Application of PDCA Cycle Methodology in Management of Continuous Improvement in Receiving and Movement Logistics

Erika Santos Queiroz
erikasantos.queiroz2@gmail.com
Centro Universitário FAMETRO – Amazonas - Brasil

David Barbosa de Alencar
david002870@hotmail.com
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Alexandra Priscilla Tregue Costa
ptreguep@yahoo.com.br
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Marden Eufrasio dos Santos
nedram.santos@gmail.com
Coordenação de Engenharia de Produção do Centro Universitário FAMETRO – Brasil

Abstract

Logistics is one of the main processes within organizations, because it is possible to store different types of items in stock. However, maintaining management is not a simple role, as the process needs to be integrated with the quality, storage and accuracy of stored resources, which are as high as possible, and this makes it a bigger challenge for the vast majority of organizations. The present work aims to propose an application and management of the PDCA cycle methodology for greater efficiency in the receiving and handling sector, reducing costs and controlling container yard operations, without major investments, just by using the PDCA and some Quality tools.

Keywords: Logistics, Receiving and Moving, PDCA Cycle, Quality Tools, Accuracy.

1. Introduction

Logistics has been the main management of the supply chain, as it is through it that the planning, implementation and control of all storage flows are efficiently and economically possible for raw materials, semi-finished materials and finished products, as well as as the relative information, from the source to its consumption, because the purpose is to meet the requirements of customers. (OAK, 2002).

According to NOVAIS (2004) the concept of logistics was mainly in military operations. When deciding to follow with their troops followed a definite line, the generals should have, before their troops orders, there was always a group that performed the locomotion, at the right time, ammunition, food and all medical

supplies and help for the battle. . Because this service was only supportive, without much strategy and no influence on battle winnings, military logistics teams worked in the dead.

Industries that aim to remain competitive in the market place processes in continuous improvement methods, so that all sectors become lean to ensure the success of the strategy. The receiving and handling cycle needs to become a fully streamlined process for the use of improvement tools to assist in the management of procedure development actions that can minimize the lead time between receiving and moving materials to production.

The justification of this paper seeks to demonstrate how it is possible to use one of the main quality management tools through the Plan, Do, Check and Act (PDCA) cycle can be used in Logistics Management, proposing a continuous process improvement, identifying and / or eliminating / decreasing divergences that directly affect the outcome of the logistics process within the company. The general objective proposed in the paper is to demonstrate means of continuous improvements in the receiving and movement logistics with the aid of the PDCA Cycle tool, separating them into three main specific objectives: to seek the main divergences, to propose ways to achieve results and to describe how The PDCA tool can be deployed in the industry.

2. Theoretical Reference

2.1. Logistics and Supply Chain

According to DASKIN (1995), he explains that logistics is a form of planning between physical operations involving warehouses, transport networks, vehicles, etc., as well as systemic information in management processes, processing and data. Where are indispensable for the raw materials and finished products that control the physical and temporal limitations of an economic aspect.

NOVAIS and ALVARENGA (1994), defined that logistics can be divided into three types: logistics in the industrial system, supply logistics and distribution and marketing logistics, where it has been admitted the dealings of identification of consumer requirements, paying attention to market and the needs customers expect.

According to CORRÊA and XAVIER (2013) is the estimated activity to move and establish inventory positions within the supply chain. That is, logistics work can include product or input transportation, fleet control and material handling, demand and / or supply planning, and logistics service management.

2.2. Receiving and Handling

According to SANTOS (2001), the receipt of material and / or raw material is the progress of the logistics sector, is the sum of operations that includes the recognition of all material that was received, so it is possible to compare tax documentation with the physicist, thus releasing for qualitative and quantitative inspection of materials and approval of the same.

For DIAS (2012) companies that have stopped inventories give rise to extra expenses and their movement is performed when it is necessary to consume. In order for the raw material to become a product, some basic elements for its manufacture are needed: man, machine and / or material to be monitored.

DIAS (2012) also concludes that the general inventory can be moved / dynamic, physical movement can

control all storage and even dispatch the material, being performed with the following equipment: transport, fixed and mobile cranes, lifts, industrial vehicles such as trolley. of various types, terex, positioning equipment, containers and other structures can support the operation.

2.3. PDCA Cycle Methodology

MARSHALL JR. (2008) tells us that the PDCA cycle is a management method and that promotes the improvement of activities, as practicing continuously can provide improvements and regularization in the organization, thus validating the systematization of all actions if they were effective in the process. .

AGUIAR (2006) tells us that the survival of an organization needs the efficiency in which it has to respond to the needs of consumers. The PDCA cycle is a method of analysis and process change by which planning does not happen once. PDCA aids control and helps to make each process go as smoothly as possible. The management system that applies the PDCA cycle must face challenges of this methodology.

According to CAMARGO (2011), Total Quality Control is a method that is the most used because it promotes behavior in the supply chain, as it promotes continuous quality improvement, thus increasing process efficiency and production. it can thus have a cost reduction, which leads to increased profits and market conquest.

2.4. Quality Tools

According to MARIANE (2005), clarifies that to conduct processes and manage decisions with increased corrections, it is necessary to obtain information that is obtained through these processes, thus having a correct analysis of the data. For this you can use the efficient techniques called quality tools.

Kume (1993) tells us that statistical methods are tools for the efficiency of improvements in the production process and reduction of defects. However, it is necessary to remember that quality tools need to be used correctly, as misuse can cause the expected result not to be obtained. Quality tools and methods such as: Brainstorming, Ishikawa Diagram, Cause and Effect Diagram, 5W2H, Flowchart, PDCA Cycle and others are the most used.

2.5. Accuracy

According to CORRÊA, CAON and GIANESI (2001) tell us that the term used as accuracy means to have quality in what is right and accurate, to do right the first time. It is necessary to perform calculations of both physical values and records and that both are equal or as similar as possible. The movement of materials or items as they are also called in stock needs to be done in real time so that accuracy in stocks can be maintained.

BALLOU (2006), states that there are four fundamental factors within the accuracy of inventory they are: purchasing, moving / storage, storage and product delivery. In order for these factors to function properly, logistical planning is required and that it has symmetry with all other processes.

3. Tools and Methods

The present work was carried out within the framework of a large stock of material imported from a

multinational industrial hub of Manaus. The approach taken to compose the improvement actions was the brainstorming tool to make everyone contribute to the process improvement by suggesting ideas to make the study viable, the Inventory Layout to verify if it is correct or requires modifications, Tack production team, to perform material delivery synchronization, as well as the use of the Mizusumashi System (productivity increase), Kanban which is essential for information flow control and material flow regulation to determine the activities they need developed as clearly as possible by all parties involved in the operation. The logistics of receiving and moving has as its main customer production, which leads the company object of study has adapted to the demand of its customer and changing working methods, in order to meet the needs efficiently.

The approach adopted came with the following steps: Diagnosis of the real and planned situation through in-process studies, proposal for continuous improvement through the PDCA cycle for the receiving and moving materials sector. Analyzes were performed with the help of the Ishikawa Diagram and submitted to an action plan in which it was used to maintain control of each step.

4. Application of the PDCA Cycle Study in Managing the Continuous Improvement of the Receiving and Movement Process

The organization object of the study has as its main activity the logistics of receiving and moving materials. The study unit has great difficulty and suffers large variations in its inventory control, from the arrival of containers at the docks to the final customer. Where five (5) phases are established within the stock. These are: 1st phase - receiving materials, where the storage process in the system is performed; 2nd phase - is when it generates a service report, where the deadline for customer service is stipulated, where the material needs to be deconsolidated and collected because the R.A informs the exact time when the material goes to the production line; 3rd phase - Picking where the material is separated by orders, quantities, models and categories as critical and non-critical; Phase 4 - is the transport or as is also known by the company Milk Run which is the method of accelerating the flow of transport to the productive sector and; Phase 5 - is Production, after the material goes through the previous phases finally reaches its destination, where the raw material finally forms into a finished product.

4.1. PLAN

At this stage began the study of continuous improvement, where a technical team was defined together with the process managers. The planning was done in stages, because after analyzing the actual situation verified in loco of the process compared to the predicted one, it was possible to identify operational failures that prevent the process from becoming efficient and agile.

Using the brainstorming tool it was possible to perform an analysis on top of all proposed ideas and select the best ones to implement continuous process improvement. Figure 01 shows how Brainstorming was performed and what ideas were accepted for the study.

1.Topic:	IMPLEMENTATION OF KANBAN LOGISTICS OF RECEIVING AND MOVEMENT AND MIZUSUMASHI SYSTEM
KANBAN	

2. Audience:	Beginner	Intermediate	Advanced
Receipt and movement logistics	✖		

3. Content Structure:	List	How-To	Q&A	News	Definition	Opinion/Why
No items can be received or moved without kanban	✖					

4. Content Medium:	MRP system	SAP system	MACRO WORKSHEET
Information Transmission - Electronic Kanban			✖

5. Ideas:	Brainstorming
Ideas for receiving and moving materials	Waste of available time (standby)
	Loss of transport
	Lose in material handling
	Daily Item List on D-2 for Inventory

Figure 01 - Brainstorming for KANBAN / Mizusumashi Application
Source: Own Authorship (2019)

After the brainstorming, a schedule for follow-up of the activities was carried out with the names of their respective responsible with established deadlines for each action that was planned as shown in figure 02. The schedule lasted four (4) months for implementation, testing phase. and studies to obtain results.

SCHEDULE																			
Activity / Task	**Responsible**	**Comments**	**Deadline**																
			July				**August**				**September**				**October**				
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	
1. Identify possible inventory waste;	Project Manager	Conduct time study within stock;																	
2. Hold a meeting every 15 days, showing what was found during the study review;	Project Manager / Area Manager	Presentation to process managers																	
3. Reorganization of stock layout to facilitate material movement;	Project Manager / Area Manager	Take area measurements and see if they can be improved																	
8. Biweekly meeting (15 days);	Project Manager / Area Manager	Presentation to process managers																	
4. Study of times and methods of receiving raw materials;	Project Manager	Check production time and adhesion time for each production line and compare how long inventory takes to fulfill																	
5. Presentation of the proposal for continuous improvements in the receiving and handling process; - Replacement of fortnightly meeting	Project Manager	Present the proposal that best suits the process to managers																	
6. PDCA cycle implementation with continuous improvement management - Kanban	Project Manager	Start deployment and awareness of employees and managers																	
7. Test Phase for continuous improvement deployment;	Project Manager	Conduct process testing to obtain expected results																	
8. Biweekly meeting (15 days);	Project Manager / Area Manager	Presentation to process managers																	
9. Perform the PDCA Cycle Spin to verify that the implemented actions are getting results;	Project Manager / Area Manager	Collect information and verify results are being obtained as planned																	
10. Biweekly meeting (15 days);	Project Manager / Area Manager	Presentation to process managers																	
11. PDCA cycle implementation with continuous improvement management - Mizusumashi System	Project Manager	Start deployment and awareness of employees and managers																	
12. Test Phase for continuous improvement deployment;	Project Manager	Conduct process testing to obtain expected results																	
13. Biweekly meeting (15 days);	Project Manager / Area Manager	Presentation to process managers																	
14. Perform the PDCA Cycle Spin to verify that the implemented actions are getting results;	Project Manager / Area Manager	Collect information and verify results are being obtained as planned																	
15. Delivery of the Project of Continuous Improvement of the Process of Receiving and Movement of Materials;	Project Manager / Area Manager	Report Delivery and Finalization of the Continuous Improvement Project																	
16. Biweekly meeting (15 days).	Project Manager / Area Manager	Presentation to process managers																	

Figure 02 - Activity Schedule

Source: Own Authorship (2019)

4.2. DO

After preparing the Schedule and defining the team in which to act in the implementation of the study, hears a presentation meeting to managers and process managers, showing what will be done and what

benefits the study will bring to the sector. This step is where all planning needs to be carried out and activities have been prioritized according to the defined action plan. Figure 03 shows the identification of the problems and their causes.

Activity / Task	Responsible	Deadline
1. Identify possible inventory waste	Project Manager	15 days
Lots waiting for availability of resources to be processed, off-batch items waiting for collection to advance the picking area, collaborators finalizing formatting and deconsolidation of materials.		
2. Loss of Transport		
Timeless transport and out-of-specification routes		
3. Loss in Material Handling		
Usually caused by operators, where it is possible to observe the oscillity.		
4. Daily List of Items in D-2 for Inventory		
The items are scheduled in the container pull always 2 days in advance, predicting the possible R.A that are scheduled		

Figure 03 - Problem Identification
Source: Own Authorship (2019)

In the first 15 (fifteen) days of the study, it was possible to identify the major problems that directly affect the Imported DCC, thus, it was possible to perform the activities that were scheduled in the schedule such as the reorganization of the company's movement layout structure, facilitating the company's supply routes, the realization of times and methods in stock with the operators in the deconsolidation, formatting and material collection part.

Implementation of Kanban continuous improvement for information flow control and material flow regulation. The purpose of the implementation is to signal the consumption of a product through a more advanced process, where it is possible to signal the programming the exact quantity and in real time the material showing if it has already been deconsolidated, formatted and collected by the operation. Rotation of the PDCA cycle needs to be performed at each stage for errors to be evaluated and not to compromise the study. Figure 04 shows the Kanban functions and the rules for their use.

KANBAN FUNCTIONS	RULES OF USE
Provide information about picking up or transporting.	The subsequent process picks up the number of items indicated by the kanban in the preceding process.
Provide information about production.	The initial process produces items in the quantity and sequences indicated by the kanban.
Prevent overproduction and excessive transportation.	No items are produced or shipped without a kanban.
Serve as a manufacturing order affixed to goods	It serves to affix a kanban to the goods.
Prevent defective products by identifying the process that produces them	Defective products are not sent to the next process. The result is 100% defect-free merchandise.
Reveal existing issues and keep track of inventory	Reducing the number of kanbans increases your sensitivity to problems.

Figure 04 - Kanban System Rules and Functions
Source: Kanban Functions and Rules (Ohno 1997, p.48)

Continuous process improvement was initiated by material scheduling, where advance scheduling of at least 4 days prior to material pull was established, with this new system in anticipation pull processes Mizusumashi system can be applied within the logistics, because with time and method studies it can be seen that operators lose about 15 to 35% of total work time due to lack of a process flow. With Mizusumashi it was possible to define a car supply route so that the Just-in-time philosophy can be put into practice. Figure 05 shows the flow in which the material needs to be taken, respecting the lead time and tack time of each process so that it does not delay the following processes.

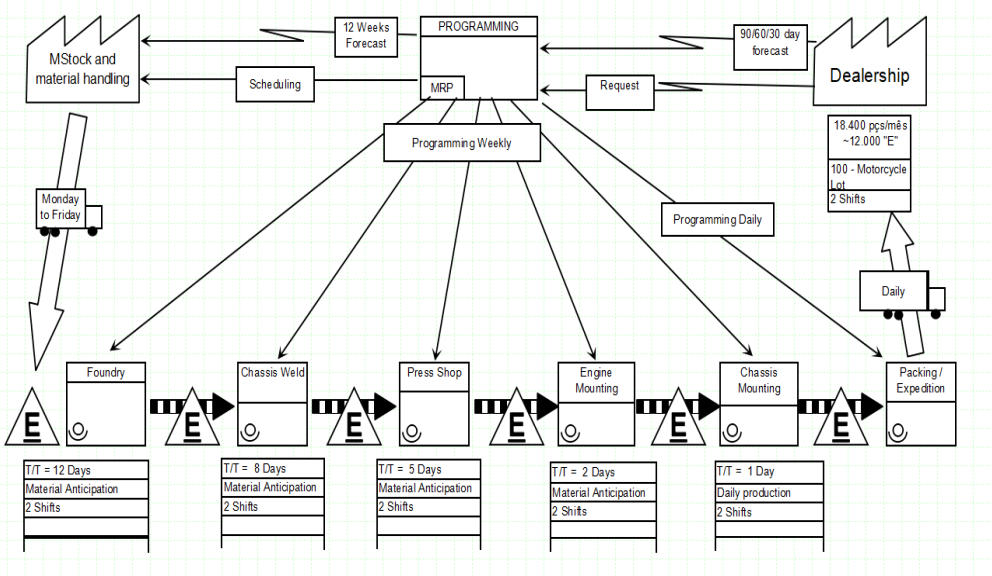

Figure 05 - Flow Implementation - Kanban / Mizusumashi for Continuous Improvement
Source: Own Authorship (2019)

4.3. CHECK

For the verification of the third phase of the PDCA cycle, a technical team was defined where the project manager performs a monthly audit, together with the area responsible for monitoring and developing the implementation of the implemented improvements. The audit was assisted by the Checklist and all results were presented in a formal meeting to the respective heads of each area involved.

The results achieved in the audit verification were quite satisfactory for those involved in the process and the person responsible for the study. In figure 06 the Checklist shows the questions that were applied in the application audit phase.

Yes	No	Initiation Phase
x		1. Is the continuous improvement proposal achieving expected results for the organization?
x		2. Will strategic resources be available to conduct the project?
x		3. Have all employees been oriented towards continuous improvement being applied to the process?
x		4. Is the strategy and scope of continuous improvement clearly defined?
x		5. Does the proposal enable results and return on the expectations of the organization?
x		6. Is the qualitative and quantitative assessment of continuous improvement consistent?
x		7. Has a preliminary risk assessment been carried out? Is the certainty of the estimates sufficient for the level of risk that the organization can tolerate?
x		8. Were key stakeholders and stakeholders adequately involved?
x		9. Will the team need any form of support, training, direction and / or follow-up?
x		10. Is all the relevant information needed to proceed with the improvements available and organized?
GP Signature:		
Space for justification if project is aborted		

Figure 06 - Verification Phase Checklist

Source: Own Authorship (2019)

4.4. ACT

After the verification and audit phase of the application process, there was a results presentation meeting, where the study leader presents the results obtained during the period of continuous improvement application. In these meetings it is possible to verify the execution of each step of the process and whenever possible make the PDCA cycle rotate for better results. The employees were trained and oriented on the

application of the new methodology applied to the process.

At this stage it was possible to correct the failures that were hindering the expected result, and thus new actions to correct errors could appear. The study obtained a satisfactory result, because with the management of continuous improvement through the PDCA cycle, the improvements are being significant for the process of receiving and moving materials. In this way, inventory can have employees and managers who can identify the problem and suggest changes in the rate at which material flow occurs.

5. Results and Discussions

The work developed allowed the application of new methodologies within the inventory and management of the PDCA cycle with the managers responsible for the area. The application of Kanban and the Mizusumashi system allowed for an easier and simpler supply route for production fulfillment reporting. The application of Kanban allowed the flow that was developed to become agile for service, from material scheduling to final customer arrival (production). The indicator in figure 07 shows from July that was the beginning of the study until its conclusion in October, where the control became satisfactory, because the errors were treated in the first month, causing the PDCA cycle to spin. and make the logistics process effective.

GOAL MONITORING - INDICATORS										SUBTITLE	
										Answered:	☺
IDEAL: M = Monitoring indicator for administration and decision making. M1 = Indicator for monitoring results generated and controlled by third parties, without the possibility of interference in the Factory. SD = No data input to generate indicator										NOT MET:	☹
UNITY SECTOR	INDICATOR	OBJECTIVE	TREND (BEST)	GOAL	IDEAL	JULY	AUGUST	SEPTEMBER	OCTUBER	OBS	
TRACK	Track attendance	Show yard performance as service times deliver containers	↓	50 CNTR	45 CNTR	☹ 43 CNTR	☺ 46 CNTR	☺ 47 CNTR	☺ 46 CNTR		
RECEIPT	Amount of Service on Receipt	Show material pickup performance	↑	50 CNTR	45 CNTR	☹ 43 CNTR	☺ 45 CNTR	☺ 45 CNTR	☺ 45 CNTR		
DESCONSOLIDATION	Material taken from KD´S to be placed in carts / pallets / basketballs	Show D4 material deconsolidation performance	↑	D-4	D-4	☺ D-4	☺ D-4	☺ D-4	☺ D-4		
FORMATATION OF MATERIALS	Time to send materials for collection	Ensure shipping and track materials until delivery to next phase - collection	↓	D-4	D-4	☺ 4 days	☺ 4 days	☺ 4 days	☺ 4 days		
MATERIAL COLLECTION	General Productivity	Ensure shipping and track	↑	TACK Each Line - 100%	TACK Each Line - 100%	☹ 89%	☺ 100%	☺ 100%	☺ 100%		
PICKING AND EXPEDITION	Production Service	Meet the production service according to R.A	↑	100%	100%	☹ 83%	☺ 100%	☺ 100%	☺ 100%		

Figure 07 - Verification Phase Checklist

Source: Own Authorship (2019)

The company object of the study had no performance indicators to follow the processes and therefore the errors became constant, as they had no proper monitoring and no records, with the application of Kanban and the Mizusumashi System it was easier to apply indicators1 and define goals and guidelines for inventory.

6. Final Considerations

To be successful in the implementation or implementation of any study and / or project is essential the involvement and commitment of all involved. The project manager needs to learn every detail of the process from the operators, as no one better than them to explain the failures, difficulties, and any issues related to the industry. It is important that managers in each area have the ability to listen and motivate their employees, so that if they are resistant to change, they can get around the situation. During the study the main difficulty encountered in making the improvements was the resistance of some managers and employees.

During the study, the company may set up a technical team to carry out the work and together with those responsible for each operation. The technical team became the main key to the changes that will still occur in the company, because thanks to the study the expected improvement was obtained. Material handling and storage control is a tool that enables greater efficiency in logistics control, as it is possible to facilitate the entry and exit of materials, preventing them from being stored in stock for too long. The company achieved greater return on how to allocate its resources and work for FIFO, improving the quality of its services and showing its true service capabilities.

7. Acknowledgments

I thank God first for making me come to this moment, a long way to go, 5 years of struggling against tiredness, discouragement and willingness to give up, but God's hand was stronger and held me here. My mother (Fatima), always supporting me and not letting me give up, took my hand and said that I was able and could and really, I got here. My sisters Flavia, Cecilia and Clecia, for believing that I was able, my brothers for cheering for me especially Caesar for helping me when I needed them most, my dear nephews Miguel, Gustavo, Vitor, Ruana, Pedro, Alice, because they always say that I am a mirror to them and my beloved Jose Guilherme my son who always supported me and said, mom you can. My best friend Alexia Renata for always saying that I am an amazing woman and saying that I can do everything. Luana Vaz and Tuany who always supported me, to my dear teacher who did not let me give up Mauro Cézar, thank you for everything, the friends that the college gave me Wander Oliveira, Padilla, Luciano Melo, Fernanda Yakushijin, because they always support us and We have come to the end. To my advisor Dr. David Alencar for having had a huge patience with me. The coordinator Priscilla Trego for supporting me as much as the course and the other teachers who have spent over these 5 years, some who have become friends like Tarciane, Marden.

8. Bibliographical References

AGUIAR, S. Integração das ferramentas da qualidade ao PDCA e ao programa seis sigma. Nova Lima: INDG, p.234,2006

BALLOU, R. H. Gerenciamento da cadeia de suprimentos/Logística empresarial.

5. ed. Tradução de Raul Rubenich. Porto Alegre: Bookman, 2006. 616 pg.

CAMARGO, Wellington. Controle de qualidade total. Curitiba: Instituto Federal do Paraná; Rede E-TEC

Brasil, 2011.

CARVALHO, José Meixa Crespo de - Logística. 3ª ed. Lisboa: Edições Silabo, 2002.

CORRÊA, Henrique L; XAVIER, Lúcia H. Sistemas de logística reversa: criando cadeias de suprimento sustentáveis.1. Ed. São Paulo: Editora Atlas, 2013.

CORRÊA, H. L; CAON, M.; GIANESI, I. G. N. Planejamento, programação e controle da produção. São Paulo: Atlas, 2001

DASKIN, M.S. Logistics: An overview of the state of the art and perspectives on future research. Transportation Science A vol 39 A no 5/6 pp 383-398,1985.

DIAS, Marco Aurélio P. Administração de materiais: uma abordagem logística. 6ª ed., São Paulo: Atlas, 2012.

KUME, H. Métodos estatísticos para melhoria da qualidade. 11. ed. São Paulo: Editora Gente, 1993. 245 p

MARIANI, Celso Antônio; PIZZINATTO, Nadia Kassouf; FARAH, Osvaldo Elias.Método Pdca E Ferramentas Da Qualidade No Gerenciamento De Processos Industriais: Um Estudo De Caso. 12 f. Universidade Metodista de Piracicaba, Bauru, 2005.

MARSHALL Jr. et al., Gestão da Qualidade. 9 ed. Editora FGV: Rio de Janeiro, 2008.

NOVAES, Antônio Galvão. Sistemas logísticos: transporte, armazenagem e distribuição física de produtos. São Paulo: Edgard Blücher, 1989. 372 p.

NOVAES, Antônio G. Logística e Gerenciamento da Cadeia de Distribuição.2 ed. Rio de Janeiro:Campus, 2004.

SANTOS, Gerson dos. Gestão de almoxarifados. Florianópolis: Editora Arth & Mídia, 2001.