# Picking Process Management Model to Improve Order Processing Time in a Spare Parts Warehouse using the 5'S Technique: Case of the Automotive Sector

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## Abstract

The problem observed in the warehouse of an auto parts company is the high picking process times due to the lack of standardization of the process itself. The objective of this research is to propose a management model to increase productivity in the order fulfillment process by means of Kaizen methodology techniques to reduce picking times and attend customer orders in the shortest possible time, for which the research is empirical with a quasi-experimental, post-positivist scope, under the case study modality. The difference in picking time depending on the type of worker in the warehouse was evidenced and through the standardization of the process a reduction in picking time of 41.37% was achieved in the case of new operators, 32.80% for a standard operator and 11.82% for old operators.

## Keywords
Picking, Kaizen, Ishikawa Diagram, standardization, 5´S.

## 1. Introduction
Peru's business market is made up of different sizes of companies. According to the Ministry of Production (2020) there are more than 1.7 million formal companies active in the country. Of the total, 99.5% are micro, small and medium-sized enterprises (MSMEs), where 95.2% are microenterprises, 4.1% are small and 0.2% are medium-sized. According to the Ministry of Economy and Finance (2022) companies are categorized as follows. Micro companies are those with annual sales up to 150 Tax Units (UIT) small companies between 150 and 1,700 UIT and medium companies between 1,700 and 2,300 UIT. Of these companies, 85.2% are engaged in commerce and services, the rest in productive activities. In addition, it should be noted that MSMEs generate more than 90% of the EAP employed in the private sector, being considered a major generator of employment.
As for the context of the Peruvian retail sector, it represents around 11% of the GDP, which would be expressed in 24 billion dollars, making this sector the third most important category behind oil-gas and financial services, according to Florián and Dominguez (2021). This shows the great importance of the sector. Retail is oriented to markets such as department stores, home equipment, hardware, auto parts, etc.
A problem faced by several companies belonging to the MSME category in the retail sector is that they have limited resources, which does not allow them to implement tools, machines or high-level and costly methodologies to improve their logistics or dispatch processes. One of them is the company of our object of study in the development of this research, located in La Victoria and founded on July 24, 1993. This company is dedicated to the auto parts market, specializing in the friction system that includes spare parts such as brake pads, brake shoes, discs and drums. It is a market which, according to the Peruvian Automotive Association (AAP 2022), has presented a notorious increase during 2020, 2021 and 2022 in terms of supply imports. These include the categories of tires, lubricants, engine parts, filters, other fuels, transmission systems, electrical parts, body parts, suspension systems, braking systems, and others, with the braking system market being the company's specialized line of business. The company has approximately 40 employees and annual sales of around PEN 10 million, categorizing it as a medium-size company.

The problem observed in the company is the long time it takes to attend to orders. The process under study can be divided into four main activities: supermarket cart pickup, picking, packing and product dispatch. The picking process is where most of the time is spent and where the operators are having the most problems in identifying the products in the warehouse.
The research contributes to the existing knowledge on warehouse management for retail companies in the automotive sector, and also to all those companies that have high picking process times in the warehouses and low resources to implement complex and costly methods. In addition, this research is methodologically justified because we have free access to the object of study; which gives us direct access to the processes that are carried out within the company, primary source information and we will be able to observe how to apply the possible improvements that are proposed throughout the work, as well as the validation of this. Likewise, the information available about the implementation of the Kaizen method in the Peruvian auto parts retail sector is scarce. The purpose of this research is to implement engineering techniques in a company of the automotive sector in order to contribute with a correct practice in the management of the picking process through a philosophy of continuous improvement such as Kaizen.

### 1.1 Objectives

The general objective of the research is to propose a management model of the picking process to improve the order attention time in a spare parts warehouse. The specific objectives were set out:

- Identify the factors that generate high picking process times.
- Evaluate the relationship between the operator's experience and the time required to locate the products required to complete the order fulfillment.
- Identify and eliminate activities that do not add value in the picking process.

## 2. Literature Review

Regarding the theoretical framework, the authors Serrano and Ortiz (2012) indicate that the word Kaizen was born as a derivation of two Japanese ideograms: Kai meaning "change" and Zen meaning "the good to improve", and that it has been established as a methodology of continuous improvement, which requires that all people, every day, in all places, can and should improve. Otsuka and Ben-Nazwi (2022) mention that the Kaizen approach consists of identifying and organizing the key strategies for the improvement of production processes, so that companies can make improvements in existing practices, day after day, that result in performance and increase profits to become highly competitive.
Likewise, citing Atehortua and Restrepo (2010) this methodology is based on two fundamental pillars: "people and process standardization", since its practice requires a team composed of personnel from the various processes of the company and the application of techniques or tools to improve manufacturing processes by reducing time, standardizing quality criteria, work methods per operation, eliminating waste, resulting in increased productivity in the company.
Similarly, Sanchez-Comas (2019) refers to picking operations as a key factor in distribution companies, because a correct implementation of it allows to have an optimal storage management, where it seeks to minimize the travel distance of workers to specific points, thus reducing the time of picking and delivery of orders. This can be done by analyzing formulas that calculate the average distance of a picking route under a series of routing codes.
Regarding the state of the art of the research, antecedents related to the implementation of Kaizen and its tools applied to the improvement of processes and specifically to the picking process in the attention of orders in warehouses were analyzed such as; the study of Noroña and Gómez (2018) who point out that "the chain begins with the suppliers of your suppliers and ends with the customers of your customers", referring to the analysis of the auto parts supply chain, and indicate that this factor is the main factor to be successful in the automotive industry. This research was carried out in Mexico, where the management and logistics administration of the auto parts supply was analyzed and the operating systems were identified to ensure that production is homogeneous, complies with customer specifications and meets the agreed-upon deadlines. Also, a study prepared by Pawliczek et al. (2022) defined the evolution between 2013 and 2021 in the management tools and systems used by logistics centers, distribution companies, transport and warehouses in the Czech Republic. The result shows that continuous improvement tools have had a popularity and positive impact on the companies' metrics, with Kaizen being the one with the highest growth, 18.20%.
Another similar case, which justifies the mentioned model, is the research of Diaz et al. (2014) in a company of the textile sector in Colombia; where they indicate that approximately 65% of the operating expenses of a distribution center are consumed by the enlistment or preparation of orders, which is why they establish a methodology to

minimize it, evaluate different scenarios of center design and create preparation and routing policies. Similarly, according to the "FlexSim" simulation model of manual order picking issued by a convenience store chain, proposed by Moya (2020) there is a way to estimate the level of workforce required to carry out picking on a daily basis, given the number of variables and constraints in the supply chain.

Another point to take into account in this research is the use of Kaizen techniques; therefore, we have previous research on the Ishikawa diagram and the application of the 6M to determine the low productivity and efficiency in a footwear manufacturing company (Andrade et al. 2019) and subsequently increase it by 5.49%. This diagram, like the Pareto diagram, is based as a study technique to contribute to problem solving and strategy design in the corporate and educational environment (Burgasi et al. 2021).

Having generated this information gap, it is clear that there are no authors who have considered Peru as an object of study. Also, there is not much relevant information on management models to improve picking times through Kaizen.

## 3. Methods

This research work is empirical because the information collected has been extracted directly from the object to be investigated. With respect to the scope of this work, it is of the quasi-experimental type (post positivist) under the modality of case study, which is developed in an auto parts trading company located in the city of Lima with more than 25 years of experience in the market. On the other hand, the research approach is quantitative, this is due to the measurement of the different variables identified, such as the collection of times in the picking process.

For the development of the research work, the following methodological process will be followed. First, the diagnostic stage, where it was possible to establish and recognize the existing problems in the object of study, which in turn allowed finding the root causes. For this purpose, the following analysis tools were implemented: the cause-effect matrix (Ishikawa) applying the 6M (Method, Machinery, Labor, Materials, Measurement and Environment) that will allow us to recognize the main category where the problem is centered, and a flowchart for the entire order process, in order to understand how each operation is carried out.

The objective of these diagnostic tools; as mentioned in previous lines, is to identify the root causes of the problem in order to perform a correct mapping of the process, with the purpose of understanding the different stages within it. This research was elaborated through the analysis of the dependent variable defined as the attention time in the picking process; and the standardization of the picking process in the warehouses was taken as an independent variable. Once the diagnostic phase was completed and the root cause was determined, we went on to investigate an engineering solution that would best adapt to reduce the time. To this end, a literature review of similar cases was carried out in order to obtain quality information on the technique that best suits the resolution of the problem observed, and in this case the standardization of the 5'S was selected.

To validate the proposed solution model, the implementation of a pilot test of an average order that includes 12 regular items within the company for approximately 15 days was proposed, in order to see the interaction of the different types of warehouse operators according to their time of permanence in the company with the new standardization improvements employed. The types of operators are as follows: new, between 0-4 months, standard, between 5-8 months and old more than one year of permanence within the company.

This solution consists of identifying the location of each product and entering them in a database so that their location appears in the order book. These will appear in order of scaffolding so that the operator does not advance to a distant scaffolding and then have to return to locate another product; therefore, the system would place in order the products to be selected according to the operator's convenience.

## 4. Data Collection

It is important to understand the complete process involved in the order processing of the selected company. In order to understand the order fulfillment process of the company under study, the activities carried out were analyzed using a flow chart for order fulfillment. The first step is that the warehouse operator receives the guide under the supervision of the warehouse manager, this happens in the order reception office. Then, the warehouse operator goes to the picking area, take a shopping trolley to place the products and start the picking process without an established route. If the warehouse operator has a question about the location of a scaffold or products, goes to ask the warehouse manager. Once the operator has finished selecting all the products, goes to the packing area where start to packs the products and checks that everything is in accordance. If the order is not complete the warehouse operator returns to the picking area and even goes to the warehouse manager if something was not clear. Once the packing is finished, the warehouse operator takes the products to the transport area to be distributed to their customers and the process ends. See Figure 1.

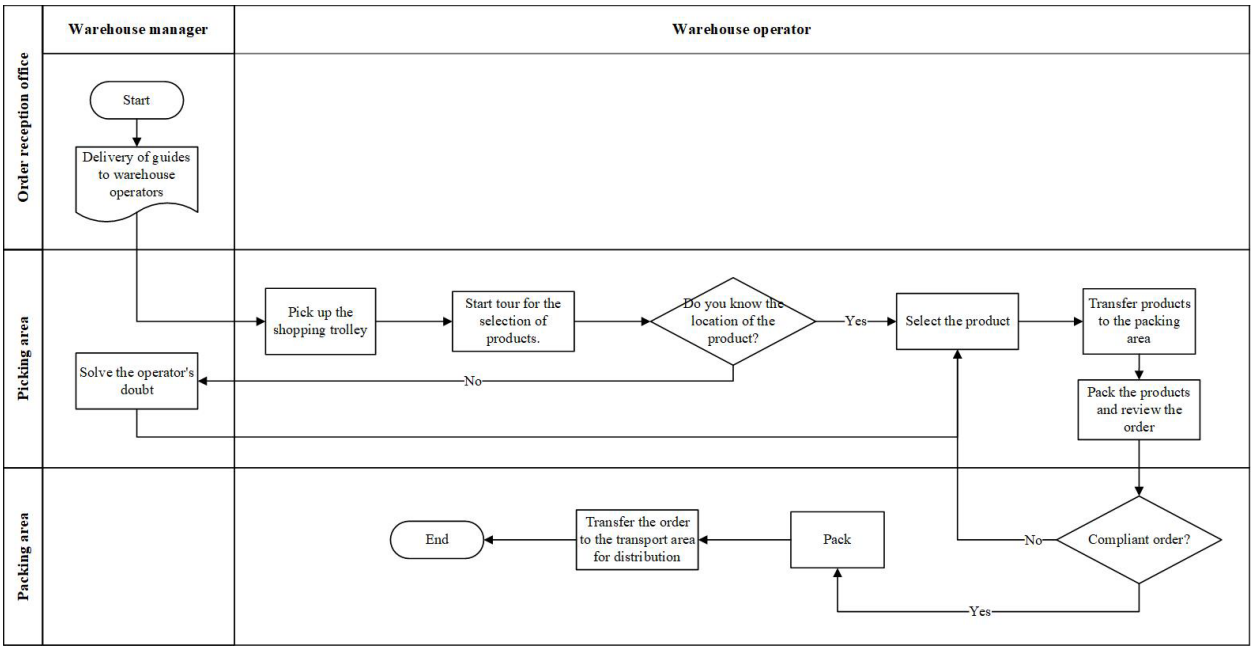


Figure 1. Flow of the order fulfillment process in the company

In order to identify the factors that affect the deficient management of picking times, a visit was made to the company, where a conversation was held with the warehouse personnel and the different people in charge of the area. Likewise, a tour was made along the whole process for a better understanding. After that, an Ishikawa diagram was made with the 6Ms in order to identify the different points that could be the main causes of this problem. Scores from 1-4 were then assigned to the causes in order to assign them the corresponding weights within the six variables analyzed. This makes it easier to identify the variables with the greatest weight and thus propose different solutions focused on them to remedy the deficient distribution in the company. In this case, the two causes that scored the highest were Method and Man, so will have the greatest attention along the article. The methodology applied in the company had inefficiencies in the sequence of scaffolding and there was a lack of standardization. Also, the codes on the scaffolding were not visible and there was not a selection path. As for the manpower, there was a lot of turnover because it is not a well-paid job, as well as lack of knowledge, training and motivation. See Figure 2.

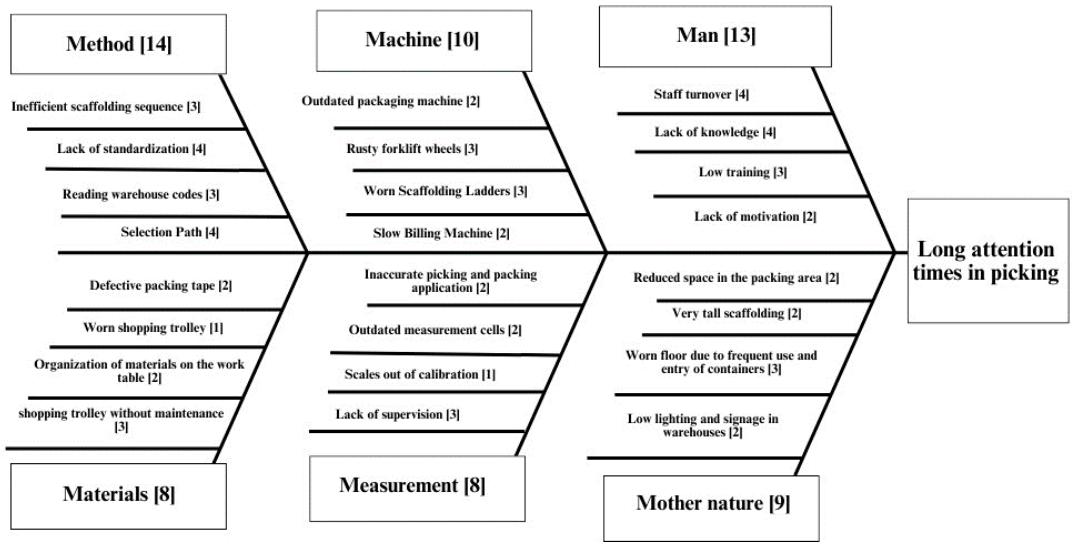


Figure 2. Root causes of long attention times for order picking

Different times were taken during the picking and packing process to identify the activities that take the longest time and possible areas for improvement. To this end, nine operators were selected, three of each type, with different lengths of stay within the company to obtain more accurate data and thus understand the behavior over time. The activities involved are as follows:

- Activity A is the time it takes to pick up the shopping cart, which allows the products to be transported throughout the entire warehouse.
- Activity B is the picking time, which is the process it takes the operator to pick the different products until they are taken to the packaging area.
- Activity C is the time spent in packing, a process where the operator is in charge of assembling the packages with the products for their subsequent distribution.
- Activity D is the time it takes to deliver the order to the dispatch area.

## 5. Results and Discussion

### 5.1 Numerical Results

The following table show the times collected from the company's current picking process, in which we can see the average time taken by each type of operator to perform each of the different activities involved in the process of taking care of orders prior to their dispatch in the company's vehicles. This average is obtained from 15 samples per type of operator in order to have an accurate data, considering that the orders have 12 items. See Table 1.

Table 1. Average time in minutes for picking according to operator in different activities

| Activity | A | B | C | D |
|---|---|---|---|---|
| New Operator | 1.14 | 44.43 | 5.65 | 1.41 |
| Standard Operator | 1.13 | 27.87 | 5.28 | 1.43 |
| Old Operator | 1.12 | 14.64 | 4.50 | 1.37 |

### 5.2 Graphical Results

The following figure show graphically the data collected by type of operator, in order to have a clearer and more visual view of the current situation of the auto parts company. See Figure 3.

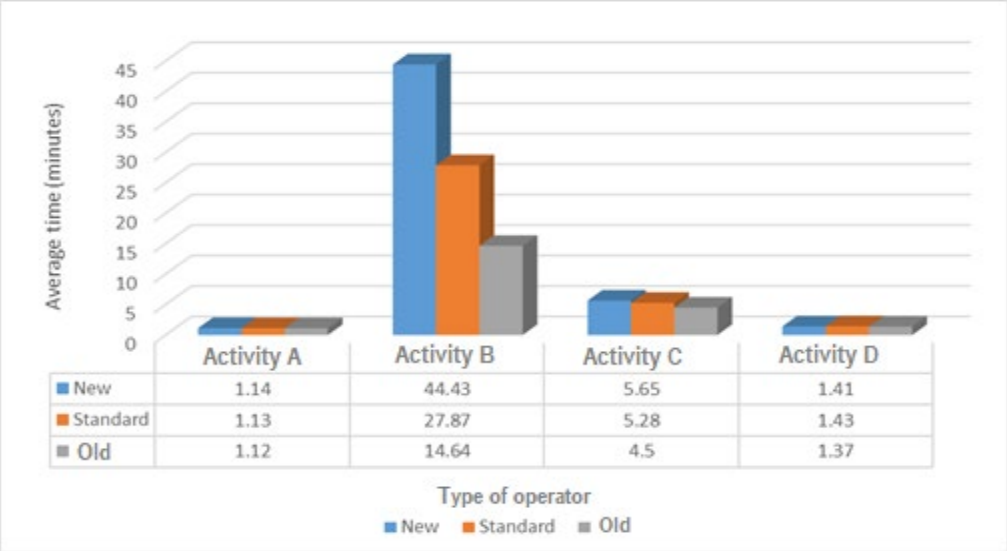


Figure 3. Average time per activity according to type of operator

### 5.3 Proposed Improvements

In order to achieve standardization within the picking process, which is the root cause of the high order fulfillment times, a new guide model will be implemented, indicating the different products to be selected and the order in which they should be picked. See Figure 4.

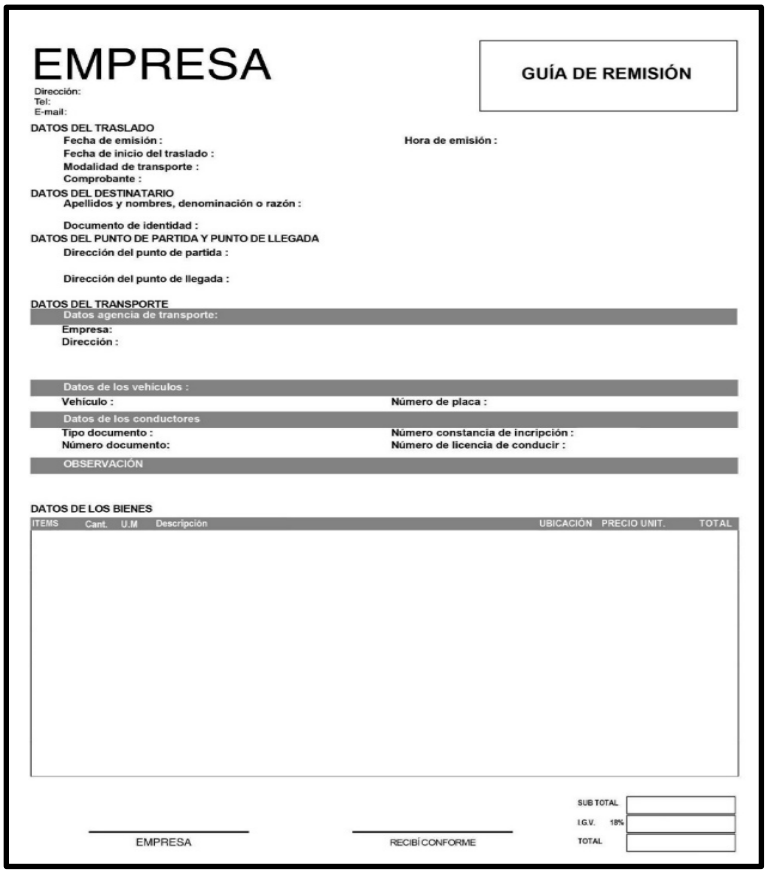


Figure 4. Prototype of the new waybill including location of the products to be selected

This, together with an induction process for the new operators that are entering the company as well as for the operators that are already working in the company, could familiarize them and have a more orderly product collection process that follows an efficient selection pattern.

This induction consists of teaching them the logistics of the warehouse in order to have a notion of the accesses and different areas within it. To do this, a brief tour of the warehouse is made, where they are taught the coding of the scaffolding to better understand the technical language. It should be noted that the company did not have proper signage which is visible and adequate cleaning of the scaffolding. The company only complied with one of the 5'S which was Seiri (Organize) in the scaffolds, since they were correctly organized. However, they did not apply Seiton (Order) or Seiso (Clean), so the labels on the scaffolding were ordered, the labels were cleaned and also printed again with a larger size so that they were more visible and easier to locate for the operators, thus reducing wasted time. This training is accompanied by constant testing of the location of the scaffolding so that when they receive the guide they only have to memorize the location of the scaffolding, of which there are only twelve instead of the more than one thousand SKUs (Stock-keeping unit) that the company handles. Once the location of the scaffolds had been identified and memorized, the operators would be ready to carry out the new picking process with the new waybill.

### 5.4 Validation

In order to validate our proposed solution, pilot tests were carried out. to this end, a fictitious order was created that resembles an average purchase order covering the company's different products, so that the pilot test would be as

accurate as possible. Then, the different operators were selected according to their time spent in the company, as executed in the previous timelines to identify the root cause. The duration of the pilot test was 15 working days, where every day the variety of products changed in order to avoid any alteration in the results. The results obtained from the test are shown in Table 2 and Figure 5.

Table 2. Results of the pilot test in the picking activity for an order of 12 items

| Day | Time (in minutes) of the types of operators | | |
|---|---|---|---|
| | New Operator | Standard Operator | Old Operator |
| 1 | 27,54 | 19,41 | 14,85 |
| 2 | 27,87 | 21,06 | 14,49 |
| 3 | 25,42 | 19,14 | 12,26 |
| 4 | 26,14 | 19,83 | 12,44 |
| 5 | 23,78 | 17,43 | 12,93 |
| 6 | 24,32 | 18,88 | 12,87 |
| 7 | 24,37 | 22,43 | 12,97 |
| 8 | 22,13 | 19,41 | 13,32 |
| 9 | 25,72 | 17,66 | 12,47 |
| 10 | 26,52 | 16,31 | 12,31 |
| 11 | 27,81 | 19,72 | 12,95 |
| 12 | 26,49 | 18,07 | 12,12 |
| 13 | 29,65 | 15,27 | 12,68 |
| 14 | 27,53 | 17,25 | 12,55 |
| 15 | 25,42 | 19,03 | 12,42 |
| **Average** | **26,05** | **18,73** | **12,91** |

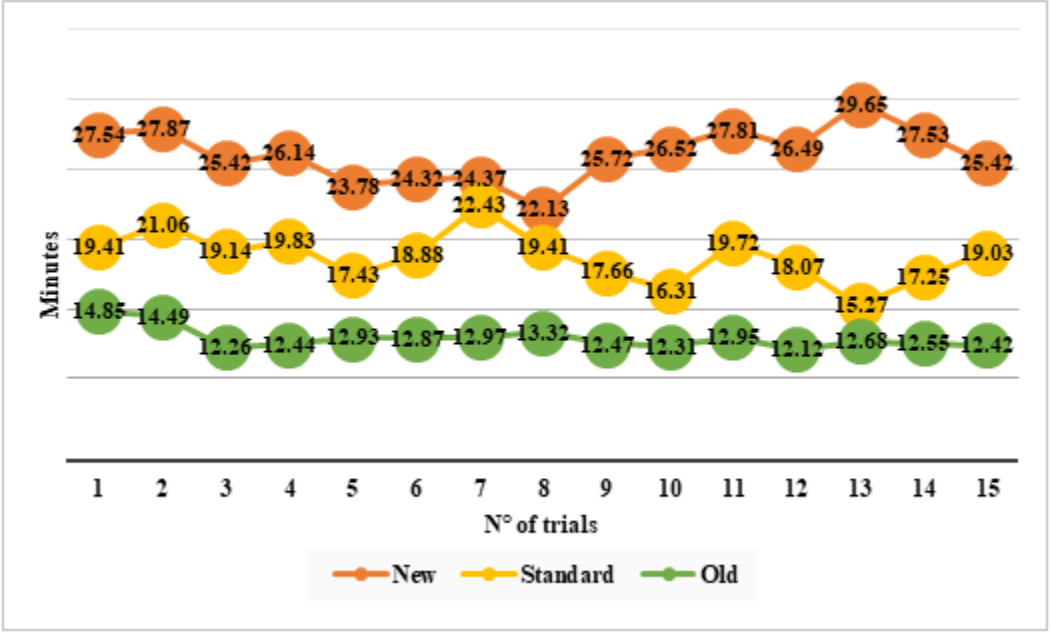


Figure 5. Average time (minutes) of the pilot test by type of operator

With the results obtained, we can see the high relationship between picking times and the time of permanence of the operators within the company. There is a clear trend of time reduction as the time of permanence increases; where

the new operator had an average time of 26.05 minutes, the standard of 18.73 minutes and the old one of 12.91 minutes. This demonstrates a natural learning curve of any new process that a person is performing for the first time. Therefore, having applied the pilot test and standardizing the product placement process through the designed guide, picking times have been significantly reduced, which makes the distribution process more efficient. See Figure 6.

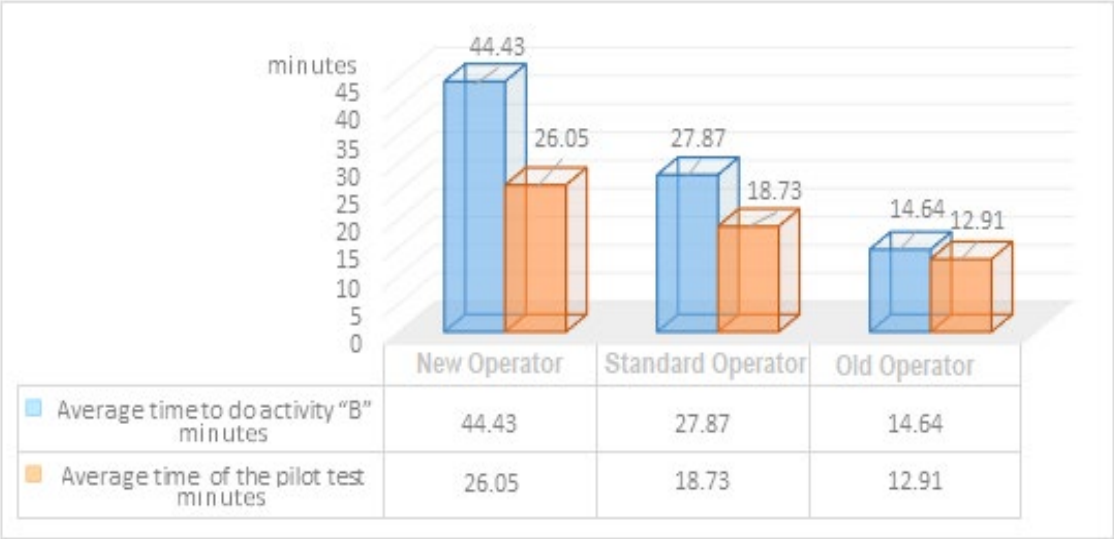


Figure 6. comparison of times between activity B and average time of the pilot test

The learning curve is still notorious, but the times for each type of operator have decreased, especially for new operators with 0-4 months of permanence. It should be noted that the times of the old operators have not varied much, this is because they already have a great knowledge about the location of the products and do not require detailed location in the guide as a new or standard operator may need.

The application of this standardization in picking brings great benefits to the company when implementing it in its order fulfillment process. First, it radically reduces the impact of high operator turnover in the warehouse. Secondly, it gives you the opportunity to deliver orders in less time, which would give you a competitive advantage over other companies in the industry. Thirdly, it has the option of reducing personnel while maintaining the delivery times already established, which would allow it to reduce operating expenses and increase its profits significantly, resulting in additional capital to invest in other types of improvements within the company and continue to evolve.

Although there is not much information about authors who have considered any Peruvian company for the implementation of warehouse management models to improve picking times, or studies of Kaizen techniques or tools; we can compare the results of this research with some that are reported in the state of the art. One of them, is the research of Gomez-Montoya et al. (2020) where he implements as we do the routing in warehouses to locate products in a faster and optimized way, only through the development of a PSO algorithm (Particle Swarm Optimization); which requires artificial intelligence, and us with the coded guidance by scaffolds and products. Finally, both tools reduce distribution times, generating important savings such as operating costs and costs related to the number of claims for orders delivered after hours.

Also, we can compare this research with the study of Pawliczek et al. (2022) on the management of logistics centers in the Czech Republic; where the best continuous improvement tool is sought, being Kaizen the one that generates the greatest growth in the performance of companies with 18.20%; in the case of this research, it was possible to reduce the average initial picking time (including the 3 types of operators) from 28.98 minutes to 19.23 minutes, by standardizing the process, meaning a decrease of 33.64%. Similarly, we can use as another example the case of a sugar company, Ammar (2022) on the problem of storage allocation to place reference codes in the most efficient locations; where they applied a shelving system with the best evaluation and the shortest product retrieval time; that is, organizing them according to demand through ABC analysis to classify codes according to picking frequency. It was estimated that the proposed solution would save 50 hours of travel time per month, which represents 22.18% of the total travel time with a random policy; and 48 hours of lost work time per month, which means a saving of 242 km of unnecessary distance.

Additionally, the research of Placencia et al. (2020) on inventory management practices during the Covid 19 pandemic to increase the level of customer service in an industrial products company in Mexico; is a clear example

that reinforces the case of this research, since a low level of service due to poor inventory picking management caused the company to not meet the promised level of service to the customer, 89%, due to the low availability of finished product inventory, impacting the customer delivery time in the distribution center with a time of 5 hours, while the goal was 90 minutes per shipment. The implementation of picking improvements achieved an increase in service level by up to 5% as of the fourth quarter of 2019.

On the other hand, there are certain limitations to the study in order to improve warehouse management. In the first place, we have the basic one, which is the lack of financial resources to be able to adapt a new system that generates the order guides; as well as the hiring of additional personnel. However, for this research they were not significant because the company has enough income to cover this new technology in picking and there would be no additional costs for new staff but only for the training of this. What really was a limitation is the availability of accurate or reliable data regarding the times of all processes, since in a pilot test of a short time level (15 days) it cannot be guaranteed 100%. Another limitation is the resistance to change on the part of the personnel, since in any case under this new system they would be obliged to follow the routing order for the picking of the products, so that they do not take longer than the calculated range, where they would be supervised by a warehouse manager.

Finally, it is suggested for future research the application of artificial intelligence to optimize any process involved in warehouse management, since this is the technology of today and is increasingly proving its effectiveness to improve processes, reduce time and costs. AI could help us to create tracking systems and accurate data collection; as well as analyze the effect of inventory standardization and error reduction in the processes of receiving, packing and dispatch, to increase the level of satisfaction of both the employee with his work and the customer with his order on time.

## 6. Conclusión

The results obtained after the implementation of the pilot test indicate that there is indeed a radical decrease in time in the picking process (40.97% for the new operator, 32.80% for the standard one and 11.82% for the old one); and therefore, the attention to orders is more efficient. This was achieved through a management model implementing the Ishikawa tool with the 6M and the 5'S technique of the Kaizen methodology, which seeks to classify, sort, clean, standardize and maintain an adequate management for the picking process, which generates a reduction in the learning curve for new operators.

Likewise, having a correct knowledge of the processes within the warehouse allows to diagram the work flow in order to identify factors that do not add value to picking. Talking to the operators and warehouse managers allowed us to understand the real situation and to separate it from the ideal one, so it was identified that the "new" and "standard" operators did not have enough knowledge about the location of the products due to lack of training and short permanence within the company. Therefore, the relationship between the operator's experience and the time required to locate the products is inversely proportional; that is, the longer the operator's permanence within the company, the less time is required to locate the products. This is reaffirmed in a sample prior to the pilot test, where the new operator takes 3,037 times longer to pick than the old operator, 303.7% more effective. Finally, in a way, this eliminates the need for the operators to consult with the warehouse managers to find the products; or, in other words, it reduces unproductive time.

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## Biographies

**Enrique Salvador Fernández Caballero,** Student of the Universidad de Lima in the tenth year of Industrial Engineering. He has solid knowledge in process management. He has great interest to develop in areas of leadership and operations management.

**Juan Diego Torres Calderón De Vettori,** Student of the Universidad de Lima in the tenth year of Industrial Engineering. He has solid knowledge in process management. He has great interest to develop in areas of leadership and operations management.

**Carlos Augusto Lizárraga Portugal,** Industrial Engineer from the University of Lima, Approved Title "Cum Laude". Master in Administration – ESAN; Doctor of Education, San Martín de Porres University. Post Degree in Auditing and Implementation of Integrated Management Systems (ISO9001 Quality, ISO 14001 Environment, OHSAS18001 Occupational Health and Safety, Social Responsibility). Business consultant specializing in Strategic Planning, Occupational Health and Safety Management Systems, Logistics Management, Purchasing Management, Strategic 344 Proceedings of the International Conference on Industrial Engineering and Operations Management Manila, Philippines, March 7-9, 2023 © IEOM Society International Inventory Control – Supply Chain Management, Warehouse Management, State Purchasing Process, Costs and Asset Management. the production. Experience in sectors such as clothing, plastics, industrial footwear, fishing, services, marketing, training, etc. Professor at the University of Lima in the Industrial Engineering career, teaching courses on Comprehensive Security, Maintenance Management, Business Diagnosis and Research Projects. Trainer and facilitator in Seminars on Strategic Planning, Business Organization, Production Management, Operations Management, Strategic

Inventory Control, Supply Chain Management, Industrial Safety and Comprehensive Safety Management. Thesis Advisor and Jury to opt for the Title of Industrial Engineer.