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**Challenges of the port of Buenaventura-Colombia for the automation
of its logistic processes.**

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Acknowledgements and Dedication

First, we want to thank God who has allowed us to overcome obstacles day by day and thus conclude our university career successfully.

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Summary

This research deals with the current situation of the port of Buenaventura and the shortcomings of its infrastructure and logistical processes; and how these processes are susceptible to automation and thus can increase its competitiveness to be at the level of the world's leading ports.

For this research we used an inductive method of information collected from different sources of authors who have addressed the issue of automation of logistics processes, seeking to take from the general to the specific, of the objectives that seek to find establish the current state of the port, which changes must be made in this to implement automation in their logistics processes based on the benefits that have had the world's leading ports.

Although Buenaventura is a strategically located port, the economic, social and infrastructure barriers that the port faces make it less competitive in the global market.

The social problem presented by the port is the most complex challenge, as it must overcome a culture of crime, poverty, inequality and corruption.

For this reason, in order to achieve a substantial change in the infrastructure through the automation of the logistic processes of the port, it is first necessary to break the social situation that surrounds it and that does not allow its evolution.

To overcome this problem, the port must ensure that the state does its part in the investment and care of the area of Buenaventura and pressure to improve the living conditions of the population, because only then can it attract the necessary investment and establish the conditions to successfully achieve a process of automation of the logistics processes of the port.

Keywords: Automation, Competitiveness, innovation, Buenaventura port, logistics terminal.

Abstract

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Introduction

With the dynamism of the global market and a high offer of services, transnational companies and the speed with which daily living conditions change become a scenario where only those who are at the forefront of the market and are constantly reinventing their business survive. The port of Buenaventura faces a series of challenges to ensure its permanence in the market in the long term, one of the challenges is to be attractive to the global market from the perspective of an innovative business, efficient and attractive offers for customers in the global market. But to achieve this, it must first pass certain endogenous and exogenous barriers such as economic investment in the port, State support, investment in the surrounding population, port management adjustments, among others. Variables that, as they will be developed later, are not in themselves a situation, but the combination between them creates a new and more complex challenge to overcome.

There are studies from the last 10 years such as that of (Ferrer Sánchez, 2018), where they show that investment in the infrastructure of a port can take years in its application, which makes it an unattractive investment, or as he says (Sánchez & Mouftier, 2016) accompanied by a government with a traditional model with inefficient programs for the current development and abandonment of certain sectors of the country, including the Buenaventura sector, since the country's budget is concentrated in a small part of the economy. The combination of all these factors creates complex tensions that can only be carried out by a leadership with certain characteristics of a culture of change, which are the responsibility of the port manager who must have certain skills, one of them is the persuasion and tenacity to face any challenge arising from a megaproject of these.

The objective of this study is to identify the challenges of the port of Buenaventura for the implementation of its automated logistics processes and how it can achieve a level of competitiveness equal to the leading ports in the world.

In addition, it seeks to identify the current state of the port of Buenaventura and which of its processes are susceptible to automation, based on world ports such as Shanghai or Rotterdam that have already successfully achieved substantial leadership in the global market. For this, it will show the importance and benefits that has the automation of a port and how it can achieve competitiveness to be at the level of the leading ports in the world.

The variables that must be considered before investing in this innovation strategy will be defined and the possible ways for the port to achieve this objective will be established.

The port of Buenaventura has an arduous work to be able to carry out the development of this objective of implementing the automation in the logistic processes, since the first step is to achieve that the State guarantees certain conditions to the population of the sector and commits itself with the continuous investment to the port, not only to maintain the conditions of quality of life, but so that a project of so expensive amounts can be sustained; The second thing is that the port manager generates a strategic plan focused on the culture of continuous change and innovation, and as a third step, after managing to prepare the personnel, to define specifically which is the flow of the logistic processes and which of them should be automated based on those that generate more impact in the logistic chain.

Also, the present work begins in internalizing the different investigations about the benefits of the automation of the ports and its different logistic processes applied in other ports of the world, followed by conceptualizing the problematic that lives the port nowadays both internally and externally, additionally, the difficulty to implement this type of innovation as the automation. Then, it is established the development of the main idea of the work, which focuses on identifying the importance of the challenges facing the port of Buenaventura with the automation of its logistics processes and provide possible solutions on how to achieve this goal.

The port of Buenaventura has a strategic geographic location that can only be exploited if it uses innovation as a resource and incorporates social responsibility as a main objective of the growth of the sector, all focused on changing the current image of the port to attract new investment to establish permanence in time.

1. Formulation of the project

1.1. State of the art

Although information from previous studies on the possible implementation of automation in the logistics processes of the port of Buenaventura is limited and only the following findings were found:

According to (Oviedo Arroyo, 2015)The current technological objective of the ports of Colombia and in which they are working including the port of Buenaventura is to innovate

in three main lines of automation of logistical processes, the first of which are the doors where the key flow of documentary exchanges directly related to the physical flow of goods is presented.

The second line focuses on the storage yard both in the equipment used in the operating system that controls them.

As a third line, they focus on dock cranes, which consists of making small scale changes in the equipment, increasing productivity in the process, but still depending on a controlling staff.

Also to make advances like the automatic mooring (MoorMaster™ of Cavotec) where in an autonomous way the knots are made that tie the boats to the port in 12 seconds, diminishing the human intervention in the physical process eliminating the risks, that besides making more efficient is safer in atmospheric adversities.

According to (Moreno & Sander, 2015) since 1988 that Colpuertos exists, automation of different processes was developed which were positive for productivity which, although not specifically mentioned, are evidenced by the impact generated at the labor level that contracted problems with the union institutions due to the reduction of personnel.

As expressed (Hernandez, 2018) since the 90's the port of Buenaventura became the most important in the Pacific and since 2005 there is evidence of substantial improvements in automated processes that as evidence demonstrated reduced costs and time for foreign traders confirmed by the Ministry of Industry and Commerce of Colombia.

With the alliance of the Pacific that from 2016 came into force the Additional Commercial Protocol to the Macro Agreement that promotes among several things the automation of logistics processes increasing productivity, simplify processes and reduce paperwork and bureaucracy.

In this constantly changing and competitive market the intention arises to implement a new innovation process that must first successfully achieve a process of adaptation and sustainability in the time that then well directed aims at a single goal that is to achieve the common objectives of society and the State (Sánchez & Mouftier, 2016, p.2).

(Sánchez & Mouftier, 2016) refers to the fact that the implementation of innovation strategies is key to long-term success, any type of business and even more so all those

businesses whose main activity is logistics. These logistic processes show important changes when it is possible to adapt new technologies and innovation strategies such as automation, but in order to adopt all these new innovations, there must be a cultural change since the people who interfere with the process are the key to its success, the change of culture must be understood as a very important challenge when applying new processes since depending on the business where it is applied, it is difficult to break with the paradigm of change, a business that is very conservative with its leadership can be more difficult to adapt than a leadership open to change.

This adaptation is fundamental to face new challenges such as the management of environmental and labor variables, among others; the continuous changes generated by business dynamics and "the cultural change, the main engine of change and innovation, will allow the revision of traditional models, which may no longer be capable of facing the expansion of basic activities and towards a business with new characteristics". (Sánchez & Mouftier, 2016, p. 3)

It is here where a business can step forward to face the markets or step back and condemn its economic activity to disappear from the market over time.

The investment in innovation will result in greater efficiency, cost reduction, as well as improvement in the performance of the spaces and, as a consequence, greater profitability that will allow for long-term sustainability. This will also allow the business to have accessibility to new markets and be more competitive.

One of the large surface area businesses are the seaports, which are purely logistical businesses and where continuous improvement processes must be applied in order to allow them to be competitive in the market. In this type of business, the leadership at the time of implementing the innovation processes depends directly on the port manager who through his approach and management skills will reach the application of this. This manager must be able to analyze the market and be able to determine which threats and opportunities to take into account before making any decision, as well as being a leader that allows the culture of change to be introduced in her work team, and must be able to intervene in any part of the logistics chain (Lazzati, 2016). The human being by nature resists the change, for this reason some projects fail because they take for granted the acceptance of the imposed change and they leave aside the process of adaptation and even more it is necessary to understand the type of employee with which one works in the port since this

one is influenced by the environment where it lives and the culture that moves in its surroundings. This culture shock creates a problem for change management. The port manager must have a high level of communication and persuasion to successfully manage change.

All the above is linked to really knowing what the needs of the port are in which to work since each port may have different approaches to innovate and the application of innovation strategies must be specifically studied for each particular case.

When it refers to continuous improvements in search of cost reduction in ports to improve operational performance, it is all those efforts that are made to adapt to new ships and to new adaptations of port infrastructure with strategies such as automation, which have already been applied in other similar types of business (Ferrer, 2018, p. 21). Terminals are businesses with ideal structures for the application of these new strategies, since due to the weight of their economic activity, the application of automation will reflect visible changes not only in logistics processes, but also in the performance of economic activity, thanks to increased productivity and efficiency. Nowadays, the need to be more efficient in the handling of large ships and reduction of time spent in ports where everything is directly proportional to business costs are more visible in terminals. Achieving this objective of automating terminals can reduce these problems that will not only be a significant impact on the management of costs but will also have the opportunity to be more competitive with other neighboring ports. "Automation offers regularity, solvency, control and security in the execution of terminal operations" (Ferrer, 2018, p. 54). In other words, it is the meticulous control of the different variables that intervenes in the logistic process, allowing to adjust the cost to the minimum possible, making it possible to maximize the competitive advantage substantially.

The growth of the global market has led to a high number of freight traffic forcing us to respond with better customer service. "The development of automation is configured as a tool for the growth of the capacity and efficiency of terminal facilities, which also provides the optimization of facilities and available spaces and limits the environmental impact" (Diaz, 2019, P. 10).

One of the most important challenges is the environmental impact that is given by the economic activity, with the growing mobilization on the management of the environment,

create more friendly and responsible business processes, for this reason automation is a response to achieve this goal of business responsibly sustainable.

Another extremely important factor is to focus greater attention on those processes that generate value for the customer, is a combination of employees trained and able to fully develop the activity, with clean processes and properly adapted to the supply chain bearing in mind that each link in the chain plays a fundamental role and that this must be controlled and must be known in its entirety by the agents involved in order to apply continuous improvement and allow the logistics process to be more efficient. "It must be based on everything necessary to meet the customer's requirements and the necessary infrastructure is planned for each of the links involved in the supply chain" (Vélez, 2009, p. 120). Everything goes hand in hand with teamwork that integrates the different processes, allowing collaboration to generate more value to the supply chain and allow optimal spaces to be generated for continuous improvement.

All the development of these strategies is motivated by the initiative to invest in innovation and automation projects, "it is necessary to facilitate technological development through innovation and automation projects, to improve competitiveness" (DNP and Colciencias, 2005) (Ovalle, 2013, p. 172).

In addition, more and more businesses cannot ignore the importance of innovation strategies, because these cease to be novelty and become indispensable for businesses to survive, "No entrepreneur can omit the automation of their processes to increase the quality of their products, reduce production times, perform complex tasks, reduce waste or poorly manufactured parts and especially increase profitability" (Ruedas, 2010, p. 1).

The factor that makes automation a profitable strategy is according to Moreno, (2001); Piedrahita, (2001) Ovalle (2013) "Industrial automation includes the technological elements, with the application of mechanical, electronic and computerized systems that allow to operate and control production, with minimum or no human intervention" (p. 172).

The omission of the great part of the human being eliminates contingency variables that can diminish the production process, since by nature the human being is not productive 100% of his working day, besides that each person has his own level of productivity and the work at the hands of the human being is more inconstant, the robotics and the automation surpass the expectations of productivity of a business operated only by people.

As Gil, Molla & Ruiz (2008) says, "the implementation of the technologies that allow such automation will be conditioned to a great extent by the financial and human resources of the company" (p. 121), everything will also depend on the resources that are invested in the automation project, because they are investments that require a high level of technology, knowledge, human strength, control and the process must be monitored in order to successfully complete its application.

After overcoming the different obstacles that this type of innovation requires, automation is the main answer to achieve the necessary level of competitiveness of the country's ports and put a business of such a high level on the global competitiveness margin.

There are ports in the world such as Shanghai or Rotterdam that are benchmarks in the application of automation to logistics processes. They are clear examples of how being pioneers in innovation gives them a lead in the global marketplace. You can see the highly competitive prices that handle Asian markets, where they ship anywhere in the world at minimal costs, making them the main market for exports and imports. With these examples you can see how automation is an extremely profitable investment that can be quickly recovered if you work to its full potential.

1.2. Problem Statement

During the last two decades with the dynamism of globalization and the growing commercial demand for products, different economic sectors have been faced with new challenges that challenge their permanence over time, including the logistics sector, which has seen the need to be at the forefront of technological processes such as automation that allows adjusting efficiency to new market demands and trade flows.

Colombia has faced challenges such as the scarcity of investment or difficulties in adapting to the rapid changes in world dynamism in its main ports, one of them is the port of Buenaventura, one of the most important in Colombia, without a doubt, thanks to its geographical position and its proximity to the main economies of the world as the Asian maritime market which is the most dynamic in the world. Through Buenaventura, it is possible to connect with approximately 300 ports, likewise, the port of Buenaventura moves 60% of the total cargo of the country's foreign trade and most of the exports directed to the

member countries of the Pacific Alliance; however, despite the large investments and efforts made to modernize the port of Buenaventura, there are a number of logistical shortcomings such as the automation of the different processes of the port to achieve efficiency and adequacy of the ports so that they can be more competitive against the ports of the world (Vargas Days, 2015).

It is less and less usual for terminals to implement innovation processes such as automation. This growing phenomenon is due to the interaction of different variables such as the world economy, economy of scale and competition between logistics terminals, motivating their development. This gives us an idea that ports must be constantly innovating if they want to survive in the market. (Sánchez, Barleta Palma, & Mouftier, 2017).

Among the new world innovation trends are automation and robotization, with which it is possible to improve the control of processes thanks to the autonomy they adopt, adopting greater safety and performance of the activities carried out. "The growth of available information allows for more efficient monitoring and also better competitiveness. It generates cost savings and allows a better reactivity to face specific changes in the logistics chain". (Sánchez, Barleta Palma, & Mouftier, 2017). For this reason, it is very important to identify which factors are substantial barriers that the port must face so that it can automate several or all of its logistical processes so that it can compete in the future with the world's leading ports.

1.3. Problem Formulation

In accordance with the above, the research question arises: What challenges does the port of Buenaventura have to overcome in order to automate its logistics processes?

Table 1. Raising the research problem

SYMPTOMS	CAUSES	FOREWORD	FORECAST CONTROL
Loss of competitiveness due to lack of port infrastructure and efficient processes.	Major public and private investment to improve the port of Buenaventura. Lack of automation of logistics processes to avoid cost overruns and increase productivity.	A large part of the port's competitiveness depends on the quality of its operational processes if inefficiencies occur and, on the contrary, no measures are implemented to increase the port's productivity and efficiency.	New automated operating systems. Optimization of logistic processes.

Source: Prepared by the authors

1.3. Objectives

1.3.1. General Objective.

□ Identify the challenges faced by the port of Buenaventura to achieve automation of its logistics processes.

1.3.2. Specific Objectives

- Define the current status of the port of Buenaventura and review which logistical processes can be automated.
- Describe the benefits that the implementation of an automation system could generate for the logistics operation of the port of Buenaventura.
- Propose improvement actions so that the port of Buenaventura can reach an ideal level of automation, comparable to the leading ports in the world.

1.4. Justification**1.4.1. Theoretical justification**

The role played by the port of Buenaventura has been fundamental for the economic development of the country, as it is one of the most recognized in Latin America, also has a privileged geographical location and specialized infrastructure for handling containers. However, due to the lack of automation in some of its processes, the control, safety, efficiency, competitiveness, among others, of certain activities carried out within it is very difficult. For this reason, this research is carried out with the purpose of identifying the different challenges faced by the port of Buenaventura in a possible process of implementation of process automation, since it allows the use of mechanical, electronic, computerized elements or systems, among others, in order for the processes to respond to rules and conditions that contribute to increasing productivity and efficiency by optimizing the control of all processes involved in the port, standardizing performance and improving service levels. (Garcia, 2019).

With the implementation of an automated system in the port of Buenaventura, we seek to increase efficiency and decrease costs in the different logistics processes. to be competitive worldwide and to be at the level of the port's leaders in automation. (Garcia, 2019).

The implementation of automation allows optimizing the use of space and facilities, improves the management and control of port operations through the use of information in real time, in addition to this, reduces costs by the existence of economies of scale and lower work requirements. (Garcia, 2019).

1.4.2. Social and/or business justification

Both for the government of Colombia and for the business sector, it will be very beneficial to be able to identify the main shortcomings that are presented in the port of Buenaventura, which can be reduced with the use of automation in their logistical processes, since when identified multiple strategies can be generated through which the obstacles of the port can be improved or remedied efficiently, contributing gradually to the competitiveness of the same, and thus, continue to be strengthened as one of the main ports nationally and internationally.

1.4.3. Personal justification

This research is carried out with the aim of applying the knowledge acquired in the university, as well as deepening the specific knowledge to broaden our knowledge in the field of application. (Agudelo & García, 2019).

After knowing the situation of the port of Buenaventura in infrastructure and investment related to automation, one of the most important trends of the world's leading ports. (Agudelo & García, 2019).

1.5. Framework of Reference

1.5.1. Theoretical Framework

The logistical level achieved by a country in its economic development is directly proportional to the factors of competitiveness and these are shaped by the new challenges imposed by the global market, there are different indicators that can measure the level of competitiveness that the country has, these are: infrastructure, macro environment, activity and intensity of markets, innovations, among others. Having these indicators at a high level is tantamount to saying that you have an ideal logistical structure to compete in the market.

According to (Hoffmann, 2,000) the ports were formerly only focused on national exports, and today they are already a business of international level where they provide services of foreign origin. Colombia began its economic opening in the 1990s by focusing on the need to work on its infrastructure. With the signing of free trade agreements and other commercial agreements, the country works at its capacity and increases the efficiency of its ports, essentially strategic ports such as Buenaventura, which have an important geographical location. (Castro Castell, Soler Niño, Umaña Castellanos, & Yepes Lugo, 2017)

But free trade agreements have allowed the country to source new products, has also shown the reality that the country lives in terms of competitiveness and does not have a port infrastructure to meet the new demands, lagging behind their peers, showing the latent need for state investment to improve ports, roads and distribution channels and social sectors

where ports are located because they have high levels of poverty and social inequality. (Castro Castell, Soler Niño, Umaña Castellanos, & Yepes Lugo, 2017)

Colombia has presented administrative inefficiencies since 1993 when it was administered by Colpuertos which failed due to the high demands of the unions that did not allow it to fully develop its activity, since the demands of these were beyond what the business could support. This is a sample that the ports in Colombia come in a slow development and with the changes of the models of economy of the country has slowed its development. (Jiménez & Delgado, 2008)

According to (Barbero, 2006) the development of ports during the last 20 years has been mediocre, as Colombia is in the 58th of 117 countries participating for overall competitiveness and ranks 85th in terms of overall port infrastructure.

And considering:

It should be noted that investment in infrastructure and machinery of a terminal is high, with periods between 15 and 25 years, and that in most cases of terminals concessioned by public entities, the concession period varies between 25 and 50 years. (Ferrer Sánchez, 2018, p.21)

With the above clearly shows that even Colombia has 20 years in this process and with current conditions it is very possible that it still lacks a large number of years to reach the ideal level of investment in port automation processes. Gómez, J. According to (M., Herrera & De la Hoz Granadillo, 2012) this problem is not only presented by Colombia, but it is a problem that affects all of Latin America.

According to (Castro Castell, Soler Niño, Umaña Castellanos, & Yepes Lugo, 2017) The following presents the state of the port of Buenaventura against the port of Cartagena and its different characteristics to give an idea of how it is at a competitive level:

Table 2. Comparative table of port infrastructure

	Puerto Buenaventura	Puerto Cartagena
Extensión del puerto	620 Hectáreas	40 Hectáreas
Número de empleados	250	700
Distancias terrestres principales ciudades (km)		
Bogotá	504	1.125
Medellín	498	632
Cali	165	1.012
Proximidad Zona Franca	120 km	10 km y 300 m
	Puerto Buenaventura	Puerto Cartagena
Para acceso al puerto		
Longitud	31,5 km	82 km
Profundidad	10,7 m	15 m
Calado máximo en Muelles	41 pies	43 pies
Muelles		
Número	14	8
Longitud en metros lineales	1.998 m	1.636 m
Almacenamiento		
Capacidad para importación y exportación	27.044 m ²	30.000 m ²
Capacidad Patios	48.000 m aprox.	22 Hectáreas
Capacidad Granel Sólido	164.000 toneladas	20.000 ton (dato 2014)
Principales equipos		
Grúas Pórtico	4	4
Otros Equipos	3 Grúas	2 grúas móviles; 21 Trans-tainer, 14 Reach Stacker; 67 plataformas; 62 Camiones
	16 Reach Stackers	
	4 grúas Pórtico Post-Panamax	
Otras Facilidades		
Tomas conexión contenedores refrigerados	384	550
Escáner	1	1
Rendimiento Portuario		
Promedio rata de cargue contenedores	31 Buque / Hora	45 Movimientos/Hora
Promedio tiempo estadía buques (días)	24 Horas	12 Horas
Tarifas promedio para carga (impo - expo)		
Carga General y Gráneles (Promedio)/por ton	Carga general 1 a 10,000 toneladas año	Entre US\$4,00 y US\$4,50
	US\$ 4,70 ton	

	Puerto Buenaventura	Puerto Cartagena
Contenedores 20' y 40' Llenos/ Unidad	Contenedor 20' de 1 a	Entre US\$ 85 y US\$ 115
	625/ año US\$ 80 por Unidad	
	Contenedor 40' de 1 a 652/año US\$ 98 por Unidad	
Vehículos Entre 1m3 y 40 m3 / Unidad	De acuerdo con M ³ por Unidad	Entre US\$ 58 y US\$ 140
	Hasta 10 m ³ : US\$ 28	
	Hasta 19,9 m ³ : US\$ 39	
	Hasta 40 m ³ US\$ 72	
	Más m ³ US\$ 132	
Para almacenamiento		
Días libres	3 días impo / 5 días expo	3
En Cubierto: Carga General Tonelada / Día (Promedio)	US\$ 1,40 día/ton hasta el día 5	US\$ 1,50
	US\$ 1,63 día/ton hasta el día 10	
	US\$ 4,05 día/ton en adelante	
Carga General Tonelada / Día (Promedio)	US\$ 1,10 día/ton hasta el día 5	US\$ 1,00 hasta el día 5 US\$ 1,30 hasta el día 10 US\$ 1,80 en adelante
	US\$ 1,30 día/ton hasta el día 10	
	US\$ 3,15 día/ton en adelante	
Contenedor de 20' Lleno Unidad/Día	US\$ 18,15/día, hasta el 4 o 6 día	US\$ 15 hasta el día 5 US\$ 20 hasta el día 10 US\$ 25 por día en adelante
	US\$ 21,45 hasta el 10 día	
	US\$ 41,45 por día en adelante	
Contenedor de 40' Lleno Unidad/Día	US\$ 20,35/día, hasta el 4 o 6 día	US\$ 25 hasta el día 5 US\$ 30 hasta el día 10 US\$ 40 en adelante
	US\$ 24,05 hasta el 10 día	
	US\$ 50,40 por día en adelante	

With these results it is visible that there is a great void in the investment of the port of Buenaventura, in addition to the fact that it lacks good administration, it lacks the capacity to receive ships and handle them, increasing the costs of handling and transaction times of goods. (Castro Castell, Soler Niño, Umaña Castellanos, & Yepes Lugo, 2017).

According to (Hurtado & Gómez, 2017) when faced with competition, questions must be answered such as: Do you have the ideal infrastructure to compete? Do you have the

qualified personnel to face any challenge presented by the port? Do you have enough innovation to face the competition? for this reason Colombia faces a possible loss of competitiveness of the economy but works on the logistics infrastructure of the country, since it is impossible to work in a single domestic market, since today it is unacceptable for a country in the world to develop without this global approach, although Colombia is a country rich in natural resources is still lagging behind in the development of its economy compared to other developing countries and even more so when it ranks seventh as the most unequal countries in the world and this is due in part to the centralization of the country's resources, where investments are only made in certain regions and in certain economic sectors, also because of the image shown by certain sectors where contracts are very marked, since they are areas where there are very profitable economic activities with a great structure and the surrounding populations live in poverty and social crisis, such as delinquency, armed groups, all because they are strategic areas for illicit activities. This state's abandonment of these sectors, such as the port of Buenaventura, makes this a complex place for the management of its population that directly affects the port itself.

The port presents uncertainty, changes and unpredictable risks that can only be solved by a mixed figure where the public and private join efforts for a greater administration of the port. This interaction of these factors generates stress by the interaction of endogenous and exogenous factors. As endogenous factors it refers to all the port issues which are the companies, the public sector and the port industry. The government manages a traditional system that is not up to the needs of the economy, accompanied by a deficient administration of the port and with the aggravating social problems surrounding the port. Being a clear indicator of the exhaustion of the port's opportunity to achieve the necessary level of innovation. Exogenous factors include shipping lines, the economy, logistics and trade. The shipping companies are a macro business that have directly affected the call to ports plus the consolidation of large shipping companies, hindering competition, additionally logistics companies and port authorities do not work at the same pace on problems, which becomes an obstacle to economic activity. The combination of endogenous and exogenous factors generates by itself the stressful situation that ports suffer nowadays, when several variables meet at the same time, they create an unexpected level of tension creating new more complex situations to handle. (Sánchez & Mouftier, 2016).

In the port business, the key to the success of port efficiency is centred on the direct relationship between agility in logistics operations and the reduction of time in port activities. (Fernandez Melle, 1996).

The implementation of automation is an answer to address the current problems of inefficiency in ports, but automation alone is not the answer because before applying this process must carefully analyze each logistical process of the port and determine which of them is best suited to modify and can generate added value to the economic activity. (Moreno Martínez, 2013).

It is clear that with the above automation is not only a complicated challenge to adapt to the port as it is conditioned to their particular needs, but also requires a large sum of money to carry out the development of a megaproject and additional must go hand in hand with a social work in the port sector to work on culture change. "For the technological progress that we have undergone and that is currently being implemented in first class container terminals, are the result of very important and substantial investments in this field, mostly from the private sector." (Coma, 2015) These investments require years of application so waiting for the return on the investment makes it unattractive to investors.

Conceptual Framework

- **Logistics**

According to the author (Castellanos Ramírez, 2015), within the different definitions given by certain authors of the logistic term, it is the function of operationally managing the activities that compose the handling of raw materials until the finished product ready to be delivered to its clients (Ferrel, 2015).

Logistics consists of a series of links in a chain in which activities such as purchasing, transport and storage of goods are carried out, where its success lies in the systemic coordination of all these elements in order to achieve an established objective that is to satisfy the needs of customers.

- **Competitiveness**

According to (Hassam, 2001), the Government of Canada proposes competitiveness in the following way: it is an economy capable of satisfying an offer of goods and services in the global market, in such a way that it achieves profitability in business, generates quality

of life through fair wages, in addition to offering safety and health at work for workers and respecting the environment; in other words, competitiveness translates into quality and price of products backed by the minimum conditions required to sustain a socially responsible business.

- **Automation:**

The author (Velásquez C., 2004) expresses that automation is a group of systematic techniques that can manage input and output information taking decisions based on a preestablished programming by an analysis of variables internalized by the autonomous system fulfilling the objective of optimizing production resources, human resource, financial and economic.

Automation is also understood as the process where the latent need for human effort is eliminated with minimal or almost no intervention, so that the accuracy of the operation and exponential levels of productivity substantially exceed.

According to Nieto (2006) automation is the management of information that incorporates computing and autonomy for real-time decision making. Human logical processes evolve at a level with a speed and efficiency imperceptible to the human being.

Specifically, port automation can be classified into semi-automated and automated terminals, and each of these can be divided into major and minor automations. The following is a brief explanation of what each of these consists of.

To classify a container terminal as fully automated, it is necessary that both yard and dock operations are fully automated. In relation to semi-automated terminals, this is commonly referred to as port terminals that do not have automated their operations between docks and cranes but do have fully automated the port yard.

On the other hand, there are the minor automatizations, which have to do with the development and implementation of software and information systems linked to the other processes susceptible to automation, such as the remaining operations of the terminal process, as well as the administrative and information activities that run parallel to the flow of cargo in the port terminal.

The automation process is ideal to make the port of Buenaventura more competitive against leading ports in the world, increasing its capacity to handle port cargo in areas such as the Pacific and ports such as Manzanillo (Mexico), Panama Pacifico (Panama) and El Callao (Peru).

□ Port Competitiveness:

This is the application of strategies focused on the development of an ideal level to attract a greater number of interested customers, the ports constantly seek to reinvent themselves always looking for the front but these depend not only on these intentions but their infrastructure, geography, location and the development of transport systems which becomes a great challenge. (Cerbán Jiménez, 2009).

1.6. Methodological Framework

The work done is done through an analytical process based on information previously researched and obtained, with which it is possible to determine a greater extent the current situation of the port of Buenaventura focused on the use of automation of logistics processes. In addition, with this investigated information, it will be sought to give answer to the problem question contributing in a concrete way to the achievement of the proposed objective.

1.6.1. Method of investigation

The method used for the collection of information is approached through the inductive method, since it allows starting from the general, as is the contribution to the competitiveness of the port of Buenaventura through the use of automation of logistics processes, to reach the specific, as is establishing the challenges presented by the port with the implementation of this process.

• Research Approach

The focus of the research is qualitative, according to the definition in the article (Definition of variables, focus and type of research). "Qualitative research is that which uses preferentially or exclusively qualitative information and whose analysis is aimed at achieving detailed descriptions of the phenomena studied. Most of these investigations emphasize the practical use of research. (Cauas, 2015).

Information was gathered and a detailed analysis was carried out that contributes to obtaining data that contributes to the development of research, such as the main challenges faced by the port of Buenaventura with the implementation of the automation of logistical

processes, as well as studying the quality of the activities and resources carried out there, among others.

- **Type of study**

The research carried out is of a simple nature, since, according to the definition set out in the journal education entitled (applied research: a way of knowing realities with scientific evidence) "Simple research", which deals with the object of study without considering an immediate application, but bearing in mind that, from its results and discoveries, new scientific products and advances may arise". (Vargas Cordero, 2009).

In view of the foregoing, the proposed research is based on identifying the main challenges that the port of Buenaventura must overcome in order to automate its logistical processes. Subsequently, the level of study carried out for the research is of an exploratory type, since by means of this it allows to know more deeply the context in which the port of Buenaventura is located, since in this one the implementation of automation in its processes is scarce, which contributes to its competitiveness being a little affected.

It is also descriptive, as it will seek to identify the challenges faced by the port that contribute to the optimization of its logistical processes and contribute to increasing its competitiveness.

Based on the above, a detailed account is sought of the actions and means that will lead to the achievement of the objectives.

1.6.2. Research methodology

- **Data collection techniques and tools**

The information will be obtained through secondary sources such as bibliographic databases such as Google Académico, Ebsco Host, scientific journals such as Refseek, Dialnet, Redalyc, Scielo and official information from pages such as Procolombia, among others; the information will be located through keywords such as seaport, modern logistics processes, automation, world-leading ports, among others.

- **Information selection and analysis**

In order to obtain truthful, quality and reliable information, filters must be carried out prior to the search, such as correctly determining keywords, classifying databases according

to their specialty, consulting relevant information on official pages according to the type of entity it is and its purpose.

This allows us to immediately discard irrelevant information and helps us to correctly profile from the beginning the sources and information that most contribute and contribute to the research problem.

Subsequently, the information obtained must be ordered in a logical and clear way, always taking as a guide the orientation of the advisor and consolidating it through digital means such as Word and Excel, which allow the modeling of the information according to the needs.

- **Bias control**

In order to guarantee the objectivity and reliability of the information, data obtained from bibliographic databases will be contrasted with similar sources such as official pages in order to validate veracity or discrepancies in the information collected. In addition, the previous sources are registered in the references section of this degree work, with the objective that any person interested in validating it may access this information, and in accordance with the above, the impartiality of the investigation is guaranteed.

1.7. Scope

This research project aims to characterize the current state of the port of Buenaventura to see what need for automation of their logistics processes to be at the level of the world's leading ports in automation.

2. Development of research

2.1. "Define the current state of the port of Buenaventura and review which logistical processes can be automated".

The port of Buenaventura is located on the shore of the Pacific Ocean, which makes it one of the most attractive ports thanks to its geographical position, because it is close to the Panama Canal and is also in the middle of two important ports of the American continent such as the port of Vancouver and Valparaiso, which makes the port of Buenaventura become an attraction for foreign and domestic investment issues. (Perlaza, 2019).

According to the (Buenaventura Chamber of Commerce, 2012) The port of Buenaventura mobilizes more than 50% of the cargo through the port societies of the country, and is predicted to increase traffic by 2020 with more than 20 million tons, in order to rank as one of the ports with greater projection in Latin America.

Since the entry into force of the FTA with the United States in 2011, the port of Buenaventura became one of the major priorities of the Colombian government, because the city, for its great geostrategic position is considered as one of the gateways to the world's most dynamic economies, located in Asia and the Pacific, in addition to the U.S. market. In line with the demands of a fully globalized market, where opportunities are no longer glimpsed, but actually became tangible business, it is imperative for Buenaventura in its legitimate nomination as the most important Colombian seaport on the Pacific, improve the level of competitiveness in all its instances. (Hurtado & Nieto, 2017).

In the port of Buenaventura several investment themes have been carried out with the purpose of improving its competitiveness. As mentioned in (THE REPUBLIC , 2018) This strengthened the port's leadership in the Pacific region, which mobilizes 71% of the cargo operated in that part of the country and is also part of the 10 most important maritime terminals in Latin America. It is worth mentioning that apart from this investment, one was made for an amount of US \$600,000, aimed at Crossdocking technology, and is used for the inspection and mobilization of refrigerated cargo, with this technology is achieved to reduce the time of export and import, as it has the capacity to perform 5,000 operations a year.

In relation to the above, other investments generated in the port were the acquisition of three gantry cranes and six RTG, and this investment amounts to US \$38 million, which allows to reinforce the equipment of the terminal with the arrival of these. With this, the Buenaventura Port Company will have a total of 13 gantry cranes, which will increase the capacity of the terminal to 1.8 million containers and the possibility of simultaneous service on its berthing line. (THE REPUBLIC , 2018).

Additionally, it also invested in the construction of the Line Tunnel, and is one of the most interesting projects that has been presented in the Colombian road infrastructure, its location is precisely on the main road connecting the interior of the country with what is considered one of the most important ports in Colombia and South America and is the port of Buenaventura, the importance lies in that it has a strategic location which connects with different countries in South America, North America, Europe and Asia. However, the main

problem that has arisen in the connection between the interior of the country and the Port of Buenaventura is due to its mountainous road infrastructure, therefore, the traffic of goods to and from the port has delays in its journey. (TRUJILLO, 2019).

In addition to this, due to the social problems that are presented in the port, this becomes attractive for illegal activities that seek exit and entry through this sector of the country. In addition, a large part of the population reflects inequality, which contributes to an increase in poverty, so that its inhabitants do not benefit from economic activities. It is for this reason that some investors are attracted very little attention by investing in the port of Buenaventura, and, in addition, the money invested in the sector is not really used in the social activity that would strengthen the economic activity of the port, additional, if the population surrounding the port is in precarious conditions this will directly affect the environment in which the port moves.

It is worth mentioning that in spite of all the investment issues that have been generated in the port of Buenaventura in order to improve its competitiveness, a series of tensions have arisen in financial matters, since through the activities carried out within it, they obtained very low results that led to the lowest dividend in recent years, this was due to a decrease in sales of US \$20 million due to the withdrawal of a service from a shipping line, high costs and greater competition, reported by (Money , 2019)This shows that the port of Buenaventura has several shortcomings in order to carry out its logistical processes.

Although the port of Buenaventura was responsible for 12% of Colombia's port traffic during the first semester of this year, it faces a series of drawbacks that stop it from improving its levels of competitiveness. One of these shortcomings is that there is a need for more articulation in the processes between the port terminals, the transporters and the actors of the chain, according to the union representative. These factors make the port less competitive than other ports in the region, such as Balboa in Panama or Callao in Peru, which are approximately 16 meters away. (Maritime World , 2019).

Apart from the above-mentioned shortcomings, there are other series of challenges that are presented in the port, and they are related to the modernization of its technological infrastructure, which, for lack of this, the logistical processes of the same become slower to carry out, which leads to a high decrease in competitiveness compared to other ports that are more advanced by the use of high technologies. In addition, the port has a low

operational efficiency, as well as its road infrastructure and the quality of electricity and Internet services are not the most adequate.

One of the difficulties presented by the port of Buenaventura is poverty, as well as the insecurity that exists in it, because there are few controls on the entry and exit of goods, which increases the issue of smuggling. Despite this, for the port has not been an impediment to continue mobilizing 50% of the country's cargo, so it continually seeks to obtain various alliances to help improve the image that currently has the port both nationally and internationally (Felipe & Ivan, 2018).

In 2018, ECLAC unveiled the ranking that evaluates the movements of TEUs in the Latin American and Caribbean region. The (National Competitiveness Council, 2018) released version 2019 which evaluated the performance of 31 countries through 118 ports, with a total volume of approximately 53.5 million TEUs, resulting in an increase of 7.7% during 2018 compared to the previous year. (National Competitiveness Council, 2018)

Below is a table showing the first 15 ports that reflected an increase in container movement:

Table 3. Movement of containers in Latin America

Movimiento de contenedores en Latinoamérica					
Cifras en TEUs					
Ranking	Puerto	País	2017	2018	Variación (en%)
1	Colón (MIT, Evergreen, Panamá Port)	Panamá	3,891,209	4,324,478	11.1%
2	Santos	Brasil	3,578,192	3,836,487	7.2%
3	Manzanillo	México	2,830,370	3,078,505	8.8%
4	Bahía de Cartagena	Colombia	2,678,005	2,862,787	6.9%
5	Panamá Pacífico	Panamá	2,986,617	2,520,587	-15.6%
6	El Callao	Perú	2,250,224	2,340,657	4.0%
7	Guayaquil (APG, terminales privados)	Ecuador	1,871,591	2,064,281	10.3%
8	Kingston	Jamaica	1,560,000	1,833,053	17.5%
9	Buenos Aires (Puerto Nuveo y Dock sud)	Argentina	1,468,960	1,797,955	22.4%
10	San Antonio	Chile	1,296,890	1,660,832	28.1%
11	San Juan	Puerto Rico	1,199,157	1,405,348	17.2%
12	Buenaventura	Colombia	920,000	1,369,139	48.8%
13	Caucedo	Rep. Dom.	1,235,801	1,331,907	7.8%
14	Lázaro Cárdenas, MICH	México	1,149,079	1,314,798	14.4%
15	Limón-Moin	Costa Rica	1,199,628	1,187,760	-1.0%

Fuente: Perfil Marítimo y Logístico de CEPAL

The table shows the comparison of 2017 and 2018 in container movement (TEUs) for the 15 Latin American ports with the best figures, the percentage variation for each of these is shown individually.

The variation presented by the port of Buenaventura between 2017 and 2018 was 48.8%, which positions it as the port of greatest increase in container movement in the region, followed only by the port of San Antonio which presented an increase of 28.1%.

It is observed that the port of Colon Panama presents the best figures at the close of 2018; if you compare the port of Buenaventura with that of Colon the movement of this is 3 times greater than the movement of the port of Buenaventura.

Regarding Colombian ports, the ranking shows the port of Cartagena as the best performance at the national level with figures at the close of 2018 of 2'862.787 TEUs which is 52% higher than the movement of containers presented by the port of Buenaventura at the close of 2018.

The port of Buenaventura should pay attention to its close competitors in the ranking because despite being the port with the greatest variation with respect to 2017 can be seen the proximity of the port of Caucedo and Lazaro Cardenas which are only 3% and 4% respectively to reach the levels of the port of Buenaventura.

In order to contribute to the improvements of some processes carried out within the port of Buenaventura, with the objective of improving its competitiveness, it is possible to identify that there are ports that are currently using systematization in their logistical processes, that is, they use mechanisms that lead to greater speed and efficiency in their activities, thus offering better levels of service and with great performances. For this process, ports such as Rotterdam, uses more sophisticated machinery, such as self-guided vehicles, automated gantry trucks, automated systems of last generation for the storage of containers, among others, obtaining more efficient yields, which contributes to using less operational labor, which are sometimes the cause of the low efficiency in the ports, which could be a road already traveled to overcome the need presented by the port of Buenaventura.

Currently, the port of Buenaventura has certain deficiencies in some of its logistical processes and are susceptible to automate, such as its logistics center and limited distribution, very inefficient waiting times due to delays in the processes, waiting times in the port become very long which reduces competitiveness due to the low confidence that is generated to investors, excessive storage costs, overcrowding of ships, disorder in the arrival and departure of goods, among others.

Therefore, by implementing port automation in these processes, port capacity would be increased, contributing to the acquisition of technological innovation, reduction of logistics costs, etc., maximizing the use and technification of each of its processes, contributing to the improvement of control and optimization of operations, the strengthening of supervision and security systems in the port, with the purpose of generating better and greater results.

The port of Buenaventura has a large potential, which can exploit significantly to obtain great growth, but for this, it is important that the performance of its port logistics increases, this can be given largely through the improvement of roads, lower freight costs and through increased shipments of cargo, in order to become more attractive to customers. (Mosquera, Martínez, Gil, & Triana, 2018).

Clearly, certain processes mentioned above can be automated, such as self-propelled gantry trucks, automated container storage systems and self-guided vehicles. With these three logistical processes, a considerable increase in productivity would be achieved in the process and it would be a plus to improve the treatment of the environment since several of these processes would be used with alternative energies that allow a cleaner process.

2.2. "Describe the benefits that the implementation of an automation system could generate for the logistics operation of the port of Buenaventura".

The world's first automated terminal, located on the European continent, is referred to as the main example.

The port of Rotterdam is considered one of the leading ports and pioneers in implementing the most advanced technology in the process of its logistics operations (Coma, Marta, 2015), the port is known for having the terminal with the highest degree of automation that exists, the terminal Maasvlakte 2. In addition, as mentioned above is a pioneer for having implemented the first automated terminal in 1993 ECT Delta Terminal.

The ECT Delta terminal has a fleet of 265 vehicles and 140 cranes that are automatically guided for the transport of containers. (Carballo Mesa & Ignacio, 2014) thanks to the automation of this machinery together with the self-motivation of the drivers, the handling in the operations in the port is more optimal, since in addition to improving its productivity, it increases the performance in the work of its operators.

As mentioned above, the control and monitoring of cranes that are operated by remote control, are supervised by cameras on board, which gives a better view in comparison when the operator is in the cabin. (Carballo Mesa & Ignacio, 2014) The implementation of these systems combined with the access to information increases the efficiency of port operations, because not having a person on board the crane, the unloading of a ship is done with greater agility, this in turn translates into greater competitiveness because it reduces the costs associated with the operation because the permanence of the ship in port is much less than in a traditional one.

According to (Carballo Mesa & Ignacio, 2014) Thanks to the investment of more than 500 million euros for the automation of the terminal, is handling one million containers 20 feet more and thus has improved production by 50% compared to other ports that handle most of their processes manually, in addition to the increase in container handling the port has also achieved greater integration with other modes of transport generating a decrease in time in terms of loading and unloading of containers.

In addition to the ECT Delta terminal (Coma, Marta, 2015), the greatest reference we can find today is the APMT Maasvlakte 2 terminal in Rotterdam, which in addition to being a fully automated terminal is a great example to follow, not only for its capacity to move 2.35 million containers a year but also because it is known to contribute to environmental sustainability thanks to its machinery is electric and wind power.

(Gayá, 2018) Since the first automated container terminal in Rotterdam came into operation 25 years ago, this tool has become the most widely used to improve productivity and efficiency in a port.

The importance of this is manifested by its positive effects in terms of productivity, safety, and environmental sustainability.

In the same way, it is important then to highlight the different benefits that can bring for a terminal such as Buenaventura automation of most of its logistics processes, initially with automation increases the efficiency of the port, having cranes with remote control has greater control and monitoring of their operations, also, as mentioned above, the discharge is much faster so the port can optimize the maximum space of its facilities because the permanence of the ship in port is much less than that of a traditional terminal. Also, because of the remote handling, the security and protection of the port is increased because it

reduces the probability of human errors and accidents. Likewise, automated terminals contribute to environmental sustainability, because they have a lower impact on the environment compared to traditional ones, in addition to having electrical and wind machinery that generates less atmospheric pollution, they also have smaller spaces, which reduces the number of transfers.

As described above, it can be concluded that traditional terminals not having their processes automated can incur higher costs in their operations, this in turn makes them less productive and competitive worldwide by their inability to respond to the great demand of the global market in a more efficient manner.

Another country as a benchmark study is Shanghai, one of the most important ports in the world and the most attractive in terms of volume of containers, unlike Rotterdam the port is recognized is thanks to the fourth phase of the deep water port of Shanghai, the largest automated container terminal in the world, (has 2.2 million square meters and has a coastline of 2,350 meters). (Prosertek, 2019)

Ranking published by The World Shipping Council on the ports with the largest movement of containers in the world.

Table 3. Movement of containers in Latin America

Rank	Port	Volume 2018 (Million Teu)	Volume 2017 (Million Teu)
1	Shanghai, China	42.01	40.23
2	Singapore	36.60	33.67
3	Shenzhen, China	27.74	25.21
4	Ningbo-Zhoushan, China	26.35	24.61
5	Guangzhou Harbor, China	21.87	20.37
6	Busan, South Korea	21.66	20.49
7	Hong Kong, S.A.R, China	19.60	20.76
8	Qingdao, China	18.26	18.30
9	Tianjin, China	16.00	15.07
10	Jebel Ali, Dubai, United Arab Emirates	14.95	15.37

Source: Own elaboration based on the ranking published by The World Shipping Council.

As can be seen in the table above, according to the ranking published by The World Shipping Council on the ports with the largest movement of containers in the world, it can be noted that the ports of China occupy the top positions, this is thanks to the massive influence they have on world trade and operations on maritime trade, however it is important to note that the port of Shanghai maintains its leadership not only as the largest port of China, if not the world, with an increase of approximately 5.4 million Teus from 2017 to 2018 respectively.

Shanghai has been recognized as the most important ports in the world thanks to the optimization and efficiency of its areas, which include Yangshan, the terminal where it is making the largest investments in logistics technology and automation.

The Yangshan area has 27 twin-lift cranes, thus achieving a crane movement efficiency of 196.64 movements per hour with a productivity per ship of 850.53 movements per hour, while the rest of Shanghai reported a lower average efficiency that is not bad, but is nevertheless similar to the average handled of a traditional terminal. (Marta Coma 2015).

With the automation of this terminal, the port has increased its efficiency in operational management and has also contributed to environmental sustainability by reducing carbon emissions by up to 10%, as reported by the president of Shanghai Chen Wuyuan International Port Group. Similarly, with the implementation of this contributes to the port remains consolidated as one of the best ports and the most active in the world. (Prosertek, 2019).

The terminals have experienced very significant benefits with the automation of their logistic processes, as they mention in (Food Industry, 2016), the advantages that we find the most are directly related to safety at work, greater control and tracking, greater capacity to handle large volumes of containers and improved cost efficiency.

From the above, automation will then allow the port of Buenaventura to increase its productivity. According to (Del Pino, 2018) the increase in productivity translates into greater capacity for import and export of goods, also helps to optimize operations in port, increases efficiency in time management lowers costs of services, and allows the port to have access to new business doors in international trade, also, as mentioned (Belito Subilete

& Velásquez Quispe, 2014) with automation decreases the incidences occurred by human errors and has better control of information because it is obtained in real time. All of the above combined with predictability, reliability and reduced environmental impact (Matorel Silva & Padilla Arias, 2016). The port of Buenaventura can become one of the most competitive ports in Latin America thanks to its innovation, efficiency and productivity in the management of its operations.

In the same way, as the benefits of two of the main automated terminals in the world are described, there is a general reference to the different benefits that could be brought by a terminal such as Buenaventura's, the automation of several or all of its port logistics processes. (Peris Carabal, 2018):

In addition to the previously mentioned benefits the port of Buenaventura can also benefit from automation in:

- Greater consistency of your operations.
- Reduced operating costs.
- Greater protection and safety at work, thanks to the absence of personnel in the operational areas.
- Reduced downtime, which translates into increased operation for the port, thanks to which the machinery can operate 24/7 without the need for personnel.
- Less environmental impact, thanks to the availability of electrical equipment and less combustion.
- Reduction in the probability of human errors.
- Greater handling according to container density

2.3. "To propose improvement actions so that the port of Buenaventura can reach an ideal level of automation, comparable to the leading ports in the world".

Starting from the aspects previously developed, where the current state of the port of Buenaventura has been evidenced and at the same time logistical processes capable of being automated have been identified; where the benefits that could be generated for the logistical operation of the port through the implementation of an automation system have been determined, it is intended to propose a series of improvement actions that will allow the

port in case of being carried out a substantial improvement of the current conditions and at the same time to increase the possibilities of success in the implementation of automated logistical processes inside the port terminal.

Such improvement actions must be addressed from several fronts, one of them is the aspect of the infrastructure where one of the initial actions could be to increase the maximum draft in the docks, which today is 41 feet, ie 12.5 meters deep, which can only receive up to Panamax type vessels, being out of the question to receive vessels such as Post Panamax or New Panamax, which require between 13 and 15.2 meters draft, with the implementation of this action to improve the port could become a place of transit, loading and unloading of multiple carriers, which today must seek to mobilize their cargoes in ports such as Balboa in Panama, Callao in Peru and Manzanillo de Mexico, an action of improvement as this would significantly increase the competitiveness of the port.

A determining exogenous factor for all stakeholders of the port of Buenaventura is undoubtedly the road infrastructure built around it, which has proved deficient, old and uncompetitive to the needs of end users of the port, despite having received resources from the state that have been translated into works such as the Loboguerrero tunnel, the prosperity highways or currently the tunnel of the line the above are still insufficient actions if you want to take advantage of the privileged position that the port has both in the country and South America; Currently the transit time between the main cities and the port is still relatively high, which translates into great costs and inefficiency for entrepreneurs; if you look at the local panorama of the port is also not encouraging despite the efforts shows deficiency in the road network and low level of modernization in road infrastructure; therefore the challenge for the State will undoubtedly consist of addressing with category the decision to invest in quality road infrastructure that allows the port to potentiate and bring it to levels of competitiveness of other ports in the region.

World-wide during the last few years, especially in developed countries, process automation has become one of the best tools to save costs and increase productivity in almost any industry, making it an increasingly important process as expressed below.

For the economic progress of companies, it is essential to identify and explore new methods in production and logistics processes, especially those based on new technologies, in order to reach the levels of competitiveness demanded in an increasingly globalized market. (Observatory of Future Trends 360°, 2017, pp. 15-16)

With respect to the machinery with which the port of Buenaventura could begin the process of automation of its operations is common in the ports that have implemented such processes start by AGV vehicles, which as it says (Rodrigo de Larrucea, 2018) "The AGV is the first type of self-guided internal transfer vehicle to serve container terminals⁷. It consists of a non-articulated platform with a load capacity of 1×20', 2×20', 1×40' and 1×45"', its main function is to transport containers autonomously and programmed into the port in usually constant routes, which allows the process of automation of the operation; another of the characteristics of this type of autonomous vehicle is the possibility of programming it from a master control according to the needs of the port through GPS or, failing that, through the use of transponders installed in the lower part of the vehicle and on the floor of the terminal which are in charge of receiving and emitting signals that allow the equipment to move according to the programming generated by the company. This is therefore an improvement action that would allow the port to improve the time of movement of goods on the port platform and would increase the security of the cargo and at the same time of the personnel.

Another piece of equipment that could become a key differentiator in port operations by radically increasing the productivity of the operation would be the acquisition of RMG (Rail Mounted Gantry Cranes) which are "Similar to RTGs, but on rails, they are usually larger so they have greater capacity and the blocks in the yard are usually larger. They're very popular because of the control and efficiency." (Ferrer Sánchez, Comillas Repository, 2018) These cranes require a specific layout to obtain maximum efficiency, but once installed they guarantee the optimization of space, optimization of movements and safety in the operation, which translates into efficiency in operating costs, these would improve the operation by having almost twice the speed in displacement that the RTG cranes and with the goodness of allowing the complete automation of the equipment.

For both improvement actions mentioned above, a significant investment would be required on the part of the shareholders, including the State, due to the high cost of the equipment and in itself to all the development that the implementation of an operation automation project in the port terminal must bring with it. The financial process then becomes one of the most important challenges to carry out such a significant change in the direction of the port, since the attainment of such resources requires studies and enough analysis to determine the leverage necessary to carry out this change in infrastructure.

Equally important should be the improvement actions that address the social, economic, cultural and political problems of Buenaventura and the Colombian Pacific coast itself, because these factors directly affect the performance of the port and the improvement of the perception of the port for nationals and foreigners.

With regard to social aspects, there are many actions to be undertaken by ordinary citizens, local and national government, the industrial sector and the port society in order to mitigate the current problems and at the same time execute structured plans that allow the municipality to overcome the scourges that have afflicted it during the last decades and that have undoubtedly led it to become one of the most complex places within the national territory due to the confluence of negative factors, information that confirms the following (García Ortega, 2016) when he says "The city has great opportunities thanks to the port, but it should be noted that many of these opportunities are not taken advantage of due to the social, economic and security problems of the area.

The set of problems faced by the District of Buenaventura should not be dealt with as independent factors since in this way the holistic vision required by the situation of the port and its inhabitants would be ignored; it then becomes imperative for the national government to establish comprehensive policies that allow it to determine each of the factors and problems to be improved (Montoya Restrepo N. , 2017), this allows it to draw an efficient and effective road map and at the same time prioritize the actions to be undertaken.

At the head of the national government should be the planning, development, monitoring and verification of policies to address issues such as unemployment which at the end of 2018 showed figures of the order of 18.4%. (DANE, 2019) This is substantially higher than the national unemployment rate, which closed in the order of 9.7%; the above denotes an obligatory field of intervention since the lack of income generates poverty and this in turn can generate that members of civil society choose to enter groups outside the law in search of some type of economic income.

Based on the above, new improvement actions arise such as the fight against poverty and inequality, which have hit most of the District of Buenaventura fundamentally to present absence or shortages in basic aspects and necessary for the development of the civilian population such as access to health, education, housing, public services.

Situation analyzed below where the author reveals what they constitute according to his perception institutional weakness.

Lack of coverage and at the same time lack of quality lead to minimal access to health and education services. When analyzing the news published in different media, Buenaventura is one of the many examples in the country where resources destined to health and education are kidnapped by unscrupulous hands of 'governors' from the same region, who are only interested in filling their own pockets, this shows the lack of planning and monitoring by the national government to these programs. (García Ortega, 2016, p. 71).

These types of indicators are an alert for future investors, since they can see that despite being a profitable business, their investment is at high risk.

This ratifies how the great efforts required by the situation and the current environment of Buenaventura should be linked to public and comprehensive strategies led by a joint effort between the national government, the departmental and municipal administration; this course of action should establish a critical route that determines, according to the levels of importance, a strategic planning that is clear, measurable and verifiable over time, that addresses the problems suffered by the district due to factors such as corruption, inequality, poverty, illiteracy, unemployment, insecurity, racism, social exclusion and criminality, among others; this strategic planning could be the most ambitious of the strategies, but without a doubt the one with the best results for the civilian population and therefore for the port.

It is the change in the culture of the country itself and in particular of that area immersed in conflict for so many years, a merciless culture of self-interest at all costs, even at the expense of harm to other members of civil society, a culture of the most "alive" that has only triggered a snowball called corruption; if it is possible to increase the population's sense of belonging to their territory, respect for others and self-care, the chances that the improvement actions proposed above will be successful will increase considerably, together with the fulfilment of the strategic plans.

3. Conclusions and Recommendations

3.1. Conclusions

- The port of Buenaventura has a strategic geographic location, but due to mismanagement of the invention received, has not managed to evolve in its competitiveness in the global market.
- The social situation experienced by the population of Buenaventura directly affects the image of the port in the eyes of interested investors. Illicit activities surrounding the port contaminate the port, creating insecurity and deterioration of the sector.
- There are leading ports in the world such as Shanghai and Rotterdam that through the automation of processes have successfully increased considerably their productivity and efficiency, in addition, they have positioned themselves as the most important leading ports in the world, in addition to creating clean energy alternatives that help the environment.
- Automation alone does not constitute a practical solution for a problem such as the port of Buenaventura, it must first be analyzed in depth to determine which logistical processes are likely to automate.
- Investments in third world seaports can range from 20 to 50 years of application, which makes it a costly and unprofitable investment for a private investor, ways must be found to achieve greater efficiency in this type of projects to attract the attention of external investors.
- There are endogenous and exogenous factors that, accompanied by the situations presented in the market change, cross forming complex tensions that become barriers to the development of the port of Buenaventura.

3.2. Recommendations

- Re-evaluate the country's current political system and change the way the national budget is distributed to cover unprotected areas, including Buenaventura.
- Redirect Buenaventura's port management with a view to open management of change management.
- According to the June 27, 2019 edition of the magazine "Todos ponen por Buenaventura" the expected investment for Buenaventura over the next 10 years will be \$10 billion pesos, which should be monitored so that the areas surrounding the port can improve the quality of life of the inhabitants of the sector and thus improve the image for foreign investors. (Money, 2019)
- To look for companies or people who already have experience with the implementation of automation processes in other ports of the world, to be guided in this process successfully.

4. Bibliography

- Agudelo, J. C., & García, B. C. (2019). *Logistic Parks*. Medellín: Esumer.
- Barbero, J. (2006). Colombia's public ports facing the challenges of the FTA. *Journal of Engineering*, (24), 101-103.
- Belito Subilete, C., & Velasquez Quispe, L. N. (2014). Implementation and evaluation of the systems integration service in process automation at APM Terminals Callao S.A. Huancayo: Universidad Nacional del Centro del Perú.
- Buenaventura Chamber of Commerce. (2012, December 13). Retrieved from <https://www.ccbun.org/articulos/ventajas-competitivas>
- Carballo Mesa, C., & Ignacio, H. S. (2014). *The Port of Rotterdam*. University of La Laguna.
- Castellanos Ramírez, A. (2015). EBSCO . Retrieved March 24, 2019, from <http://web.a.ebscohost.com/ehost/detail/detail?vid=8&id=f46ad21e-638c-40db-a95bf9ec5e1f6d15%40sessionmgr4007&data=JnNpdGU9ZWwhvc3QtbGl2ZQ%3d%3d#A N=1531650b=nlebk>
- Castro Castell, O., Soler Niño, E., Umaña Castellanos, R., & Yepes Lugo, C. (2017). Port infrastructure in Colombia: asymmetries between the port of Buenaventura and the port of Cartagena for it. *University & Company*, 87-106.
- Cauas, D. (2015). Definition of variables, approach and type. Retrieved from https://s3.amazonaws.com/academia.edu.documents/36805674/IVariables.pdf?response-content-disposition=inline%3B%20filename%3Dvariables_de_Daniel_Cauas.pdf-Amz-Algorithm=AWS4-HMAC-SHA256-Amz-Credential=AKIAIWOWYYGZ2Y53UL3A%2F20191005%2Fus-east-1%2Fs3%2
- Cerbán Jiménez, M. d. (2009). *Economic Competitiveness of Ports*. Seville.
- Coma, M. (2015). Influence of automation systems applied in the management of new container terminals. Barcelona: Universitat Politècnica de Catalunya.
- National Competitiveness Council . (2018). -

=<http://www.competitividad.org.do/wp-content/uploads/2019/05/Movimiento-deCarga-en-Contenedores-de-los-Puertos-de-LAC-2019.pdf> sync:BCÈÊÈÊ

DANE. (2019, April 15). DANE. Retrieved from Technical Bulletin: https://www.dane.gov.co/files/investigaciones/boletines/ech/ml_nvos_dptos/bol_cc_dptos_amazonia_orinoquia_18.pdf

Del Pino, K. H. (2018). Implementation of a network infrastructure for a port company. Barcelona: Univesitat Politècnica de Catalunya BarcelonaTech.

Díaz Durán Lourdes. (S.f.) Automation and digitisation in the stevedoring sector. The future in ports. Retrieved from: <https://anesco.org/wp-content/uploads/2019/06/Automatizacion-y-Digitalizacion-de-los-Puertos-delFuturo.pdf>

Díaz Vargas, Á. H. (2015). Buenaventura: City-port or port without city. Bogotá: National University of Colombia.

Money. All-put-in-for-adventure. 6/27/2019. Retrieved from: <https://www.dinero.com/empresas/articulo/todos-ponen-por-buenaventura/273680>

Money. (2019, May 30). Retrieved from <https://www.dinero.com/edicion-impresa/pais/articulo/cuales-son-las-diferencias-y-problemas-en-el-puerto-debuenaventura/272629>

Felipe, B. G., & Iván, G. O. (2018). Navigating towards a fourth generation system in the port of Buenaventura. Colombia: Catholic University of Colombia.

Fernández Melle, F. (1996). Telematic applications in the maritime-port sector. Strategy Notebooks, 79.

Ferrel, H. R. (2015). International commercial logistics. In A. Castellanos Ramírez, Logística comercial internacional (page 282). Barranquilla : UN Universidad del Norte .

Ferrer Sánchez, B. (2018). Automation study of the port terminal of Inter Sagunto, Port of Sagunto.

García, B. C. (2019). Theoretical justification of research work. Medellín.

García Ortega, P. M. (2016). Analysis of the social and economic situation of the Port of Buenaventura. *Mercatec*, 66-74.

Gayá, R. (2018). Port automation and other challenges for Latin America. *Bridges*, 9.

Gil, I., Mollá, A., & Ruiz, M. E. (2008). Automation of the warehouse and assortment in the distribution of products of durable use. *UCJC Business and Society Review* (formerly known as *Universia Business Review*), (19).

Gómez, J. M., Herrera, T. J. F., & De la Hoz Granadillo, E. (2012). Analysis of financial indicators in Colombian port companies. *Frame*, 8(1), 14-26.

Hassam, B. (2001). Competitiveness and foreign trade. *Bancomext*, 767.

Hernandez Gomez, R. *Pacific Alliance Competitiveness*.

Hoffmann, J. (2000). The potential of pivot ports on the Pacific coast of South America. *ECLAC Magazine*.

Hurtado, J. L. M., & Gómez, L. E. N. (2017). Internal factors affecting the international competitiveness of the port of Buenaventura, Colombia. *Free Enterprise*, 15(1), 103118.

Food Industry. (2016). Automation: an entry for greater capacity and productivity in the cold chain. *Food Industry*, 42-43.

Jiménez Pérez, N., & Delgado Moreno, W. (2008). The public policy of privatization of the port sector and its impact on the organization of work in the port of Buenaventura. *Thought & Management*, (25), 178-213.

The Republic . (2018, December 4). Retrieved from <https://www.larepublica.co/economia/sociedad-portuaria-de-buenaventura-invierteus83-millones-en-infraestructura-2801551>

Lazzati, S. (2016). *Manager: strategist and change leader, El: Beyond operational management*. Granica Editions.

Montoya Restrepo, N. (2017). Informality as mismatch. An approach to the treatment of Integral Neighbourhood Improvement (MIB)*. *Scenarios*, 35-50.

Matorel Silva, Y., & Padilla Arias, F. J. (2016). Implementation of automated Segcarts:

impact on the efficiency of operations in a maritime container port. Cartagena: University of Cartagena.

Moreno Martínez, C. (2013). Methodology for maximising the profitability of a maritime container terminal by optimising its degree of automation. E.T.S.I. Roads, Canals and Ports (UPM).

Moreno, W. D., & Sander, Á. M. M. (2015). Port Privatization in Colombia: Management Modes and Public-Private Relations. *Revista de Administración Pública*, 46, 53-91.

Mosquera, Martínez, S., Gil, D. M., & Triana, D. A. (2018). Comparative study of the ports of San Antonio and Buenaventura with a view to improving competitiveness: Case of Colombia. *Point of View*, 20.

Maritime World . (2019, October 8). Retrieved from <https://www.mundomaritimo.cl/noticias/puerto-de-buenaventura-colombia-caladode-125-metros-resta-competitividad-frente-a-otros-terminales-de-la-region>

Nieto, E. C. (2006). Manufacturing and automation. *Engineering and Research*, 26(3), 120128.

Observatory of Future Trends 360°. (2017). Intelligent control and automation. *Mercatec*, 15-23.

Oviedo Arroyo, C. A. (2015). *Analysis of the environment of an organization of the port sector of the special, industrial, biodiverse and ecotourism District of Buenaventura*. Buenaventura: Universidad del Valle.

Ovalle, A. M., Ocampo, O. L., & Acevedo, M. T. (2013). Identification of technological gaps in industrial automation of companies in the metal-mechanic sector of Caldas, Colombia. *Engineering and Competitiveness*, 15(1), 171-182.

Peris Carabal, M. (2018). Study for the automation of the Noatum maritime container terminal in the port of Valencia. Valencia: Universitat Politècnica de València.

Perlaza, O. J. (2019). The Responsibility of the Colombian State for forced displacement in the Special Port District of Buenaventura, due to Public Port Policies. Santiago de Cali: Universidad Santiago de Cali.

Prosertek. (2019, January 29). Prosertek. Retrieved from

Rodrigo de Larrucea, J. (2018, 06 20). Automated and semi-automated terminals. Operative and equipments. Retrieved from UPCommons: <http://hdl.handle.net/2117/118227>.

<https://riunet.upv.es/handle/10251/117134>

Ruedas, C. (2010). *Industrial Automation: Areas of application in Engineering*. Guatemala: Universidad Rafael Landivar.

Sánchez, R., & Mouftier, L. (2016). Reflections on the future of ports: from current stress to future change and innovation.

Sánchez, R. J., Barleta Palma, E., & Mouftier, L. (2017). Reflections on the future of container ports. *Natural Resources and Infrastructure*, 24-25.

Trujillo, L. J. (2019, June). Article Final Work of the program of Specialization in Integral Logistic Management. Retrieved from <https://repository.unimilitar.edu.co/bitstream/handle/10654/31730/CabreraTrujilloLeidyJohana2019.pdf.pdf?sequence=1&Allowed=y>

Vargas Cordero, Z. R. (2009). *Educación Magazine* . Retrieved from <https://www.redalyc.org/pdf/440/44015082010.pdf>

Velásquez C., J. (2004). How to justify automation projects. *Industrial Data*, 7-11.

Vélez, P. C. O. (2009). Logistic and global management. *Business School Magazine*, (66), 113-136.

World Shipping Council. 2019. *Sobre la Industria. Los 50 Puertos Mundiales de Contenedores*. Recuperado de: <http://www.worldshipping.org/about-theindustry/global-trade/top-50-world-container-ports>