Merchandise traceability system in México's customs warehouses

Sistema de rastreabilidad de mercancías en los almacenes aduanales en México

Fuente: a través de Freepik.com Licencia Creative Commons

UNIVERSIDAD DE INVESTIGACIÓN Y DESARROLLO

I+D Revista de Investigaciones
ISSN 2256-1676 / ISSN en línea 2539-519X
Volumen 19 Número 2 julio-diciembre de 2024 pp. 52-66

Merchandise traceability system in México's customs warehouses[1]

Sistema de rastreabilidad de mercancías en los almacenes aduanales en México

Eduardo Isidro Esparza-Nava [2], Myrna Hortencia Lezama-León [3], Osiris María Echeverría-Ríos[4], Héctor Armando Figueroa-Urrea[5]

Article received on September 1st 2023; accepted on January 10th 2024

Abstract

This research aimed to identify the need for a merchandise traceability system in bonded warehouses in México for seized and abandoned goods. This system would indicate their real-time location and eliminate missing goods to improve resource management within the bonded warehouse. Qualitative descriptive research was conducted as a case study in the customs of Nuevo Laredo, Tamaulipas, to understand the current situation in detail. Interviews with personnel were used as the primary instrument, and the information was analyzed via a data matrix. This analysis revealed several issues: an optimal warehouse management system, more electronic systems in warehouse processes, and a technological solution to enable goods traceability. Radio Frequency Identification technology emerges as a promising implementation option in this context.

Keywords: information technology, foreign trade, public administration, monitoring.

Resumen

Esta investigación tuvo como objetivo identificar la necesidad de contar con un sistema de rastreo de mercancías en los almacenes fiscales de México para mercancías incautadas y abandonadas. Este sistema indicaría su ubicación en tiempo real y eliminaría las mercancías perdidas para mejorar la gestión de recursos dentro del almacén fiscal. Para

[1] Case study, qualitative approach type, result of a completed research project, belonging to the area of Engineering, subarea of Logistics, developed in the Supply Chain and Transportation Research Group, without funding (Tolcayuca, México). Address: Exhacienda San Javier, Tolcayuca 1009, 43860 Tolcayuca, Hgo, PBX: +52 7712474014. Start date: 2018. Completion date: 2021.

[2] Master in International Trade and Logistics, Universidad Politécnica Metropolitana de Hidalgo. Universidad del País Innova (Tuxtla Gutiérrez, México) Address: 22 Poniente Sur #332, colonia Samuel León Brindis, PBX: +52 96112.9011. ORCID ID: https://orcid.org/0000-0002-4025-7789. Institutional e-mail: eduardoesparza@uninnova.mx. Author's role Credit: research and writing - original draft

[3] PhD in Strategic Planning and Technology Management, Universidad Popular Autónoma del Estado de Puebla. (Puebla, México). Address: 17 sur 901, barrio de Santiago, PBX: +52 2222299400. ORCID ID: https://orcid.org/0000-0001-8181-3705. Institutional e-mail: myrnahortencia.lezama@upaep.mx. Author's Credit role: conceptualization, methodology, supervision, and writing, revising and editing.

[4] PhD in Management Sciences, Universidad Autónoma de Tamaulipas. Universidad Autónoma de Coahuila (Saltillo, México). Address: Blvd. V. Carranza s/n. Col. República Oriente, PBX: +52 8444381600 . ORCID ID: https://orcid.org/0000-0002-3390-2559. Institutional e-mail: oecheverria@uadec.edu.mx. Author's Credit role: methodology and supervision.

[5] Master in Transportation Planning, Universidad Nacional Autónoma de México. Supply Chain and Transportation Research Group. Universidad Politécnica Metropolitana de Hidalgo (Tolcayuca, México), PBX: +52 7712474014. ORCID ID: https://orcid.org/0000-0001-6240-0470. Institutional e-mail: hfigueroa@upmh.edu.mx. Author Credit role: supervision.

conocer a detalle la situación actual, se realizó una investigación cualitativa descriptiva como estudio de caso en el depósito fiscal de Nuevo Laredo, Tamaulipas. Como instrumento principal se utilizaron entrevistas con el personal y la información se analizó mediante una matriz de datos. Este análisis reveló varias cuestiones: un sistema óptimo de gestión del almacén, más sistemas electrónicos en los procesos del almacén y una solución tecnológica que permita la trazabilidad de las mercancías. En este contexto, la tecnología RFID (Identificación por Radiofrecuencia) se perfila como una opción de aplicación prometedora.

Palabras clave: tecnologías de la información, comercio exterior, administración pública, seguimiento.

Introduction

Under the procedures and controls with which customs authorities currently operate, the Asset Administration and Disposal Service (SAE) held 64 auctions in 2016, from which it obtained approximately US$260 000 000 in revenue from the disposal of property (seized and abandoned goods), entering fiscal precincts in México (Secretaría de Hacienda y Crédito Público [SHCP], 2023).

However, inconsistencies in the amounts of secured goods led to monthly modifications or eliminations due to double correction. As of June 2018, the Attorney General's Office (Procuraduría General de la República, [PGR]), now known as Public Prosecutor's Office (Fiscalía General de la República [FGR]), via official letter PGR/UTAG/DG/003707/2018, requested treating the information on the secured assets as confidential, i.e, they will not be published. This is within the General Law of Transparency and Access to Public Information (LGTAIP) framework.

In addition to preliminary inquiry (now investigation files) by the Public Minister (MP), more efficient control of the process of safekeeping and custody of the goods is required. Therefore, when the merchandise reaches the SAE or is returned to the exporter or importer, precise traceability over time is necessary, with a technology system in the fiscal or customs warehouses.

In this sense, the principal objective of this article is to identify the need for a traceability system using technologies for seized or abandoned goods arriving at the tax or customs warehouses of the Tax Administration Service (SAT). This is done to obtain real-time information to eliminate missing goods through controlling the introduction, extraction, handling, storage, or custody.

Currently, several technological developments support the traceability of products; according to Moreno *et al*. (2015), successful tracking has been achieved by proposing the technology of a barcode attached to the merchandise. Likewise, Herrera and Orjuela (2014) considered Radio Frequency Identification (RFID) technology, a wireless technological option that can be used to identify targets through communication between the reader and a tag.

México has 49 customs offices authorized to enter and exit goods throughout the country (Servicio de Administración Tributaria [SAT], 2014). The Nuevo Laredo, Tamaulipas customs office is the country's most significant crossing point for import and export cargo vehicles. The Administración General de Aduanas (2019) reported that, in the Mexican Republic, Nuevo Laredo customs recorded the highest number of operations, with a total of 23 565 (23.25%). Therefore, this research was conducted at Nuevo Laredo customs, which has the highest percentage of import and export operations. The increased flow of merchandise generates increased complexity in the traceability of the inputs safeguarded, thereby, the perfect object of study.

Context of customs in México

The SAT regulates the systems, methods, and procedures the General Customs Administration (AGA) must adhere to; it is decentralized from the Ministry of Finance and Public Credit (SHCP). According to Article 10 of Reglamento de la Ley Aduanera (Regulation of the Customs Law [LA]) (2015), customs regulates the entry and exit of goods into and out of Mexican territory, whether legal or illegal, with external and internal logistics to give a specific authorized place.

The Universidad Nacional Autónoma de México (2002) considers the importer as the one who submits foreign merchandise to regulation and fiscal control so that it can be freely introduced into the country for consumption or production. The exporter is the one who sends domestic goods for consumption or use abroad, considering that both incoming and outgoing goods must undergo a customs process.

Customs personnel, called Foreign Trade Officers (OCE), must inspect the merchandise that legally intends to enter or leave the country. The operation implies entering the merchandise into the fiscal or inspection area. According to Article 14 of LA (2018), these precincts are places where customs operations handle foreign trade goods, including custody, loading, and unloading. Castro (2014) mentions that there are two principal warehouses, defined as follows:

- General bonded warehouse: stores and safeguards a customer's merchandise.
- Bonded warehouse: facility recognized by customs authorities, used to store goods by the established conditions and for an unlimited time; it also has the same functions as a warehouse.

According to Article 23 of the LA (2018), the goods presented to customs must be registered in a *pedimento*. According to Méndez (2015), the pedimento is a format of different sections for customs operation. It shows whether they have paid the contributions to the SAT for the entry or exit of foreign trade goods and verifies whether they are legal.

The goods in a bonded warehouse will be assigned a customs regime according to the exporter's or importer's request. Sometimes, the goods may be abandoned or confiscated. *The Diario Oficial de la Federación* (DOF, 2018) establishes that regulations will proceed in favor of the Federal Treasury with the goods, according to the terms of Article 29 of the LA. Thus, the abandonment of goods can be in two ways, following the Article 90 of the LA (2018):

Express, the interested party does so in writing.

- Tacit, goods are not withdrawn within the established deadlines:
  - Three months: goods intended for export.
  - Three days: explosive goods, perishable goods, and live animals.
  - Two months: goods seized by the customs authorities for administrative or judicial processing, and not removed from the bonded warehouse.

Table 1 presents the procedure for the abandonment of goods, according to the Customs Operation Manual (MOA), to be done legally and processed at the SAE and give a final destination to the goods (SHCP, 2021).

Table 1
Abandonment of goods procedure

Procedure	Activity
1	The merchandise will be registered the after it enters customs, the fiscal or bonded warehouse.
2	Notify the interested party by certified mail, not to exceed 5 working days.
3	CERYS staff enters information into SICOBI.
4	Notify the owners of the future address and that they have 15 working days to remove them.
5	If they ignore the deadlines mentioned above, the goods become the property of the Federal Treasury.
6	The goods are transferred to the SAE to determine their final destination.
7	Sixty calendar days to go to reception with a delivery request to pick them up.
8	If the merchandise is not removed within 10 business days, customs may destroy or donate it.

Source: SHCP (2021).

According to Article 151 of the LA (2018), the precautionary seizure shall proceed:

- When the import or export merchandise is prohibited under the regulations and non-tariff restrictions, or payment of countervailing duties.
- Failure to accredit the necessary customs documentation and introduce the undeclared merchandise.
- Exceed by more than 10% of the total value declared in the customs documentation describing the merchandise.
- Introduction cargo vehicles with merchandise for import into the fiscal precinct without a customs declaration.
- Name, address of the supplier abroad, tax residence of the importer, or company name is false or non-existent.
- When the declared value is 50% or more than the transaction value of identical merchandise.

Table 2 shows the steps detected by the customs authority in the seizure of goods.

Table 2
Precautionary seizure procedure

No.	Process
1	Customs examination
2	Second examination
3	Verification of goods in transport
4	Review of documents during clearance
5	Verification
6	The customs broker will deliver a record of the facts to the importer or exporter

Source: (SHCP, 2021).

According to MOA (SHCP, 2021), the Administrative Procedure in Customs Matters (PAMA) is called to provide a solution to seizure irregularities. Its purpose is to resolve foreign merchandise in Mexican territory or outgoing merchandise when customs authority detects a situation.

Abandoned and seized goods, when not removed within the terms established in the customs law and by the importers or exporters, are part of the Federal Treasury and are transferred to the SAE.

The SHCP (2016) mentions that the SAE started its operations on June 17, 2003, and is responsible for allocating assets for the State supporting the Rule of Law, Public Finances, and the Mexican Financial System, with the corresponding responsibility or commitment. Table 3 shows the functions SAE provides: alienation, donation, destruction, and assignment of assets, with their different functions, regulated by Federal Law for the Administration and Disposal of Public Sector Assets (LFAEBSP).

Table 3
Functions of the property administration and disposal services

SAE		
Service	**Functions**	**Article**
Disposal	1. Public bidding 2. Auction (online or in-person) 3. Auction 4. Direct adjudication	Articles 44 to 51 - Articles 41 to 50 Articles 52 to 54 - Article 51 Articles 55 to 67 and 39 - Articles 53 and 54 Article 68 - Article 55
Donation	Federal public administration Governments of the federal entities and municipalities. Local public utilities	Articles 34 and 35 - Articles 56 to 60
Destruction	Property still unavailable for sale	Articles 69 to 75 - Articles 61 and 62
Assignment of goods	Assignment and donation system SAT goods	Non-transferable foreign trade goods that become property of the Federal Treasury

Source: Federal Public Administration Accountability Report 2006–2012.

Recovery of abandoned merchandise in favor of the Federal Treasury

Under LA (2018) Articles 29, 30, and 32, as the legal basis, and the 2017 General Rules of Foreign Trade Matters 1.2.2.2.and 2.2.4, as well as its Annexes 10 and 28, former owners may definitively import the merchandise that has become the property of the Federal Treasury. Provided they obtain authorization from customs. Such permission will be granted once, as long as there is no debt with the bonded warehouse. In addition, compliance with non-tariff regulations and restrictions must be proven, the payment of taxes and, if applicable, the corresponding countervailing duties. The interested party (importer or exporter) in a merchandise withdrawal from the bonded warehouse must present the following information along with the documentation indicated:

- Description and quantity of the merchandise as stated in the shipping document and submission of a copy.
- Customs documents of the fiscal or bonded warehouse.
- Date on which the merchandise was abandoned, presenting, if pertinent, a copy of the official notice issued by customs office.
- Tariff classification of the merchandise.

Those interested shall have a period of 1 month to remove the goods from the tax precinct or bonded warehouse. In this case, the customs shall partially or cancel the transfer documents, and the goods shall be placed in the fiscal premises. Provided that the interested party submits an affidavit stating that the goods are high-risk in terms of animal, phytosanitary, or public health instead of definitive importation, the goods may be returned.

Theoretical framework

Zhuangzhuang (2020) considered traceability a process of product circulation, maintaining brand image and improving stakeholder confidence. Hui and Kexin (2023) remarked that the traceability system can identify the key indicators of each process and thus track and manage specific information. In addition, the stakeholder knows that their products are traceable and effectively protect their rights and interests. Tagarakis *et al*. (2021) stated that traceability enables access to information about a product and its movements, becoming a commodity quality and safety key.

The implementation of technologies for the timely tracking of goods is supported by traceability definitions. According to Burganova *et al*. (2021), current warehouse technology has been able to grow impressively, with an evolution not seen until today. The most impactful proposal is that of Gestión Calidad Consulting (2016), which mentions that traceability is the ability to track historical data, application, or location of everything available to operate.

It is of utmost importance to provide timely tracking of goods in detail, where they come from and their final destination for stakeholders. Calvo (2015) indicates that traceability makes it possible to track a product throughout the production, transformation, distribution, and marketing process. Likewise, he refers to the operational part of the value chain and the importance of internal and external logistics, what matters is to trace the customs operational part. Finally, Herrera and Orjuela (2014) mentioned that the lack of traceability generates losses, so monitoring and controlling entry, storage, and distribution is necessary. Technology allows control and monitoring to obtain assurance in processes with high variability. According to Charlotte *et al*. (2022), a proper warehouse can reduce losses, if it implements a tracking and control system.

Applying traceability processes is a powerful tool to combat crime. It strengthens customs operations, preventing the introduction of illicit goods into the country and thus timely tracking goods from their introduction to fiscal precincts or warehouses. It is necessary to arrange the system properly and know the existing tracking types. According to Purwandoko *et al*. (2023), a traceability system is necessary to record activities in a warehouse to verify inputs and outputs, obtaining the collection and analysis of traceability-related information in a database system.

VINSSA (2018) established that traceability is composed of three processes: the first is bottom-up (backward) to identify incoming raw material, type of supplier, etc.; the second is internal or process (within the company), and the third is top-down (forward) where distribution is defined in detail, including its destinations.

Singh and Kumar (2021) mentioned that the quality of a warehouse is based on the data information obtained within the warehouse.

The customs authority must consider what is applicable to track goods, within the regime of abandonment of goods, by the provisions of the Second Unit, section C, of the Customs Operation Manual (MOA). For its part, the Ley Aduanera de Mercancía (Customs Law of Merchandise) (LA, 2018), also states in Article 29, Eighth Unit, subsection B of the MOA, that "el procedimiento para el tratamiento de bienes de comercio exterior, Faltantes, y sobrantes en recintos fiscalizados" (The procedure for the treatment of foreign trade goods, missing, and surplus in bonded warehouses).

Studies applying traceability

Zhang and Shao (2022) mentioned that technology enables real-time monitoring of things in warehouses to ensure traceability. Through encouragement, technology has proposed several solutions for traceability challenges and improved the existing ones. According to studies conducted for traceability, it has been applied in warehouses, customs, distribution centers (CEDIS), food companies and exporters. Mbakop *et al.* (2023) also considered that traceability can trace all aspects, as ISO 8402 established in 1987, defining traceability as "the ability to retrieve the history, use, or location of an entity through recorded identifications". In addition, it has an economic value by increasing the traceability of the product's origin, as well as allowing consumers to better judge the quality of the product they buy. Table 4 shows studies where traceability has been implemented, including the different methodologies and technological systems employed.

Table 4
State of the art of traceability

Reference	Country	Methods	Technological system	Results
Sales (2016)	Esmeraldas-Ecuador	Cause-effect diagram, ABC analysis, Pareto theory	Acces	A control method is needed to monitor the goods with traceability.
Francisco (2014)	Perú	Cost-Benefit Analysis. ABC Classification	WMS-barcode	It facilitates coordination of information and distribution within the warehouse, : decreases shrinkage and inventory levels and coordinates space.
Herrera-García *et al.* (2018)	México	ABC methodology	Master plan	It sorts products, handles them properly and eliminates existing inventory.
Núñez (2014)	Bogotá, Colombia	Rational and systematic procedure	RFID-WMS	It reduces cost and improves information flow through ICTs.
Rodríguez (2016)	Bogotá, Colombia	Process flow diagram	Barcode	It improves customer service, reduces error rates and operating cost overruns, obtains real-time information, and controls merchandise to reduce potential operational errors.
Yarín (2017)	Perú	Pareto analysis case study	RFID	Localization and inventory control, it achieves 46.2% reduction in localization time and reduces operation and logistics cost.
Durán *et al*. (2016)	Ecuador	Cause-effect diagram	Barcode	Ensuring product traceability is an opportunity that generates benefits, favoring international trade.
Herrera & Orjuela (2014)	Colombia	Causal analysis, conceptual model, linear programming, Delphi model, genetic algorithms, simulation, mixed integer linear programming.	Barcode and RFID	It implements traceability in the fruit supply chain and its relationship with investment capacity and product quality.
Milić *et al*. (2017)	Croacia	Business Model	RFID	Efficiency and optimization of the supply chain via management, maintaining a high level of product quality.
Moreno *et al*. (2015)	España	Business Model	RFID and 2D barcode	It ensures access to medicines, without affecting quality and with adequate protection.
Kubáč (2018)	Praga	Optimization model	RFID — Blockchain	Increased transparency by preventing counterfeiting in the supply chain and achieving customer satisfaction.
Mukhina *et al*. (2015)	Suecia	Cryptographic methods / Encryption method	Barcode	Improvement in a cross-information evaluation system and internal staff development.
Solanki & Brewster (2014)	Reino Unido	Framework Apache Storm	EPCIS, SPARQL y SPIN	Real-time supply chain traceability from manufacturer to final destination.
Liukkonen & Tsai (2016)	Reino Unido	Business Model	Auto-ID	Identification of the most common objects for production determination.
Rivera (2015)	Guatemala	Deming cicle- SWOF	Electronic cards and personal codes	Improvement in internal procedures.

Technology for traceability

Technology is adaptable to traceability and plays a decisive role in meeting the need to respond effectively to stakeholders regarding seized or abandoned goods. Gandara-González *et al.* (2021) established that traceability is significant by identifying strengths and weaknesses in this relationship and knowing the weaknesses of the consumer-customer.

Figure 1
Most commonly used technologies for traceability

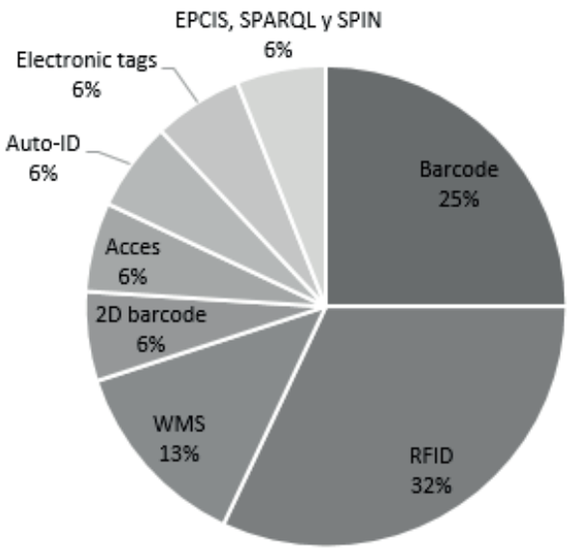

Figure 1 shows RFID as the most frequently applied technology in traceability studies, with 32% of the total. León-Duarte *et al*. (2020) conveyed traceability refers to tracking and tracing products until they reach the interested party at the end, to know the location and trajectory, to find the product quickly, and to reduce labor costs; they proposed six types of traceability: product, process, inputs, conditions, genetics, and measurements. In the study by Bargui and Ben-Abdallah (2021), traceability resulted in storage rules for data from specific requirements to obtain an up-to-the-minute improvement.

Barcoding follows at second place of use, with 25%, and Warehouse Management System, WMS, places third obtaining 13%. According to Tufano *et al*. (2022), WMS tracks storage and select operations through data analysis. Besides the purpose of traceability and according to Tong *et al*. (2023), WMS becomes fundamental in warehouse management as it uses software to perform warehouse check-in/check-out for allocation, inventory, and disassembly/assembly review to ensure safety, integrity, and entry.

The three most popular technologies are detailed to show their basic operation and influencing features. Likewise, a brief description of their components, advantages, and disadvantages is made, collecting information for traceability rapidly, accurately, and efficiently. As tools of supreme help, they control and facilitate the location, optimize inventories to measure the performance of operations, and decrease errors, counterfeit goods, and loss, protecting with increased security.

Affia and Aamer (2023) suggest that technologies have simplified the process within the warehouse. By applying the best and most innovative ones, it is possible to reach traceability, such as RFID, which is the integrated connection between physical elements (sensors or devices), to gain real-time visibility, exchange information, and access to data.

Banerjee *et al*. (2020) considered the development of a traceability system within the warehouse, to allow and monitor the data of their products updated and at a low cost.

Similarly, Singh and Jenamani (2021) argue traceability is based on RFID technology, indicating in real-time and generating data. Moreover, its features include adaptation to different environments through a powerful tool for the processes of industries or warehouses, improved and accurate traceability, and rapidity to protect goods.

Finally, Walaszczyk and Szymonik (2021) recognized that proper traceability management is the primal stage of a warehouse.

According to Herrera and Orjuela (2014), ten important features of RFID tags are in Table 5.

Table 5
RFID tag characteristics

No.	Features	Description
1	Storage	High data-storage capacity
2	Automatic	Automatic processes to maintain traceability, reducing human error.
3	Security	Tags (passive) can be hidden on the goods, preventing their visibility in case of theft.
4	Links	It stores data without direct contact with tags.
5	Robustness	It ensures operation in adverse conditions (dirt, humidity, temperatures, etc.).
6	Costs	It reduces operating costs.
7	Handling	Easy removal
8	Access read/write	Rewrite to add and delete information many times as desired (read/write tag).
9	Identification	It identifies the products.
10	Updating	Information stored in the tag in case it is read/written.

Source: Vázquez (2017).

Zhang and Shao (2022) affirmed that accurate information is now required for traceability and visibility of goods. Today, it is vital for any stakeholder to provide complete and truthful information about each commodity's history to understand what, when, where, and why of any goods in the fiscal or bonded context warehouse.

Mabeya (2022) established that RFID technology is effective in locating and managing the flow of goods, providing the current location, status, and history of objects to store. It generates better traceability in real time, so it is recommended that human intervention be kept to a minimum to avoid errors.

According to Nosenko *et al*. (2021), controlled technological operations are the pivotal element for improving the efficiency of production organization and scheduling; they consider QR coding and RFID technology, with which merchandise identification can be tracked.

RFID to traceability (Herrera & Orjuela, 2014) leads to safety and quality. Few studies have focused on exploring the optimization of traceability procedures, such as transfer times and the steps followed until reaching the interested party, or in this case, the SAE.

Garde (2016) identified that barcodes have certain disadvantages, such as the limited amount of data information to store, since they cannot be reprogrammed. According to León and de la Re-Iñiguez (2020), barcode technology is a control system that allows obtaining traceability of products due to the identification and recording of information. Therefore, it facilitates control, and the origin can be identified so that reliable results are obtained with minimal errors, making it mandatory to have a direct line of sight between the reader and the code. Even when its application is limited depending on distances, but it reads in 1 second.

Quisberth (2021) pointed out the possibilities offered by RFID technology, such as multiple simultaneous readings (in some cases, writing) and the remote reading of the information through a tag without physical contact. According to Couoh *et al.* (2015), RFID technology is the gateway to various applications in various areas: provide traceability solutions, offer enhanced inventory control in a warehouse for traceability, track and identify objects and people, and gain security in access.

Shahbazi and Byun (2020) considered that the development of technology in areas related to traceability system is based on low-cost implementation. Georgise and Mindaye (2020) identified that warehouse management relies heavily on human labor, so they recommended improving traceability for distribution with the support of technologies such as RFID cards.

Methodology

Type of study

This research's approach is qualitative-descriptive applied to a case study, since the information obtained is analyzed to describe the phenomena in detail (Cauas, 2015). Thus, the paper is labeled as non-experimental (Hernández *et al*., 2014), with a cross-sectional design, whose purpose is to describe the variables and analyzes their changes, such as merchandise procedures, evaluating the bonded warehouse. In that way, data can be collected, having the corresponding advantages and consequences of the technology for a traceability system. Three phases encompass the study: interview, information analysis, and conclusions proposal.

Participants

The PGR (2018) established that the information recorded in the systems used by the General Directorate of Control and Registration of Ministerial Securitization is not provided on time or trustingly; the same occurs with the data shared with institutional areas; therefore, part of the data collection process involved interviews, and given that the information handled in customs is confidential, the number of people interviewed was, so the type of information requested.

Since non-probabilistic samples correspond to qualitative studies, the present one is demarcated following this principle (Hernández *et al*., 2014 citing Creswell, 2013). The sample was applied under convenience because the available information is limited and comes from two sources: Foreign Trade Officers (FTOs), who represent operational profiles, and a department head, who constitutes a managerial profile. All participants belong to the Nuevo Laredo, Tamaulipas customs office, making the sample adaptable and acceptable.

Materials and instruments

The interviews were conducted under the methodologies outlined by Ruales (2017) and Sales (2016), as shown in Table 6. Significant similarities exist between the interviews developed by these authors, with a closer match to the study variables.

Table 6
Interview

Author	Questions	Variable	Interview type
Sales (2016)	Do you consider that the operations performed in the bonded warehouses are managed under an optimal warehouse management system? What does it consist of?	Warehouse	Senior management interview
	Are there defined policies in the warehouses that guide the activities?	Warehouse	
	Are electronic systems used in any of the warehouse processes? Which ones?	Traceability	
	What indicators does management use to measure the effectiveness of the bonded warehouse processes?	Warehouse	
	On average, how long do goods remain in a bonded warehouse?	Traceability	Operational staff interview
	Do the tools and equipment used match the operations performed there?	Warehouse	
	Is the physical space adequate to the needs of the goods (allocation of spaces and areas) and are physical inventories carried out periodically (how often)?	Warehouse	
Ruales (2017)	Is the inventory of goods coded?	Traceability	
	Briefly explain the processes of the goods within the warehouse / bonded warehouse.	Warehouse	
	Is there a technological system in place that allows the traceability of the goods?	Traceability	
	If inventory information is entered manually, where is this recorded?	Traceability	
	Is there an updated record of the location of the goods?	Traceability	

Procedure

The second phase of the process employs a data matrix from the interviews conducted by Sáenz and Tamez (2014) to analyze the information. This matrix identifies the dimensions evaluated and their meaning about the objects of study. Following Monje (2011), a table was elaborated with the responses recorded in the columns, whereas the emerging themes or categories from the interviews were placed in the rows. The last column contains a "conclusive summary," which highlights the different opinions of each interviewee.

Based on the matrix analysis, the third phase proposes an opinion or conclusion for each subcategory, aiming to identify areas of opportunity to recommend the most effective tracking system for the fiscal precinct.

Results

The interviews were conducted with individuals in a complex, sensitive, and confidential environment, making it challenging to obtain information and personnel for the interviews. Interviewees were offered the option of having their responses treated anonymously to encourage openness, which they accepted. After the interviews were collected, a tabulation was designed to relate and analyze the answers.

Various scenarios related to Nuevo Laredo Customs operations were analyzed based on the information gathered. It became evident that the results were quite contradictory, particularly among responses from the head of the Customs Department and those of the foreign trade officers (operational staff).

This contradictory information reveals a divergence in perspectives: the head of the department believes that there is an optimal warehouse management system for operations within the bonded warehouse. In contrast, the operational staff thinks there is inadequate control of merchandise and a lack of designated areas for proper storage due to disorganization.

To address this, a discussion is conducted that juxtaposes these conflicting views with the relevant literature. This analysis begins with the contradictory information,

followed by a discussion of the issues agreed by both parties.

Discussion

In the theoretical framework, Flamerique (2018) and Ganivet (2017) emphasize the importance of warehouse management, which facilitates the control and proper placement of products, indicating how and where goods should be stored. It reduces handling operations and minimizes errors. An effective management system accelerates the processing of goods, reduces turnarounds, and increases stakeholder satisfaction with seized or abandoned goods, thereby improving quality and shortening costs. Developing an optimal warehouse management system is essential to ensure all goods are stored according to nature.

Karimi and Namusonge (2014) point out warehouse management systems (WMS) offer basic storage location functionality. Similarly, Francisco (2014) highlights the principal advantages of WMS, including data efficiency and reliable readability. These systems can be stand-alone or integrated into an Enterprise Resource Planning (ERP) system and use advanced technologies such as RFID.

Regarding performance measurement, the department head mentioned that management applies indicators to assess the effectiveness of the bonded warehouse processes. However, operational staff indicated that they are unaware of these indicators, underlining the need for improved training and communication to ensure that workers are informed and engaged. Ballesteros *et al*. (2015) stress the importance of training, as operational weaknesses can lead to poor performance in internal processes and potential legal issues.

Operators also reported a lack of understanding of the processes related to goods within the bonded warehouse, as their role is limited to handing over seized or abandoned goods to the warehouse manager. In contrast, the department head stated that only a record of goods leaving the premises exists, with no detailed procedures for goods management within the bonded warehouse. Therefore, there is a pressing need to improve the Manual of Operations (MOA) for managing abandoned goods and seizures and overall control. Burgos and Quinapallo (2016) suggest that developing a procedures manual involves establishing control points and management indicators, creating process flow diagrams, and identifying policies, roles, and activities. This approach ensures clarity on what, how, when, and where tasks are to be completed, as well as the necessary resources and requirements.

Both management and operational areas acknowledged the scarcity of a technological system for tracking goods until they become part of the SAE. The department head revealed that the facility's function is limited to receiving, storing, and delivering goods, stating that tracking is neither cost-effective nor within their mandate. However, to reliably deliver requested goods and be accountable for them to the SAE, a technological traceability system is essential. Núñez (2014) identifies RFID as a promising technological innovation that, when implemented in warehousing, can reduce inventory losses, enhance process efficiency, and nurture information accuracy. Although the initial investment for RFID may be higher than that for other technologies, such as barcodes, its coverage range is more remarkable. Yarín (2017) reports that RFID can reduce product location time by 46.2%.

Although operatives note that inventory information is recorded manually in control books and filing cabinets, the department head denies the existence of such manual records without clarifying how inventory management is conducted. According to Fan *et al*. (2014), detailed inventory management can minimize effort, prevent fraud, and resolve discrepancies: outcomes that RFID can help achieve.

The department head claims that there is an updated record of the location of assets, while the operational staff asserts that there is not. This contradiction is striking, as the department head previously denied having a manual inventory record and did not specify how inventory management is executed, suggesting a lack of knowledge about operational processes. It is critical to mention that while there may be an updated system for tracking goods, its details are not disclosed, and the staff is unaware of its existence, indicating a gap in traceability technology.

In the second part of this article, we discuss the matters of agreement among the interviewees. Management and operational staff concur that there are policies in the warehouses to guide activities. Castro (2014) highlights the need to coordinate all warehouse operations to confirm that the merchandise is stored according to its nature and that there are adequate facilities for its correct handling and information systems.

Regarding the usual time that the merchandise remains in a bonded warehouse, the department head informed that this depends on pending procedures. Operational staff corroborated this, stating that items can be for months or years, depending on the legal processing. Castro (2014) asserts that bonded warehouses can store goods indefinitely.

The department head indicated that the tools and equipment used are conditioned to the type of facility, an aspect that operational staff confirmed due to the variety of equipment available. Castro (2014) recommends coordinating four factors: merchandise, facilities, storage systems, and personnel.

The department head specified that the physical space responds to the needs of the goods, including allocating specific areas, and information shared by the operatives. Ganivet (2017) notes that the physical space of the

warehouse should be divided into zones to optimize operations, such as reception areas, storage, picking, verification, and offices.

Both management and operational staff agreed that barcodes identify the merchandise, following Rodríguez's (2016) proposal to use them as part of an internal traceability system. Table 7 summarizes the issues identified at the inspected sites.

Table 7
Existing situations in bonded warehouses

No.	Problems
1	Lack of an optimal warehouse management system
2	Lack of electronic systems in warehouse processes
3	Lack of equipment
4	Lack of a technological system that allows the traceability of goods

Conclusions

After discussing the results of this research for developing a traceability system in bonded warehouses in México, the analysis of various authors highlights the relevance of technologies such as RFID, barcodes, and WMS. Each of these technologies offers advantages in inventory management, mainly by improving the procedures for entry, registration, identification, control, and withdrawal of goods. Therefore, adopting these technologies is crucial in the case of bonded warehouses in México, where there is no technology for the traceability of insured goods. Poor management generates losses for the SAT and frustration for the owners who cannot recover their merchandise.

The analysis and discussion of the interviews reveal a clear need for asset control, leading to the following recommendations.

Recommendations and future work

1. RFID technology is recommended for the traceability of goods in bonded warehouses from entry to exit to share the information generated by the system. It is a system that does not require direct scanning for its identification.
2. A quality department is recommended, which can monitor the actual and correct information, with the help of traceability technology provided by the operators.
3. With the implementation of the technology, a significant amount of paper records will be eliminated. It is recommended that bonded warehouses implement an internal exit order for goods that are withdrawn to the SAE or returned to the interested party. A document indicating the detailed information of each merchandise is required to have internal control.
4. It is recommended that staff be trained to use the goods traceability control system optimally.

Finally, as future work, it is suggested that the procedures established in the MOA be reviewed for better management of confiscated goods and a portal where users can track them within the bonded warehouses and recover them. Or, if necessary, the SAT can dispose of them immediately to clear the space occupied within the premises.

Acknowledgments

We appreciate the support of the participants in providing information.

Conflicts of interest

The authors declare that there is no conflict of interest in this study.

References

Administración General de Aduanas. (2019). *Ventanilla única*. https://ventanillaunica.gob.mx/vucem/cifras.html

Affia, I. & Aamer, A. M. (2023, April). A framework for designing IoT-based smart warehouse infrastructures. In *AIP Conference Proceedings* (Vol. 2646, No. 1). AIP Publishing. https://doi.org/10.1063/5.0139399

Ballesteros Silva, P. P. Robledo Castro, M., & Barrios Mendoza, H. M. (2015). Modelo de capacitación sobre logística integral de almacenamiento para autoservicios de retail. *Scientia et Technica, 20*(1), 32-41. https://doi.org/10.22517/23447214.9019

Banerjee, S., Saini, A. K., Nigam, H., & Vijay, V. (2020, January). IoT instrumented food and grain warehouse traceability system for farmers. In *2020 International Conference on Artificial Intelligence and Signal Processing (AISP)* (pp. 1-4). IEEE. https://doi.org/10.1109/AISP48273.2020.9073248

Bargui, F. & Ben-Abdallah, H. (2021). An ontology-based approach for automatic goal requirements engineering in data warehouse design. *International Journal of Information and Decision Sciences, 13*(2), 143-165. http://dx.doi.org/10.1504/IJIDS.2021.116494

Burganova, N., Grznar, P., Gregor, M., & Mozol, Š. (2021). Optimalisation of internal logistics transport time through warehouse management: Case study. *Transportation Research Procedia, 55*, 553-560. https://doi.org/10.1016/j.trpro.2021.07.021

Burgos Roca, A. F. , & Quinapallo García, C. M. (2016). Importancia de los manuales de procedimientos para la mejora de los procesos operativos en las agencias de aduanas. *Revista Caribeña de Ciencias Sociales*. https://econpapers.repec.org/RePEc:erv:rccsrc:y:2016:i:2016_10:21

Calvo Dopico, D. (2015). Implantación de la trazabilidad y su relación con la calidad: Marco conceptual y retos estratégicos. Aplicación al sector pesquero. *Economía Agraria y Recursos Naturales, 15*(1), 79-98. https://doi.org/10.7201/earn.2015.01.05

Castro, G. E. (2014). *Operaciones auxiliares de almacenaje: Organización de los almacenes y análisis de documentación, riesgos, proceso y mantenimiento* (1st ed.). Ideas Propias Editorial.

Cauas, D. (2015). *Definición de las variables, enfoque y tipo de investigación*. https://gc.scalahed.com/recursos/files/r161r/w24762w/Definiciondelasvariables,enfoqueytipodeinvestigacion.pdf

Charlotte, L., Vimalraj, L., Monisha, R., & Murugan, R. (2022). Automated food grain monitoring system for warehouse using IoT. *Measurement: Sensors, 24*(1), 100472. http://dx.doi.org/10.1016/j.measen.2022.100472

Couoh Novelo, M. A., Uh Kauil, A., & Yam Uc, J. A. (2015). Control y trazabilidad de hatos ganaderos mediante la implementación de sistema web-móvil con tecnología RFID. *Tecnología Educativa*. https://doi.org/10.32671/terc.v2i3.150

Creswell, J. W. (2013). *Steps in conducting a scholarly mixed methods study*. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1047&context=dberspeakers

Diario Oficial de la Federación. Decreto por el que se reforman, adicionan y derogan diversas disposiciones de la Ley Aduanera. June 25th 2018. https://dof.gob.mx/nota_detalle.php?codigo=5528958&fecha=25/06/2018

Durán Salazar, G. M., Salazar Soledispa, V. B., & Meza Clark, T. (2016). Estrategias de trazabilidad para la exportación de cacao. *Revista Publicando, 3*(8), 375-389. https://dialnet.unirioja.es/servlet/articulo?codigo=5833396

Fan, T. J., Chang, X. Y., Gu, C. H., Yi, J. J., & Deng, S. (2014). Benefits of RFID technology for reducing inventory shrinkage. *International Journal of Production Economics, 147*, 659-665. https://doi.org/10.1016/j.ijpe.2013.05.007

Flamerique, S. (2018). *Gestión de existencias en el almacén*. Marge Books.

Francisco Marcelo, L. (2014). *Análisis y propuestas de mejora de sistema de gestión de almacenes de un operador logístico* [Master´s thesis, Pontificia Universidad Católica del Perú]. http://hdl.handle.net/20.500.12404/5279

Gandara-González, F., Loza-Covarrubias, I. E., & Lara-Cruz, J. (2021). Trazabilidad hacia atrás en la MIPyME de la Ciudad de Aguascalientes, México. *Conciencia Tecnológica, (62)*, 5. https://www.redalyc.org/journal/944/94469878004/html/

Ganivet Sánchez, J. (2017). *UF0926: Diseño y organización del almacén*. Elearning. https://www.editorialelearning.com/catalogo/media/iverve/uploadpdf/1525973126_UF0926_demo.pdf

Garde Paniagua, P. (2016). Estudio de implantación de sistema de trazabilidad RFID en el proceso productivo de Tasubinsa [Degree project, Universidad Pública de Navarra]. https://academica-e.unavarra.es/handle/2454/21919

Georgise, F. B. & Mindaye, A. T. (2020). Technologies for storage & warehouse management of coffee beans in Ethiopia. *TRKU, 62*(9), 5375-5393. https://www.kansaiuniversityreports.com/article/technologies-for-storage-warehouse-management-of-coffee-beans-in-ethiopia

Gestión Calidad Consulting. (2016). *Trazabilidad en calidad*. http://gestion-calidad.com/trazabilidad-en-calidad

Hernández, R., Fernández, C., & Baptista, P. (2014). *Metodología de la investigación* (6th ed.). McGraw Hill. https://www.esup.edu.pe/wp-content/uploads/2020/12/2.%20Hernandez,%20Fernandez%20y%20Baptista-Metodolog%C3%ADa%20Investigacion%20Cientifica%206ta%20 ed.pdf

Herrera-García, R. A., Juárez, C. G., Chiw-Gramillo, E. D., & Am, L. (2018). *Implementación de la metodología ABC en un centro de distribución*.

Herrera Ramírez, M. & Orjuela Castro, J. (2014). Perspectiva de trazabilidad en la cadena de suministros de frutas: Un enfoque desde la dinámica de sistemas. *Ingeniería, 19*(2), 63-84. https://dx.doi.org/10.14483/udistrital.jour.reving.2014.2.a03

Hui, X. & Kexin, Z. (2023). Dynamic evaluation of a post-pandemic agricultural traceability system based on the HFLTS-DEMATEL method. *International Journal of Quality & Reliability Management*. https://doi.org/10.1108/IJQRM-03-2022-0104

Karimi, K. , & Namusonge, G. S. (2014). Role of information technology on warehouse management in Kenya: A case study of Jomo Kenyatta University of Agriculture and Technology. *International Journal of Academic Research in Business and Social Sciences, 4*(11), 2222-6990. http://dx.doi.org/10.6007/IJARBSS/v4-i11/1294

Kubáč, L. (2018). RFID technology and blockchain in supply chain. *Transactions of the VŠB, 64*(1). http://dx.doi.org/10.22223/tr.2018-1/2042

León-Duarte, J. A. , & de la Re-Iñiguez, B. M. (2020). Review of traceability system applications: Case study of the wiring harness industry. *Estudios de Administración, 27*(2), 96-112. http://dx.doi.org/10.5354/0719-0816.2020.58138

León-Duarte, J. A., de la Re-Iñiguez, B. M. , & Romero-Dessens, L. F. (2020). Ventajas del uso de sistemas de trazabilidad electrónica en procesos de manufactura. *Información Tecnológica, 31*(1), 237-244. http://dx.doi.org/10.4067/S0718-07642020000100237

Liukkonen, M. , & Tsai, T. N. (2016). Toward decentralized intelligence in manufacturing: Recent trends in automatic identification of things. *The International Journal of Advanced Manufacturing Technology, 87*, 2509-2531. https://link.springer.com/article/10.1007/s00170-016-8628-y

Mabeya, F. (2022). Improved warehouse for SMT material management using modern technology retrieval system and better traceability [Master´s thesis, Minnesota State University, Mankato]. https://cornerstone.lib.mnsu.edu/etds/1231/

Mbakop, L., Jenkins, G. P., Leung, L., & Sertoglu, K. (2023). Traceability, value, and trust in the coffee market: A natural experiment in Ethiopia. *Agriculture, 13*(2), 368. https://doi.org/10.3390/agriculture13020368

Méndez, C. R. (2015). *Pedimento aduanal: Manuel práctico para su elaboración*. Tax Editores Unidos S. A. https://idoc.pub/documents/idocpub-eljq03zr1v41

Milić, D. C., Martinović, M., & Šimović, V. (2017). Pallet tracking and cost optimization of the flow of goods in logistics operations by the serial shipping container code. *World Academy of Science, Engineering and Technology International Journal of Computer and Information Engineering*, *11(12*), 1278-1284. https://doi.org/10.5281/zenodo.1314604

Monje, A. C. (2011). *Metodología de la investigación cuantitativa y cualitativa: Guía didáctica*. Universidad Surcolombiana.

Moreno, A., Angulo, I., Landaluce, H., & Perallos, A. (2015). Easy to deploy solution for pharmaceutical drugs traceability in distribution warehouses. In *IEEE International Conference on Intelligent Transportation Systems (ITSC)*.

Mukhina, M., Chah, K., & Wang, T. (2015). Improving the processes in a warehouse: A case study.

Nosenko, V., Silaev, A., & Grednikov, S. (2021). Information model of the automated system of assembling plant identification and traceability. In *Proceedings of the 6th International Conference on Industrial Engineering (ICIE 2020) Volume II* (pp. 596-605). Springer International Publishing. https://doi.org/10.1007/978-3-030-54817-9_69

Núñez Quijano, M. J. (2014). *Gestión de almacenamiento: Vinculación y utilización de los sistemas de almacenamiento en la cadena de abastecimiento* [Degree project, Universidad Militar Nueva Granada]. http://hdl.handle.net/10654/12626

Procuraduría General de la República. (2018). *Centro Nacional de Control de Bienes Asegurados (CENACBA) mensual*. https://datos.gob.mx/busca/dataset/centro-nacional-de-control-de-bienes-asegurados-cenacba-mensual

Purwandoko, P. B., Seminar, K. B., Litaay, C., Triyono, A., & Mayasti, N. K. I. (2023, April). Analysis and design of internal traceability system for rice processing industry. In *IOP Conference Series: Earth and Environmental Science* (Vol. 1168, No. 1, p. 012050). IOP Publishing. DOI 10.1088/1755-1315/1168/1/012050

Quisberth Colque, E. E. (2021). Implementación de un sistema de cobro de productos con tarjetas RFID y lector de código de barras mediante PIC18F2550 para supermercados [Doctoral dissertation].

Reglamento de la Ley Aduanera. (2015). *Diario Oficial de la Federación,* April 20th 2015. http://www.dof.gob.mx/nota_detalle.php?codigo=5389356&fecha=20/04/2015

Rivera Arévalo, V. M. (2015). *Habilitación de la agencia de Aduana Consultores Rivera como operador económico autorizado para la facilitación del comercio exterior* [Master's thesis, Universidad de San Carlos de Guatemala]. Repositorio del Sistema Bibliotecario Universidad de San Carlos de Guatemala. http://www.repositorio.usac.edu.gt/id/eprint/1267

Rodríguez, F. E. (2016). *Diseño de un sistema de trazabilidad interno para el control de mercancía en un centro de distribución del sector farmacéutico* [Degree project, Universidad Militar Nueva Granada].

https://repository.unimilitar.edu.co/server/api/core/bitstreams/5a18e27b-070d-46eb-b835-db2ec22e1c9e/content

Ruales, D. M. (2017). *Implementación de un sistema de código de barras para mejorar la trazabilidad de los materiales en un warehouse de una empresa de servicios de mantenimiento de turbinas* [Degree project, Universidad Nacional Mayor de San Marcos]. https://1library.co/document/zkx82j4y-implementacion-sistema-trazabilidad-materiales-warehouse-servicios-mantenimiento-turbinas.html

Sáenz, L. K. , & Tamez, G. G. (2014). *Métodos y técnicas cualitativas y cuantitativas aplicables a la investigación en ciencias sociales*. Tirant.

Sales, H. (2016). *Gestión de almacén de las mercancías en abandono del SENAE Distrito Esmeraldas* [Master´s thesis, Pontificia Universidad Católica del Ecuador]. Repositorio Nacional. https://repositorio.puce.edu.ec/handle/123456789/38343

Secretaría de Hacienda y Crédito Público. (2016). ¿Qué es y de qué se encarga el SAE? https://www.gob.mx/shcp/articulos/que-es-y-de-que-se-encarga-el-sae?idiom=es

Secretaría de Hacienda y Crédito Público. (2021). *Manual de operación aduanera (MOA)*. https://anam.gob.mx/moa/

Secretaría de Hacienda y Crédito Público. (2023). Comunicado conjunto SHCP - SAE No. 196. SAE logra ventas por 4.5 mil millones de pesos. https://www.gob.mx/shcp/prensa/comunicado-194-sae-logra-ventas-por-4-5-mil-millones-de-pesos

Servicio de Administración Tributaria. (2014). *Directorio de Aduanas*. http://omawww.sat.gob.mx/contacto/contactenos/Paginas/dir_adu.aspx

Shahbazi, Z., & Byun, Y. C. (2020). A procedure for tracing supply chains for perishable food based on blockchain, machine learning, and fuzzy logic. *Electronics, 10*(1), 41. https://doi.org/10.3390/electronics10010041

Singh, S. K. , & Jenamani, M. (2021). Cassandra-based data repository design for food supply chain traceability. *VINE Journal of Information and Knowledge Management Systems, 51*(2), 193-217. https://doi.org/10.1108/vjikms-08-2019-0119

Singh, T., & Kumar, M. (2021). Empirical study to predict the understandability of requirements schemas of data warehouse using requirements metrics. *International Journal of Intelligent Engineering Informatics, 9*(4), 329-354. http://dx.doi.org/10.1504/IJIEI.2021.120317

Solanki, M., & Brewster, C. (2014, November). A knowledge-driven approach towards the validation of externally acquired traceability datasets in supply chain business processes. In *International Conference on Knowledge Engineering and Knowledge Management* (pp. 503-518). Springer International Publishing.

Tagarakis, A. C., Benos, L., Kateris, D., Tsotsolas, N., & Bochtis, D. (2021). Bridging the gaps in traceability systems for fresh produce supply chains: Overview and development of an integrated IoT-based system. *Applied Sciences, 11*(16), 7596. https://doi.org/10.3390/app11167596

Tong, Q., Ming, X., & Zhang, X. (2023). Construction of sustainable digital factory for automated warehouse based on integration of ERP and WMS. *Sustainability, 15*(2), 1022. https://doi.org/10.3390/su15021022

Tufano, A., Accorsi, R., & Manzini, R. (2022). A machine learning approach for predictive warehouse design. *The International Journal of Advanced Manufacturing Technology, 119*(3-4), 2369-2392. https://doi.org/10.1007/s00170-021-08035-w

Universidad Nacional Autónoma de México. (2002). *Importación y exportación de México*. Instituto de Investigación Jurídica. https://archivos.juridicas.unam.mx/www/bjv/libros/6/2951/10.pdf

Vázquez Mouzo, J. (2017). *Control automático de temperatura para cadena de frío mediante tecnología RFID* [Master´s thesis, Universitat Oberta de Catalunya]. https://openaccess.uoc.edu/bitstream/10609/59787/12/jvazquezmouTFM0117memoria.pdf

VINSSA. (2018). *Proceso de rastreabilidad en la industria*. https://blog.vinssa.com/proceso-de-rastreabilidad-en-la-industria

Walaszczyk, A., & Szymonik, A. (2021). Model of food traceability process in the context of warehouse management. In B. Galińska (Ed.), *Wieloaspektowość współczesnej logistyki – transport, miasto, konsumenci* (pp. 1-12). Wydawnictwo Politechniki Łódzkiej. https://repozytorium.p.lodz.pl/server/api/core/bitstreams/3f738a7b-e874-48cb-94d2-0c2a4dba1d7a/content

Yarín Achachagua, Y. H. (2017). *Diseño e implementación de un sistema de localización y control de inventarios en un almacén de aduanas, utilizando tecnología RFID* [Master's thesis, Universidad Nacional Mayor de San Marcos], https://hdl.handle.net/20.500.12672/5910

Zhang, X., & Shao, P. (2022). Logistics information traceability mechanism of fresh e-commerce based on image recognition technology. *Applied Bionics and Biomechanics, 2022*. https://doi.org/10.1155/2022/2949216

Zhuangzhuang, L. (2020). Study on the construction of traceability system of cold-chain agricultural products based on blockchain: A case study of Ningxia cabbage. In *2020 International Conference on Big Data & Artificial Intelligence & Software Engineering (ICBASE)* (pp. 270-274). IEEE. https://doi.org/10.1109/ICBASE51474.2020.00063