


REORGANIZATION OF THE WAREHOUSE ACTIVITIES PROCESSES WITH THE FRAMING OF THEIR PROBLEMS AND SOLUTIONS

Abdelilah Kerouich^A, Abdellah Azmani^B, Monir Azmani^C



ARTICLE INFO	ABSTRACT
<p>Article history:</p> <p>Received 03 August 2023</p> <p>Accepted 06 November 2023</p>	<p>Purpose: The aim of this study is to examine and identify goods processing operations in a warehouse and propose a reorganization of tasks to minimize processing time.</p>
<p>Keywords:</p> <p>Warehouse; Operation Chain; Goods Processing.</p> <div data-bbox="172 913 480 1160" style="text-align: center;">  </div>	<p>Theoretical framework: Current literature highlights the need to reorganize and adapt the operations chain (LOMBA Cédric, 2018). Some areas still need to be studied in depth to improve the supply chain. The literature on warehouse management has not sufficiently studied partial time management or closed-loop time management in the supply chain (CLSC) from goods-in to goods-out. The potential links between the risks of lost time and the management of the quality of the goods handling service have not been studied in depth.</p> <p>Design/Methodology/Approach: The in-depth analysis of recent international studies published on warehouse management and the supply chain enables us to identify the studies that have the greatest impact on research.</p> <p>Findings: The result of this work is the development of a double typology, one linked to the chain of operations and the other to the constraints linked to the CLSC in a warehouse. Tools will be applied to diagnose the constraints and factors adversely goods handling operations.</p> <p>Research, Practical & Social implications: To help logisticians and researchers, we have proposed an operational reformulation of a warehouse, enriched with a logical framework linking the problems and their potential solutions.</p> <p>Originality/Value: The article proposes an original vision to improve the spatio-temporal organization of warehouses, by synthesizing its different entities, operations, and processes while presenting all the existing problems and identifying their possible solutions.</p> <p>Doi: https://doi.org/10.26668/businessreview/2023.v8i11.3805</p>

REORGANIZAÇÃO DOS PROCESSOS DE ATIVIDADES DE ARMAZÉM COM O ENQUADRAMENTO DOS SEUS PROBLEMAS E SOLUÇÕES

RESUMO

Objetivo: O objetivo deste estudo é examinar e identificar as operações de processamento de mercadorias em um armazém e propor uma reorganização de tarefas para minimizar o tempo de processamento.

Referencial teórico: A literatura atual destaca a necessidade de reorganizar e adaptar a cadeia de operações (LOMBA Cédric, 2018). Algumas áreas ainda precisam ser estudadas em profundidade para melhorar a cadeia de abastecimento. A literatura sobre gestão de armazéns não estudou suficientemente a gestão de tempo parcial ou a

^A PhD student in Intelligent Automation and Bio Med Genomics Laboratory (IABL), Abdelmalek Essaadi University, Faculty of Science and Technology of Tangier, Morocco. E-mail: kerouiche@gmail.com

Orcid: <https://orcid.org/0009-0000-9208-881X>

^B PhD in industrial computing, Dynamic System Modelling and Artificial Intelligence, Sciences and Technologies University of Lille – France. Abdelmalek Essaadi University, Faculty of Science and Technology of Tangier, Morocco. E-mail: a.azmani@uae.ac.ma Orcid: <https://orcid.org/0000-0003-4975-3807>

^C PhD in Signal Processing, and Computer Science. Abdelmalek Essaadi University, Faculty of Science and Technology of Tangier, Morocco. E-mail: m.azmani@uae.ac.ma Orcid: <https://orcid.org/0000-0002-7434-3781>

gestão de tempo em circuito fechado na cadeia de abastecimento (CLSC), desde a entrada até à saída de mercadorias. As potenciais ligações entre os riscos de perda de tempo e a gestão da qualidade do serviço de movimentação de mercadorias não foram estudadas em profundidade.

Desenho/ Metodologia/ Abordagem: A análise aprofundada de estudos internacionais recentes publicados sobre gestão de armazéns e cadeia de abastecimento permite-nos identificar os estudos que têm maior impacto na investigação.

Resultados: O resultado deste trabalho é o desenvolvimento de uma tipologia dupla, uma ligada à cadeia de operações e outra às restrições ligadas ao CLSC num armazém. Serão aplicadas ferramentas para diagnosticar as restrições e fatores adversos às operações de movimentação de mercadorias.

Implicações de investigação, Práticas e Sociais: Para ajudar logísticos e investigadores, propusemos uma reformulação operacional de um armazém, enriquecida com um quadro lógico que liga os problemas e as suas potenciais soluções.

Originalidade/Valor: O artigo propõe uma visão original para melhorar a organização espaço-temporal dos armazéns, sintetizando as suas diferentes entidades, operações e processos, apresentando todos os problemas existentes e identificando as suas possíveis soluções.

Palavras-chave: Armazém, Cadeia de Operação, Processamento de Mercadorias.

REORGANIZACIÓN DE LOS PROCESOS DE ACTIVIDADES DE ALMACÉN CON EL ENMARCAMIENTO DE SUS PROBLEMAS Y SOLUCIONES

RESUMEN

Propósito: El objetivo de este estudio es examinar e identificar las operaciones de procesamiento de mercancías en un almacén y proponer una reorganización de tareas para minimizar el tiempo de procesamiento.

Marco teórico: La literatura actual destaca la necesidad de reorganizar y adaptar la cadena de operaciones (LOMBA Cédric, 2018). Algunas áreas aún deben estudiarse en profundidad para mejorar la cadena de suministro. La literatura sobre gestión de almacenes no ha estudiado suficientemente la gestión del tiempo parcial o la gestión del tiempo de circuito cerrado en la cadena de suministro (CLSC) desde la entrada hasta la salida de los productos. Los posibles vínculos entre los riesgos de pérdida de tiempo y la gestión de la calidad del servicio de manipulación de mercancías no se han estudiado en profundidad.

Diseño/ Metodología/ Enfoque: El análisis en profundidad de los recientes estudios internacionales publicados sobre gestión de almacenes y cadena de suministro nos permite identificar los estudios que tienen mayor impacto en la investigación.

Hallazgos: El resultado de este trabajo es el desarrollo de una doble tipología, una ligada a la cadena de operaciones y otra a las restricciones ligadas al CLSC en un almacén. Se aplicarán herramientas para diagnosticar las limitaciones y factores que perjudican las operaciones de manipulación de mercancías.

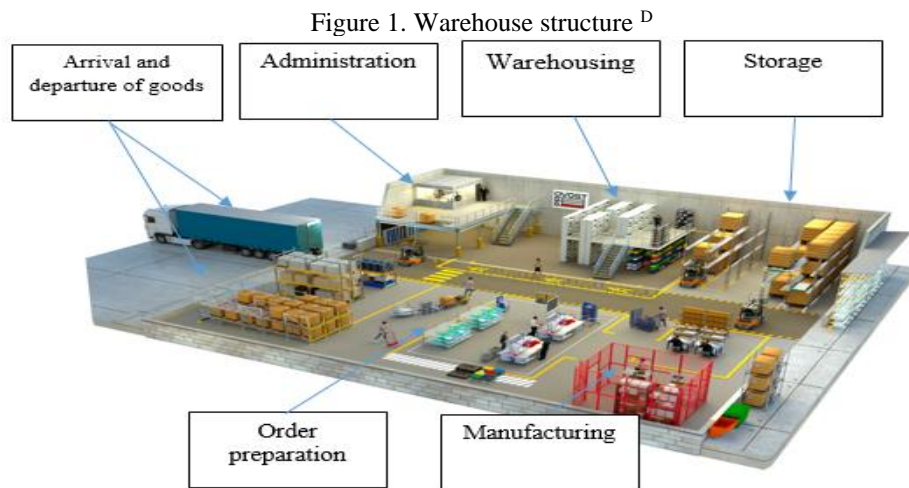
Implicaciones de investigación, Prácticas y Sociales: para ayudar a los logísticos e investigadores, hemos propuesto una reformulación operativa de un almacén, enriquecida con un marco lógico que vincula los problemas y sus posibles soluciones.

Originalidad/Valor: El artículo propone una visión original para mejorar la organización espacio-temporal de los almacenes, sintetizando sus diferentes entidades, operaciones y procesos, presentando todos los problemas existentes e identificando sus posibles soluciones.

Palabras clave: Almacén, Cadena de Operación, Procesamiento de Mercancías.

INTRODUCTION

Optimizing time during the passage of goods in a warehouse between the moment of unloading, storage, preparation, and eventually total or partial loading (Fig. 1) requires identifying and framing all the problems encountered in the activities of a warehouse and its operation. For this purpose, this article focuses on framing and studying the problems that emerge during each operation and developing effective solutions.



Source: Prepared by the authors (2023)

This document is structured as follows. The first section outlines the commodity processing flowchart or chain of operations and provides a clear view of the transition from one entity to another. Subsequently, the paper presents and explains the type of operations and identifies the different processes of operations related to the functioning of a warehouse in goods processing.

Then, a section focuses on the framing and identification of the major problems related to the processing of operations in the warehouse. The last section shows the elaboration of solutions related to the above-mentioned problems.

OPERATION CHAIN

According to LOMBA Cédric (2018), the effective and efficient use of human resources (HR) and material resources (MR) requires a reorganization and adaptation of the chain of operation.

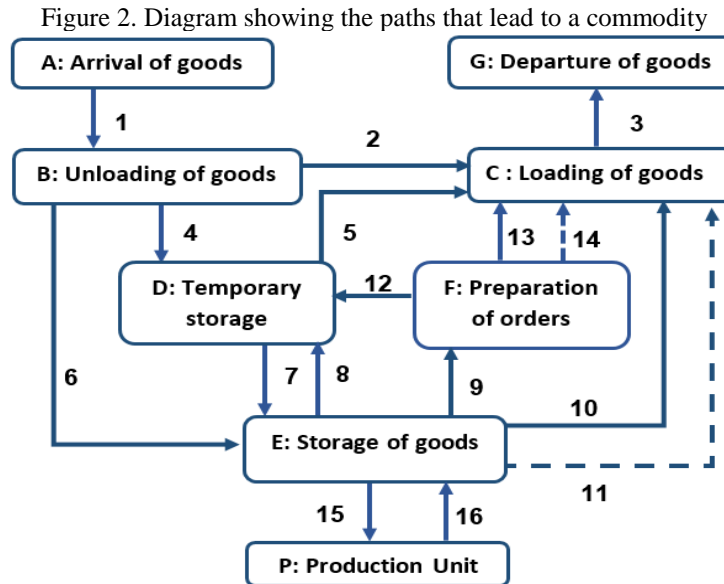
The contribution of this work is represented by Fig. 2, which identifies the value of the chain by specifying the nature of the operations related to the warehouse functioning.

Figure 2 provides a clear vision of the transition from one entity to another. The latter is the path taken by goods or the spatial cycle of goods, depending on the type and criteria applied during their processing, from their arrival at the warehouse to their delivery.

To get an idea of the labels used in the warehouse block diagram, reference should be made to the following Tables 1, 2, and 3, such as:

^D Source : <https://www.provost.fr/fr/content/173-amenagement-de-vos-entrepots-logistiques>

- Type of transitions between entities: Table 1 indicates the meaning of transitions linking the different entities.
- Nature of the operational entities of a warehouse: Table 2 represents the main encoding warehouse entities involved in processing the goods.



Source: Prepared by the authors (2023)

Table 1 – Meaning of the transitions involved

Number	Indication
1	Pre-unloading
2	Urgent delivery
3	Post warehouse situation
4	Temporary storage
5	Long delivery
6, 7, 16	Permanent storage
8, 12	Temporary storage
9	Picking
10	Delivery
11	Very fast delivery
13	Normal delivery
14	Fast delivery
15	Towards production

Source: Prepared by the authors (2023)

Table 2 – Nature of the operational entities of a warehouse

Situation	Signification
A	Incoming goods
B	Goods unloading
C	Goading goods
D	Goods temporary storage
E	Goods Storage
F	Order preparation

G	Departure of goods
---	--------------------

Source: Prepared by the authors (2023)

- Types of potential problems in a warehouse and its environment: Table 3 shows the nature of the dominant problems that affect the smooth running of activities in a warehouse if planning is disrupted, according to Sabah BELIL (2021), the process of manufacturing, storing, transporting, and shipping products is very complex, making planning very difficult.

Table 3 – Problems impacting warehouse operations

Problems	Description
A	Saturated parking
b	Blocked door
c	Vehicle puncture
d	Lack of loading/unloading resources (equipment, personnel)
e	Saturated (receiving) area (loading, unloading) (waiting area, receiving area)
F	Saturated dock (loading, unloading)
g	Late vehicle (inbound or outbound)
h	Lack of packaging supplies
i	Blocking of the warehouse management information system

Source: Prepared by the authors (2023)

DETERMINING THE TYPE OF OPERATIONS

In a warehouse, there is often a set of operations, each of which is processed according to a well-defined process. The processing of these can be parallel or sequential.

Parallel:

Cited in MALET Jean-Baptiste (2013) and LOMBA Cédric (2010), the same merchandise can be conditioned or reconditioned at the time of order preparation, as one can condition or recondition the units of loads to store them in a state-ready to use.

Sequential:

The same goods cannot be stored and used for an order at the same time, rather they must be stored (Storage operation) and then called at the time of order picking (Order picking operation).

The rest of this part focuses on:

- Determining the type of operations.
- Determining the process of each operation.
- Determining the requirements of each operation.

Table 4, specifies the types of operations met in a warehouse from the arrival of goods to the warehouse until their delivery.

Table 4 – Types of warehouse operations

Principal operations	Secondary operations
Unloading of goods	Temporary storage ^E
Storage of goods	Temporary storage
Preparation of orders	Packaging
Loading of goods (delivery)	Repackaging

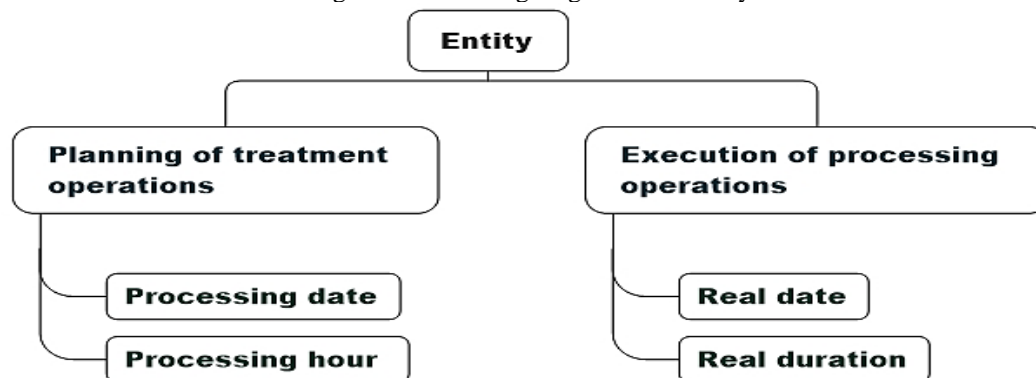
Source: Prepared by the authors (2023)

The temporary storage operation is similar to the unloading operation except that for the temporary storage operation the docks can be used instead of searching the areas where the goods will be deposited.

Definition

An operation is any action of unloading, warehousing, packaging, storing, loading, or delivering. Similarly, an entity is a loading unit that requires several operations to process efficiently to become ready for use. Figure 3 gives a general example of entity processing.

Figure 3. Processing diagram of an entity



Source: Prepared by the authors (2023)

The process of an operation treatment

To achieve efficiency in the treatment of the entities-related operations (for storage or local use, production department) or orders (delivery) in a warehouse, rigorous and conscious planning is an obligation. For this reason, it is necessary to analyze the diagram of the requirements for an operation execution (see Figure 4).

^E Temporary storage is the act of depositing goods for a shorter period before sending them to a destination. This principle concerns the exchange platforms, for this reason, the temporary storage is classified as a secondary operation in a warehouse, if not, if its frequency of presence in the warehouse is high it must be treated in an exchange platform.

The optimal execution of an operation is characterized by the satisfaction of the diagram in Figure 4.

The analysis of this diagram shows that it contains two levels:

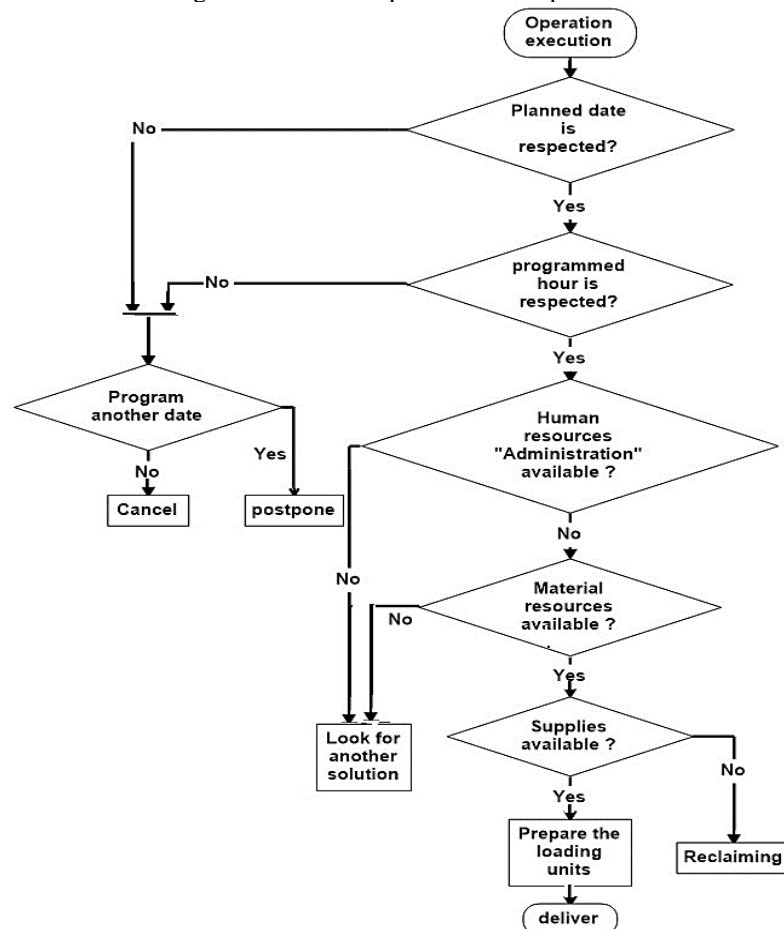
- The first one concerns verifying whether the planned date and time are respected. In case of non-compliance, the problem is counted for the carrier.

- The second level concerns the verification and availability of human or administrative resources for the reception and handling of material resources. In case of failure, the problem is marked for the warehouse.

The analysis of the attribute relating to the search for an alternative solution converges on the following scenarios:

- The possibility that the vehicle is available to wait.
- The feasibility of leaving the goods on the vehicle board until their return.
- If these two scenarios are invalid, then automatic cancellation is opted for, and additional charges are supported.

Figure 4. Execution process of an operation



Source: Prepared by the authors (2023)

IDENTIFICATION OF THE DIFFERENT OPERATIONS PROCESSES RELATED TO A WAREHOUSE'S FUNCTIONING

Determining the operating process of each operation within the warehouse and developing the requirements for each operation thus makes it possible to identify, predict, or estimate the risks that may arise.

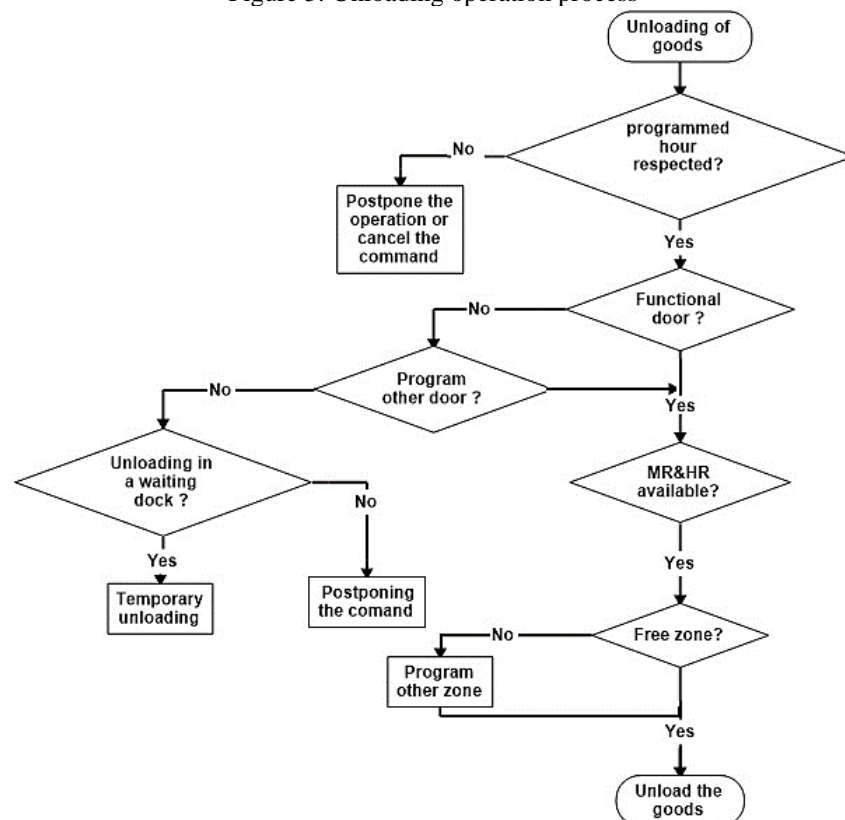
Unloading Process

The diagram in Figure 5 shows the process of unloading the goods. This diagram allows for checking the feasibility of goods unloading at the right time and place.

In the diagram of Figure 5, the parking lot's saturation criterion is not mentioned. Since the date has already been planned (or the order has already been accepted), the parking lot will be available, except in the case of a major force or a new disturbance which will be detailed in the following section (framing of the problems).

According to Walid Behiri (2017), when the time is not respected, the person in charge of the orders (or the warehouse manager) decides the postpone to a later time or date or its cancellation.

Figure 5. Unloading operation process



Source: Prepared by the authors (2023)

Storage Process of Goods

Figure 6 shows the essential steps in the process of storing goods to keep them in good condition and without risk of influence on the goods.

The process of Figure 6 contains two branches the first one is direct; it concerns the ideal case (availability of any need). On the other hand, the second branch represents the failing case. At this level, it is possible to postpone storage due to the unavailability of material and personal resources. The storage operation is generally carried out after the unloading, which mobilizes resources that are likely to be unavailable. Likewise, when the main storage area is not available, another area should be programmed to free up the space where the goods are initially stored.

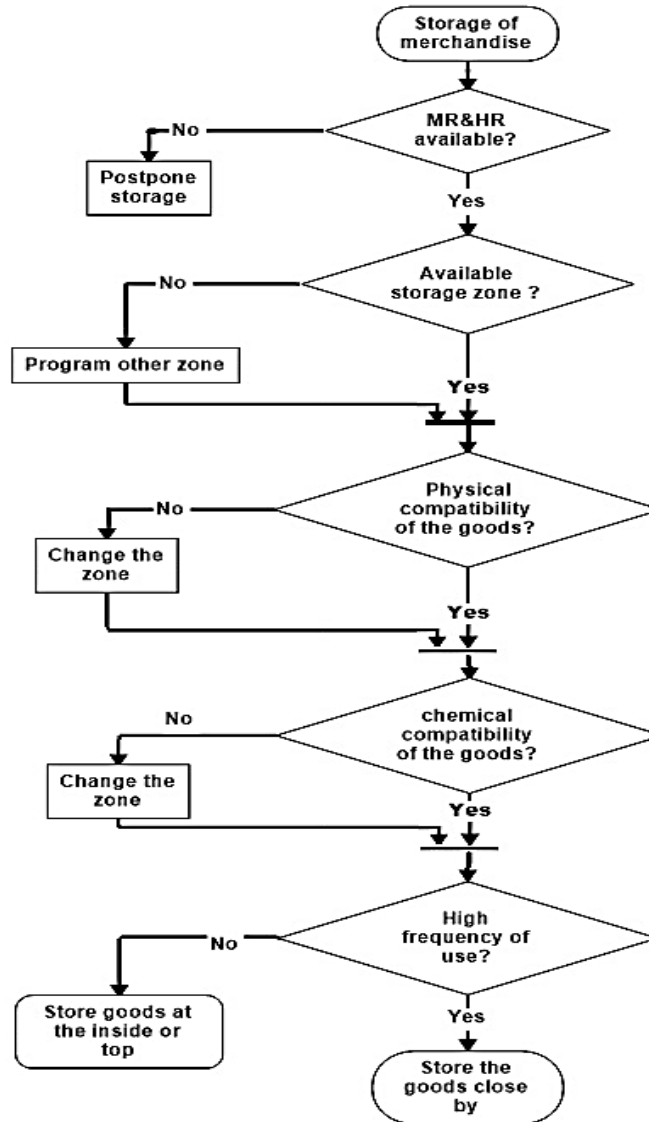
While storing, it is always necessary to verify the goods' frequency of rotation.

The Order-picking Process

A definition quoted by Reif R. & Walch D. (2008), order picking is the collection of goods in response to customer orders, then according to Schwerdtfeger B. & Klinker G. (2008), the pickers then deliver these orders following a specific process.

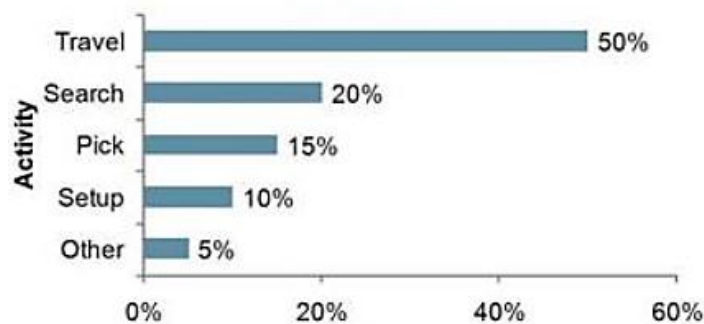
In a related study by Gharbi S. (2015), the operation of order picking allows employees to gather items in a warehouse according to a work order, in logistics, according to Harper R. L. (2010), order picking is one of the most important processes, consuming 50% of the total picking process time (Figure 7).

Figure 6. Representation of the storage process



Source: Prepared by the authors (2023)

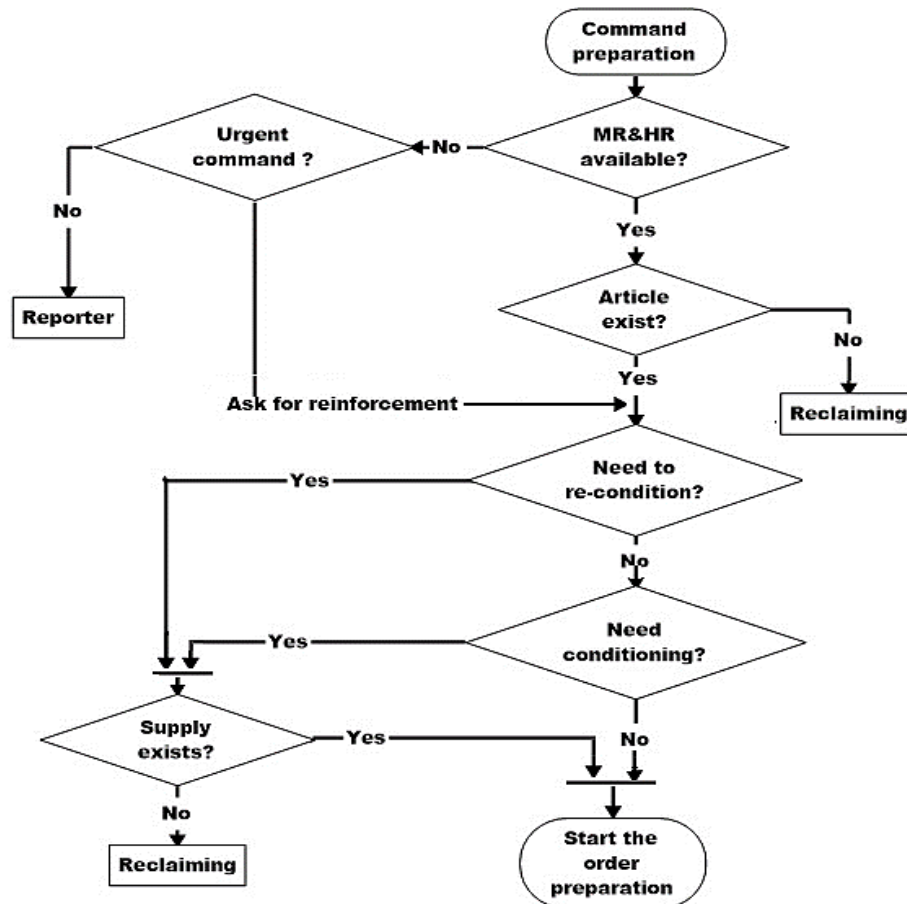
Figure 7. Typical distribution of an order picker's time



Source: Gharbi S. (2015)

Figure 8, illustrates the order-picking process. The order-picking operation is involved in the quality of the order; from this effect comes the complexity of the order-picking graph.

Figure 8. Order-picking process



Source: Prepared by the authors (2023)

Fig.8 Interpretation: The activity diagram includes an entity that checks the urgency of the order. This property is classified before the criterion that concerns the existence of the articles (the one that constitutes the loading units) because the articles of urgent character must be present permanently and in feasible quantity. The claim mentioned in this diagram is always directed to the supply department.

The Goods-loading Process

The process of goods loading is similar to the process of unloading, i.e., almost the same resources are mobilized for the execution of the operation. Figure 9 concerns the unloading process.

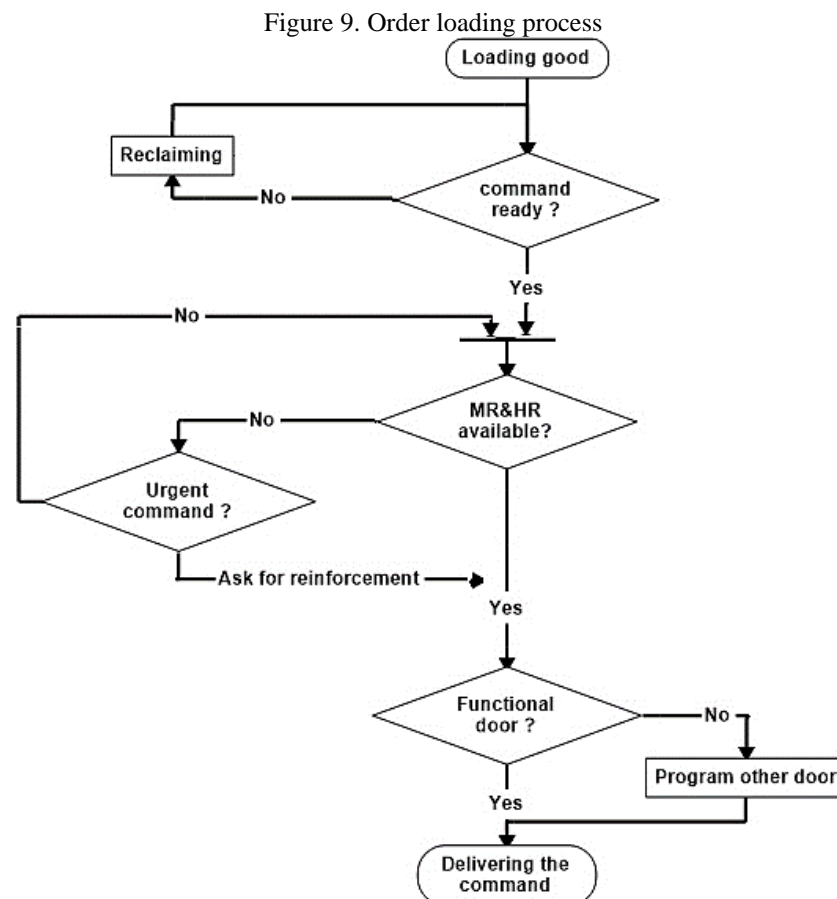
Interpretation: The urgent order always has priority, in the case of insufficient resources you have to ask for more reinforcement, even if you stop another operation and focus on finalizing the urgent order.

Qualification of the Impact of Each Problem on the Above Entities

The processing of a commodity goes through a life cycle to deliver an order at optimal conditions (cost, quality, and delay). In this phase, our study focuses on the temporal aspect.

To have optimal temporal governance, it is necessary to identify the impact of each problem on the warehouse units. Table 5 shows in detail the direct and indirect impacts that occur both outside and inside the warehouse during the handling of goods (transport, loading, unloading, storage, etc.).

In a related study by Bakkali (2016), effective warehouse management comes down to effectively managing critical resources as mismanagement of human resources (HR) leads to losses and possible planning delays.



Source: Prepared by the authors (2023)

Lenoble (2017) describes the various activities related to warehouse management, mainly those involved in functional areas. Lenoble (2017), considers the arrival of products to the warehouse to be limited to the receiving area followed by the unloading of trucks. The receiving and unloading operations are directly impacted by the vehicle delay.

According to Tanaka & Tierney (2018), delays can occur in one zone and can be caused by several factors.

The merchandise arrives at the warehouse via trucks (vehicles) which can suffer delays due to undesirable situations; cited in Cattaruzza D. (2014), the drivers can communicate their delay to the operation center, which can modify the operation planning.

In their research, Anderson (2005), cites that loading and unloading operations have experienced temporal disruptions explained by the existence of long loading or unloading queues.

The picking of alternatives influences the picking time and the delivery efficiency of the goods delivery 3. Consequently, there is a temporal relationship between the picking way and the picking time. However, according to Raicu (2010), they can be adapted to the requirements to optimize the processing time.

The study by Lenoble (2017), defines the order-picking area as the place where orders will be picked according to quantities specified by the customer orders. From a time perspective, Lucas Tranchant (2019), shows that the lack of packaging supplies influences the collection and processing of the order as well as the lack of material and personal resources.

Table 5 – Direct and indirect impacts

impacted entity	Nature of the problems								
	a	b	c	d	e	f	g	h	i
A	++	++	++	+					+
B				++	++	++			
C	++	++	++	++	++	++	++	+	++
D				++	++	+		+	+
E				++			+	+	+
F				++				+	
G	++	++	++					+	

++: Direct and important impact, resulting in the triggering of a problem situation.

+: Indirect impact, introduces a little delay.

Source: Prepared by the authors (2023)

IDENTIFICATION OF THE VARIOUS PROBLEMS RELATED TO THE PROCESSING OF OPERATIONS WITHIN THE WAREHOUSE

The following section is dedicated to identifying and studying the various problems associated with goods handling operations in a warehouse.

Problems Related to the Loading(unloading) of Goods

In a certain way, the loading and unloading of the goods encounter almost the same problems, hence the fact of considering both situations in a single case study.

The loading of the goods is an important stage during the goods' life, for that it is necessary to take into account the problems that can meet the operation of goods loading, Figure 10.

Physical loading: Following the study by Azevedo & al. (2018) and Araújo & al. (2016), there are two ways of unloading goods, depending on where the goods are located on the transport vehicle:

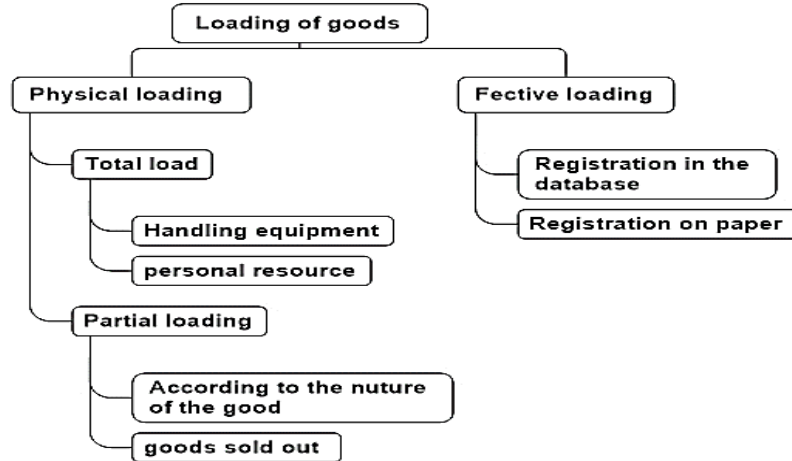
- **Total loading:** According to Soleilhac (2022), when you want to load goods completely, it is necessary to have the effort feasible from the handling equipment and personal resource point of view, but this could cause an imbalance in the normal functioning of the warehouse and would pose capacity problems in terms of manpower for loading goods.

- **Partial loading:** The fact that partial loading of goods is imposed according to the nature of the order, an order may contain different loading units, in this case, it will be necessary to separate the batches of goods and to repackage them, this work consumes some time and additional energy. On the other hand, the goods can be sold out, which requires waiting for the arrival of additional goods.

Fictive loading: This type of loading involves the following items:

- **Registration in the database:** In case of a problem with the computer system, there is the possibility of forgetting the registration of the data which leads to certain problems of delay or loss of traceability of the goods
- **Registration in the paper:** The traceability on paper, solves the problem of loss of information at the time of the computer system blocking but causes a problem of synchronization in real time of the information concerning the goods
- Ding & Chou (2015), consider that unproductive loading and unloading movements waste time and money.

Figure 10. Possible problem with loading time

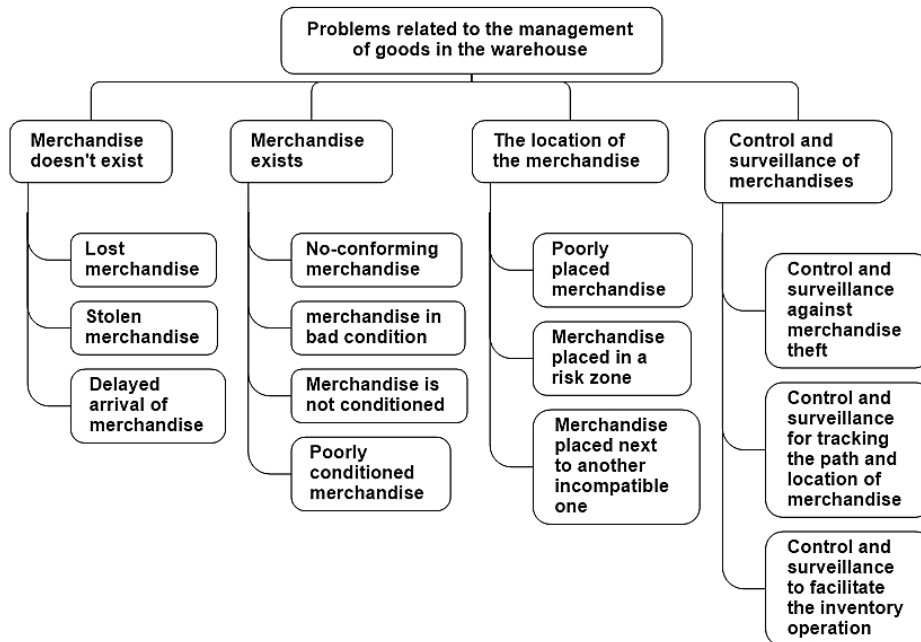


Source: Prepared by the authors (2023)

Problems Related to the Storage or Management of Goods in the Warehouse

According to VALEYRE Antoine (2001), large flows lead to the emergence of significant constraints relating to goods.

Figure 11. Merchandise Management



Source: Prepared by the authors (2023)

The study brought by Atik el ftouh M. (2020), shows that most of the wasted time during order picking is usually caused by the lack of a classification of goods by order or nature, the application of such an order-picking model leads to changes in the level of the organization of the distribution chain. The study by Önut S. (2008) proposes a policy of placing incoming goods where there is space when they are received. This random storage policy makes good use of

space, but according to De Koster and al. (2007) this method increases the number of goods movements, which can have an impact on performance (packaging, deformation, etc.), Figure 11 lists the problems that lead to the general problem of inefficient goods management:

Good or merchandise doesn't exist: Efficient goods management avoids the following problems:

- **Lost goods**

The loss of merchandise presents a major problem, causing the cancellation or delay in processing the order. These impacts increase the time and cost of the order processing.

- **Stolen goods**

When merchandise is stolen, it generates additional charges and delays in processing the associated order. So, you need to know how, when, and where it was before it was stolen to apply penalties. And to easily determine its previous location, the goods must be ordered properly.

- **Good late arrival**

The delay of goods can be direct or indirect. The first one is delaying the preparation of the order, while the second one will cause a delay to the concerned vehicle, i.e., delaying the unloading in the warehouse.

Merchandise exists: The processing of an order at the right time does not only depend on the existence of the associated goods in the warehouse. To avoid the delay of the existing goods, the following relative disturbances must be taken into consideration:

- **Erroneous good (no conforming merchandise)**

Erroneous merchandise: that is to say, merchandise that does not meet the criteria mentioned in the requested specifications should not be kept in the storage area of the warehouse (in order not to lose time and space during the operations: order preparation, reception...)

- **Good in bad condition**

It is necessary to know the time when the merchandise changes state: before the reception (if this is the case, it must be refused) or after the reception to the warehouse, in this last case, it must be repackaged to return it to a good state.

- **Unpackaged or poorly packaged well**

Unpackaged or poorly packaged merchandise represents a source of wasted time, and to remedy this problem (It must be packaged, it must be qualified by repackaging to minimize the time of preparation of an order). Lee & al (2006), in their research, says that applying

simulation models for each operation of treatment of goods (loading, unloading...) leads to minimizing the goods processing time.

The location of the merchandise: The location of the goods plays an important role in the order-picking process; either the way the goods are placed or the place where they are placed can be a source of additional time. As indicated below:

- Poorly placed goods

Keeping goods in the wrong place presents two risks: the first one is the increase in handling time and the second one is a risk threatening the safety of the employees (so the Merchandise must be placed correctly).

- Goods placed in a risk zone

The goods placed in risk areas in terms of the passage of handling machines or in their vicinity always present a double and reversible risk: Either the handling of the goods causes a temporary blockage of the passages in the vicinity or when it is about temporary passages see their deviations, or in risk of falling or rubbing, which impacts their quality and causes damage.

- Goods placed next to another incompatible one

Merchandise that is incompatible with each other presents a risk to other goods that are stored or stocked nearby.

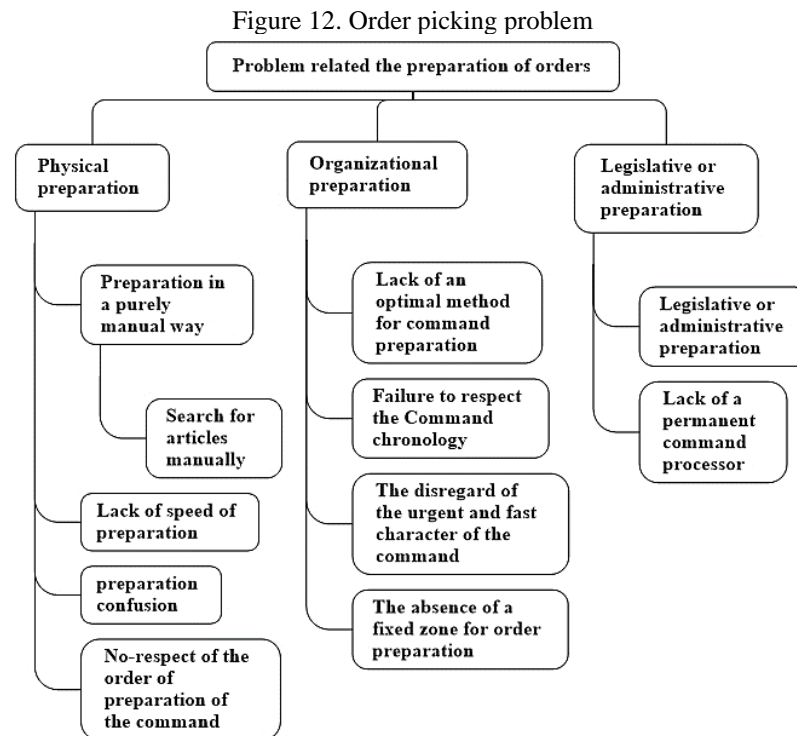
Control and surveillance of goods: The absence or lack of control and monitoring of goods during their processing cycle presents one of the major problems that result in:

- Theft of merchandise.
- Losses in the warehouse in articles of different natures.
- The complexity of the inventory task.

Problems related to the preparation of orders

The study by Reif R. & Walch D. (2008), requires a focus on improving the functional process while taking into account order processing speed and process quality, but this requires a precise elaboration of the problems associated with order picking.

The sub-problems related to the preparation of orders are illustrated below, Figure 12:



Source: Prepared by the authors (2023)

Efficient order picking guarantees and saves more time during the order picking, delivery, or receiving phase. It guarantees a higher service rate. To attain these objectives, it is necessary to remedy problems related to the:

Physical preparation: Among the effects that impact the quality of physical preparation are:

- **Purely manual Preparation**

Preparation in a purely manual way has two negative effects: the first according to Virginie G. (2014), is the increase in work-related accidents with lost time while the second is the increase in document processing time which slows down the order processing operations in the warehouse. Aqib Khan M. (2020) & De Koster (1999), have retraced the notion of order picking as a complex process that requires employee movement, and according to Calzavara (2017), this work exposes workers to musculoskeletal disorders.

- **Search for articles manually**

Loading units (LUs) generally constitute orders, so searching for an item manually is delaying an order. In general, processing items manually increases the time it takes to prepare orders. Soleilhac (2022), shows that would also pose capacity problems in terms of the manpower needed to prepare the orders. For this purpose, Sameh Belaid Mohamed (2022), says that demand planning is used to prepare the order plan based on the forecast.

- **Lack of speed of preparation**

The lack of speed of preparation, either because of the area's occupation, the docks, or the non-availability of the handling material (not in good condition or already used), always presents a risk of increasing the time of preparation of the orders.

- **Preparation confusion**

To increase the efficiency of the work, it is necessary to separate the tasks; each person must execute a specific task to avoid having more than one person execute the same task at the same time for the same article.

- **No respect for the sequence of order preparation**

The failure to respect the chronology of the preparation of orders leads to the overloading of the docks and the storage areas. In addition, this allows orders of an urgent or priority nature to be delayed.

Organizational preparation: The organization is a success, to have good preparation and an effective organization it is necessary to take into account the following challenges:

- **Lack of an optimal method for order preparation**

The absence of an efficient method for order preparation allows for a fluctuation in order processing time, especially when the person who manages the order processing changes, i.e., the newly arrived operator only adapts after a certain amount of execution of the order preparation tasks. (The use of an intelligent system, with a method to follow or very precise steps, the task becomes easy and fast)

- **Failure to respect the order chronology**

When the processing of orders is advanced about others in an unordered way, the problem of not respecting the order delivery time is encountered which increases the preparation time of subsequent orders.

- **The disregard for the urgent and fast character of the command**

Normally, to keep the loading, unloading, and order preparation activities running smoothly, orders must be separated according to their nature, i.e.: urgent order, express order, fast order, and normal order...

- **The absence of a fixed zone for order preparation**

It is always necessary to keep an order preparation area according to the nature (urgent) of the order. If you are preparing a normal order, and another urgent order arrives immediately, the best solution is to process the urgent order in a special area, and not stop the preparation

that is in progress. In general, orders of an urgent nature are unexpected and difficult to schedule.

- **Legislative or administrative preparation**
- **The absence of traceability documents of the merchandise loaded in the order**

The traceability documents represent the identification and the judgment (a document that judges that such and such a command carried) of each order made. Therefore, it is always necessary to keep traceability using paper or digital documents. However, the current trend is moving more and more towards the digitization of traceability, thus avoiding the abusive and cumbersome use of paper.

- **Lack of a permanent command processor**

The absence of a permanent order processing manager increases the adaptation time with the flow and fast processing of orders.

RESULTS AND DISCUSSION

In the above, the article proposes a flexible organization and highlights various problems to overcome to ensure the proper functioning of a warehouse and its exchange platform. Several works reported in the literature provide their vision in particular for the resolution of the problems identified in the previous section. In the following, the article presents various avenues for resolving these problems.

The study prepared by Crainic and Hewitt (2021), considers that the associated optimization problems are often design and implementation problems. According to a concentrated study in the literature, the problem studied in the aforementioned paragraph concerns the time optimization of goods passage in a warehouse. These problems can be classified under three categories of global solutions as shown in Table 6, such as:

Problems related to the storage of goods, for which a solution can be the surveillance and monitoring of goods and also the implementation of security and compliance with working conditions.

Problems about the follow-up of the goods, for which a solution can be the surveillance and follow-up of the goods.

Problems with the preparation of the orders, for which a solution can be the security and respect of the working conditions.

Problems related to the unloading and loading of goods and the overall proposed solution is scheduling.

Table 6 – Problem assignment by the proposed solution

Monitoring and tracking of goods	Safety and working conditions	Scheduling
Storage of goods	Storage of goods	Unloading of goods
Tracking of goods	Preparation of orders	Loading of goods

Source: Prepared by the authors (2023)

Figure 13, gives a schematization of the global solutions and the sub-solutions in detail, such as the solution tree containing three essential axes for the effective management of a warehouse, to control the time of passage of the goods by this last.

Incompatible goods must be known in advance to avoid their storage nearby to avoid any type of risk due to their incompatibilities.

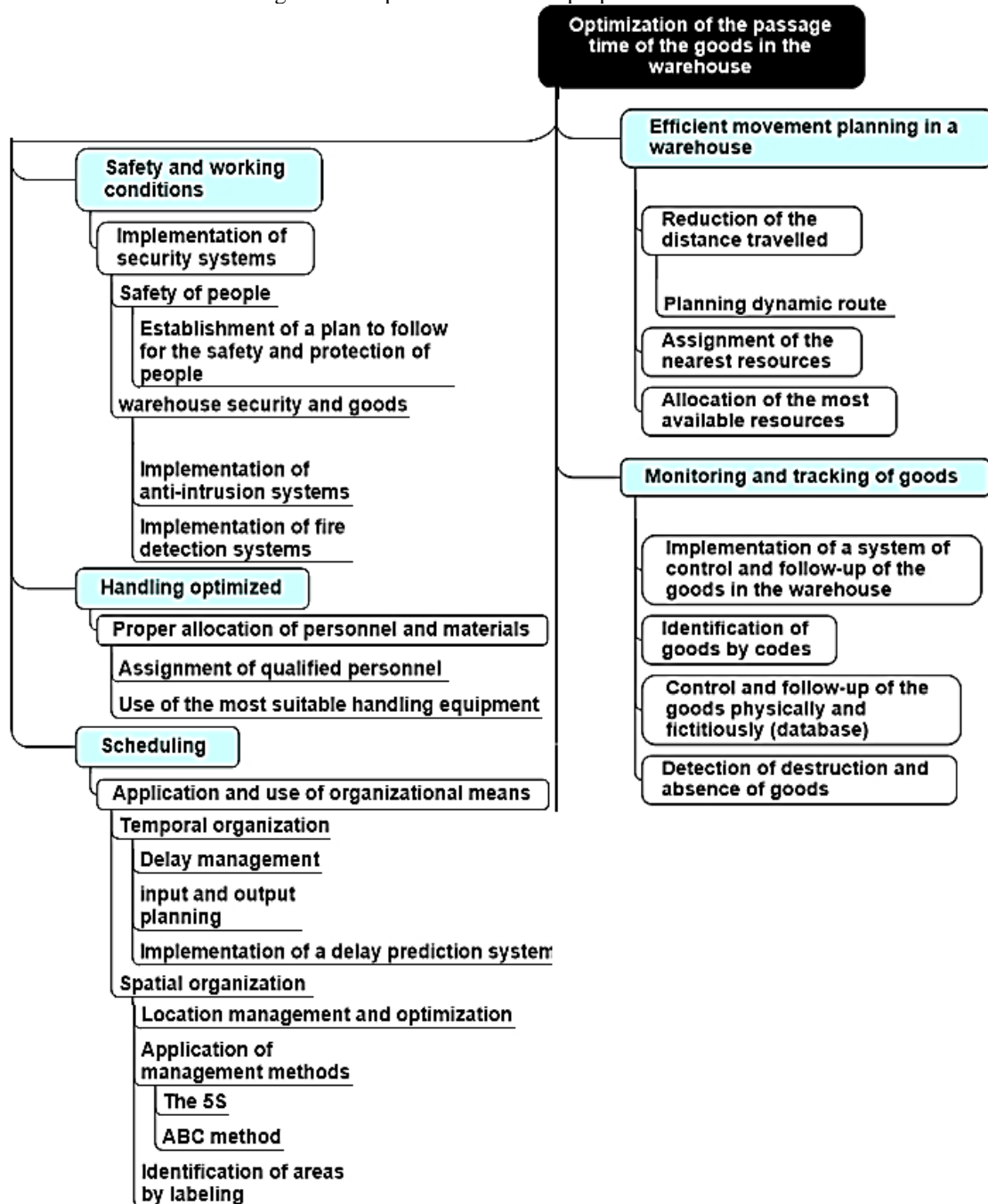
This solution tree contains essential axes for the efficient management of a warehouse, to control the passage time of the goods through it.

The first axis concerns the scheduling, it is used to apply methods of organization and management of time and space, to remedy the space-time losses, namely:

Temporal organization: The temporal organization results in:

- Implementation of a communication system with the incoming vehicles, to know the arrival time as accurately as possible. Soleilhac (2022), proposes the integration of a traceability module that allows the tracking of the vehicle in question and the goods and sends an alert in case of a problem planning of feasible entries and exits at the right time.

Figure 13. Representation of the proposed solutions



Source: Prepared by the authors (2023)

These two factors help to manage and optimize the delay.

Spatial organization: The spatial organization is translated by:

Managing and optimizing the use of warehousing, storage, loading, unloading, and order processing locations and areas.

Implementation of management methods: Application of the 5S method and the ABC method.

Zoning allows for ease of use and cost-effective management of these areas.

The second axis is reserved for the surveillance and the follow-up of the goods in the different locations of the warehouse zones and this is done by:

Control and surveillance of goods: The control and surveillance of goods play an essential role; they help to reduce the risk of loss, theft, or disappearance of goods and increase the efficiency of employees. For this purpose, the following considerations must be taken into consideration:

- **Control and surveillance against theft of goods**

The goods must be permanently controlled against theft (lost goods imply a delay or a cancellation of the associated order).

- **Control and monitoring for tracking the path and location of goods**

Tracking the path and location of goods facilitates the arrangement of load units and articles from different locations in the warehouse when preparing an order.

- **Control and monitoring to facilitate the inventory operation**

Inventory in a heterogeneous environment in terms of nature, quantity, and different locations of items, represents one of the most difficult tasks. A permanent inventory makes the task easier and faster. According to a published study, “Alliance^F” considers that every company or warehouse needs a clear and updated visibility on these elements (infrastructure, products), so the integration of automatic inventory, allows to:

- Quickly repair any defects encountered.
- Define the best solution.
- Optimize repair time.
- Reduce labor costs.

The third axis is related to safety and working conditions in the warehouse. The aspect of security concerns the protection of the personnel, as well as the goods protection and the warehouse itself, which is reflected in the implementation and monitoring of a safety system that corresponds to the:

- **Safety of people:** The safety of people allows them to work in optimal conditions and allows the increase of the employees’ profitability.
- **Security of the warehouse and goods:** The goods security is included in the security of the warehouse, this is achieved by the implementation of security systems such as anti-intrusion systems, and fire detection systems...

^F Alliance <https://www.alliancesolutionslogistiques.com/>

The fourth axis deals with the aspect of handling and manipulation of the goods (at the time of unloading, warehousing, storage, and treatment...) in an optimal way namely:

Proper allocation of personnel and materials: This can be explained by the assignment of qualified people to handle and use the handling equipment correctly to keep them in good condition, and on the other hand to avoid work accidents. At the same time, it is necessary to designate the most suitable material for the operation to be treated, to increase the speed and efficiency of treatment. Imail & al. (2002) and Hun & Cai (2017) have suggested the design of a storage function improvement system avoids the restriction of goods at the time of loading and unloading.

The last axis which is oriented towards internal planning, including the partial planning of the movement of people, materials, and goods in the warehouse, focuses on the following aspects:

- Reduction of the distance traveled
- Dynamic route planning
- Assigning the closest resources
- Assignment of the most available resources

The implementation of technologies that help to make the inventory automatically advantageously facilitates the task. (ULTIMS^G) Develops automation solutions for the Internet of Things based on the principle of integrating permanently active and low consumption tags (said to be autonomous), This technology avoids the need to scan an RFID tag or a barcode. With a lifespan of about 10 years, the investment cost tends to be reduced (ULTIMS).

According to Agerschou (2004), the proper packaging of loads or goods improves safety, reduces damage and losses, and cuts load breakage times.

CONCLUSION AND OUTLOOK

This article presents the different processes of a warehouse and the operations of goods processing, from their arrival at the warehouse to their delivery.

The presented work concerns the logical framing of the major problems met by goods during their passage in a warehouse, as well as the presentation of the solutions relative to the problems.

The perspectives of the work presented here are of several kinds. First of all, the elaboration of parameters makes it possible to explain the causes of the aforementioned

^G ULTIMS. universal live tracking and inventory solution, <https://ultims.com/>.

problems to set up a system, based on rules of inference, to accentuate the diagnosis and help decision-making.

Finally, the consolidation of the approach, by a learning algorithm, makes it possible to predict the initial causes and to dynamically determine their value to apply an objective approach.

ACKNOWLEDGMENT

This research is supported by the Ministry of Higher Education, Scientific Research and Innovation, the Digital Development Agency (DDA), and the National Center for Scientific and Technical Research (CNRST) of Morocco (Smart DLSP Project - AL KHAWARIZMI IA-PROGRAM).

REFERENCES

- Agerschou, H. (2004). Planning and design of ports and marine terminals. Thomas Telford.
- Anderson, S., Allen, J., & Browne, M. 2005. Urban logistics - How can it meet policymakers' sustainability objectives? *Journal of Transport Geography*, 13(1 SPEC. ISS.), 71–81. <https://doi.org/10.1016/j.jtrangeo.2004.11.002>.
- Aqib Khan M. 2020. Design and control of a robotic system based on mobile robots and manipulator's arms for picking in logistics warehouses p31-33. s.l. : Université Le Havre Normandie.
- Araújo, E. J., Chaves, A. A., de Salles Neto, L. L., & de Azevedo, A. T. (2016). Pareto Clustering Search applied for 3D container ship loading plan problem. *Expert Systems with Applications*, 44,50-57.
- Atik el ftouh M., 2020. Modeling of a smart digital ecosystem for optimized and collaborative management of urban freight transport, aggregating several artificial intelligence methods and techniques for decision support. s.l. : PhD, Faculty of Science and Technology of Tangier, Abdelmalek ESSAADI University-Tetouan Morocco.
- Azevedo, A. T., de Salles Neto, L. L., Chaves, A. A., & Moretti, A. C. (2018). Solving the 3D stowage planning problem integrated with the quay crane scheduling problem by representation by rules and genetic algorithm. *Applied Soft Computing*, 65, 495-516
- Bakkali, H. 2016. Modeling of a decision support tool for improving profitability in warehouses and logistics platforms. PhD, Faculty of Science and Technology of Tangier, Abdelmalek ESSAADI University-Tetouan Morocco: s.n.

Cattaruzza D., 2014. VEHICLE ROUTING FOR CITY LOGISTICS: Optimisation de tournées de véhicules pour lalogistique urbaine. PhD, higher national School Mines of Saint-Étienne.

Crainic et Hewitt, (2021). « Service network design », in: Network Design with Applications to Transportation and Logistics. s.l. : Springer, p. 347-382.

De Koster et al., 2007. Design and control of warehouse order picking: a literature review [Revue] // European Journal of Operational Research. - 2007. - Vol. 182. - pp. 481–501.

De Koster, R., Roodbergen, K.J. and Van Voorden, R., 1999. Reduction of walking time in the distribution center of De Bijenkorf. In New trends in distribution logistics (pp. 215-234). Springer, Berlin, Heidelberg.

Ding, D., & Chou, M. C. (2015). Stowage planning for container ships: a heuristic algorithm to reduce the number of shifts. European Journal of Operational Research, 246(1), 242-249

Galzavara, M., Glock, C.H., Grosse, E.H., Persona, A. and Sgarbossa, F., 2017. Analysis of economic and ergonomic performance measures of different rack layouts in an order-picking warehouse. Computers & Industrial Engineering, 111, pp.527-536.

Gharbi S., 2015. Augmented reality at the service of optimizing picking and putting operations in warehouses. PhD, Automation, Computer Engineering, Central School of Lille: s.n.

Harper R. L., 2010. Warehouse Technology in the Supply Chain Management Systems,

Hu, M., & Cai, W. (2017, April). Multi-objective optimization based on improved genetic algorithm for containership stowage on full route. In Industrial Engineering and Applications (ICIEA), 2017 4th International Conference on (pp. 224-228). IEEE

Imai, A., Nishimura, E., Papadimitriou, S., & Sasaki, K. (2002). The containership loading problem. International Journal of Maritime Economics, 4(2), 126-148

Lee, C., Huang, H. C., Liu, B., & Xu, Z. (2006). Development of timed Colour Petri net simulation models for air cargo terminal operations. Computers and Industrial Engineering, 51(1), 102–110. <https://doi.org/10.1016/j.cie.2006.07.002>

Lenoble, N., 2017. Optimization of order picking in distribution warehouses. Grenoble University.

LOMBA Cédric, 2018, La restructuration permanente de la condition ouvrière : de Cockerill à ArcelorMittal, Vulaines-sur-Seine, France, Éditions du Croquant, 365 p

LOMBA Cédric, 2010, « Les petites mains des petites entreprises : gestion informelle et fractures ouvrières », Sociologie du Travail, 52(4), p. 503-520

Lucas, T. (2019), Les ouvriers du déplacement : travail en entrepôt et recompositions du salariat populaire en France (1980-2018) P 323(326 / 637).PhD University of Paris sciences and letters, 2019. French. (NNT: 2019PSLEE024).

MALET Jean-Baptiste, 2013, En Amazonie : infiltré dans le « meilleur des mondes », Paris, Fayard, 168 p.

Önüt S., 2008. A particle swarm optimization algorithm for the multi-level warehouse layout design problem [Revue] // Computers and Industrial Engineering 2008. - 4: Vol. 54. - pp. 783–799.

Raicu, R., Raicu, S., Popa, M., & Costescu, D. 2010. More efficient urban freight consignment preparation and transportation. *Procedia - Social and Behavioral Sciences*, 2(3), 6027–6041. <https://doi.org/10.1016/j.sbspro.2010.04.016>.

Reif R. and Walch D., 2008. Augmented & Virtual Reality applications in the field of logistics, *Vis. Comput.*, vol. 24, no. 11, pp. 987–994, Aug. 2008.

Sabah Belil, 2021. Tools for planning the production and distribution of bulk products: the case of OCP Morocco. P 238-239. PhD, Clermont Auvergne University, 2021. French. (NNT: 2021UCFAC021).

Sameh Belaid Mohamed, 2022. Modeling supply chain forecasting processes to improve industrial performance P.22.

Schwerdtfeger B. and Klinker G., 2008. Supporting order picking with Augmented Reality, in 7th IEEE/ACM International Symposium on Mixed and Augmented Reality, 2008. ISMAR 2008, 2008, pp. 91–94.

Soleilhac, Gauthier (2022). Optimization of the distribution of goods with transport outsourcing: a problematic shipper. Nante: PhD, National School of Mines Telecom Atlantic.

Tanaka, S., & Tierney, K. 2018. Solving real-world sized container pre-marshaling problems with an iterative deepening branch-and-bound algorithm. *European Journal of Operational Research*, 264(1), 165-180

VALEYRE Antoine, 2001, « Le travail industriel sous la pression du temps. », *Travail et emploi*, 86, p. 127-149. LU

Virginie G., 2014. Logistics order preparation: Technological change and changes in occupational risks. *INRS-hygiene and safety at work- 2009- 214, P3_P12*

Walid Behiri, 2017. Une méthodologie pour modéliser et optimiser la mutualisation du transport ferroviaire urbain de marchandises et de passagers P. 144(150 / 210).