Operations Management Model Implementation Analysis

Logistics Outsourcing Distribution Center Case Study

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Abstract

Globalization has led to a considerable increase in logistics activities. As a consequence, business opportunities for logistics operators have increased due to their ability to monitor technology and achieving economies of scale. One of these logistics operators is company A, a Portuguese subsidiary of multinational B, one of the world's leaders in logistics. In this context, multinational B developed an Operations Management Model (OMM) related to Lean, to be implemented in their distribution centers (DC), with the goal of achieving competitive advantage. The objective of this paper consisted in the analysis of a first attempt to implement the model in a company's A DC and in the elaboration of a strategy for implementing the model. More so, other objectives were the estimation of the model operational impact, the beginning of the application of Lean tools to diagnose opportunities for improvement, the development of warehouse management solutions and the estimation of their impact. After the impact analysis, it was estimated a reduction of 54% in the number of operators with the implementation of the model. According to one of the solutions, the increase of the picking cases clustering capacity, it was estimated a reduction of 50% in the time of movement for pickers, which would represent an increase of 27.5% of time available for picking. With another solution, a new layout product slotting with Multicriteria ABC analysis, the set of five aisles with higher percentage of picking cases would represent 49.1%, while in the old layout product slotting the best combination represents 37%. With the new layout product slotting, it was also estimated a 9% increase in the occupancy rate of reserve locations, as well as a reduction of 18% of the total rack area.

Keywords: Operations Management Models, Logistics Outsourcing, Distribution Center, Lean, Multicriteria ABC analysis, Product Slotting

1. Introduction

Technological advances in information and communication, as well as the expansion of global financial flows as consequence of the deregulation of financial markets in the 1980s, have contributed to the reduction of production and transportation costs, giving the opportunity to create a global trade (Ndhlovu, 2012). In consequence, the increasing globalization of commodity flows, the relocation of production and the specialization of production markets have led to an increase in the distances traveled by goods, promoting the transport of large quantities of products to distribution centers (CD), which are essential to feed consumption markets (MOPTC, 2006). As a consequence, logistics gained more and more relevance and this trend allowed a significant increase in opportunities for logistics operators, which strive to implement new management models to ensure competitive advantage (Rousseau et al., 2012).

Company A, studied in this paper, is one the subsidiaries of the multinational B, which is one of the largest logistics companies in the world. As part of its global strategy, company B has the goal of implementing an OMM in all the DC of its subsidiaries, to achieve an operational performance improvement, by standardizing all the operational management. The model was created in Brazil three years ago and is based on *Lean* culture, which has the principle of maximizing value for the customer, continuously seeking to minimize waste (Womack et al., 1990). This ability to learn and use network tools is a source of competitive advantage for multinationals (Shi and Gregory, 1998). In addition, the OMM has four principles:

1. Organization that delivers
2. Performance Management
3. Job Standardization
4. Continuous Improvement

Currently, the model has been replicated in different countries, with some difficulties, like company's A example in Portugal. This company tried the implementation in one of its distribution centers, without success, and one of the purposes of this paper is to identify the main causes for this failure. In sequence, company A wants to have success in a future implementation process and does not intend to make the same mistakes, by having an adequate strategy. Besides, the company intends to have some estimation of the model's impact on the operational efficiency of the DC in study.

For this company, the OMM will be essential for logistics costs minimization and the reducing of processing time of an order, which is the value proposition to be presented by a logistics operations to its customers (Rousseau et al., 2012). In addition, company A is a result of the merger and acquisition of several companies, with different management processes and models, which has led to inefficiencies in operations, so the management model could become a solution for these identified differences.

Another purpose of this paper is to start the application of continuous improvement tools, which is a principle of the OMM, identifying opportunities for improvement and then develop solutions and estimate results. The goal is to demonstrate the potential of this culture, which is not in practice in the DC. In sequence, a key point for the successful implementation of Lean is to understand that it is not only the application of methodologies and tools, but also a dedication to the philosophical aspect implicit in this culture (Bhasin and Burcher, 2006). For this mindset transformation, it is being considered that will be essential to the DC employees know some consequences of *Lean* implementation.

2. Methods

As explained before this paper has two focus, the global OMM and the Continuous Improvement principle of the model. The methods for this two focus analysis are presented in figures 1, related to the model, and 2, related to the Continuous Improvement principle.

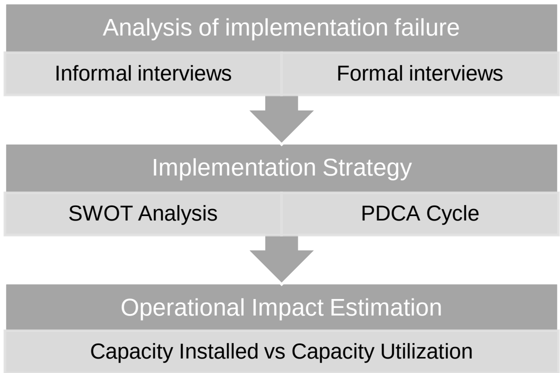

Figure 1 – Focus on global OMM.

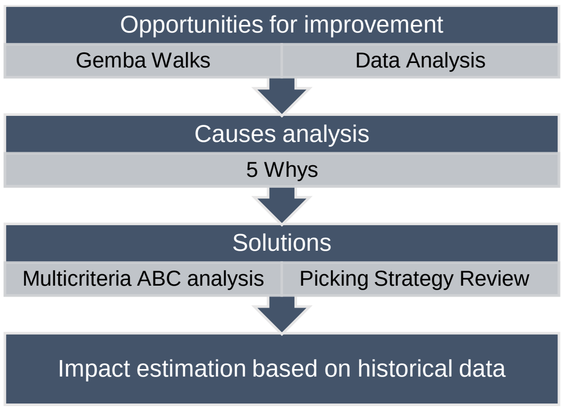

Figure 2 – Focus on Continuous Improvement.

Starting the explanation of the main concepts and tools presented in figures 1 and 2, SWOT analysis means Strengths, Weaknesses, Opportunities and Threats and is typically used to analyze the internal and external environment of an organization, allowing a better view before making strategic decisions (Phadermrod et al., 2016). In consequence, SWOT analysis was considered as the starting point for the development of an OMM implementation strategy. Another tool was the PDCA cycle, which means Plan, Do, Check, Act, which is a problem-oriented and process-oriented approach, defined in a circular form (figure 3). All the four elements are repeated cyclically until harmony is achieved (Singh and Singh, 2012).

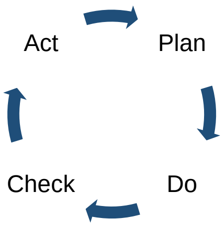

Figure 3 – PDCA Cycle.

The PDCA cycle was the selected tool for developing an OMM implementation strategy. Finally, for OMM impact estimation were considered two equations (2.1 and 2.2), which are part of the model and evaluate the operational efficiency performance.

$$\boldsymbol{Capacity\ Installed} = Direct\ hours\ target * Productivity\ target * \#\ Total\ direct\ labor \qquad (2.1)$$

$$\boldsymbol{Capacity\ Utilization} = Real\ direct\ hours * Real\ productivity * \#\ Real\ people\ available \quad (2.2)$$

The operational efficiency, according to the model, is evaluated by comparing equations 2.1 and 2.2. The target is to have the capacity installed with the same result of the capacity utilization and that will mean a 100% operational efficiency performance of resources utilization. The OMM support DC to leverage their performance to fulfill and maximize their potential consistently by reducing variation through standards setting, behavioral change and routine management based on three dimensions of the equations 2.1 and 2.2: People Availability, Productivity and Direct Hours.

Continuing the tools' explanation, according to Womack (2011), "Gemba" is the place where any organization creates value and the goal of going to "Gemba" is to realize how to make it a better place, by creating more value with less waste. For this, everyone must go and see, ask why and show respect. In sequence, another tool was 5 Whys, which is an interrogative technique to identify causes and effects of a problem. The goal is to ask five times "Why?" until achieving the root causes of a problem.

Regarding the solutions, it was considered a new layout product slotting by the utilization of the Multicriteria ABC analysis. This technique allows the selection of two independently criteria for product slotting and was developed by the authors Flores and Whybark (1985). Product slotting refers to the careful placement of individual cases within the warehouse (Bartholdi e Hackman, 2016) and it could allow a picking productivity and quality increase. Finally, picking strategies are related with picking operations and they define the way that a picker must follow to pick the cases. A good picking strategies must consider all the characteristics of the products and is a cost-effective way to maximize productivity in warehouse operations. Some of the most popular picking strategies are the following (Richards, 2014):

A. Picking to order: picker takes one order and following a route travels throughout the warehouse collecting items until the whole order is complete.

B. Batch picking: products are picked for a different number of orders and after are distributed by the different customers.

C. Cluster picking: clustering of orders to different compartments, to pick in the same warehouse route.

D. Zone picking: products are picked from defined areas in the warehouse and each picker is assigned to a specific zone.

3. Case Study

3.1. The Operations Management Model

The OMM consists of a management model focused on supporting DC to fulfill their maximum performance potential by translating company B objectives into specific actions at the shop floor level, defining the way that the company operates and distinguishing it from the competition. This model sets in place the right organizational structure, measures individual performance, identifies opportunities, standardizes the job and offers a training infrastructure that develops the required skills continuously, creating simplicity at operations by reducing high level concepts and increasing execution at the shop floor, translating opportunities into simple tasks. To achieve this, the model was structured like a PDCA cycle, with the four principles mentioned in the introduction corresponding to a PDCA step. The four principles are translated into twelve elements (figure 4) which build an operational management model; therefore, actions are connected to each other and the success depends on having the elements implemented altogether with discipline and routine management, which will provide the basic conditions for sustaining the long-term results. In conclusion, OMM is a systematic approach used to drive progress toward world-class performance and change behaviors within operations focused on performance management mindset.

Figure 4 - The OMM Principles and Elements.

3.2. The distribution center

Company's A first DC, where it was defined by company B to implement the OMM, is a retail distribution center, with company A as a logistic operator from inbound until outbound operations. This DC supplies 27 retail stores in Portugal with room temperature products and has two main operations: batch picking (figure 5) and picking to order (figure 6).

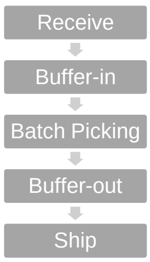

Figure 5: Batch picking flow.

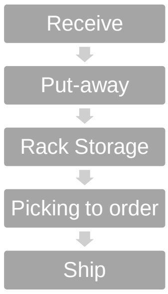

Figure 6 – Picking to order flow.

The layout of the DC has been changing year after year, according to retail market changes. Initially, there was only picking to order flow, but for some years now it became necessary to create a place to batch picking. In table 1 are resumed some of the DC's physical characteristics and in figure 7 is presented the DC's layout.

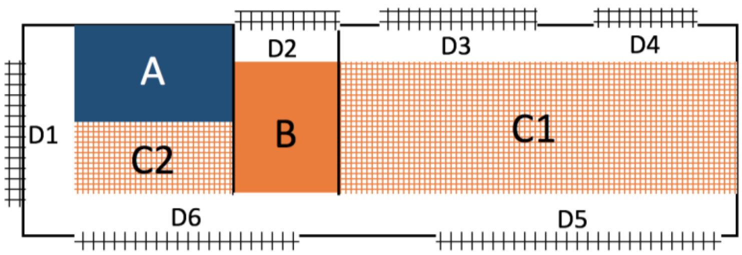

Figure 7 – DC's actual layout.

The letters' meaning in figure 7 is the following:

A – Batch picking zone
B – Block stacking zone
C1 and C2 – Aisles racks zones
D1, D2, D3, D4, D5 and D6 – Shipping bays

Table 1 - DC's physical characteristics.

Total area (m^2)	Batch picking area (m^2)	Total of aisles racks
9500	875	10
Height (m)	**Pallets capacity**	**Shipping Bays**
3	8550	18

According to Bartholdi and Hackman (2016), Warehouse activity profiling is the careful measurement and statistical analysis of warehouse activity, which is a necessary first step to almost any significant warehouse or DC project to understand the customer orders. In tables 2 and 3 is presented the activity profiling average per day in 2016, according to the two flows of the DC in study.

Table 2 – Batch picking flow activity profiling.

Orders	Lines	Lines per order	Cases Shipped	Cases per line
120	4122	27	8706	1,8

Table 3 – Picking to order flow activity profiling.

Orders	Lines	Lines per order	Cases Shipped	Cases per line
122	4073	29	9088	2

The activity profiling of the two flows are similar, but according to company A, the batch picking flow has increased since 2015 and the picking to order flow is decreasing since the same year. This is creating some space problems on the batch picking zone, which was projected to a different capacity from the actual reality.

3.3. Why the implementation failed?

One of the objectives of this paper is to know the causes of the OMM implementation failure in 2016. As mentioned before, to do this analysis a formal interview was conducted with company's A country manager and informal interviews during visits to the DC. According to these two methods, the following causes were detected:

- Technical limitations in performance tracking
- Weak leadership ability of team leaders
- Difficulties to understand the OMM's future impact
- Lack of knowledge about Lean
- Not implementation strategy was defined
- Lack of a culture of innovation and improvement

After analyzing, this causes were almost considered to the future implementation strategy. However, the technical limitations are being solved by the company and were not considered.

3.4 Opportunities for improvement

To identify opportunities for improvement Gemba Walks were scheduled for April and May of 2017. After the Gembas the following main opportunities were identified:

- Increase picking to order productivity
- Increase rack storage locations utilization (figure 8)

Figure 8 – DC's racks.

In order to confirm the conclusions from the Gembas some data analysis was done and the conclusion about picking to order productivity was that it is too low comparing to benchmarking. Relating to the storage locations, the utilization average in 2016 was 52% and according to Richards (2014) for a good productivity the average should be around 85%, which means the occupation rate of locations can be maximized. However, in October 2016 the storage utilization was 84%, which indicates a good storage efficiency and productivity only in this month.

To identify the causes for a low picking to order productivity it was defined the 5 Why tool and the main conclusions were the following:

- Layout product slotting by articles typology
- Low picking cases per route on average
- Waste of picking to order transport utilization, which has capacity for two pallets per route, but only one is in utilization
- Aisles length
- Standard work is not in practice

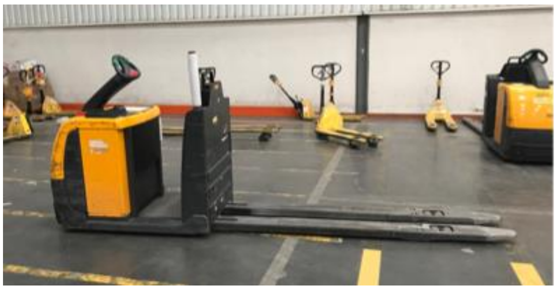

Figure 9 – Order picker transport.

About the causes for weak storage utilization was considered the DC customer characteristics. This customer is one of the largest retail companies in Portugal and before the Christmas season it has a picking to order flow peak related with the toys for Christmas gifts. That's why in October's 2016 the average storage utilization was 84% and as a consequence, during the rest of the year, the DC has an inefficient storage utilization.

4. Solutions

4.1. An implementing strategy

Before the definition of a strategy, it was done a SWOT analysis to a future OMM implementation (table 4), as starting point for the future PDCA cycle as strategy tool.

Table 4 – SWOT analysis

Strengths	**Weaknesses**
Company A committed to the OMM Support from a specialized team in OMM	Lack of knowledge about Lean Operational culture Demotivation to present suggestions for improvement Technical limitations in performance tracking Lack of skilled workers Lack of team spirit
Opportunities	**Threats**
Hiring of skilled labor Train employees	Customer requirements

With the conclusions from SWOT analysis, literature review, Gembas and interviews, the PDCA cycle steps for the implementation strategy are presented next. The previous steps were considered part of the PDCA cycle.

PLAN:

1. Diagnosis to global operational management;
2. OMM elements diagnosis in the actual DC state of art. Some of OMM elements could be in practice in the DC and the goal is to know how deep will be the elements implementation;
3. SWOT analysis;
4. Selection of a "Model Cell", which means that implementation should begin by a specific zone of the DC. This will allow the experimentation of the model in a more controlled way, maximizing the probability of success of the test to the implementation (Swank, 2003).
5. Identification of key persons;
6. Preparation of a training plan where should be included: team building, presentation of the results of this paper and a workshop about Lean tools and methodologies.

DO:

1. Training plan implementation;
2. Implementation of the OMM elements in the "Model Cell". The order should not be respect in a first a phase: the continuous improvement culture is not in practice, so starting by work instructions creation would not be a good idea. The suggestion is to respect all the elements order, less the elements 7,8, 10 and 11. They should be arranged in the following order: 11, 7, 8 and 10

CHECK:

1. Audit the OMM's elements implementation;
2. OMM's KPIs and equations 2.1 and 2.2 analysis.

ACT:

1. Review of previous steps;
2. Implementation strategy validation and replication by another operational zone.

4.2. Warehouse management solutions

According to the two opportunities for improvement identified, three main solutions were developed. Firstly, for picking to order productivity improvement, a new layout product slotting was defined to concentrate the number of pick cases in less aisles. The actual DC layout is defined by articles typology, which dispersed the picking cases and increases the travel time of a picker. In sequence, Multicriteria ABC analysis was selected as tool to a new layout product slotting and, in sequence, with this tool the products were classified according to two criteria to define popularity: shipping daily frequency and order volume. Besides, according to rules of hygiene, the food and non-food products must be picked separately, so the Mulcriteria ABC analysis was implemented in the two main products groups. In conclusion, the new layout is presented in figure 10.

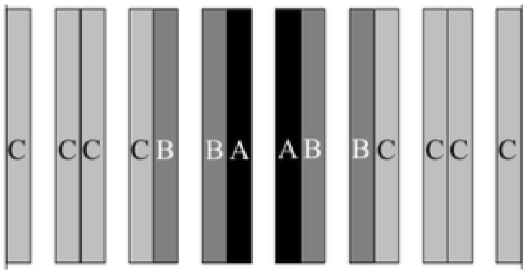

Figure 10- New layout product slotting.

According to this new layout, the most popular articles of each group should be storage in A aisles. The goal is to reduce the order picking travel area and, as consequence, increase production time (De Koster *et al.,* 2007).

Another solution to increase picker to order productivity is to increase the cases pick capacity per route. This is possible by starting to use the picker transport (figure 9) in it full capacity. The goal is to maximize the picking time and to minimize waste time, such as travel to shipping bays. This solution is not possible with actual Warehouse Management System (WMS), but in 2018 will be implemented another WMS which will allow this functionality.

Finally, to increase rack annual average utilization was defined to reduce the number of aisles. In consequence, two steps were identified as necessary:

1. Starting to use High Level Order Pickers (figure 11) to pick less popular articles, classified in the Mulcriteria ABC analysis, from storage rack levels;
2. Transfer the Christmas seasonal articles to another DC close to the DC in study. This new DC is owned by company A and has capacity to more volume. As mentioned before, the only reason that the actual number of racks is necessary, is to face the increase of volume caused by Christmas articles.

Figure 11 - High Level Order Picker.

5. Results and discussion

Starting the results estimation by the OMM impact, as mentioned before, were chosen equations 2.1 and 2.2. As a consequence, to implement this two equations were select two samples from 9th and 10th May 2017 picking to order resources, volume and productivity. Then, were compared the capacity utilization and capacity installed according to the reality of the mentioned days and to benchmarking productivity in OMM scenario. The conclusions were that, in the OMM scenario, in the first day it would be necessary less 57% of pickers and in the second day less 52% to pick the same cases volume that in samples. This analysis assumed that all pickers in OMM will produce 2500 cases per shift, without any deviation, which are the OMM targets. In the actual scenario, the productivity target per shift and per picker is 1200 cases and deviation of this target is +/- 600 cases.

Related to product slotting and picker to order productivity, in table 5 is present the difference between the actual layout and a new layout according to Mulcriteria ABC analysis product slotting. To present this difference it was selected a set of five aisles followed with more picking cases in the actual product slotting and in the ABC product slotting, in a sample day from 2016.

Table 5 – Comparing Product Slotting scenarios.

Actual product slotting		**ABC product slotting**	
Aisle	*% of Picking cases*	*Aisle*	*% of Picking cases*
R130	14%	**R105**	10,07%
R135	0,01%	**R110**	8,83%
R140	3,36%	**R115**	9,98%
R145	13,12%	**R120**	9,60%
R150	6,30%	**R125**	10,60%

As presented in table 5 the increase of availability picking cases per aisle is obvious: the set of five aisles followed with greater percentage of total picking cases represents 37% of the total in the actual layout, while in the new layout product slotting there is a set of five aisles that represent 49.1% of total picking cases.

According to presented solutions to increase the efficiency of reserves racks occupation, which means transfer of seasonal Christmas articles to another DC and utilization of reserve locations to height picking cases, was estimated, based on historical data between January and August 2016, a maximum occupation rate of reserve racks locations of 76%. In sequence, the estimated average of reserve racks locations occupation would be 63%, which means an increase in the efficiency of locations utilization of 9%, compared to the current scenario of 52%. The reduction of the rack storage area was estimated at around 18%, from representing 40% of the total area of the DC, to represent 33%. This reduction could be a great opportunity to increase batch picking area.

About another solution, according to Bartholdi and Hackman (2016), order-picking typically accounts for about 55% of warehouse operating costs; and order-picking activity distribution time is estimated like represented in table 6, column two.

Table 6 – Picker activity distribution time.

Activity	One pallet per route	Two pallets per route
Travelling	55%	27,5%
Searching	15%	15%
Extracting	10%	10%
Other activities	20%	20%
Total	100%	72,5%

Notice that traveling comprises the greatest part of the expense of order-picking, which is itself the most expensive part of warehouse operating expenses (Bartholdi and Hackman, 2016). To estimate the impact of two pallets per picking route, which will increase to double the picking capacity, it was consider the analyses from table 6. Then, considering that with the new scenario picker will reduce by half the travels to shipping bays, the available picking time per shift will increase 27,5%.

After the results estimation, a critical analysis of limitations to the work performed is carried out. Therefore, relating to the OMM it is considered that the greatest limitation identified was the estimation of the impact of the model. The OMM presents some subjective elements, whose impact could vary from operation to operation. In this sense, the estimation through the analysis of the installed capacity and capacity utilization does not represent all the benefits that the model can bring, besides it had been realized based on a target of realistic productivity according to benchmarking and not to the DC reality.

Regarding the suggested solutions, about the Multicriteria ABC analysis, it is considered that the great limitation was the non-consideration of the characteristics of the articles. For a good quality service, it is important that the articles route sequence respects some rules, like articles weight.

In sequence, a detailed analysis of the financial costs of transferring part of the operation to another DC between September and December was not done and that will be essential to a future decision.

In addition, the impact of height picking was not defined to analyze if it would compensate the productivity increase with the concentration of more picking cases per area. Besides, the increased congestion of aisles due to the greater concentration of picking cases in each aisle could affect productivity.

6. Conclusion

The present paper consists in the elaboration of an analysis to the implementation of a management model (OMM) in a retail CD in logistic outsourcing to an operator (company A). This analysis was based on a first failed attempt to implement the OMM on the selected CD and two paths were defined: firstly, the global OMM, by analyzing the causes for failure of the previous implementation, defining a strategy for future implementation and estimating the impact of the model. Secondly, the principle of continuous improvement of the model was considered, by identifying opportunities for improvement with Lean tools, developing solutions from warehouse management and estimating the impact of these solutions.

As a consequence, the main causes for the failure of the first attempt to implement the OMM were identified as difficulties for performance tracking, leadership capacity, difficulties to understand OMM's impact, lack of knowledge about Lean, lack of a culture for innovation and improvement and a clear implementation strategy. As a strategy using a PDCA cycle, after a literature review, a SWOT analysis and a diagnosis to the operational management, the focus was on training the team, as it was identified that the main change required for the OMM's success will be in the mindset. In addition, it was concluded that at an early stage it would be too complex to achieve implementation in the entire DC, and it was suggested the selection of a specific operational zone. In order to estimate OMM impact, a two-day sample was analyzed for picking to order resources, and was estimated an average reduction of 54% of pickers per day, due to the increase in production efficiency related to OMM elements.

In relation to opportunities for improvement, there were two identified, the inefficiency in the utilization of racks reserve locations and the reduced picking to order productivity. To improve these situations, a solution was developed: multicriteria ABC analysis. With this solution, the articles of the picking to order flow were analyzed by daily frequency and volume of shipment and were identifying the less popular for height picking, to increase the use of reserve locations. In sequence, a new layout product slotting and a reduction of the rack's number were done, to concentrate the most popular articles in a smaller area, contributing to the increase of picking to order productivity. As a consequence of the increase of availability cases for picking per aisle, it was identified that the set of five aisles followed with the greater percentage of the total cases represents 37% of the total in the previous layout, while in the new layout product slotting there is a set of five aisles that represent 49.1% of the total picking cases.

In continuation, with the definition of the new layout and number of locations, a 9% increase in the utilization rate of reserve locations between January and September was estimated, as well as a reduction of 40% to 33% of the total rack area on the DC.

In addition to the previous solution, to increase the productivity of the picking to order, a change in the picking strategy was developed, by increasing the capacity of cases transport in each route, passing the picker to take advantage of the equipment transport that has capacity for two pallets. Therefore, instead of a pallet being used as a cluster, it will use two, with will reducing times that do not add value to the picking process. In consequence, with this change in the picking strategy it was estimated a reduction of 50% in the actual movement time, which represents a gain of 27.5% of the time available for picking.

As future work, it is suggested to address the limitations identified in results discussion, especially the financial analysis to the transfer of part of the operation at Christmas season to another DC, achieving the return of the products at room temperature for the DC or the layout's improvement. In addition, it is suggested that an analysis be made of the allocation of more than one picking location at ground level to articles that are identified with the best work-efficiency relation (Bartholdi and Hackman, 2016), to reduce the frequency of repositions to picking location and decrease congestion in the aisles. Finally, the analysis of the relationship between the logistics operator and the customer will be relevant as a case study, mainly due to the advantages and disadvantages of outsourcing only the internal logistics and not the entire supply chain. Another pertinent study would be the analysis of the limitations that the operator faces related to customer requirements.

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