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ANALYSIS OF THE MATERIAL STORAGE PROCESS OF AN INDUSTRIAL ORGANIZATION IN MANAUS, BRAZIL

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ABSTRACT

Objective: This study analyzed the stages of the material storage process in an industry that operates in the industrial hub of Manaus.

Theoretical Framework: The research was based on the theories of processes and storage to build a theoretical architecture that summarizes the state of the art.

Method: The method used was a survey, with data collected using a semi-structured interview script and another observation script, analyzed using the client-supplier technique and organized using tables summarizing the stages and their contents and objectives.

Results and Discussion: The results showed that a) there are eight stages in the storage process used, including a previous stage of weighing the material; b) the more complex stages are performed with a greater number of sub-stages, which allows for fewer failures in the operations as the labor force and technological instruments are specialized in their execution; and c) the specific objectives of each stage are aligned with the intended objective of the storage process.

Implications of the Research: The findings show that the empirically observed stages are in line with the theoretical architecture of the study, with the first and last stages being, respectively, reception and dispatch, and the intermediate stages varying according to the type of material and specificities of the production process.

Originality/Value: The main contributions of the study to science were the proposition of a conceptual definition for the materials storage process and the confirmation that this process begins with reception and ends with dispatch, differing in the intermediate stages.

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ANÁLISE DO PROCESSO DE ARMAZENAMENTO DE MATERIAIS DE UMA ORGANIZAÇÃO INDUSTRIAL EM MANAUS, BRASIL

RESUMO

Objetivo: Este estudo analisou as etapas do processo de armazenagem de materiais em uma indústria que atua no polo industrial de Manaus.

Referencial Teórico: A pesquisa foi fundamentada nas teorias dos processos e da armazenagem para a construção de uma arquitetura teórica sintetizadora do estado da arte.

Método: O método utilizado foi o de levantamento, cujos dados foram coletados com o auxílio de um roteiro de entrevistas semiestruturadas e outro roteiro de observação, analisados a partir da técnica cliente-fornecedor e organizados com o auxílio de quadros sintetizadores das etapas e seus conteúdos e objetivos.

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Resultados e Discussão: Os resultados mostraram que a) há oito etapas no processo de armazenagem utilizado, contando com uma etapa prévia, de pesagem do material; b) as etapas mais complexas são executadas com um maior número de subetapas, o que permite menos falhas nas operações quanto especializa a mão de obra e instrumentais tecnológicos na execução; e c) os objetivos específicos de cada etapa estão alinhados com o objetivo pretendido pelo processo de armazenagem.
Implicações da Pesquisa: As descobertas evidenciam que as etapas observadas empiricamente estão em consonância com a arquitetura teórica do estudo, com a primeira e última etapas sendo, respectivamente, recepção e expedição, e as etapas intermediárias variando em conformidade com o tipo de material e especificidades do processo produtivo.
Originalidade/Valor: As principais contribuições do estudo para a ciência foram a proposição de uma definição conceitual para processo de armazenagem de materiais e a confirmação de que esse processo inicia com a recepção e termina com a expedição, diferenciando-se nas etapas intermediárias.

Palavras-chave: Armazenamento de Materiais, Logística Interna, Etapas da Armazenagem, Armazenagem de Resina, Operacionalização da Armazenagem.

ANÁLISIS DEL PROCESO DE ALMACENAMIENTO DE MATERIALES DE UNA ORGANIZACIÓN INDUSTRIAL EN MANAUS, BRASIL

RESUMEN
Objetivo: Este estudio analizó las etapas del proceso de almacenamiento de materiales en una industria que opera en el polo industrial de Manaus.
Marco Teórico: La investigación se basó en teorías de procesos y almacenamiento para construir una arquitectura teórica que sintetice el estado del arte.
Método: El método utilizado fue la encuesta, cuyos datos fueron recolectados con la ayuda de un guión de entrevista semiestructurada y otro de observación, analizados mediante la técnica cliente-proveedor y organizados con la ayuda de tablas que resumen las etapas y sus contenidos y objetivos.
Resultados y Discusión: Los resultados mostraron que a) existen ocho pasos en el proceso de almacenamiento utilizado, incluyendo un paso previo de pesaje del material; b) los pasos más complejos se ejecutan con un mayor número de subpasos, lo que permite menos errores en las operaciones al especializar la mano de obra y los instrumentos tecnológicos en la ejecución; y c) los objetivos específicos de cada etapa estén alineados con el propósito previsto del proceso de almacenamiento.
Implicaciones de la Investigación: Los hallazgos muestran que las etapas observadas empíricamente están en línea con la arquitectura teórica del estudio, siendo las primeras y últimas etapas, respectivamente, la recepción y el envío, y las etapas intermedias variando según el tipo de material y las especificidades del proceso productivo.
Originalidad/Valor: Las principales contribuciones del estudio a la ciencia fueron la proposición de una definición conceptual del proceso de almacenamiento de materiales y la confirmación de que este proceso se inicia con la recepción y finaliza con el despacho, diferenciándose en las etapas intermedias.

Palabras clave: Almacenamiento de Materiales, Logística Interna, Etapas de Almacenamiento, Almacenamiento de Resina, Operacionalización del Almacenamiento.

1 INTRODUCTION

Material storage in an industrial organization is a crucial logistics function involving interconnected processes to ensure that raw materials and finished products are managed effectively. Several studies suggest that warehousing should be understood as a process composed of steps that aim to optimize the movement and storage of products (Kumar & Sajdlerova, 2023; Szewerda et al., 2025; Simani & Dehghani, 2025). For this reason, its importance should be reflected in developing a well-structured strategic plan. Planning ensures

operational efficiency and is essential to meet the growing market demands, in which agility and precision are crucial to customer satisfaction. Exploring this perspective, storage space management is a vital aspect for the success of logistics operations. Effective space management maximizes storage capacity and facilitates product access and movement, directly impacting operational efficiency (Santos et al., 2022). In industrial environments, where competition is fierce and contribution margins are small, adequately managing physical resources becomes a strategic differentiator. Thus, efficient management of storage processes can result in significant improvements in both productivity and reduction of operating costs, the possibility of which varies according to the clarity of the procedures carried out at each stage.

The storage process emphasizes the essentiality of a continuous and organized flow of materials, from receiving raw materials to the product shipment (Ferreira, 2021). Each stage is essential in ensuring that materials are available when needed and in adequate conditions. The process-based approach improves understanding of internal logistics operations and builds a resilient and responsive supply chain that adapts to demand and market variations. In this sense, this study aimed to analyze the storage process practiced by an industrial organization that operates in the industrial hub of Manaus. To this end, a survey was carried out on the stages, descriptions, and objectives to be achieved by the storage process of an industrial company operating in the plastic packaging segment. The data were collected through interviews and observations and analyzed based on the customer-supplier relational logic so that its dynamics and the specificities of each stage could be understood.

2 STORAGE PROCESS: DEFINITION AND STEPS

The literature review did not provide any conceptual or operational definition for the phenomenon of the storage process. For this reason, it was necessary to take stock of the various approaches to processes and storage to develop a theoretical framework capable of meeting the objectives of this research. In this sense, the review presented several approaches to the phenomenon of process. The study by Çuha and Aydin (2023) considers it a form of combination, in which various arrangements can be made based on human variables, equipment, materials, methods, and environment. This means there are several ways to organize and reorganize these variables to produce a product or service as a predetermined result. The sequential integration approach present in the study by Nur (2024) is very similar, with marked differences in the idea of a sequence of events that integration needs to present so that the

process can be designed and in the production of added value for customers, which may or may not be a product or service. The idea of a set was a prevalent approach in the literature, with some slight variations. The study by Redavid and Ferilli (2023) focuses on the actions performed by someone that, organized by distinct types, form the sets that represent any process, if a workflow can be described formally, so that the connections between them can be seen. The study by Ruck (2024) replaces actions with events, highlighting a starting point, an initial point, so that the first event can occur, and a final point of arrival, representing the workflows. A process would then be a sequence of events into which a larger event could be divided. The third variant says a set of tasks is a process if they are logically related, so a well-defined commercial result can be materialized when the last of these tasks is executed. This context of set also fits the approach found in the study by Zavrbska and Besta (2024), as a group of activities, if they are logically organized, with the primary purpose of transforming input resources into output products, whether they are physical products or products in the form of services. Table 1 summarizes these findings.

Table 1

Approaches and purposes of the processes found in the literature.

References	Approaches	Purposes
Çuha & Aydin (2023)	Combination of variables	Create a product or service
Nur (2024)	Sequential integration	Produce added value
Redavid & Ferilli (2023)	Set of actions	Workflow
Ruck (2024)	Set of events	Explain an event
Barrins et al. (2025)	Set of tasks	Business outcome
Zavrbska & Besta (2024)	Group of activities	Products or services
Hernández-Hernández et al. (2023)	Change of properties	Unspecified
Dincer & Temiz (2024)	Change in properties	Unspecified
Buhari & Bello (2024)	Procedure	Unspecified
Lewakabessy & Serano (2024)	Series (actions, operations, processing)	Output (add value)
Iamandii et al. (2024)	A series of activities	Output (product or service)

Source: data collected by the authors.

A third group of approaches found in the literature is centered on the idea of change, in such a way that a process is a change mechanism. The study by Hernández-Hernández et al. (2023) considers the process as a change in the properties of an object, be it in geometry, hardness, state, content, shape, content or information data, while that of Dincer and Temiz (2024) is quite generic, pointing only to the change of properties from one state to another. It is essential to understand that change as a process and vice versa reveals the transformative nature to which practically everything that exists in the world is subject, given that changes are a constant in almost all components of reality, which also includes ideas, knowledge, and all sorts

of extraphysical phenomena. The fourth and final group of approaches sees processes as procedures or series of activities. The study by Buhari and Bello (2023) shows that a process is a type of procedure that can be visualized and materialized from a sequence of acts, which is also composed of a series of steps, but must be put into practice in a specific order. The study by Lewakabessy and Serano (2024) also considers processes as a series, but not only of actions, but fundamentally of operations and processing, adding the condition that these series must convert inputs into outputs. Finally, the approach found in the study by Iamandii et al. (2024) is that processes are a series of activities aimed at adding value to inputs so that there are outputs in the form of products or services. What can be seen from the literature review is that a process can be defined as a sequence of steps, beginning, middle, and end, previously described and planned, so that, when the last step is carried out, an inevitable result or output can materialize. This definition is essential so that it can be coupled with the idea of storage to have a conceptual understanding of the storage process.

Like what was discovered about process approaches, the literature review on storage also presented various conceptual conceptions. One of them is centered on the idea of activities, so that storage can be seen as a set of activities (Silva & Martins, 2020) to maintain an organization's physical stocks adequately, as well as carry out temporary storage and distribution activities of these materials (Torrico et al., 2018). Several studies have used the storage approach as a set of activities (Garcia & Coelho, 2021; Ndjambou et al., 2024) and activities (Andryani et al., 2025; Pambudi & Windiasari, 2024). The idea of activity is fundamental to understanding the proposal of a conceptual definition for the storage process.

A second group of approaches to storage focuses on the notion of location. One of them states that storage is a way of assigning a specific place to place a particular product (Alvez, 2022), so each material should have a corresponding location or area in which it should be placed. The other approach relates to determining an area or physical space that is suitable and safe so that goods can be made available and moved (Fagundes et al., 2022). Speed and ease are two fundamental requirements for these materials to be distributed and made available, in addition to guaranteeing their physical integrity. The third approach focuses on space, where materials, products, and goods can remain unchanged (Goggins, 2022; Kopec, 2021). This space is part of the production, trade, and distribution infrastructure. Several studies have used the attribution approach (Khan et al., 2023; Karandeh et al., 2021), determination (Octaviani et al., 2024; Yehud, 2022), and space (Barack & Walthew, 2025; Oh & Shon, 2024). Table 2 summarizes these findings on storage.

Table 2

Storage approaches.

References	Approaches
Torrico et al. (2018); Andryani et al. (2025); Pambudi & Windiasari (2024)	Activities: temporary storage and distribution of materials.
Silva & Martins **(**2020); Garcia & Coelho (2021); Ndjambou et al. (2024)	Set of activities: maintaining physical stocks.
Alves (2022); Khan et al. (2023); Karandeh et al. (2021)	Assigning products to a location.
Fagundes et al. (2022); Octaviani et al. (2024); Yehud (2022)	Effective determination of a suitable and safe area
Goggins (2022); Barack & Walthew, 2025; Oh & Shon (2024); Kopec (2021)	Storage space for materials, products, and goods
Santos et al. (2022); Hernandez (2022); Gebretsadik (2021); Costa (2023)	Economic and effective management of space
Bucko et al. (2023); Watari et al. (2024); Silva (2021)	Logistics subsystem, ensuring storage
Ferreira (2021)	Receiving, storage, and distribution process
Kumar et al. (2023); Xu et al. (2023); Szewerda et al. (2025); Iordache et al. (2025)	Process: storing for use

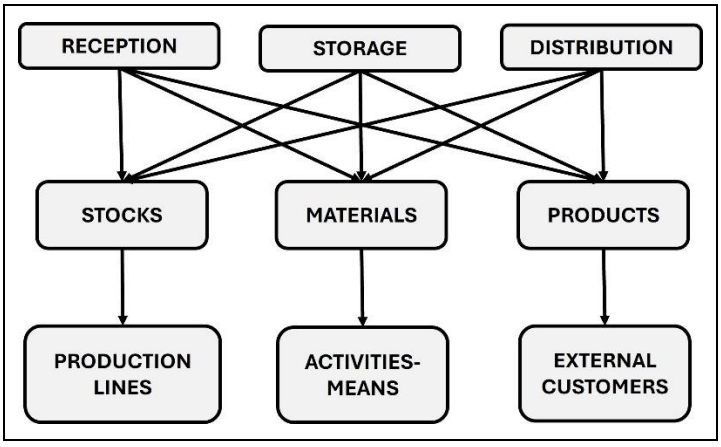
Source: data collected by the authors.

Management was another approach to storage found in the literature. What underpins this concept is the need for organizations to maintain and make the most of available physical (and extra-physical) spaces, configuring both economic management (Santos et al., 2022) and the effectiveness of the location (Costa, 2023). To ensure these goals, it is necessary to develop activities for locating, planning, and organizing the physical space, applying instruments and techniques for stock recovery, designing and using docks and berthing bays, and configuring the warehouse and its corresponding data and information based on information technology. This is done by using the stages of the management process (planning, organization, leadership, and control) and their respective key activities. Studies such as those by Hernandez (2022) and Gebretsadik (2021) used the management approach as equivalent to storage. Another approach found in the literature considers storage as a subsystem of the logistics system, found in the study by Bucko et al. (2023), but which is also used in several other fields (Watari et al., 2024; Silva, 2021). This concept begins with entering materials at the warehouse reception in various forms (raw materials, parts, semi-finished products, and finished products). It ends with the output to the production lines (raw materials and in-process products) and customers (finished products). The primary function of this approach is to guarantee the storage of these different types of products without altering their properties. Finally, the storage as a process approach aims to store for use (Kumar et al., 2023). This purpose is achieved through the execution of three functions or stages: 1) reception of products, 2) storage of products, and 3) distribution of products to internal and external customers (Ferreira, 2021). The first stage of the process

connects the warehouse and the organization to the supply chain, which integrates them into the logistics macrosystem. The second stage supports the organization's core activities and means activities, feeding the production chain and meeting the needs of auxiliary services, respectively. The third and final stage connects the organization to the distribution chain, a component of the logistics macrosystem, and to the various internal production lines. The process approach is widely used in science and practice, as shown by studies by Xu et al. (2023), Szewerda et al. (2025), and Iordache et al. (2025). In this sense, storage can be defined as the safekeeping of materials and stocks to be used in the production lines and the execution of the organization's support activities and distribution to external customers. Materials are products that do not enter the production line, such as those consumed by subunits that are not part of the core activities in an industrial organization, such as the legal and human resources departments. Stocks are divided into stocks of raw materials (which have not yet undergone any production), in-process products (which have not yet completed their production cycle), and finished products (which are ready to be taken to the organization's customers).

Figure 1

Theoretical architecture of the study.



Source: data collected by the authors.

Considering the findings on the phenomenon of processes, the storage process can be defined as the sequence of reception, storage, and distribution of stocks, materials, and finished products for subsequent distribution to the organization's production lines, supporting activities, and external customers. The reception, storage, and distribution stages configure the idea of a process, according to the findings presented on this phenomenon. Reception configures the first stage or initial phase, while distribution represents the last. Each stage is executed based on a series of activities, which need to be correctly predicted and planned, so that they can deliver

to the next stage the by-products that will be processed until the intended final objective is achieved, which is the satisfaction of the recipients of the materials and stocks, their intermediate or final customers.

3 RESEARCH METHODOLOGY

This study analyzed the material storage process practiced by an organization that operates in the industrial hub of Manaus. It used the survey method as its object of study, the storage process in its multiple stages, with data originating from semi-structured interviews and observation of each stage. It had as its unit of analysis the storage process, procedural level of analysis (the findings apply only to the analyzed process) and the perspective of synchronic analysis, given that the intention was to make a current description of the object studied, in line with the guidelines of Nascimento-e-Silva (2020; 2021a; 2021b; 2021c; 2023).

3.1 GUIDING QUESTIONS

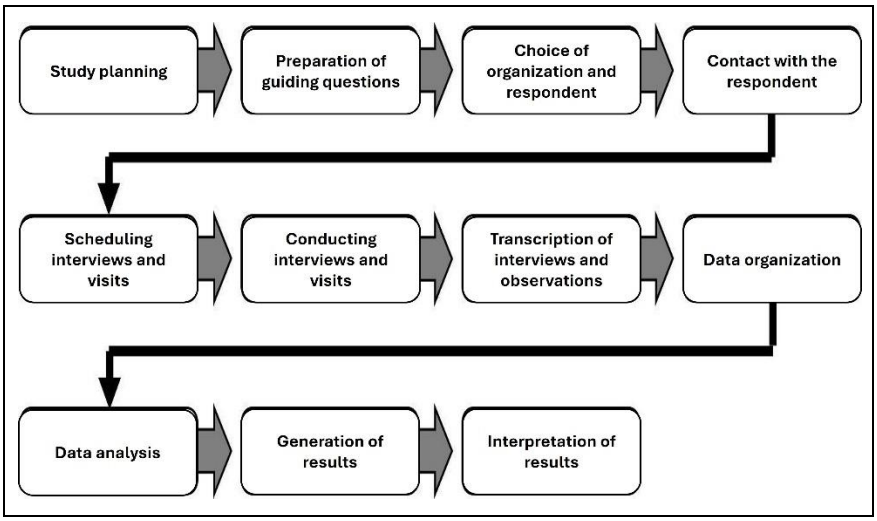
The objective proposed by the investigation was achieved by answering the following guiding questions (Nascimento-e-Silva, 2021b): This question was divided into three well-defined objectives, transformed into guiding questions: 1) What are the stages of the storage process practiced by the company? 2) How are the stages of the material storage process operationalized? and 3) What are the objectives of the stages of the material storage process?

3.2 STUDY DESIGN

The study design consisted of 11 stages. The first was the definition of the specific objectives of the research. In the second, the particular objectives were transformed into guiding questions. In the third step, the respondents, the companies where the study could be conducted, and their representatives were chosen. In the fourth step, the companies were contacted, and the one that would be the study's object was selected, per the protocol (logistics processes were duly controlled and documented). In the fifth, the interviews with the company were scheduled, according to the availability of the supervisor and the company's departments for data collection. In the sixth stage, the data were collected using a script of semi-structured questions and another script for observing the storage process. Figure 2 summarizes the procedures used.

Figure 2

Study design.



Source: prepared by the authors, based on Kristian and Nascimento-e-Silva (2024), Cardoso and Nascimento-e-Silva (2024), Cardoso and Nascimento-e-Silva (2025), and Oliveira et al. (2025).

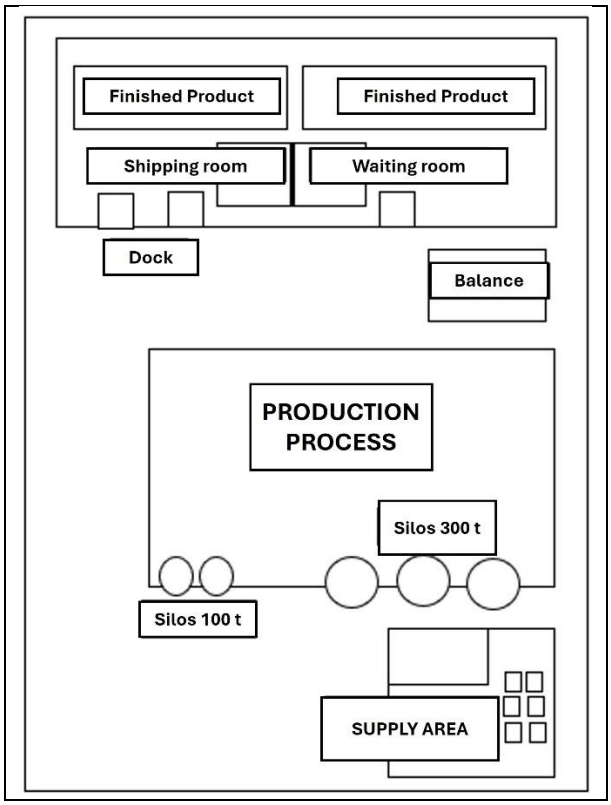
In the seventh stage, the collected data were transcribed, maintaining how the questions were answered. In the eighth stage, the data were organized using a word processor, placing the answers obtained for each question in order. In the ninth stage, the data were analyzed using semantic analysis techniques. The tenth stage consisted of generating the results, which represented the systematization of the answers to the guiding questions of the research. In the eleventh stage, the results were interpreted, and the empirical findings were compared with the theoretical architecture developed.

3.3 OBJECT AND LOCUS OF RESEARCH

The object of this study was the material storage process used by an industrial organization that operates in the industrial hub of Manaus. Specifically, the analysis focused on the eight storage steps or subprocesses carried out by the packaging company, from weighing the material when it arrives at the factory to shipping it to the end customer. The spaces used to store raw material (RM) and the finished product (FP) were analyzed. The script executed was based on the guiding questions of the research that identified all the procedures that each of the steps had and the sequence of how it was carried out, so that it could move on to the next step. An example of this is the “Reception” step that has the subprocesses a) checking the container, b) filling out the receipt document, c) removing the big bags from the container, d) placing them in the warehouse, and e) releasing them to the truck driver.

Figure 3

Research locus



Source: data collected by the authors.

Figure 3 shows the locus of the research on material storage. The physical space is divided into three main blocks. The first is the supply or reception area adjacent to the product process, a standard configuration in organizations that adopt a JIT-type pull production system. Next to the production process area, which is the second block of the physical space, are the silos, a central environment for material storage. The third block of environments is related to shipping, where the finished products are prepared and distributed to the end customers, with the appropriate and necessary docks and weighing equipment.

3.4 DATA COLLECTION INSTRUMENTS AND STRATEGY

Data were collected through semi-structured interviews, with the help of a question script (Nascimento-e-Silva, 2023). Each question was included in a general table used to quickly fill in the supervisor's answers, with blank spaces to be filled in. The script was developed based on the theoretical architecture of the study. To understand all the storage processes adopted by the company studied, the interview script included a list of a) the stage's

name, b) the client and supplier of the stage, c) how the stage is carried out, and d) the objective of the stage. After being developed, the script was validated by comparing it with the theoretical architecture of the storage processes and evaluating the supervisor. The data collection strategy began with the coordinator of the logistics course at IFAM/CMDI and the supervisor of the study issuing a letter to the company to be studied requesting the researchers to participate and collect data on the logistics storage processes practiced, attaching a copy of the semi-structured script that would be applied in the interviews. On the scheduled day and time, the first part of the interview was conducted with the logistics supervisor, who first introduced the company and its market, its branches, scope, and logistics processes; he also explained about its inventory, production, and shipping, together with the logistics team responsible. He explained how the PM arrives at the company and to which stages it goes, one after the other, and showed the equipment used to store the material. The presentation lasted about 30 minutes, including the time taken by questions that arose during the explanation. Then, everything presented in the presentation was shown on site, getting to know what was covered in practice. At that time, each detail was noted in our field notebook to increase the accuracy of the information provided. The second part of the interview was conducted in the warehouse after we had put on the personal protective equipment necessary to enter the sectors, such as boots, gloves, safety vests, helmets, safety glasses, and hearing protection. We visited the departments responsible for executing each storage stage, in sequence, from the first stage to the last. It took us about an hour to complete the interview, while we got to know all the departments: receiving, supply, inventory, production, and shipping. No interactions with other employees were allowed, but we were free to take notes and ask questions throughout the process. The interview was concluded after the questions were answered, and the notes were completed. A few days after the interview and the answers were typed, we held video conferences with the supervisor to clarify any doubts during the data transcription and better understand the procedures for each stage.

3.5 DATA ORGANIZATION AND ANALYSIS TECHNIQUES

The interview was transcribed and typed using a “Word” word processor, in the same way it was collected. The purpose of this procedure was to maintain the integrity of the responses and organize the report data, placing each piece of information together with the process under investigation. The tables summarizing the data emerged from the completion of

this stage. In the first column, named “Stage”, the storage stages adopted by the organization were listed in sequence, such as “First”, “Second”, “Third”, etc. The responses were placed in the second and third columns. The challenge was to organize the stages in sequence, from the initial to the final, naming them according to the type of process performed. The data analysis was done in line with each corresponding guiding question. For the question that sought to determine the stages of the company’s storage process, the study focused on knowing a) the supplier and b) the customer stages. The question asked about the storage stages linked to each other so that the chain would function efficiently. The table allowed us to visualize the subordination of a “client” stage to a “supplier” stage.

3.6 TECHNIQUES FOR GENERATING AND INTERPRETING RESULTS

The results were generated from the answers to each guiding question. The result was a list of the company's suppliers and customers to identify the storage steps performed. The result of the question about the procedures adopted in each storage step was a summarized and sequentially organized description of each procedure performed by those responsible for completing the process, continuing the storage flow efficiently, and controlling it. The result of the question about the objectives of each step of the materials storage process was to list the procedures performed in each step, which are the subprocesses. A comparison was made between the tables and the transcribed answers to determine whether the objective of the step was followed. The interpretation of the results consisted of seeking answers to two central questions: how each step of the storage process happens, and why it happens. These two questions were answered based on empirical evidence compared with the theoretical architecture of the study, so that each of the results constructed exclusively with the empirical data could be understood. This means that the findings of this study began with empirical evidence and made sense from what the stock of scientific knowledge defined in the theoretical architecture signaled for each guiding question.

4 RESULTS AND DISCUSSION

This section presents the study's results, following the logical sequence of the research's guiding questions. The first part introduces the stages of the materials storage process practiced in the organization analyzed, followed by the part that shows the stages and the ways of

operationalizing storage in each stage. The third part presents the intended objectives in each stage of the process, and the fourth constitutes the discussion of the results, while comparing the empirical findings with the theoretical architecture of the study.

4.1 STAGES OF THE MATERIAL STORAGE PROCESS

The company's storage process is studied in eight stages. The process begins with weighing up the material that will be received by the company and ends with the shipment of the preforms to the customers. The weighing provides essential information for the reception department to check and enter the data about the material into the system (the silos supply 100 tons or 300 tons of resin to the injection molding companies requesting production). The process follows the pull production model (JIT), in which customers request a scheduled delivery schedule from the dispatch department, which requests the material in the quantity and model desired by the customer from its "Storage" supplier, which contacts its internal supplier to be able to meet the shipment within the established deadline, and so on. The eight storage stages are interdependent and allow the organization to have many Finished products (FP) available to its customers. The company operates as a distribution center in Manaus and can serve all its customers thanks to the performance of each stage. Table 3 summarizes these findings.

Table 3

Stages, customers, and suppliers of the storage process

Stage	From	For
First	Weighing	Reception
Second	Reception	Supply
Third	Supply	Silos
Fourth	Silos	Production
Thursday	Production	Temporary stock
Sixth	Temporary stock	Storage
Seventh	Storage	Dispatch
Eighth	Dispatch	Customers

Source: data collected by the authors.

The storage stages (weighing, reception, supply, silos, temporary stock and storage) exist with the sole purpose of supporting the production and shipping processes to the customer, with maximum efficiency and effectiveness of the company's main logistics processes. The 100 t silos (big bags) and 300 t silos (liners) ensure that the resins are available for production thanks to the continuous supply (PM), which in turn is possible due to the correct material checks and entries from the reception. Each stage remains aligned with its internal customer to serve its

external customers. The company has three places to store its material, with the silos used to store the PM and the temporary stock together with the warehouse used to store the FP.

4.2 OPERATIONAL MODE OF THE MATERIALS STORAGE PROCESS

The operational method of each stage aims to correctly and organizedly pass the requested material on to the next stage. During weighing, the truck goes to the scale and its weight is measured; then, it is redirected to one of the three docks, which can receive and ship the material. The reception area gets the material, opens the container for big bags, and checks its quality. After checking, the material is removed from the container using a forklift and placed in an identified space within the warehouse, while it waits for the previous big bags to be processed and sucked through the ducts. In the case of liners, they are entered at the reception area and are placed in a waiting area, supported by a trolley that, together with the dock truck, is taken to be sucked when the queue is shorter. The supply process works directly with the production planning and control department (PPC) to refill the silos with the quantity that will be released when the requesting injection molding machines meet their needs, through ducts connected to a hose on the supply platform (big bags) or in the container (liners). The silos store according to the type and quantity requested by the injection molding machines.

Table 4

Operationalization of the steps in the material storage process

Stage	Operational method
Weighing	1) The product arrives in a container, packed in big bags or liners; 2) the truck is weighed to determine the amount of resin that came in the container; 3) the truck goes to one of the company's three docks to formalize the receipt of the big bags or liners.
Reception	1) The receiving team checks the container, opening it to see if it corresponds to the purchase order; 2) if the material is by the request, the “Receipt of raw material” document is used to enter the material via the system; 3) the liners remain in the container after the inspection and the big bags are removed and placed in the stock; and 4) the container with the significant bags returns to the port from which it left after unloading.
Supply	1) The liner containers are placed in the Silos within 48 hours, while the big bags can take as long as necessary; 2) the PPC controls the supply and production area, creates a PMP so that the injectors use the liners and that the 300 t silos can store the resins from the containers that have arrived; 3) the operator is informed by the PPC about the demand for big bags and liners, with the “Daily Supply Planning” document; 4) the liner containers enter a cage isolated from the platform where there are pipes that, when connected to the container, suck up the resins inside and transport them to the silos; 5) the big bags remain in the supply area to be lifted by a customized platform to a certain height, where they will be suspended and connected to a pipe that will suck up the resins.
Silos	1) Two types of silos are used: 100-ton and 300-ton silos; 2) 100-ton silos only receive resins from big bags, while 300-ton silos receive resins from liners; 3) the resins await the injection molding machine's request for material; 4) when the injection molding machine requests, via

Stage	Operational method
	the system, the quantity of resin stored in the 100-ton or 300-ton silo, it will be released to go directly to the requesting injection molding machine.
Production	1) The PPC sends the production order (PO) to the computer, informing the quantity that will be in the batch; 2) the production operator releases the requested quantity of resin into the silo via the system and automatically sends it to the injection molding machine, starting the production process with extrusion, to shape the resin; 3) then, the material is injected, to undergo thermal shock and be taken to the end of the automatic conveyor belt; 4) the process ends with the preforms (FP) going directly to a production box; 5) the end of the process is notified to the production operator via computer and a label is issued to identify that batch containing the material code, injector that processed the resins, batch number, quantity of resin, mold drawn on the resins and weights, quantity that was requested in the OS, time it ended and a unique batch that the system automatically gives for tracking.
Temporary stock	1) The operator separates the box identified with the quantity produced in the batch and moves it to the transfer area; 2) it is placed on a pallet; 3) and waits for the forklift to come and pick it up and take it to the warehouse.
Storage	1) The forklift takes the material from the temporary stock and takes it to the warehouse; 2) the forklift uses equipment to enter the address of the new batch into the SAP system to facilitate tracking; 3) the forklift places the material in the place it entered in the system.
Dispatch	1) The customer requests delivery of the material; 2) the dispatch department verifies the quantity requested, the forklift performs the write-off and refill of the batches; 3) the dispatch department checks to ensure that the material being shipped is the material that was requested; 4) the material is sent for delivery.

Source: data collected by the authors.

The production process is as follows, as shown in Table 4: the PPC surveys what will be necessary to produce and deliver to the customer. It informs the supply operator of the quantities from those productions that will be made for replenishment. Afterwards, it records the purchase order and overdue Invoices (OI) on the operator's computer, making that batch. In addition to going through stages inside the injection molding machines to present the final result, it is closed in a sturdy cardboard box sealed with nylon threads that will maintain the box's integrity. The temporary stock is a small place where the operators or forklifts will leave the produced batches to be taken to the warehouse. The warehouse consists of entering the batch into the system at the available address, placing it on a pallet to guarantee its quality, and managing the available spaces to store new FP productions. The expedition separates the material the customer requests from the stock and moves it to the area in the container for delivery within the pre-established deadline. A final check is carried out to see if what was requested will be delivered to the customer, and finally, the material is placed in the container.

4.3 OBJECTIVES OF THE STAGES OF THE MATERIAL STORAGE PROCESS

All stages of an organization are created to achieve an organizational goal, to make the primary process more efficient and safer. The general goal of the storage stages is to ensure that the raw material arrives in perfect condition and the desired quantities, avoiding waste of parts

that were poorly processed by the injection molding machine or that fell when the big bags were suspended, so that they reach the customer in perfect condition. To achieve this, each stage must fulfill its operational, administrative, and analytical parts, ensuring the accuracy of the process, that it does not affect the others, and that no defects or failures are passed on to the following stages.

The purpose of weighing is to measure the quantity of raw material that comes from the supplier, and the reception validates it, if it is the quantity requested by the buyer, and checks it qualitatively to ensure that the material is in good condition for use. Supplying ensures that all the resins that have arrived are placed on the supply platform (big bags) or in the container compartment (liners), prioritizing the liners because the containers must be returned to the ports from which they were taken. Silos are cylinder-like, slightly thinner containers that allow the separation of resins that came in liners from those that came in big bags. Liners and oversized bags are models that the company's suppliers use to ensure that the material arrives safely at the factory. Large bags come in 20-foot containers, according to the quantity requested; liners cover all the resins inside the container. Table 5 shows the objectives of each stage of the material storage process.

Table 5

Objectives of the stages of the material storage process

Stage	Objectives of the stage
Weighing	To check whether the quantity of raw material requested is the same as that in the truck load
Reception	To find out whether the quantity and quality required are what the supplier delivered, and to identify possible deviations in PM through the traceability carried out by the inspectors.
Supply	To ensure that the resins that arrived in stock are placed in production, without waste, especially the liners, so that the containers return to the port.
Silos	To ensure that the resins in the big bags and liners are stored separately and without waste, to be fully used in production.
Production	To comply with the Master Production Plan with no or as few defective parts as possible and within the established deadline, so that all customers are served.
Temporary stock	Separate the finished batch in a location that does not interrupt production while waiting for a forklift to move the material.
Storage	Store the material in the addressed location so the logistics team can control the available apartments and streets and be found more easily when it is time to deliver.
Dispatch	Comply with the daily, weekly, and monthly delivery schedule to customers on time, without delays and defects in the finished product.

Source: data collected by the authors.

The purpose of production is to comply with the master production plan (MSP), reducing resin waste with as few downtimes as possible for the injection molding machines. In addition, it ensures the quality and traceability of every batch produced. Temporary stock is used to store the material made in the injection molding machine until the logistics stacker is available to remove it from production and place it in the warehouse. The purpose of storage is

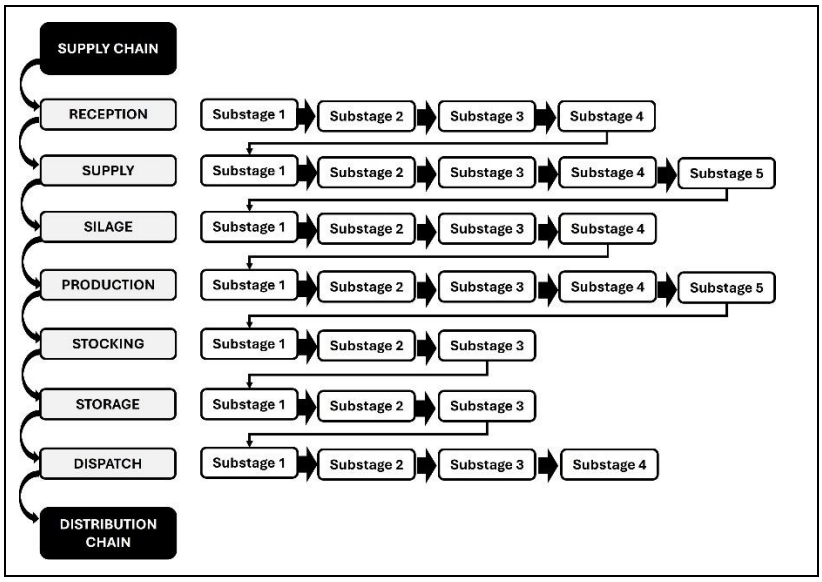
to store the batch produced until the day of its delivery, all physically and systematically addressed on a wooden pallet, so that the material is not exposed to situations that could damage it, while the challenge of shipping is to make daily, weekly and monthly deliveries on time, with the quality requested by the customer.

4.4 DISCUSSION OF RESULTS

The analysis of the material storage process practiced by the target organization of this study showed that the theoretical architecture constructed adapts to the reality of the internal logistics investigated. This means that the processes are made up of subprocesses, as suggested by the studies of Rani et al. (2025), Richter et al. (2025), Wings and Harkonen (2025), and Cai et al. (2025). By extension, the organization's material storage process is a component of a macrosystem and interconnects the supply chain with the distribution chain, as shown in Figure 4. From the perspective of the customer-supplier relationship, the organization under analysis is the customer of the supply chain and, at the same time, a supplier of the distribution chain. From the systems theory perspective, the material storage process processes inputs from the supply chain, processes them, and delivers its products as outputs of its transformation system to the external environment through the distribution chain. As the theoretical architecture of this study shows, these are the three predominant approaches to material storage found in the literature.

Figure 4

Material storage stages and substages.



Source: data collected by the authors.

The results also allow us to see the consistency between the sequencing of the intended objectives in each substage of the storage process to achieve the aim of each stage of the overall process. For example, the material reception stage is composed of four substages. Each substage is executed from a series of activities, which converge to achieve the objective intended in that substage. This objective will feed the next substage, until the end, when the purpose intended by the material reception stage is achieved. Each substage generates a result that contributes to the generation of the stage's outcome, as shown in the studies by Yuan et al. (2023) and Figueiredo (2015).

These results allow us to state that the material storage process is a succession of objectives that must be achieved at each stage so that internal logistics can fulfill its organizational mission. And the more complex the stage of the process, the greater the number of substages that compose it, as suggested by the studies by Han et al. (2025) and Gémar (2023). The reason for this is that a logistics system is composed of key activities (such as customer service levels, transportation, inventory management, etc.) and support activities, which have storage as their central point, such as material handling, purchasing, packaging, and others (Martins et al., 2019), as part of the infrastructure of the logistics macrosystem (Binh et al., 2023), especially those supported by advanced contemporary technologies, such as artificial intelligence (Veloso & Nascimento-e-Silva, 2025; Montenegro et al., 2025). The more storage fulfills its logistical mission, the greater the likelihood that organizational logistics will be able to achieve the degree of synchronization necessary for the supply chain to gain efficiency.

5 CONCLUSION

This study analyzed the material storage process of an industrial organization in Manaus. Eight stages of the overall process were discovered, including prior weighing, before the actual storage stages began. The first stage consisted of reception, and the last was the dispatch of the finished product to customers, as predicted by the theoretical architecture. The intermediate stages were all constructed by the nature of the product and its production process. Each stage presented its operational system, with well-defined sub-stages aligned with its objectives. The specific objectives of each sub-stage contribute to achieving the purpose of the stage, which in turn helps to achieve the aim of the entire storage process. It was also noted that the main characteristics of the stages studied, and the procedures adopted in each of them, act in a balanced way so that the input is transformed into semi-finished products and, later, into

final products. The main characteristics indicate that the storage practices focus threefold: interdependence of stages, investment in qualified labor, and machinery that facilitates the storage process. They also efficiently use technological machinery, such as robots and intelligent machines, to promote increasingly integrated interactions between the actions of operators and machines, resulting in a gradual and significant reduction in errors and logistical failures. Because human limitations do not impact the capacity of the machines, they become superior in speed and handling large volumes of materials and demands, delaying operator fatigue, and improving control over the warehouse space.

These results indicate at least two essential developments. The first refers to using strategic machinery according to the company's needs and the training of employees to use these machines efficiently. An example of this in the company studied is the supply sector, which has a compartment that turns the container positioned there at 90° degrees, which makes it easier to transfer the resins from the whole container to the silos, through the commands that the employee gives through the machinery. It is worth noting that the equipment (such as forklifts, tipping compartments, silos and the machines that transform the resins into proformas) are subject to damage when not used in the best way, without guidance or the necessary maintenance of this equipment. The second is the need for logistics professionals to understand all the logistics stages as an ordered sequence of organizational processes, which need each other to complete each other and maintain the standard established by the client. By adopting this more accurate vision, professionals will be better prepared to solve process problems and make the necessary changes to streamline or improve the procedures performed.

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