Error Ratio	%	1	0.1
Number of workers	Number	15	5

The implementation of barcode scanning in this warehouse yields processing times of under 25 minutes for tertiary and secondary packaging. This aligns with our research on registering products by full boxes or individually. This tool also enhances productivity in the reception and registration process, expediting subsequent supply chain processes.

The barcode tool mentioned in the article by Hara et al. (2017) proposes the idea of adopting barcodes as part of a standardized global system for product identification and data capture, serving as the basis for interoperability. Additionally, the error rate during data registration is reduced thanks to a handheld optical scanner, the Motorola MC920 model, used to register products in the system via barcode. It is also noted that this scanner model is ergonomically suitable for scanning and provides higher speed, thus making the time spent registering products in the reception area more productive. In this research, a record was made of the time taken to register products using barcodes, and consideration was also given to the type of packaging: primary, which consisted of a blister containing 6 pills; secondary, which was a box containing 2 blisters; and tertiary, which was a plastic wrap with 7 boxes inside. Below is a table showing the obtained times (Table 4).

Table 4. Registration time by packaging type

Packaging type	Number of scans	Time (minutes)
Tertiary	13	3.62
Secondary	63	24,63
Tertiary	13	2
Secondary	50	15
Secondary	230	>25

The results of implementing the barcode system for this warehouse show times of less than 25 minutes for tertiary and secondary packaging types, which also aligns with our research findings regarding registering products either by full boxes or individually. This indicates that this tool contributes to enhancing productivity in the reception and product registration process within the warehouse, thereby streamlining subsequent processes in the supply chain.
According to Fillip (2021) says the technology for order. picking will continue to evolve, and this will impact human quality of life and other activities. For example, Barcode Technology is one of the most used in the field of logistics Van Geest (2021) and in according to him this technology is cheaper than other technologies and can read information faster and more accurately than a human can read and talk. It is recommended that barcode scanning be used in systems that are too small to justify the installation.

3. Methods

To identify the main problem of this research, the problem tree diagram was used. This diagram addresses root causes, then proceeds to the causes generated by these root causes, then reaches the reasons, and finally, the main problem is identified and grounded.
The methodology employed for this research involved simulation using software to obtain results as close to reality as possible. The software "Arena" was utilized for this purpose, using both physically collected benchmark times and data guided by the literature review described earlier in point 2. With these data, we approximated a result that could be achieved through the proposed implementation outlined throughout the research.

4. Data Collection

The company was requested to take measures of the workers who had direct contact with picking and receiving activities, which amounted to 10 operators. These measurements were taken every 5 days over a total period of 1 month. From the data obtained, an average of the times was calculated to obtain the most accurate data possible. The measurements were carried out by the supervisor of the operators. In addition to this, the operators were also asked to record the times they spent on their activities.

5. Results and Discussion

5.1 Numerical Results

In this chapter we will show the results obtained from the collection of information that has been carried out both physically. For this purpose, a table of the average time that was made from the measurement of times per order of 10 average units was made (Table 5).

Table 5. Collected times

Selected indicator	Unit	Average Time
Productivity in the picking and receiving process (Shelving Area)	Minutes	60
Productivity in the picking and receiving process (receiving Area)	Minutes	100

In the table shown above, the manually collected times in the warehouse are displayed, both by us and by the workers, to obtain a more accurate average time, which are different both in the picking area and in the shelving area.

5.2 Graphical Results

In the previous graph, the average times taken over one month are shown, with each point on the graph representing one week of that same month. In the case of the shelving area, there was an average time of between 55 and 65 minutes to complete the activities. As for the reception area, operators took between 95 and 105 minutes to complete the activities in this area (Figure 3).

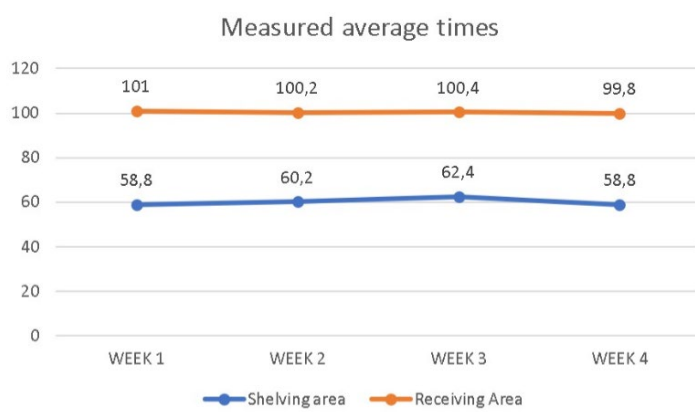

Figure 3. Measured Average Times

5.3 Proposed Improvements

The proposed improvements being implemented by the company include the introduction of tools such as RingScanners, Handhelds, and a WMS (Produmex) to reduce manual logistics operations, which often lead to errors. To assess the potential impact, a simulation was conducted using Arena software to visualize potential time improvements in the receiving and shelving areas for receiving and picking operations.

Two simulation models were developed, each corresponding to the specific area of the warehouse under focus. The following parameters were considered for this simulation model:

- Operational profile: 10 units per order
- 8 hours for each iteration
- The first order arrives 1 hour after the warehouse opens at 8:00 am

For the reception area, the following simulation configurations were made to ensure proper functioning:

1. A delay of 25 minutes on average for orders to remain in the reception area before undergoing package inspection.

2. During package inspection, an operator is utilized, with the inspection time following a normal distribution with a mean of 15 minutes and a standard deviation of 5 minutes.
3. An attribute was set to determine how many products passed quality inspection, using a discrete distribution of DISC(0.8,1,1,2), where 1 represents accepted orders and 2 represents rejected orders, thus indicating which orders proceed to the next registration process and which remain in the reception area.
4. Scanning of boxes is initiated following package inspection, with scanning time following a normal distribution with a mean of 20 minutes and a standard deviation of 5 minutes. This activity is performed by a group of 3 operators and 3 scanners, marking the conclusion of this segment within the overall model for order reception and registration time (Figure 4).

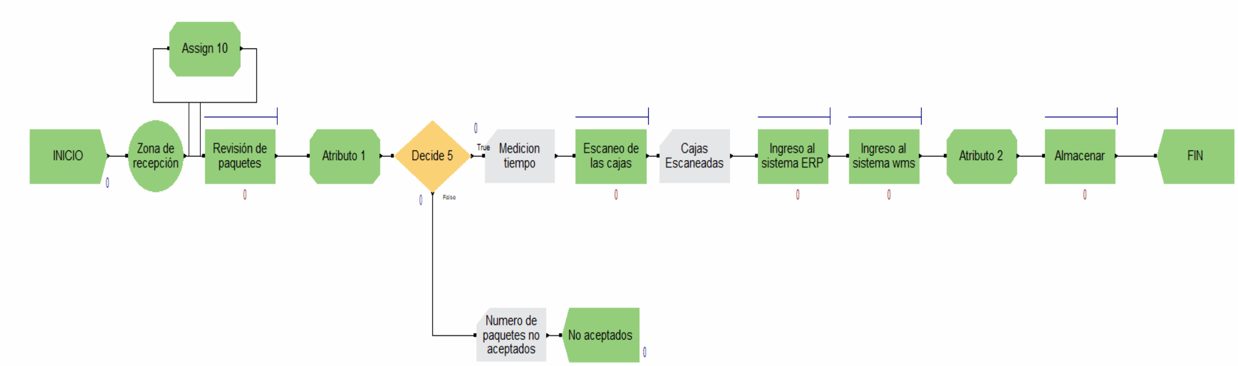

Figure 4. Simulation model for the reception

For the shelving area, the following configuration was decided upon (Figure 5):

1. An activity where product data is entered into the system, processing 20 entries at a time. This task takes time following a normal distribution with a mean of 8 minutes and a standard deviation of 2 minutes. The information is also input into the WMS for further processing and to facilitate product location within the warehouse. This activity takes time following a normal distribution with a mean of 5 minutes and a standard deviation of 2 minutes.
2. For the picking process, the same tool is utilized. Orders arrive every 2 hours throughout a day, within an 8-hour shift over 6 days. Upon receiving the order, the picking list is printed, taking time following a normal distribution with a mean of 5 minutes and a standard deviation of 2 minutes. Subsequently, the operators review the optimal route according to the WMS for picking the required products, which takes them 5 minutes. Once the route is established, the 3 operators retrieve their baskets for picking, which takes them an average time of 20 minutes.
3. The same 3 operators then pack everything into a box and proceed with the packaging process, which takes time following a normal distribution with a mean of 10 minutes and a standard deviation of 2 minutes.

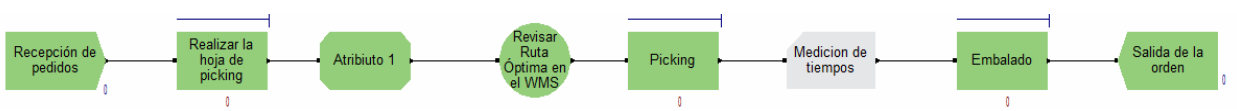

Figure 5. Simulation model for the shelving area

5.4 Validation

The proposed hypothesis was that the productivity of receiving and picking would increase by more than 10%. As a result, it was found that for the receiving area, both activities improved their productivity by 58%, and for the shelving area, it increased by 38% compared to the pre-implementation levels of these tools.
Here is a table displaying the proposed results (Table 6):

Table 6. Comparison of the results

Tools	Selected indicator	Unit	As Is	To Be	Improvement
WMS (PRODUMEX)	Productivity in the picking and receiving process (Shelving Area)	Minutes	60	37	38%
Scanners y Bar codes	Productivity in the picking and receiving process (receiving Area)	Minutes	100	42	58%

In this table, you can observe the "As Is" times collected before implementing the mentioned tools, and the "To Be" times after the implementation of the tools. These "To Be" scenario results reflect that productivity would not only improve in the time taken to perform logistics activities but also in monetary terms, as there would be a capacity to handle almost double the number of orders per day in both the reception area and the shelving area (Figure 6).

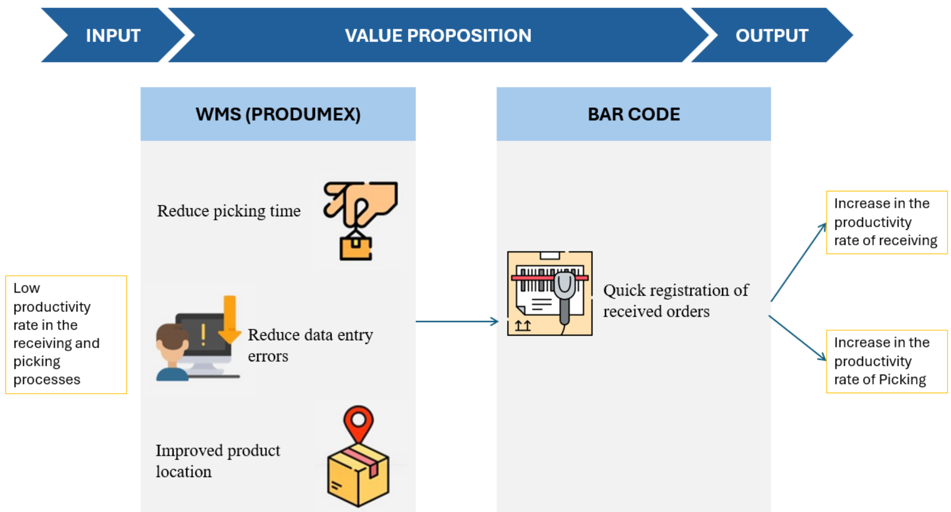

Figure 6. Value proposition

The image shown above describes the improvements that would be achieved with the proposed model for the first tool, which would be the WMS. This would help to streamline productivity in the warehouse picking process. Next is the implementation of the barcode, which helps to speed up the item reception process, making registration faster and less laborious.

6. Conclusion

It can be concluded that implementing the mentioned tools in the article results in a significant improvement in reception and picking times. Additionally, operators do not need to exert extra effort or work overtime to meet the demand of daily orders. An effective solution design was achieved through systematization, meeting productivity KPI standards with improvements of 58% and 38% in each process, quantitatively substantiating the enhancements. Regarding time analysis, due to the company's restrictive schedule, a larger dataset couldn't be obtained for a more precise time average, which could lead to better results. For future work, focus should be placed on better time analysis and the recreation of a simulation for even greater accuracy in potential improvements.

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Biographies

Mateo Zuloeta is Bacheller in Industrial Engineering specialist for Supply Chain Management for University of Lima. His work in the logistics area of a company that sells biomedical equipment.

Diego Zavaleta is an industrial engineering student with all courses completed at the University of Lima. He works in the logistics area in a company that provides b2b services to a hydroelectric plant.

Paul Sanchez is master's degree in supply chain management from ESAN Graduate School of Business, Distribution Center Manager at Empresas Virutex Ilko, Area Manager at Ajegroup, Logistics & Warehouse Coordinator at Mars, Business Manager and Supply Chain Leader at Rans, Commercial Manager at Almacenera Pacífico, Business Development Manager at DHL Supply Chain, Lecturer at the University of Lima, and Commercial Manager at Nexos Operador Logístico.