Automation of Storage and Distribution Terminals: The Case of Logistics Operators

Jania Saucedo Martinez[1], Carlos Regalao Noriega[2(✉)], and Luis Ortiz Ospino[2]

[1] Facultad de Ingenieria Mecanica y Electrica, Universidad Autonoma de Nuevo Leon, Ciudad Universitaria, San Nicolas de los Garza, Nuevo Leon, Mexico
jania.saucedomrt@uanl.edu.mx
[2] Facultad de Ingenierias, Universidad Simon Bolivar, Barranquilla, Atlantico, Colombia
{crega-lao,lortiz27}@unisimonbolivar.edu.co

Abstract. Thinking about the logistics of an organization means grouping together all the processes of loading, routing, and distribution of the finished product to the end customer. The project proposes to study the automation of storage and distribution terminals: The case of the logistic operators of the department of Atlantico for the improvement of the decision making in the distribution activities in relation to the logistic operators of the department of Atlantico - Colombia for the improvement of the business effectiveness. Therefore, in the present investigation, a research is made, which uses a defined methodology and which leads to observe some results and conclusions framed in the categories: Intralogistics, Automation, Technologies 4.0, Business efficiency, which seeks to validate through the statistical application the importance of these as a resource to the insufficiencies that are represented in the environment of the logistics operators of the Department of Atlantico.

Keywords: Intralogistics · Automation · Technologies 4.0 · Business efficiency

1 Introduction

Humanity, as recorded in our history, has needed products in its living, which are generally not accessible, nor are they found or produced in the place of origin or in the place you want to consume. Foods and other essential products of coexistence are widely dispersed and only accessible in abundance at specific times and places. The ancient civilizations managed to consume only the most immediate food to their environment, for the time still did not have transportation and methods of In the case of modern storage, the movement of food or goods was limited to the capacity that a group of people could mobilize personally, and therefore, the storage of perishable food was only available for a short period time, forcing individuals to settle close to the sources of production in order to use the food and goods that could be produced in the environment or granted by nature. One can still see striking models of developing nations in Asia, South America, Australia, and Africa, where a group of their inhabitants lives in small, self-sufficient

J. A. Marmolejo-Saucedo et al. (Eds.): COMPSE 2020, LNICST 359, pp. 99–114, 2021.
https://doi.org/10.1007/978-3-030-69839-3_7

villages, where a large proportion of the goods needed by the people are produced or purchased in the immediate vicinity. By the above, it is evident that logistics is vital for the daily development of an individual or a community, which is why companies today are exploring various options in the area of logistics and supply chain management as a representation of a context of multiple concepts, rules, and theories, from the most conservative disciplines of marketing, production, accounting, purchasing, and transportation, to the areas of applied mathematics, organizational behavior, and economics, to provide solutions to the consumption needs of human beings on a global scale, according to modern paradigms.

Therefore, the logistic activities that take place inside the cities are of great importance for the economic and social growth of the communities, in particular, the Logistics Operators and their supply chain. For the specific case of the Colombian Caribbean region, specifically in the Department of Atlantico and in its capital city, Barranquilla, which is the object of this research project, where organizations respond to the continuous operation of the different economic and industrialized movements. Therefore, adopting the definition of the supply chain as: "The Supply Chain, or simply Supply Chain, is a chain of suppliers, factories, warehouses, distribution centers, and retailers through which raw materials are acquired, transformed and sent to the customer" [1]. The intralogistics processes of logistics operators account for almost 30% of the logistics costs of organizations in Colombia, which, according to the Colombian National Planning Department, represent approximately 15% of an organization's sales [2]. In Colombia, the intervention in logistics and especially the area of intralogistics continues in debt, and those modest processes within the organization, but of great organizational relevance increase the costs of all the products that must be transported on the domestic market [3]. Following Crespo [4] "The logistical cost in the country is several percentage points from the evidence of other nations in America and Europe. This shows that in comparison with the USA it represents only 8,7% of the sales achieved, in Europe, it increases to 11,9% and in Latin America, the estimate is around 14,7%".

Among the elements, the costs, in the intralogistics is a preponderant factor in all the economies of the world. In Colombia, we do not have the data on how much represents this value over the total of the logistic distribution and the supply chain, but for example for Brazil, it constitutes on average 28% of the costs, that is to say, that a good part of the value of a product towards the final consumer [5]. Therefore, in order to find tools that tend to improve decision-making that impact the indicators and in turn, the factors that determine the index of organizational efficiency in logistics operators. These requirements are delimited by three main scenarios: The First Scenario called Operational: The objective of this one focuses on the improvement of the processes in the intralogistic activities regarding the loading and unloading of the warehouse, emphasizing the point of view of the suppliers, to influence the synergy that must be developed as a pillar of the logistic operators and the performance of their human capital in the role of adaptation or non-adaptation of the new technologies in the framework of the industry 4.0. The second scenario described as Structural: It is defined as a valuable component for the execution of the activities of the logistics operators from the evaluation of the objectivity of the organization, according to the use of spaces for the intralogistic processes of raw materials and finished products. The third scenario is the Results: Which develops the items in

the decision making process for the improvement of the organizational efficiency using the same based on the implementation of a simulation model via optimization, meeting the demands of the internal and external client of the logistics operators under study in this project. From the above, the problems presented by the organizations within their intralogistics processes are determined, defined in the aspects the non-existent value chain, unmanaged storage, low technological investment, lack of human talent, and the lack of cost vs. Income structure, which derives from aspects such as high costs in urban centers, increased lab our costs, low productivity, the non-adoption of new technologies and organizational efficiency rates below the region's standard, as shown in Fig. 1.

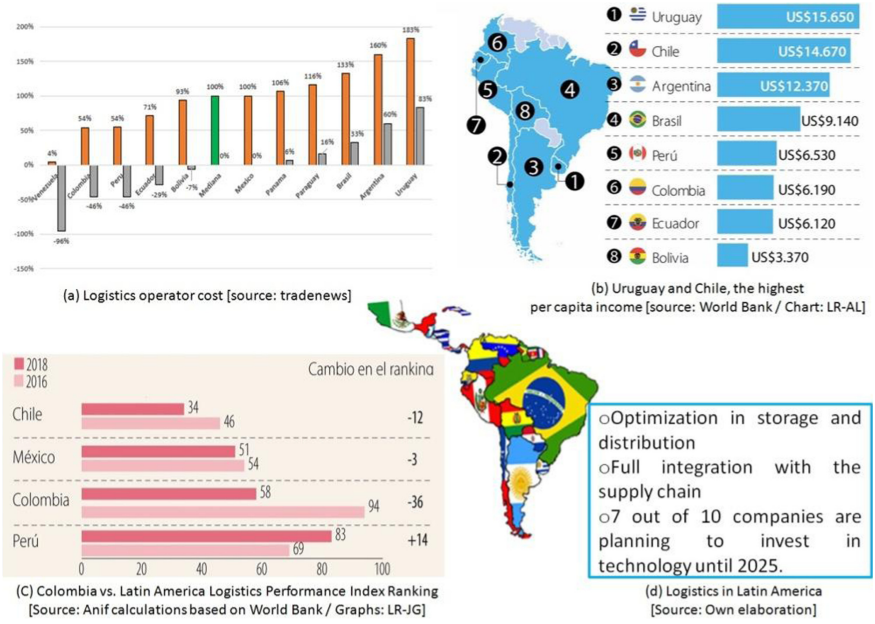

Fig. 1. Trend and state of logistics in Colombia, 2018

1.1 Needs of Logistics Operators in the Caribbean Region

According to the proposed problem, the objective of this research is focused on: Improve the organizational efficiency index by implementing 4.0 technologies using simulation as a tool for decision making in the intralogistics processes of the Logistics Operators of the Atlantico department. As key points of this investigation, we will be looking to meet the following specific aspects: i) Performing a diagnosis of intralogistics processes and 4.0 technologies in the logistics operators of the Department of Atlantico. ii) Design the simulation model where the scenarios for the decision making on whether to implement industry 4.0 technologies in the intralogistic processes of logistics operators. iii) Evidencing by means of statistics the relevance of the object of study of the present project as a reference framework in the implementation of 4.0 technologies in

intralogistic processes. iv) To evaluate the scenarios proposed for the improvement of intralogistic processes and the significant improvement of the organizational efficiency of the population studied.

This article establishes the premise that such a scenario assessment will provide greater certainty in decision-making for the implementation of 4.0 technologies in a general comparative framework of the organization's needs and will open the door to a global approach that contemplates the development, implementation and research in other industry sectors in their intralogistic processes. It is possible to measure the organizational efficiency indexes in the factors that impact the decision making, by means of the implementation of simulation in intralogistic processes of the logistic operators of the department of Atlantico. The prospect of growth in the logistics sector generates the need to include new technologies, which understand and address the challenges of achieving permanence in the market through the application of continuous improvement of efficiency organizational, from the vision of the dynamics and international standards, main aspects that frame an intelligent decision making [6].

1.2 The Logistics Sector and the Chain of Supply

A great number of authors emphasize the beginning of logistics to the military development Philippe-Pierre [7], Jordi [8], Roux [9], Ballou [10], Carranza [11]. This is primarily because the term logistics took on its current meaning from the appearance of the first theories on military logistics at the end of the First World War and obtained its maximum expression in the so-called most complex and best planned logistical operation of that time: the invasion of Europe during the Second World War [10]. However, the interaction of logistics with the military is not new; towards the last third of the fourth century, it contemplates in one of its parts a treaty on logistics in this military development. Although, history shows other great moments of non-military examples in logistic techniques such as the construction of the Pyramids of Egypt [12], which demystify its exclusive origin in the militia and place logistics as a discipline that is born the with man himself and his social origin [13].

Then, in the business field, the concept dates back to 1844 by of the French engineer Jules Dupuit who supported the idea of exchanging (Trade-off) a cost for other (transportation costs for storage costs) and the selection between land and water transport based on cost criteria [10]. The first documents dedicated to business logistics appeared in 1961 [14]. They define the benefits of organized logistics management. At the same time, Drucker [15], emphasized the concept of logistics as one of the last frontiers with real possibilities to improve business efficiency and described it as "the dark continent of the economy" [12]. The National Council of Physical Distribution Management (NCPDM), created in 1963, officially defined the concept of logistics as follows "A set of activities that are responsible for the efficient movement of finished products from the end of the production line to the consumer and that, in some cases, includes the movement of raw materials from the source to the line" [16]. Thus, even in these times, the definition of logistics was limited only to the activity of physical distribution. However, throughout the 1970s, special attention began to be paid to purchasing and handling of inputs at the beginning of the production chain. Consequently, the MRP (Materials Resource Planning) model was born as a solution to the problem of minimizing costs

and providing some flexibility to the company, because the management and supply of inputs had been developed under the subordination to the function of the production process [17]. However, the management of the supply chain, in synthesis is defined as the planning, organization and control of the activities of the supply chain; defined in a wider way by the CSCMP: "The strategic and systematic combination in the competences of the traditional business and the tactics used inside the different companies of a supply chain, to improve the long term performance of the organizations individually as well as in the whole supply chain".

1.3 The Simulation in the Intralogistic Processes and Its Relation in the Industry 4.0

The continuous changes and advances in logistics and production systems make improvements and decision making necessary. Simulation is a good support tool for this type of action. Based on "what if" analysis, simulation allows us to reproduce processes and study their behavior, to analyze the impact of possible changes, or to compare different design alternatives without the high cost of full-scale experiments. Three basic components in the decision process that must be determined to formulate a simulation model, which are: i) The decision variables, ii) Problem constraints and, iii) Determine the objective function to be optimized.

Usually, the word simulation is related to computer tools such as video games or virtual reality, and in the case of the Air Force, to the word "war games" or "flight simulator". But in the design and optimization of logistics processes, simulation is defined as the process by which constructs, executes, and analyzes a process or case, following the variables and restrictions of real life. However, many models, due to their complexity, require time to design and execute them: also, the model validation process is usually complex as the system becomes more complex. The achievement of organizational efficiency must be referred to the corresponding business plan, which sets out the vision, mission, objectives, and corporate strategies based on a situational diagnosis. The use of management factors and indicators become the vital signs of the organization and are defined as useful tools in the procedure of making a decision, primarily when there are accurate data and enough time available to make the respective analysis. At its most basic level, analysis implies, fundamentally, looking for relationships between organized data, which can lead to: i) Identify correlations and cause-effect relationships between indicators, ii) Determining trends and building projections for an indicator and, iii) Carry out comparisons for the performance of an indicator.

Taking into account the above, it is necessary to establish evaluation methods that allow the capture of both quantitative and qualitative information [18], defines: "Logistics Performance Indicators as measures of quantifiable performance applied to logistics management that allow to evaluating the performance and the result in each process of reception, storage, inventories, dispatch, distribution, delivery, invoicing and information flow between the parts of the logistic chain. It is essential that every company develops skills around the management of logistics management indicators, to be able to use the resulting information on time manner".

1.4 Importance of Improving Business Efficiency

The organizations that are making their way into the third decade of the 21st century are self-directed in achieving and evidencing a higher performance in their processes, by controlling the negative impact that today generates the intralogistics within the supply chain and the adoption of technologies of the industry 4.0, which allows us to observe that organizations are in the development of adapting and structuring their processes to international requirements and standards. The collaborative integration of the supply chain is based on establishing multiple planning activities and defines the various information changes. Colombia, its departments and cities suffer from this scourge in intralogistics, especially the Caribbean Region which observe a significant impact on the levels of productivity and competitiveness concerning to other regions of the country and Latin America; the current administration of President Ivan Duque framed in the National Development Plan 2018–2022. The Future Belongs to All and the strategic work of the Department of Atlantico of Governor Elsa Noguera Atlantico is the people, added to the district strategic plans of the mayors of the cities of the department, include an item especially and of rigorous compliance for logistical. Studies conducted worldwide, according to Both of [19], determine that logistics costs as a percentage of GDP in Latin American and Caribbean countries are set to be between 50% and 100% higher than in the member countries of the Organization for Economic Cooperation and Development (OECD). In Colombia in particular, the lack of progress in road infrastructure has led to less efficient land-based freight transport, problems with port capacity and competition, and a small increase in other internal modes of transport such as rail (used only for coal transport) or river transport, which also harms on logistics operators. Likewise, The BDI [20], states that the sector of logistics operators presents a great opportunity for small businesses, considering that logistics management is part of the most strategic processes of organizations, where the costs that this generates represent 19% of the Gross Domestic Product (GDP) in Latin American countries like Colombia, justified mainly by the complexity of the customs processes among other factors. State, business and academia agree that technologies of industry 4.0 will play a decisive role in the efficiency levels at superlative degrees causing all organizations to establish a synopsis of continuous improvement, high productivity and competitiveness in their activities [20]. The growing business innovation in technological aspects emanating from industry 4.0 that we are experiencing today indicates that the organizations that adapt to these demands will be prepared to know, develop and apply the solutions that provide this technological boom, where simulation via optimization will be highly linked to decision-making in the operations and activities of the organizations, especially to the intralogistic aspects of the logistics operators. Accordingly, the Private Competitiveness Council (CPC) agreed with the World Bank's Logistics Performance Index for the period 2018–2019. In 2018 Colombia obtained the highest rating in its history in the logistics performance index, where it advanced 36 positions compared to 2016 (it went from 94th to 58th place) and today it is fifth in Latin America [21], as shown in Fig. 2. However, there are still challenges in: efficiency and effectiveness of customs, quality of infrastructure, competition and quality of logistics services [20]. Freight transport in the country concentrated in road mode, of the 2400 registered transport companies, around 2000 are informal and only 25% of drivers are formalized [20].

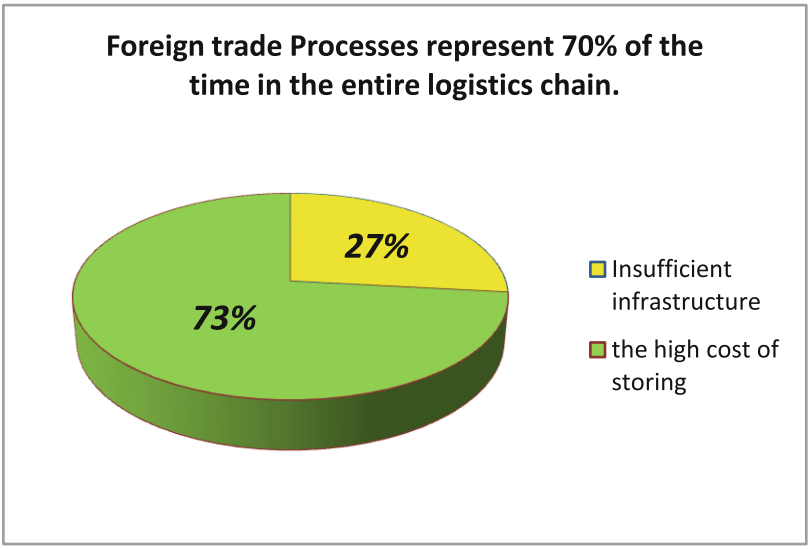

Fig. 2. Logistics Performance Index. Colombia and reference countries, 2018.

The result of the Logistics Performance Index Fig. 2 of the World Bank is ratified by the DNP national logistics survey, in which users of the in addition to insufficient infrastructure, logistics bottlenecks are caused by the high cost of storing, loading and unloading goods, inefficient information systems, inefficient procedures, lack of areas for loading and unloading goods, and a shortage of human capital and logistics areas, among other factors. The country, then, is not unaware of the existence of a higher level of competitiveness in the field. Therefore, one of the major advances the country's most important event was the preparation of the CONPES document [27], called the National Logistics Plan, which was approved in 2018 and established the policy guidelines, infrastructure needs and inclusion of 4.0 technologies, and financing for the development of actions to increase competitiveness through the adoption of better logistics practices. The development plan Atlantic Departmental Territorial Development Vision 2020: The route for development (2025) lays down the guidelines in which it should focus its efforts on the growth of competitiveness and economic strengthening. In the same way, the development plan of the current district administrations is articulated to the same guidelines [22]. Table 1 shows the current level of penetration of ICT applied to the logistics industry and in particular its availability in the country's logistics operators.

Table 1. ICTs in the logistics operators of the Department of Atlantico

ICTs in logistics operators	Available	Not available
Optimization, planning and control of transport	57%	43%
Distribution Center Management (WMS)	28%	72%
Distribution Management System (DMS)	28%	72%
Business Transaction Management/Orders	28%	72%
Integrated WMS TMS	15%	85%
Demand management and planning software	24%	76%
ERP Interfaces	33%	67%
Fleet Management Software	45%	55%
Barcode system	24%	76%
Radiofrequency System	15%	85%
System for Invoicing/Auditor's	49%	51%
Real-time tracking and tracing system	73%	27%
Internet access for the client	63%	37%
Electronic Data Interchange System (EDI)	24%	76%
Picking Optimization System	15%	85%

The results show a degree of use of ICTs that is not very high since according to the trends of the sector at an international level it would be desirable to have penetration levels above 80%, however, none of the categories of ICTs analyzed reach that level of availability. In this way, it can be seen that although Colombia has made progress in modernizing the provision of logistics operations services, especially in activities linked to intralogistics processes, where there are still lags in terms of infrastructure, and performance indicators.

2 Methodology

The project method is part of the Operations Management research line regarding the study of the thematic axis of supply chains from the perspective of intralogistics operations. From a process of direct observation and analysis to determine the factors that influence decision-making according to the scenarios in the implementation or not of 4.0 technologies in the case of logistics operators in the department of Atlantico. From the above, a three-phase research process is proposed:

i) It begins with a general characterization of the companies studied taking as a reference to analysis of the vertical and horizontal integration systems within the framework of industry 4.0. This is a photograph of the current reality that is presented in the logistics operators according to the factors under study.

ii) Next, using the computer package and the use of the statistical tool, the possible scenarios are established for the factors under study in this project.
iii) It continues with establishing quantitatively which are the factors that allow the evaluation of the scenarios and the impact of implementing or not the technologies of Industry 4.0 and which significantly impact intralogistics processes in the search for improvement in organizational efficiency, through simulation via optimization evaluated in the computational tool.

2.1 General Characterization of the Company

This section consists of evaluating the entire system of operations of the logistic operators, for which the procedure defined by Perez [23] was used, in which three considerations stand out in the characterization process: integration On vertical, horizontal and, as the last point, the use of Industry 4.0 technologies, Table 2 describes them.

Table 2. Mapping the organizational structure

Consideration	Description
Vertical integration	It is based on the socio-technical system and the value creation modules
Horizontal integration	It is based on operations management requirements
Technologies 4.0	It contains the tools studied in the literature analysis

The mapping delimited in Table 2 allows us to know the organization in general, that is, it shows the outstanding elements and activities, deficient situations and critical points of the process, consequently the ordered form of the instrument used to characterize the logistic operators as a function of its vertical and horizontal integration systems within the framework of Industry 4.0 technologies. From the above, we can see in Fig. 3 the diagnostic result of the vertical and horizontal integration systems within the framework of the technologies of Industry 4.0, of the company which is the object of this research, which allows us to deduce the degree of absorption which is presented in the intralogistic activities of the logistics operators and to delimit the roadmap towards the continuous improvement of the indicators of organizational efficiency.

However, in the characteristics of horizontal integration, more work needs to be done. In this case, the diagnosis shows that the external perception shows 59% adaptability and the internal vision only reaches 53%, which generates interesting opportunities.

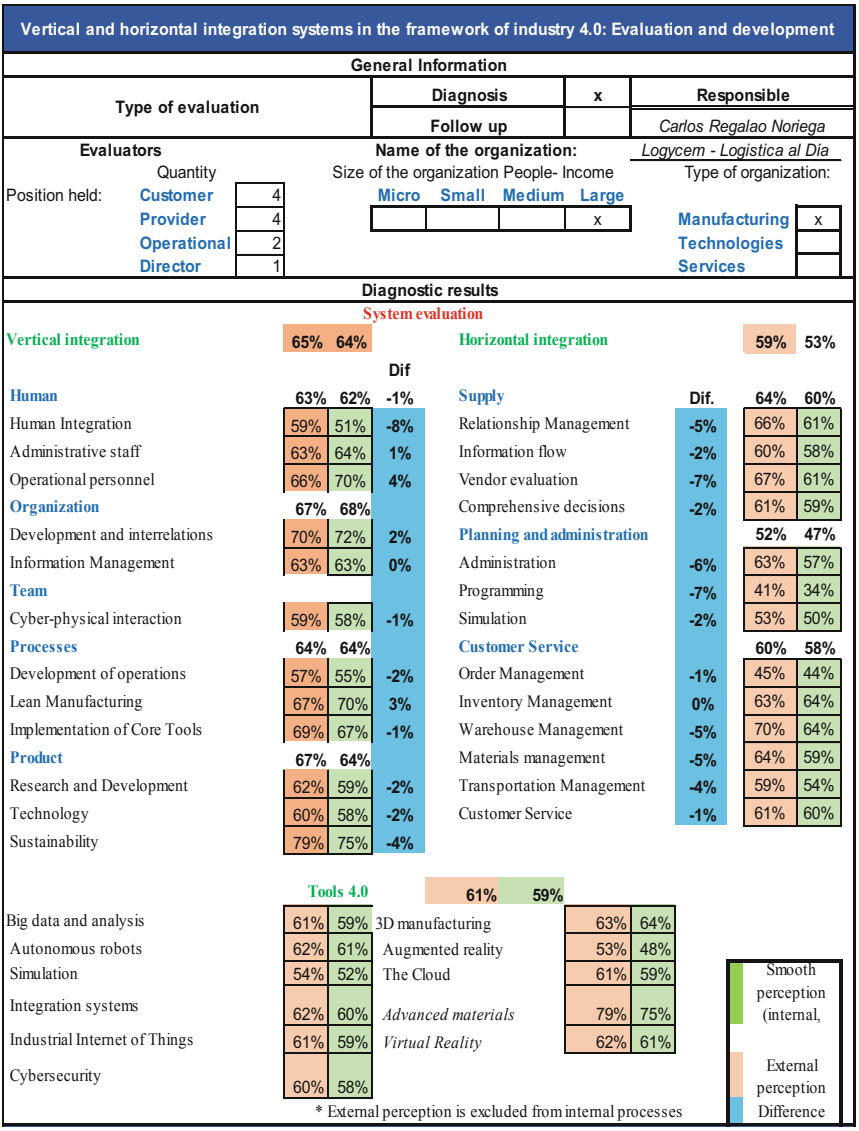

Fig. 3. Vertical and horizontal integration systems in the framework of industry 4.0: Evaluation and development

2.2 Scenarios Understudy

There are different ways to approach the future, to foresee the needs of an organization and to strive for its continuous improvement; In the case of the present study, the methodological aim is to build scenarios through the implementation of simulation as a tool that allows analyzing the impact on the inclusion of the technologies of Industry

4.0 and defining implementation proposals for the analysis of the different options for solutions to the problem studied. To see Fig. 4.

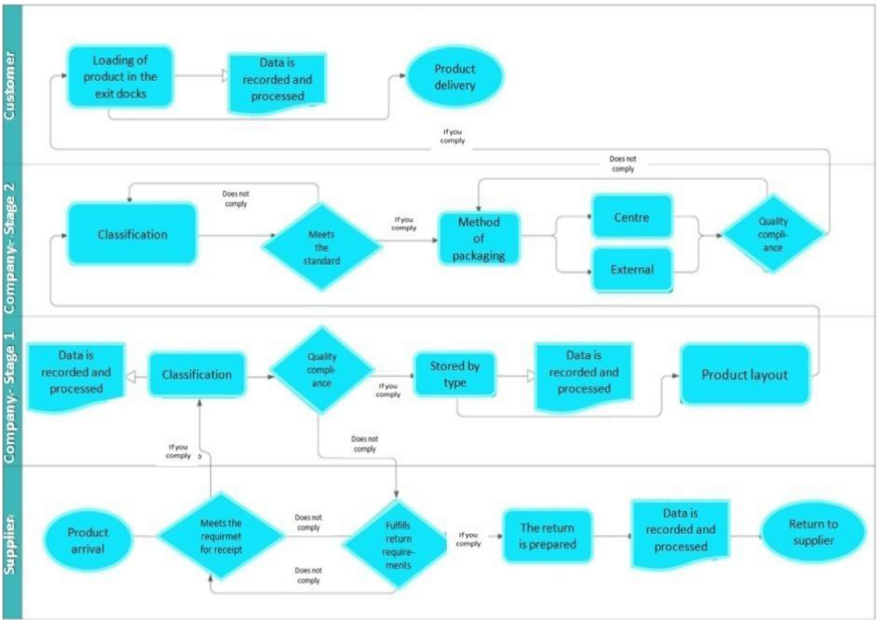

Fig. 4. Current scenario of the company understudy

In a warehouse, the main objective of the improvement is focused on the optimization of space and on providing means of handling loads normally at high heights and with medium volumes of work. While in a Distribution Center the optimization focuses on a rapid flow of materials and the optimization of labor, especially in Picking tasks.

Table 3. Optimization characteristics in the study setting

	Warehouse	Distribution center
Principal function	Storage management and inventory layout	Flow management products
"Cost driver" Principal	Space and facilities	Transport, Hand working
Order cycle	Months, weeks	Days, hours
Activities of value-added	Punctual, in rotation cyclical	They are an intrinsic part of process
Expeditions	On customer demand and Vendors	According to orders
Rotation of inventory	3, 6, 9, 12	12, 24, 48, 96, 120

The above is visualized and studied in the present scenario, where concepts of plant distribution, process optimization and reorganization of functions are involved to solve the problem. Thus, as Jung [24] put it, "the new world scenario of globalization has made organizations transform, adapt and play new roles". Therefore, governments and international organizations have proposed to generate strategies to counteract negative impacts, such as the Millennium Project, [25].

3 Analysis of the Results Obtained

In this section, the results of the applied instrument are presented and, based on that, the solutions according to the simulation model via optimization to the logistic operators of the present project, emphasizing the reference organization study. The application style to obtain the results studied in this section is directed at the methodology developed in the previous section, in which a criterion of fixation proportional. However, compliance with statistical assumptions in the analyzes is vital for the usefulness of the study's inferences. In the first subsection, an overview is established of how the logistic operator chosen as the object of study is found above the components evaluated in the research instruments, the results are considered in the following sections:

i) Instrument: The instrument used in this research work is an adaptation of the instrument developed in the investigation of vertical and horizontal integration systems within the framework of Industry 4.0: Evaluation and development [23]:, where it is exposed all of the items included for obtaining information in specific areas related to vertical and horizontal integration systems, as well as the development and use of technology. It is the level at which an instrument produces consistent and coherent results [26]. Cronbach's alpha has been used in the research to measure internal consistency, locating the results from variances or through correlations between reagents, in this case, the following formula is used

$$\propto = \left[\frac{k}{k-1}\right]\left[1 - \sum_{i=1}^{k} \frac{S_i^2}{S_t^2}\right] \quad (1)$$

Where: k is the number of reagents.
Reliability testing is carried out through the supply of measurement instruments, to prove their effectiveness in the logistics operators' sector. To this end, an evaluation was carried out in which various organizations were included A total of 44 agents took part in a critical review of which the organization under study was selected as adopting the main characteristics and adaptable to other organizations in the sector. This test was carried out by mean of cronbach alpha resulting in $\alpha = 0.98$; It can be stated that the structure of the measuring instrument based on the reliability criterion is in the range of excellent.

ii) Scenarios: Scenarios are defined as the events that can occur or dissipate in the possibility of applying or not applying the simulation model by means of optimization, the Flexsim software is applied as a simulation tool and develops the problem situation studied with its distinctive results which can be seen in Table 4, determined in the result of the analysis of the vertical and horizontal integration systems.

Table 4. Table of analysis of the projected scenarios

Factors	Indicators	Scenarios		
		Current	Different distribution or layout	Technology 4.0
Information management	Volume of purchases	32.12%	30.59%	34.55%
	Inventory time	28.56%	36.45%	50.61%
Strategic planning	Perfect delivery received	36.54%	30.29%	44.37%
	Inventory time	28.78%	50.18%	58.85%
	Types of transport	22.54%	82.62%	59.93%
	Punctuality of the offices	30.23%	42.51%	73.17%
Subcontracting	Perfect delivery received	8.71%	14.63%	44.77%
Business model	Certificate of suppliers	54.38%	74.48%	84.49%
Logistic barriers	Quality of infrastructure	64.81%	80.07%	90.45%
Cost	Order quality	70.23%	58.15%	68.38%
	Perfect delivery received	36.19%	30.74%	44.02%
	Inventory time	28.70%	36.52%	38.27%
Risk	Volume of purchases	22.76%	38.38%	28.68%
	Efficiency in the offices customs officers	82.94%	86.17%	84.48%
Distribution strategy	Types of transport	8.67%	6.05%	11.33%
	Punctuality of the offices	40.42%	30.72%	44.57%

i) Supplier aspect: This item defines the capabilities, relationship, communication and integration that the company under study has with organizations that provide you with the inputs for your operation.

ii) Organization aspect: It defines the aspects inherent to intralogistics within the company, synthesizes the object of study of this research project; it is defined as the item that contains the aspects of improvement in and adaptation of the different scenarios that can be designed.

iii) Customer aspect: It develops the dependent and independent variables according to the requirements of the product and the needs of the client; it allows the measurement of the organizational efficiency indicator and the parameters for it.
iv) Evaluation: It consists of the results of the tests of objectivity, validation and reliability of the simulation model. Table 4, presents the comparison of results between the Factors in accordance with the indicators that interact and how these vary according to the scenario in which they are used, with which we can determine that the inclusion of technologies of the industry 4.0.
The previous table shows the results obtained by simulating the established scenarios using the Flexsim tool and parameterized in the statistical and control assumptions in accordance with the results derived from the instrument applied in this research and the aspects developed with the applied diagnosis of the vertical and horizontal integration systems in the framework of industry 4.0.
v) Research Analysis: Shows the analysis of the organization object of study of the logistics operators of the department of the Atlantic pertaining to the results of the diagnosis, the analysis of the model of simulation and recommendations for its evolution to industry 4.0 technologies. It was also defined that the analysis factors are those identified as Information Management, Business Model and Logistic Barriers, the latter being the which benefits most from the adoption of 4.0 technologies in the intralogistics activities of logistics operators, and which represents an increase in infrastructure quality of 90.45%.

4 Conclusions and Discussions of Information Analysis

In this work, a quantitative research was carried out, framed in a positivist epistemological approach, that is, it is based on the analysis of real facts that are validated by experience, seeking to find the main factors that intervene in a simulation process through the optimization for the inclusion of technologies of the Industry 4.0 in the intralogistics activities, that allow to improve the organizational efficiency. The results of the research identify trends related to establishing that there is an association between the predominant factors and indicators in the logistics sector, specifically in the logistics operators, primarily in relation to the scenarios studied.

Consequently, it is necessary to build decision models that receive these results as input and provide solutions to intralogistic processes using Industry 4.0 technologies in strategic and operational spaces, not only for decision making but also to provide coordination mechanisms between the different variables involved in relation to the supply chain. In this sense, the literature proposes to explore relationship alternatives based on operating costs in intralogistics processes and the supply chain. The research carried out in the present study, as mentioned above, has determined that the logistics operators of the department of Atlantico object of study of this project, the factors that influence are the costs as a dependent variable, the Planning factors strategic and Subcontracting. For this reason, it is recommended to replicate the present research work and its methodology for the study of the sectors in which cargo loading and unloading tasks are carried out regarding various types of logistics, in order to identify opportunities for improvement. In the aspects studied in this project. In terms of the Business efficiency,

the organizations under study have a dynamic system in the way that they operationalize their processes in relation to intralogistic processes. The need for flexibility in industry 4.0 technologies is prioritized in order to be more efficient, consistently impacting the costs of supply chain operations or activities in intralogistics of the logistic operators. The first reflection of the present study and of the logistics operating organizations is to consider the importance of assuming a commitment to the articulation of strategies that promote the reduction of costs in terms of the implementation of Industry 4.0 technologies in intralogistic processes, generate better mechanisms and contribute to improving decision-making. In other words, building a collaborative policy that allows working on the opportunity that intralogistics provides for the supply chain and the logistics operators sector. However, one must work on the simulation model optimization that addresses the right strategies for each of the actors and takes into account It takes into account the variables studied in the present project, the future windows of study and the complexities that may arise as the topic addressed is deepened. In another thematic line, it is highlighted that the government must seek a way to regulate the tax positions of the cities that make life in the department of Atlantico, because it has been found that the economic environment tends to vary according to the fleet of the company that circulates through cities of the metropolitan area from Barranquilla. For this reason, companies choose conservative investment strategies that slow down the expansion of businesses and it is necessary to establish for this study an analysis unit that guarantees the type of additional information that logistics operators require. For decision making and the continuous search for the improvement of organizational efficiency.

References

1. Lambert, D.M., Cooper, M.C., Pagh, J.D.: Supply chain management: implementation issues and research opportunities. Int. J. Logist. Manag. **9**(2), 1–20 (1998). https://doi.org/10.1108/09574099810805807
2. DIAN: Dirección de Impuestos y Aduanas Nacionales, 07 July 2018. https://www.dian.gov.co/. Accessed 23 Oct 2019
3. Silva, J.D.: Gestión de la cadena de suministro: una revisión desde la logística y el medio ambiente. Entre Ciencia e Ingeniería, **11**(22), 51–59 (2017). https://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S1909-83672017000200051&lng=en&tlng=es. Accessed 03 Nov 2020
4. Orjuela-Castro, J.A., Suárez-Camelo, N., Chinchilla-Ospina, Y.I.: Costos logísticos y metodologías para el costeo en cadenas de suministro: una revisión de la literatura. Cuadernos de Contabilidad, **17**(44), 377–420 (2016). https://doi.org/10.11144/Javeriana.cc17-44.clmc
5. Johnson, M.P., Midgley, G., Chichirau, G.: Emerging trends and new frontiers in community operational research. Eur. J. Oper. Res. **268**(3), 1178–1191 (2018). https://doi.org/10.1016/j.ejor.2017.11.032
6. Mera, C.: UNAD Retos y Desafíos de la Prospectiva en las Organizaciones del Futuro, Grupo de Investigación y Estudios Prospectivos y Estrategicos (2019). ISBN 978–958–651–600–6
7. Dornier, P.-P., Ernst, R., Fender, M., Kouvelis, P.: Global Operations and Logistics: Text and Cases, Hardcover – January 1 1714 (1998)
8. Jordi Pau i Cos, Ricardo de Navascués y Gasca, Manual de logística integral, Madrid: EdicionesDíaz de Santos (2001). ISBN 84-7978-345-1
9. Roux, M.: Manual de logística para la gestión de almacenes. Gestión 2000, Barcelona (2003). ISBN 10: 8480881720

10. Ballou, R.: Logística administración de la cadena de suministro. Pearson Educación, México (2004). ISBN 970-26-0540-7
11. Carranza, O., Sabria, F.: Logística: mejores prácticas en Latinoamérica. Internacional Thomson Editores, México (2005). ISBN 13: 9789706864116
12. Christopher, M.: Logística aspectos estratégicos. Limusa, México (1999). ISBN 9789681852825
13. Casas, G.G., Romero, B.P.: Logística y distribución física: Evolución, situación actual, análisis comparativo y tendencias. Mc Graw-Hill.Interamericana, Madrid (1998). ISBN 84-481-1366-7
14. Smykay, E.W.: Physical Distribution Management: Logistics Problems of the Firm. Macmillan, New York (1961). A Macmillan marketing book (OCoLC) 614422824
15. Duran, S.: Liderazgo transformacional como estrategia de adaptación en la gestión logística empresarial. Revista Desarrollo Gerencial **4** (2017). https://doi.org/10.17081/dege.9.2
16. Farris, M.T.: Evolution of academic concerns with transportation and logistic. Transp. J. **37**, 42–50 (2017). https://www.jstor.org/stable/20713336
17. Chen, R., Liu, L., Wu, J.: Logistics capability and its grey assessment model. In: International Conference on IEEE Grey Systems and Intelligent Services (2007). https://doi.org/10.1109/GSIS.2007.4443455
18. Sanchez, O.: Guía para la construcción y análisis de indicadores, Departamento Nacional de Planeación, Bogota (2018)
19. BotthofErnst, A., Hartmann, A.: Zukunft der Arbeit im Kontext von Autonomik und Industrie 4.0. Zukunft der Arbeit in Industrie 4.0. Springer (2015). https://doi.org/10.1007/978-3-662-45915-7
20. BID: Logística Urbana: Los desafíos de la Distribución Urbana de Mercancías,» Centro de Estudios Económicos para el Desarrollo y la Competitividad , Cámara de comercio de Cartagena (2009). https://publications.iadb.org/es/publicacion/14260/logistica-urbana-los-desafios-de-la-distribucion-urbana-de-mercancias
21. de Lima, P., Orlem, B.S., Sandro, R.T., Manuel, C., Follmann, N.: Una nueva definición de la logística interna y forma de evaluar la misma. Ingeniare. Revista chilena de ingeniería **25**(2), 264–276 (2017). https://doi.org/10.4067/S0718-33052017000200264
22. La Rosa, V.: Resumén ejecutivo 2016 – 2019. Gobernación, Atlantico (2019)
23. Pérez: Sistemas de integración vertical y horizontal en el marco de industria 4.0: Evaluación y desarrollo. UANL, Monterrey (2017). https://eprints.uanl.mx/id/eprint/16246
24. Jung, K.: Mapping strategic goals and operational performance metrics for smart manufacturing systems. Procedia Comput. Sci. **44**, 184–193 (2015). https://doi.org/10.1016/j.procs.2015.03.051
25. Rennung, C.: Service Provision in the Framework of Industry 4.0. Procedia Soc. Behav. Sci. **221**, 372–377 (2016). https://doi.org/10.1016/j.sbspro.2016.05.127
26. Hernandez Sampieri, F.: Metodología de la Investigación. Mc Graw Hill, México (2014). ISBN 978-607-15-0291-9
27. Mejía, L.: Documentos CONPES consejo nacional de política económica y social república de Colombia departamento nacional de planeación, Bógota (2018). https://colaboracion.dnp.gov.co/CDT/Conpes/Econ%C3%B3micos/3918.pdf