Volume 7, Issue 13 — July — December — 2023

Journal-Industrial Organization

ISSN 2524-2105

RINOE®

Journal - Industrial Organization, Volume 7, Issue 13, July – December, 2023, is a journal edited semestral by RINOE. La Raza Av. 1047 No.- Santa Ana, Cusco. Peru. Postcode: 11500, WEB: www.rinoe.org journal@rinoe.org. Editor in Chief: MIRANDA-GARCIA, Marta. PhD. ISSN-2524-2105. Responsible for the latest update of this number RINOE Computer Unit. ESCAMILLA-BOUCHÁN, Imelda. PhD. LUNA-SOTO, Vladimir. PhD. La Raza Av. 1047 No.- Santa Ana, CuscoPeru.Postcode: 11500 last updated June 30, 2023.

Journal-Industrial Organization

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Support the international scientific community in its written production Science, Technology and Innovation in the Field of Social Sciences, in Subdisciplines of Market structure, Firm strategy, and Market performance: Production, Pricing, and Market structure, Size distribution of Firms, Monopoly, Monopolization strategies, Oligopoly and Other imperfect markets, Transactional relationships, Contracts and reputation, Information and Product quality, Industrial Organization and Macroeconomics, Macroeconomic industrial structure; Firm objectives, Organization, and Behavior: business objectives of the Firm, Firm organization and Market structure, Vertical Integration, Organization of Production, Firm Size and Performance; Nonprofit organizations and Public Enterprise: Nonprofit institutions, Public enterprises, Boundaries of public and private enterprise, Privatization, Contracting Out; Antitrust policy: Monopolization, Horizontal anticompetitive practices, Vertical restraints, Resale PRICE maintenance, Quantity Discounts, Legal Monopolies and Regulation or Deregulation, Antitrust policy and public enterprise, Nonprofit Institutions, and Professional Organizations; Regulation and industrial policy, Economics of regulation, Industrial policy, Sectoral planning methods; Industry studies: manufacturing, Metals and Metal products, Cement, Glass, Ceramics, Automobiles, Other transportation equipment, Microelectronics, Computers, Communications equipment, Other Machinery, Business equipment, Armaments, Chemicals, Rubber, Drugs, Biotechnology, Food, Beverages, Cosmetics, Tobacco, Other Consumer Nondurables, Appliances, Other consumer durables; Industry studies: Primary products and construction, Mining, Extraction, and Refining: Hydrocarbon fuels, Other nonrenewable resources, Forest products, Construction; Industry studies: Services, Retail and wholesale trade, Warehousing, Entertainment, Media, Sports, Gambling, Recreation, Tourism, Personal and professional services, Real estate services, Information and internet services, Computer software; Industry studies: Transportation and utilities, Transportation, Railroads and Other surface transportation, Air transportation, Electric utilities, Gas Utilities, Pipelines, Water utilities, Telecommunications, Utilities, Government policy.

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Presentation of Content

In the first article we present, *Business model for enterprise 4.0*, by CANEDO-MONTOYA, Enrique Daniel, CANEDO-MONTOYA, Gerardo Miguel and CANEDO-ROMERO, Gerardo Enrique, with ascription in the Universidad Politécnica de Juventino Rosas and Universidad de Guanajuato, as following article we present, *Maintenance administration system for the infrastructure of a higher education institution*, by FORNÉS-RIVERA, René Daniel, CANO-CARRASCO, Adolfo, CONANT-PABLOS, Marco Antonio and DUARTE-ARMENTA, María de la Luz, with adscription in the Instituto Tecnológico de Sonora, as following article we present, *Documentation of the post-sales service process in a car dealership in southern Sonora*, by GONZÁLEZ-VALENZUELA, Elizabeth, FORNÉS-RIVERA, René Daniel, CANO-CARRASCO, Adolfo and ZAVALA-BORBÓN, Luis Arturo, with affiliation at the Instituto Tecnológico de Sonora, as last article we present, *Development of processes for the distribution system of the tomato cold supply chain*, by PORTUGAL-VÁSQUEZ, Javier, LAGARDA-LEYVA, Ernesto Alonso, GARCIA-CUEVAS, Ana María and VEGA-TELLES, Ernesto Alonso, with secondment in the Instituto Tecnológico de Sonora.

Content

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Business model for enterprise 4.0

Modelo empresarial para la empresa 4.0

CANEDO-MONTOYA, Enrique Daniel´, CANEDO-MONTOYA, Gerardo Miguel´´ and CANEDO-ROMERO, Gerardo Enrique´´

´*Universidad Politécnica de Juventino Rosas, Hidalgo 102, Comunidad de Valencia Santa Cruz de Juventino Rosas, Guanajuato, C.P 38253.*
´´*Universidad de Guanajuato, Campus Irapuato-Salamanca, División de Ingenierías, Departamento de Electrónica, Comunidad Palo Blanco S/N, Salamanca, Guanajuato, C.P 36500.*

ID 1st Author: *Enrique Daniel, Canedo-Montoya* / **ORC ID:** 0000-0002-8062-9567, **CVU CONAHCYT ID:** 520884

ID 1st Co-author: *Gerardo Miguel, Canedo-Montoya* / **ORC ID:** 0000-0002-4036-2394, **CVU CONAHCYT ID:** 99425

ID 2nd Co-author: *Gerardo Enrique, Canedo-Romero* / **ORC ID:** 0000-0001-6624-185X, **CVU CONAHCYT ID:** 994269

DOI: 10.35429/JIO.2023.12.7.1.4 Received July 10, 2023; Accepted December 30, 2023

Abstract

In this paper we propose a business model for the company 4.0. The model is validated with the case study of the toy industry, focused on collecting figures. This domain was selected as it requires an intensive use of information systems and information technologies.

Resumen

Actualmente, se realizan esfuerzos para el desarrollo de la gestión de las empresas 4.0, donde la innovación y las tecnologías juegan un papel importante. En este trabajo se propone un modelo empresarial para la empresa 4.0. Se valida el modelo con el caso de estudio de la industria juguetera, enfocado al coleccionismo de figuras. Se selecciono este dominio ya que se requiere de un uso intensivo de los sistemas de información y las tecnologías de la información.

Business Model, Enterprise 4.0 and Value Circle

Modelo empresarial, Empresa 4.0 y Circulo de Valor

Citation: CANEDO-MONTOYA, Enrique Daniel, CANEDO-MONTOYA, Gerardo Miguel and CANEDO-ROMERO, Gerardo Enrique. Business model for enterprise 4.0. Journal-Industrial Organization. 2023. 7-13:1-4.

*Correspondence to Author (E-mail: ecanedo_ptc@upjr.edu.mx)
† Researcher contributing first author.

Introduction

Antecedents

Toy industry

During the time of the third industrial revolution, the toy industry suffered a decline in sales. During this time, a new line of marketing was established that consisted of collecting action figures from the comics, movies, and video games of the time. Companies in the toy industry offered figures to the interested market, which led to an increase in sales in this industry.

The offer of figures was determined by the companies in this sector, the client chose the figures of interest from the existing offer. Toy companies were modeled after Porter's value chain. [1] This led to the massification of action figures that were offered to the customer.

From the Fourth Industrial Revolution onwards [2][3] Changes are made in the marketing processes, now the customer selects the action figure of their preference. To meet this new form of demand, the company is using the economic model of pre-sales. With this new model, toy companies are continuously detecting the demand for action figures that customers request in an individualized and personalized way. [4]

Currently, efforts are being made for the development of the management of 4.0 companies, where innovation and technologies play an important role. This paper aims to contribute to these efforts by proposing a circular model to maintain competitiveness in 4.0 companies. [5] [6]

For this new marketing scheme, Porter's value chain model presents problems for its implementation. Companies now require models based on a value cycle.

Companies now require models based on a value cycle

Porter's value chain is shown in Figure 1

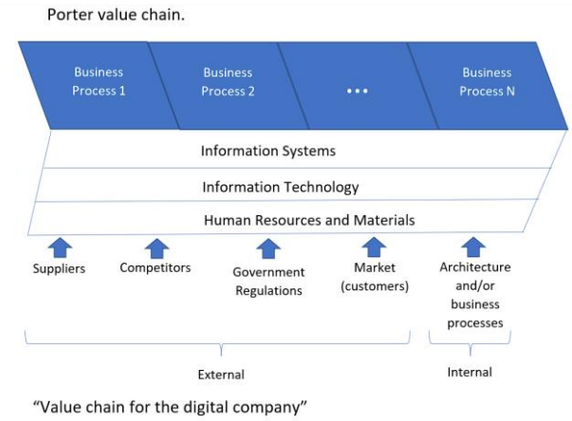

Figure 1 Porter's value chain
Source: Adapted from [4]

In this model the strategic part is represented by the order of the processes. This model is linear, as its name suggests, this model considers the impact market until the end of the process chain, does not consider it for the detection of the demand for products or services.

Value Circle Proposition

In order to respond to an individualized and personalized demand for goods and services, a business architecture is necessary to continuously detect market demand and generate knowledge to determine the production of products and services that are demanded.

In this paper, we propose a Value Circle model with a cyclical architecture. This model specifies the strategic, tactical, operational part and a new stage that is known as the knowledge generator. See Figure 2.

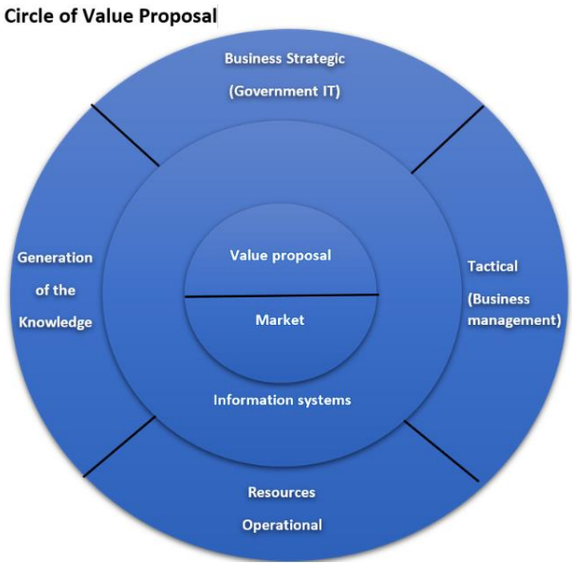

Figure 2 Proposal of a value cycle model
Source: Elaboration by the authors.

ISSN-2524-2105

In the strategic part, knowledge governance is considered, that is, business architecture, innovation policies and the definition of business processes to make the company competitive. The tactical part consists of the business processes both in series and in parallel that the company requires for the management of the information it needs to meet the goals and objectives of this.

The operational part consists of the technical resources, financial resources, human resources and infrastructure for the operation of the company.

The innovative stage is the generation of knowledge, in this stage a large amount of data is stored, behavioral patterns are generated and with them the necessary knowledge is generated to adjust strategies and maintain or increase the competitiveness of the company.

Case Study: Applying the Value Cycle to the Toy Industry

Currently, the toy industry, in particular figure collecting, is characterized by the following aspects:

a) An individualized demand for figures

b) A continuous detection by the company of the demand for figures

c) Personalized delivery of the figures directly to the customer

From the above, it follows that the client is directly involved in the supply and demand of the figures. For this situation, the value chain presents drawbacks since the customer is at the end of the chain.

In this case the value circle proposed presents advantages, since the customer is at the center of the value circle, with this model the demand is detected, which, at a strategic level, plans the production to satisfy the demand of customers. Another aspect is that it allows the commercialization of the figures in a programmed way. See Figure 3.

(1) Production planning

- Defining Roles and Processes

(2) Development of Processes and Services

- Supply of Materials
- Production
- Marketing
- Sales

(3) Instrumentation of an Information System: ERP, CRM, SCM.

- Enterprise Resource Planning Systems
- Supply Chain Management
- Customer Relationship Management Information Technology
- Internet
- Application Servers

(4) Development of the System for the Generation of Knowledge.

- Data Warehouse.
- Data Mining.
- Big Data.
- Data Visualizers.

(5) Value Proposition

- Manufacturing Quality.
- Quality of Finishes.
- Packaging Quality.
- Competitive Price.

(6) Customers

- Segmented customer marketplace with offers to action figure collectors

(7) Operability

- Human Resources.
- Financial Resources.

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- Equipment & Materials.
- Infrastructure.

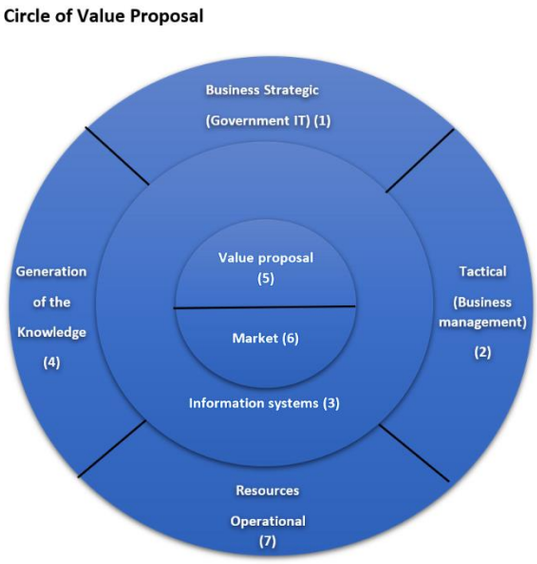

Figure 3 Proposed model for the toy industry

Conclusions

This work fulfills the objective of generating a model for the intelligent company to be competitive in the globalized world, this work proposes a model of value circle to develop in future works a more solid model for the intelligent company.

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ISSN-2524-2105

Article **Journal-Industrial Organization**
December 2023, Vol.7 No.13 5-10

Maintenance administration system for the infrastructure of a higher education institution

Sistema de administración de mantenimiento a la infraestructura de una institución de educación superior

FORNÉS-RIVERA, René Daniel†*, CANO-CARRASCO, Adolfo, CONANT-PABLOS, Marco Antonio and DUARTE-ARMENTA, María de la Luz

Instituto Tecnológico de Sonora. Department of Industrial Engineering, Mexico.

ID 1st Author: *René Daniel, Fornés-Rivera* / **ORC ID:** 0000-0002-7438-0056, **Researcher ID Thomson:** G-3906-2018, **arXiv Author ID:** rene_fornes, **CVU CONAHCYT ID:** 280435

ID 1st Co-author: *Adolfo, Cano-Carrasco* / **ORC ID:** 0000-0002-3392-3667, **Researcher ID Thomson:** G-5035-2018, **arXiv Author ID:** adolfo. cano, **CVU CONAHCYT ID:** 276064

ID 2nd Co-author: *Marco Antonio, Conant-Pablos* / **ORC ID:** 0000-0002-3364-3702, **Researcher ID Thomson:** G-3911-2018, **arXiv Author ID:** Mconant, **CVU CONAHCYT ID:** 687331

ID 3rd Co-author: *María de la Luz, Duarte-Armenta* / **ORC ID:** 0009-0004-3163-1152, **arXiv Author ID:** MariaDuarte, **Researcher ID Thomson:** ISS-9035-2023

DOI: 10.35429/JIO.2023.13.7.5.10 Received July 15, 2023; Accepted December 30, 2023

Abstract

This research was carried out in a Higher Education Institution and addresses the need to develop a preventive maintenance program, since corrective maintenance is only carried out with an institutional log where complaints are addressed in the families of Refrigeration, Lighting, Hydraulic -Sanitary, Electrical System, Building Conservation, Painting, VIALTA, Miscellaneous, Locksmith and Waterproofing, which are sent by users on a day-to-day basis, correcting failures in the institution's infrastructure in a reactive manner and frequently without adequate training of the technicians. That is why this research aims to carry out improvement actions, through the 5QS methodology, to have a relevant maintenance and training program. The procedure consists of five phases that are: diagnosis, design, implementation, measurement and improvements, its development generated as a result a preventive maintenance program, in the Pool, Library, Comprehensive Center for Information Technologies of Extension and Culture, Center for Strategic and Business Studies, Management, Acquisitions, Aquaculture, CIIBAA, CEVE, A100, A200, A300, A400, A800, L500 and L600. With the application of this methodology, the stated objective was achieved since the preventive maintenance and training programs were obtained

Infrastructure, Maintenance, Administration

Resumen

Esta investigación se llevó a cabo en una Institución de Educación Superior y aborda la necesidad de desarrollar un programa de mantenimiento preventivo, ya que únicamente se realiza el mantenimiento correctivo con una bitácora institucional donde se atienden las quejas en las familias de Refrigeración, Iluminación, Hidráulico-Sanitarias, Sistema Eléctrico, Conservación de Edificios, Pintura, VIALTA, Misceláneos, Cerrajería e Impermeabilización, que envían los usuarios en el día a día corrigiendo las fallas a la infraestructura de la institución de forma reactiva y con frecuencia sin la capacitación adecuada de los técnicos. Es por ello que esta investigación tiene como objetivo realizar acciones de mejora, a través de la metodología 5QS, para contar con un programa de mantenimiento pertinente y capacitación. El procedimiento consta de cinco fases que son: diagnóstico, diseño, implementación, medición y mejoras, su desarrollo generó como resultado un programa de mantenimiento preventivo, en los edificios Pool, Biblioteca, Centro Integral de Tecnologías de Información de Extensión y Cultura, Centro de Estudios Estratégicos y de Negocios, Rectoría, Adquisiciones, Acuacultura, CIIBAA, CEVE, A100, A200, A300, A400, A800, L500 y L600. Con la aplicación de esta metodología se logró el objetivo planteado ya que se obtuvieron los programas de mantenimiento preventivo y capacitación.

Infraestructura, Mantenimiento, Administración

Citation: FORNÉS-RIVERA, René Daniel, CANO-CARRASCO, Adolfo, CONANT-PABLOS, Marco Antonio and DUARTE-ARMENTA, María de la Luz. Maintenance administration system for the infrastructure of a higher education institution. Journal-Industrial Organization. 2023. 7-13:5-10.

*Correspondence to Author (E-mail: alexhuerta360@hotmail.com)
† Researcher contributing first author.

Introduction

The maintenance; it is to procure the longest useful life of the facilities and productive machinery; It is also a whole series of actions that must be carried out by the people in charge of this department, with the purpose that the equipment, machines, components and facilities involved in an industrial process are in the required operating conditions for what was designed, built, installed. and put into operation (Pérez, 2021 and Fernández, 2018). Although for Chanta (2017), it is the planning of tasks and resources to avoid failures or stops in production, in such a way that what is sought is to minimize maintenance and stoppages in the company, which cause losses substantial resources; Consequently, it is the set of operations and care necessary so that facilities, buildings, industries, among others, can continue to function properly (Royal Spanish Academy [RAE], 2021).

According to Bermúdez-Puente (2019), the types of maintenance are characterized by the way in which the intervention is carried out in the system (equipment, machine tools, facilities, etc., involved in the production of any good or service), and is classified as: Corrective: it is carried out only after the failure or decrease in the performance of a piece of equipment, machine or system; Preventive: repairs and/or replacements are carried out, without the occurrence of a specific failure, through the execution of a set of activities planned in advance; Predictive: it consists of carrying out inspections at regular intervals of time and the activities are programmed based on the expected time of future failures and other relevant aspects of the physical condition of the system; Detective: it is the regular inspection of the functions; and it is done with the help of a previous monitoring of the system without taking it out of operation based on human senses; Improvement: it is the modification or redesign of the original conditions of the equipment or the way of its installation.

Total Productive Maintenance: it is keeping the equipment ready to produce at its maximum capacity products of the expected quality, without unscheduled stops; in turn, Reliability-Centered Maintenance is for Tambra-Sanchez (2021) a methodology to develop maintenance plans that include all kinds of strategies (preventive, predictive, fault finding); but for Moubray (2021), it is a process to determine what must be done and guarantee that the teams continue performing their function for which they were designed.

On the other hand, the 5QS methodology depends exclusively on the validity of the answers given to the questions made in each of the phases (diagnosis; design; implementation; measurement; and improvements), objectivity being important in the conception of the diagnosis, since It is the starting point, although the flexibility of the methodology allows adjustments to be made according to the integral characteristics of the organization, to satisfy and guarantee the real expectations of maintenance in each of the equipment and facilities (Binotto and Britch, 2020). . The aforementioned will be achieved as long as there is adequate training, which is an educational activity that improves the development of human capacities. It is a simple process when it is used as a means to provide knowledge, however, it becomes complex when it is part of a training system to generate changes in people.

Currently, maintenance is widely related to education, unlike a few years ago when it was considered an expense or a requirement in labor laws (France, 2018). For Salgado et al. (2017) is a key activity for the survival of companies and their adaptability to the environment and to the changes that are taking place; in a complementary way Labrador et al. (2019), argues that the human factor is the resource that has the ability to transform the organization's resources into acceptable results. Currently the databases for Tasé-Velazquez et al. (2020) are necessary in the efficient use and administration of a preventive maintenance program; At the same time, they are currently useful for any discipline or application area where there is a need to manage data. They are becoming more voluminous every day, since the amount of information and its degree of precision is greater (Pulido et al., 2019).

ISSN: 2524-2105

Finally, databases are essential for information systems in their computer programs, servers or mobile applications (Arcidiacono, 2021 and TheOMS, 2021).

The institution wishes to minimize unforeseen events such as: Defects in air conditioning, lighting in general, leaks, failures in the supply of electricity and water, failures in doors and windows when opening-closing or infiltration of dust and water, which makes it difficult to provision of the service in classrooms, laboratories and administrative offices; as well as the damage of computer and office equipment, derived from the non-planning of preventive maintenance in the buildings. The distribution of buildings under study of the preventive maintenance program is presented below, see figure 1.

Figure 1 Distribution of buildings
Source: ITSON (2022)

The buildings have the service of different families such as: Refrigeration, Lighting, Hydraulic-Sanitary, Electrical System, Building Conservation, Painting, VIALTA, Miscellaneous, Locksmithing and Waterproofing, which are provided, in addition to the above there is poor training in general terms. Therefore, the need to carry out improvement actions was raised, through the 5QS methodology, to have a relevant maintenance and training program.

Results

The result obtained in which there are figures is presented, which due to their size will only present a part.

Phase 1. Diagnosis

Maintenance requests were analyzed, see Table 1

N° Application	Date	Applicant Name	Campus	Location
15544	30/09/22	Edgar Valdez	Obregón	Maintenance
15542	30/09/22	Daniel Nájera	Obregón	Lab. Microbiology
15538	30/09/22	Elsa Meleros	Obregón	Coordination Services for teachers
15537	30/09/22	Manuel Portillo	Obregón	Directorate of financial resources

Table 1 Maintenance requests
Source: Own elaboration (2022).

and an inspection format for the buildings and services was carried out, see table 3, which indicates the building, the date, the deterioration and its level.

Maintenance Inspection Record				
Date: 18/10/22			Inspector: María Duarte	
Campus: Centro			Building: 200	
Inspection Details				
Item: Electrical System	Reason for Inspection:		• Periodic inspection (preventive) ( ) • Maintenance request (corrective) (X)	
Description: The 200 is equipped with the highest technology which is available for the use of the facilities when required, it has classrooms for teaching classes.				
Deterioration/ Failure	Conditions			Observations
	None	Mild	Serious	
Contact status			X	Ground floor: improvised double contact in poor condition in the utility room.

Table 2 Inspection form
Source: Own elaboration (2022)

Phase 2. Design

The design and elaboration in Excel of the preventive maintenance administration system for the institutional infrastructure continued, see figure 2.

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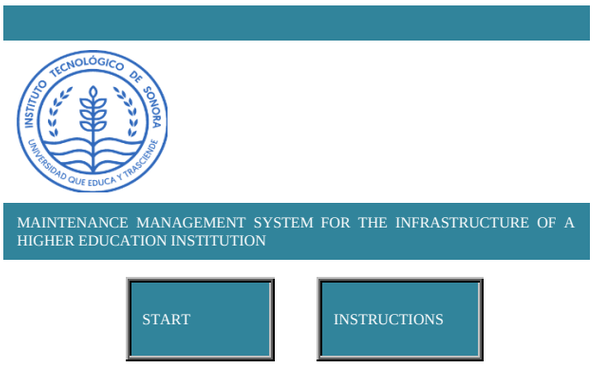

Figure 2 Preventive maintenance program
Source: Own elaboration (2022)

At the same time, a training program is developed in the use and management of the database in the Excel program.

As an example, the service sheet of the rectory maintenance program is shown, see figure 3.

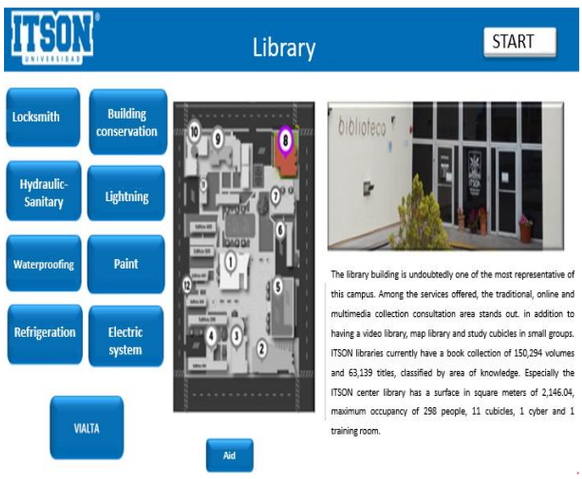

Figure 3 Library service sheet
Source: Own Elaboration (2022)

Phase 3. Implementation

The data recording was carried out in the preventive maintenance program of each one of the 10 families, taking as an example the lighting of the acquisitions building as shown in board 3; This information was collected by making tours of each of the buildings.

Date	Building	Type	Turn	Brand	Ability	Model	Specifications	Note
14-09 2022	Acquisitions	Fluorescent			32 W	2 x 3 2		3 8
21-09 2022	800 PB	Fluorescent			32 W	2 x 3 2		4 , A - 8 1 2
21-09 2022	800 ext	Led			30 W	2 x 3 0		8
21-09 2022	800 ext	Led reflectors			50 W			1
21-09 2022	800 PA	Fluorescent			60 W	2 x 6 0		2 , C 1

Table 3 Acquisition building lighting data record
Source: Own Elaboration (2022)

Phase 4. Measurement

A survey was applied, see figure 8, for satisfaction through the google forms tool https://forms.gle/QqDEgCvirqBxW96c7, towards the client, which allows knowing if the established objective of the preventive maintenance system was met, and shows a small description and rubrics that were used to measure said satisfaction.

Phase 5. Improvement

The analysis concluded with the delivery of results, through a project completion letter to the corresponding area. This must be signed validating the delivery and fulfillment of the objectives committed in the project.

ISSN: 2524-2105

Conclusions

This project was developed in the aforementioned buildings of the Instituto Tecnológico de Sonora Campus Centro, the purpose was to create a preventive maintenance program, as well as a training program in the use and management of the database for use in a timely manner. and efficient preventive maintenance program in decision-making, due to this it can be said that the proposed objective was achieved, since improvement actions were carried out, managing to improve the design (migrating from corrective maintenance to a preventive one, which does not had) and functionality, data was captured and also the information of each building was updated.

Recommendations

Specific emphasis is placed on continuing to feed the database in real time for decision-making in a timely manner, and thereby reduce complaints and failures in the aforementioned infrastructure, managing to comply with the services offered in each building. , whether they are classrooms, practice laboratories or administrative offices, for which constant training is important.

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ISSN: 2524-2105

Article **Journal-Industrial Organization**
December 2023, Vol.7 No.13 11-18

Documentation of the post-sales service process in a car dealership in southern Sonora

Documentación del proceso de servicio postventa en una empresa concesionaria de automóviles del sur de Sonora

GONZÁLEZ-VALENZUELA, Elizabeth†*, FORNÉS-RIVERA, René Daniel, CANO-CARRASCO, Adolfo and ZAVALA-BORBÓN, Luis Arturo

Instituto Tecnológico de Sonora, Department of Industrial Engineering, Mexico.

ID 1st Author: *Elizabeth, González-Valenzuela* / **ORC ID:** 0000-0003-3774-5324, **Researcher ID Thomson:** G-5042-2018, **arXiv Author ID:** elizabeth_gonzalez_v, **CVU CONACYT:** 276316

ID 1st Co-Author: *René Daniel, Fornés-Rivera* / **ORC ID:** 0000-0002-7438-0056, **Researcher ID Thomson:** G-3906-2018, **arXiv Author ID:** rene_fornes, **CVU CONAHCYT ID:** 280435

ID 2nd Co-author: *Adolfo, Cano-Carrasco* / **ORC ID:** 0000-0002-3392-3667, **Researcher ID Thomson:** G-5035-2018, **arXiv Author ID:** adolfo. cano, **CVU CONAHCYT ID:** 266064

ID 3rd Co-author: *Luis Arturo, Zavala-Borbón* / **ORC ID:** 0009-0007-1495-1498

DOI: 10.35429/JIO.2023.13.7.11.18 Received July 20, 2023; Accepted December 30, 2023

Abstract

The company under study started in 1944 as a manufacturer of bicycles and motorcycles. In 1974, it began producing automobiles, in 1986, it began exporting them, and in 1992 it began producing engines and transmissions. Since then, the company has experienced great growth and expansion in the world, offering a wide range of vehicles. Today, it is one of the most popular and recognized car brands in the world. In one of its concessionaires located in the south of Sonora, Mexico, it is planned to carry out the accreditation of an internal audit, necessary for the corporate. In this audit, it is stated that all activities must be carried out in compliance with the quality parameters established by the company in all its concessionaires. For this, a process documentation is proposed and developed to ensure its correct operation in the post-sale area. This area gives you follow-up regarding the maintenance of the cars sold by it. With the process documentation, it was possible to accredit the audit required by the corporate, work instructions were developed that explain in detail the flow of actions to be followed in the different processes to comply with the quality points established by the company.

Documentation, Quality, Process, Service

Resumen

La empresa bajo estudio inició en 1944 como fabricante de bicicletas y motocicletas. En 1974, comenzó a producir automóviles, en 1986, inició a exportarlos y en 1992 comenzó la producción de motores y transmisiones. Desde entonces, la compañía ha experimentado un gran crecimiento y expansión en el mundo, ofreciendo una amplia gama de vehículos. Hoy en día, es una de las marcas de automóviles más populares y reconocidas a nivel mundial. En una de sus concesionarias ubicada al sur de Sonora, México, se planea realizar la acreditación de una auditoría interna, necesaria para el corporativo. En esta auditoría se plantea que deben realizar todas las actividades cumpliendo los parámetros de calidad dispuestos por la empresa en todas sus concesionarias. Para esto, se propone y desarrolla una documentación de procesos que asegure su correcta operación en el área post-venta. Esta área le da seguimiento respecto al mantenimiento de los automóviles vendidos por esta. Con la documentación de procesos se logró acreditar la auditoría requerida por el corporativo, se desarrollaron instrucciones de trabajo que explican detalladamente el flujo de acciones a seguir en los diferentes procesos para cumplir con los puntos de calidad establecidos por la empresa.

Documentación, Calidad, Proceso, Servicio

Citation: GONZÁLEZ-VALENZUELA, Elizabeth, FORNÉS-RIVERA, René Daniel, CANO-CARRASCO, Adolfo, ZAVALA-BORBÓN, Luis Arturo. Documentation of the post-sales service process in a car dealership in southern Sonora. Journal-Industrial Organization. 2023. 7-13:11-18.

† Researcher contributing first author.

Introduction

Cubillos and Rozo (2009) describe quality as a concept inherent to the very essence of the human being, who from the very origins of man has understood that doing things well and in the best possible way provides him with a competitive advantage over his peers. conspecifics and on the environment with which it interacts. According to ISO (2015), the standard that specifies the requirements for quality management systems states that the quality of products and services is determined by the ability to satisfy a need and by the expected and unforeseen impact on the relevant stakeholders. With this, ISO asserts that the quality of products and services includes not only their function and intended performance, but also their perceived value and benefit to the customer. This quality within an organization promotes a culture that results in behaviors, attitudes, activities and processes to provide value by meeting the needs and expectations of customers and other interested parties (ISO, 2015).

From this scenario and with an increasingly competitive market, where quality is understood as a fundamental variable in the results of organizations, it is necessary to manage it as one more resource, within them. Since 1987, the ISO body proposes the quality management system (QMS) as a tool to achieve quality management, it includes activities through which the organization identifies its objectives, determines the processes and resources required to achieve the desired results. . This QMS posed by the ISO standard achieves results for the relevant parties, managing processes that interact and resources that are required to provide value (ISO, 2015).

Arious studies have shown that Continuous Improvement Systems generate greater productivity and competitiveness within companies, one of the main tools that supports continuous improvement is a Business Process Management. However, Castillo and Carreño (2020) that within the companies even when they have implemented Quality Management Systems, they are not productive because in the characterization and design of the processes they present errors.

The importance of documented information control is specified in the ISO 9001:2015 standard, indicating that it must be ensured that the information is available and suitable for use, where and when it is needed; In addition, it must be adequately protected to avoid inappropriate use or plagiarism of information. According to ISO TOOLS (2020), there is not a single process that is exempt from failures, irregularities and inconveniences. On the contrary, they appear almost daily and it is the duty of the company to apply adequate solutions. These errors can occur in both manufacturing and service processes, therefore, the continuous improvement proposed in this standard can be implemented in both sectors.

According to data from the Mexican Association of the Automotive Industry (AMIA), in 2020, this sector represented 3.8% of Mexico's GDP and generated around 980,000 direct jobs and more than 3.5 million indirect jobs in the country. According to the Institute.

In addition, by 2020 Mexico was one of the main vehicle producers in the world. According to AMIA, the country is the fourth largest exporter of vehicles worldwide in 2020, with a total of 3.3 million units sold. Being one of the main manufacturing centers for components and parts for the automotive industry, which has attracted significant investment from international companies.

According to Bancomext (2022), the automotive sector is considered relevant for the economy in Mexico. It specifies that it is an industry that promotes technology transfer, develops advanced manufacturing ecosystems and also encourages the development of suppliers in the different stages of the production process. It also establishes that Mexico is the 6th largest car producer in the world. On the other hand, The Logistics World (2023) states that the automotive industry represents almost 4% of the national gross domestic product (GDP) and 20.5% of manufacturing GDP in Mexico.

The editorial team of THE LOGISTICS WORLD (2023) specifies that the National Institute of Statistics and Geography (INEGI) reports that the production and export of Mexican cars grew by more than 8% year-on-year in the first quarter of 2023. According to the article the sale of light vehicles increased by 24.79% at the end of the first quarter.

ISSN-Online: 2524-2105

The concessionary company under study officially opens its first production plant in Mexico in 2016, that same year it acquires licenses to establish itself as a vehicle distribution concessionaire. With the mission of offering the best automotive purchasing and service experience, it seeks to be recognized as the leading Automotive Group in customer service in the country and the best place to work, generating a positive impact in the community.

Figure 1 presents a process map to describe the organization's processes. When conducting an unstructured interview with the person in charge of the after-sales service, service manager, the following information was collected: Within the company in the area of "After-sales service" there is a high rate of staff turnover, which causes Losses or leaks of information, failures are also generated within the process that impact customer satisfaction (customer satisfaction surveys) and are reflected in the way processes are carried out within the organization. "By not having official manuals or guides for internal procedures, when a position is vacated, the information on the requirements and activities to be carried out in said position is lost, this causes failures in the operation and consequently causes the correct operation to be prolonged. incorporation of new collaborators generating disagreements in the service provided." Services Manager

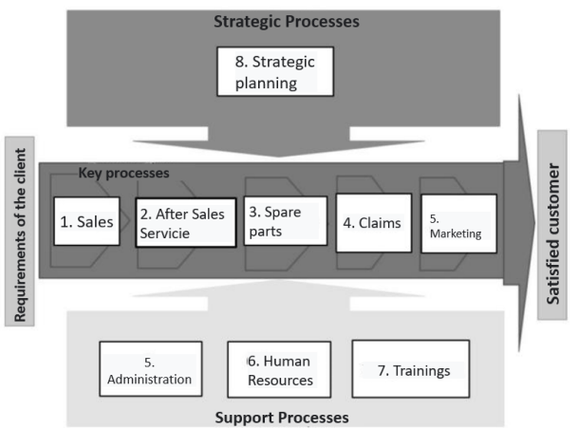

Figura 1 Automotive company process map
Source: Own elaboration

Table 1 summarizes symptoms that represent an opportunity for improvement for the company.

Symptoms
- Partial compliance with internal audits that verify the proper functioning of the process.
- Low rating in quarterly evaluations of the concession company.
- Place 50 in the national Rankin of vehicle distribution agencies
- Long incorporation times for new employees due to the lack of operating manuals with work instructions.
- Feeling of work overload in collaborators caused by the lack of a definition of roles.
- High staff turnover in areas related to the object under study (after-sales service process).

Table 1 Company Symptom Summary
Source: Own elaboration

The impact of the lack of official procedures can be identified and measured through the % of compliance with the company's internal quality audits (Audit Machine) and the performance in the evaluations carried out by the concessionaire company on a quarterly basis to its service advisors. based on customer surveys. In the latter, aspects such as the knowledge of the service advisor are evaluated; the last weighting obtained for the advisors within the object under study was 5, on a scale of 1 to 10, with ten being the best rating. It is necessary to mention that the internal training process of the company is long, the training lasts around three to four days in the format of face-to-face sessions in Mexico City, in addition said sessions are scheduled on dates already established by the high management, forcing the company to adjust to that calendar, this makes it impossible to provide immediate training to new employees, having to adapt the company to the training times already provided. The following table shows the indicators and their weighting. See table 2.

Indicator	Entrance	Process	Exits	Qualitative or quantitative	Real	Ideal
Internal audit Audit Machine		X		Quantitative	Fails	100%
Weighting in evaluation of quarterly services area		X		Quantitative	5	10

Table 2 Summary of indicators
Source: Own elaboration

ISSN-Online: 2524-2105

Problem statement

Given the circumstances that arise within the company and the information collected in the unstructured interview, it is observed that there are deficiencies within the after-sales service process, which are reflected in errors during the operation, impacting customer satisfaction. Based on the above, it is argued that:

Within the After Sales Service process there are no formal documents which ensure the execution of the corresponding activities that must be carried out for the correct operation of the process.

Objetive

Prepare the documentation that describes the after-sales service process to ensure the standardization and correct operation of the process.

Justification

At the end of this project, employees will have official documents with which they can rely to know exactly how and what activities should be carried out in the After-Sales Service. This project seeks to benefit the quality of service provided by employees to customers who will receive the After Sales Service process. The documentation of the process will also help to detect possible opportunities to improve it. The importance of this project lies in reducing the failures that could occur within the activities carried out by collaborators or new collaborators, improving the qualification in customer satisfaction surveys (Customer satisfaction survey, weighting of the dealership) and increasing the % compliance with internal audit requirements (Audit machine).

If the project is not carried out, the company risks that collaborators who do not know the process and the activities to be carried out well cause errors, altering the final result, in this case negatively affecting customer satisfaction.

Methodology to develop

The following authors were taken as a basis for the documentation of the processes: Alexander Servat (2005), Peach (1999) and Stebbing (1999):

Identification of the need

It will begin by identifying the activities that require formal procedures from a tour of the process and an unstructured interview with the people in charge. To define the scope of the documentation, a diagram will be made to describe the process under study and a map of the organization's processes showing the position of the process under study within the organization. The following points are considered as a necessity to define processes:

- The Management orders that the activities be formalized.
- The person responsible for carrying out the activities needs clear definitions of the corresponding activities.

Define the format for the procedure

To define the format of the procedure, take into account the elements required by the ISO / TR 10013 guideline: purpose, scope, procedure, references, definitions, documents. In this format, information will be collected that explains in a simple way to the reader who is in charge of doing what and when.

Document current practice

Through flowcharts, the activities currently used to carry out the process are described, confirming the information with all interested parties, in order to guarantee that the data is accurate. The information collected clearly describes how the activity is carried out, how each step of the process is started and how the next step is reached. This information passes to the formats already chosen in activity 1.

Write work instructions

The activities that need work instructions will be determined taking into account whether those involved describe it as a critical activity that impacts quality. The format and the elements that the work instructions should contain were defined with the result of current practice, these were prepared digitally, corroborating them with those in charge of the process through interviews and observation. The observations of the people in charge of carrying out the activity are considered within the instructions.

ISSN-Online: 2524-2105

Review and validate current methods

The current methods will be reviewed, with the help of the responsible personnel, they will be given a draft of the documented process and the work instructions so that they can operate the procedure and provide feedback with observations in order to evaluate the results and determine the following:

a) If the process, as defined, meets the stated objectives

b) The method to reach the stipulated level of compliance in the event that the stated objectives are not met.

c) If these levels of conformity are sufficient to sustain the rest of the process.

Authorize and publish the procedure

It must conclude by reaching a consensus and validating the final document by the person in charge in the area of the organization, a unique code will be assigned in such a way that it is easily identified when it is published and distributed to all personnel. This publication will be in charge of the organization, defining the place and means of support.

Results

Identification of the need

It began by identifying the need within the process in the organization with an informal interview with the person in charge of the process. The clear need was established with the person in charge of official documents with the procedures as instructions to mitigate the problems that arise in the company. Once this need was defined, a SIPOC diagram was made in order to better understand the nature of the process. The SIPOC diagram is presented below describing the interrelationships of the object under study (suppliers, inputs, process, outputs and customers).

S Suppliers	I Inputs	P Process	O Outputs	C Customers
Customers Adviser spare parts supplier appointment manager	Appointments in CVIS service policy spare parts note diagnostic sheet Bill Work order Guarantee Carriage Status Diagnosis Format	PHASES: prior to service Service execution service tracking Back power and end of service	Bills stamped service policy Work orders signed and fulfilled Approved and signed spare parts orders	Vehicle owner High direction

Table 3 SIPOC diagram of the after sales service process
Source: Own elaboration

Define the format for the procedure

The proposal for the format to be used for the documentation continued to be prepared. This format includes what is required by ISO / TR 10013: "Guidelines for the documentation of quality management systems" for a documented process (Purpose, scope, procedure, references, definitions, documents). Figure 2 shows the format of documented procedures.

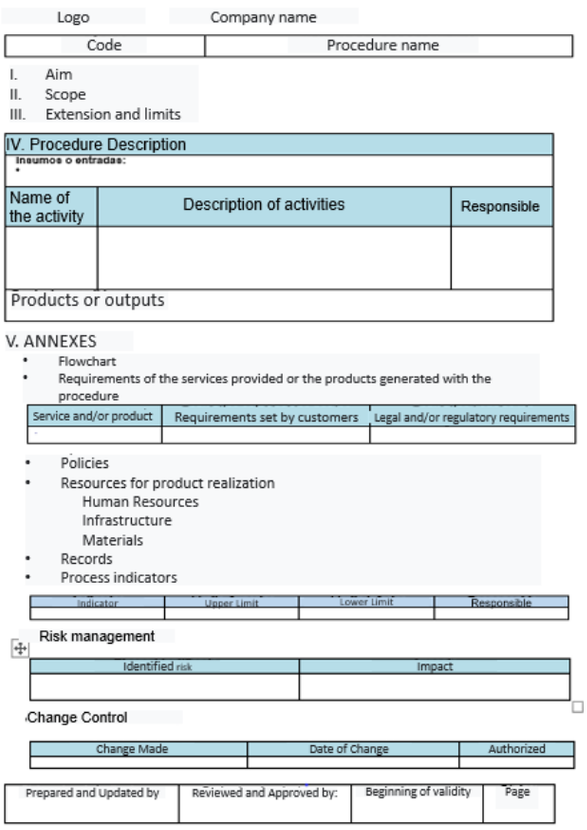

Figure 2 Format of documented procedures
Source: Own elaboration

ISSN-Online: 2524-2105

After having selected the format, it was also defined that the work instructions will be compiled in a process manual, this considers the recommendations that a manual should include according to the "Technical Guide for the elaboration of procedures" prepared by the General Directorate of programming, organization and budget management of organization.

Document current practice

To document the current practice, flowcharts began to be used, these in turn were verified with those in charge of the processes. Three flowcharts were obtained as results, each one describing one of the three phases of the process.

Once the diagrams with the process flow were validated, we continued to fill out the formats selected in step 2 of the methodology.

Document name	Document key	Objetive	Activities	Responsible	Reference to documents	Applicable Records
Pre-service phase	SERVICIO – POP –PD – 01 - 00	Give instructions to carry out the pre-service phase of the vehicle	1. Preparation of appointment 2.Customer vehicle reception3.Diagnóstico 4.Cotización	Appointment manager Spare parts Service advisorTécnico	SERVICIO – POP – IT – 01 – 00 SERVICIO – POP – IT – 02 - 00	Appointment in CVIS Repair order
Service execution phase	SERVICIO – POP – PD - 02 - 00	Give instructions in the execution of the service to the vehicle	1.Perform service 2.Final inspection 3. Preparation of pre-invoice	Service advisor workshop technician Car washerEncargado de refacciones Técnico master	SERVICIO – POP – IT – 03 - 00	Repair order Prefectura Guarantee Policy
Service monitoring and feedback phase.	SERVICIO – POP – PD – 03 - 00	Give instructions in the follow-up and feedback of the service	1.Vehicle delivery 2.Feedback	Service advisor Appointment manager	SERVICIO – POP – IT – 01 - 00	Guarantee Policy Customer satisfaction surveyNota de pago Diagnóstico del vehiculo firmado

Tabla 4 First version of the documented processes
Source: Own elaboration

Write work instructions

The work instructions are drafted according to the recommendations in the ISO / TR 10013 standard: instructions and observations by the current operator.

Document name	Document key	Objetive
Work instructions for: Appointment preparation	SERVICIO – POP – IT – 01 - 00	Give instructions to make an appointment in the CVIS system.
Work instructions for: order preparation	SERVICIO – POP – IT – 02 - 00	Give instructions for the elaboration of orders.
Work instructions for: close order	SERVICIO – POP – IT – 03 - 00	Give instructions for closing work orders.

Tabla 5 Work Instructions Servat
Source: Own elaboration

Review and validate current methods

Once the first version of the work instructions and the documented procedures were finished, they were sent for review for approval or editing by the organization under study. From the validation, the corresponding adaptations were made and the latest version of the documents ends.

Authorize and publish the procedure

Once the work instructions documents are approved, they are transferred to the most convenient means for the organization. In this case, the work instructions will be stored digitally for easy access by collaborators who require it, while the documented procedures will be incorporated into a process manual which will be physically available within the company.

Document Name	Document Key	State	Documents Control
Pre-service phase	SERVICIO – POP – PD – 01 - 00		Operation manual
Service execution phase	SERVICIO – POP – PD - 02 - 00		Operation manual
Service feedback and monitoring phase.	SERVICIO – POP – PD – 03 - 00		Operation manual
Work instructions for: preparation of appointment	SERVICIO – POP – IT – 01 - 00		Digital files on usb
Work instructions for: elaboration of order	SERVICIO – POP – IT – 02 - 00		Digital files on usb
Work instructions for: close order	SERVICIO – POP – IT – 03 - 00		Digital files on usb

Table 6 Table of approved procedures
Source: Own elaboration

Conclusions

It is concluded that the objective of the documentation of the post-sale service process is successfully fulfilled since it helps to standardize the activities, giving it the opportunity to be improved in the future, allowing new collaborators to have a guide on which to base themselves to carry out their activities.

ISSN-Online: 2524-2105

The realization and implementation of a QMS is recommended for the development of continuous improvement within the organization. A SGC would allow the company to have more practical control over its quality objectives as well as give the company the opportunity to point its quality objectives towards what the company might really need, this mostly points towards the needs of the customer.

In addition, a standardization of processes in the workshop area within the company is also recommended, this would in turn ensure the maintenance that is carried out by the technicians. If these actions are carried out, it is possible to control and observe possible deficiencies in the activities that involve the different maintenance of the vehicles.

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ISSN-Online: 2524-2105

Article **Journal-Industrial Organization**
December 2023, Vol.7 No.13 19-32

Development of processes for the distribution system of the tomato cold supply chain

Desarrollo de procesos para el sistema de distribución de la cadena de suministro de tomate en frío

PORTUGAL-VÁSQUEZ, Javier†*, LAGARDA-LEYVA, Ernesto Alonso, GARCIA-CUEVAS, Ana María and VEGA-TELLES, Ernesto Alonso

Instituto Tecnológico de Sonora. Departamento de Ingeniería Industrial

This project has been funded by Instituto Tecnológico de Sonora.

ID 1sr Author: *Javier, Portugal-Vásquez* / **ORC ID:** 0000-0002-8986-2023, **CVU CONAHCYT ID:** 249136

ID 1st Co-author: *Ernesto Alonso, Lagarda-Leyva* / **ORC ID:** 0000-0001-9552-9908, **CVU CONAHCYT ID:** 433524

ID 2nd Co-author: *Ana María, García-Cuevas* / **ORC ID:** 0009-0002-7557-9486

ID 3rd Co-author: *Ernesto Alonso, Vega-Telles* / **ORC ID**: 0000-0002-8260-3002, **CVU CONAHCYT ID:** 1179288

DOI: 10.35429/JIO.2023.13.7.19.32 Received July 25, 2023; Accepted December 30, 2023

Abstract

This research project aims to propose a technological solution to the problems faced by the tomato cold chain; Based on different investigations, it was found that the problems that should be paid more attention to are within the processes of storage, transport and customer service. The research question of the project was: What are the best logistics practices in the storage, transport and customer service of the tomato cold chain in the Southern region of Sonora? the objective: to develop the best logistics practices in storage, transport and customer service of the tomato cold chain in the southern region of Sonora in order to improve the operational efficiency of organizations. To meet the objective, a methodological route was generated where different regulations are identified to establish a dashboard of key performance indicators. As main results, the objectives and the most important key processes to be carried out in the cold distribution process were found according to different authors, the procedures for each process (storage, transport and customer service) were established, in the same way a control board was generated with key performance indicators according to each key process.

Cold supply chain, Processes, Efficiency

Resumen

El presente proyecto de investigación tiene como finalidad plantear una solución tecnológica a los problemas que enfrenta la cadena de frío del tomate; basándose dentro de diferentes investigaciones se encontró que los problemas a los que se les debe de poner más atención están dentro de los procesos de almacenamiento, transporte y servicio al cliente. La pregunta de investigación del proyecto fue: ¿Cuáles son las mejores prácticas logísticas en el almacenamiento, transporte y servicio al cliente de la cadena de frío del tomate en la región Sur de Sonora?, el objetivo: desarrollar las mejores prácticas logísticas en almacenamiento, transporte y servicio al cliente de la cadena de frío del tomate en la región sur de Sonora con el fin de mejorar la eficiencia operativa de las organizaciones. Para cumplir con el objetivo se generó una ruta metodológica donde se empieza por identificar diferentes normativas hasta establecer un tablero de mando de los indicadores claves de desempeño. Como principales resultados se encontraron los objetivos y los procesos clave más importantes que hay que llevar a cabo en el proceso distribución en frío de acuerdo a diferentes autores, se establecieron los procedimientos para cada proceso (almacenamiento, transporte y servicio al cliente), de igual manera se generó un tablero de control con indicadores clave de desempeño de acuerdo a cada proceso clave.

Cadena de sumintros fría, Procesos, Eficiencia

Citation: PORTUGAL-VÁSQUEZ, Javier, LAGARDA-LEYVA, Ernesto Alonso, GARCIA-CUEVAS, Ana María and VEGA-TELLES, Ernesto Alonso. Development of processes for the distribution system of the tomato cold supply chain. Journal-Industrial Organization. 2023. 7-13:19-32.

*Correspondence to Author (E-mail: javier.portugal@itson.edu.mx)
† Researcher contributing first author.

Introduction

In the logistics of perishable products, the cold chain is a key concept. This is why this project will focus on providing solutions to the distribution system of the tomato supply chain of companies in southern Sonora; this implies a challenge in food supply, with optimal processes in post-harvest, handling and transport, as well as strict controls in the management of the cold chain of products that require temperature control and thus meet the food needs, all because the development of information technologies have forced companies to make logistics management more efficient to maintain and improve their competitiveness. The role of logistics is traditionally focused on placing the right products, in the right place, at the right time and in the desired conditions, contributing as much as possible to the profitability of a firm. But nowadays, logistics is conceived at a much broader level where the aim is to achieve a synchronised interaction between all those involved in logistics activities. An interaction in which time, space and movements are reduced and thus achieve better products and higher profits for the final consumers (E-logistics, 2019).

Logistics and supply chain is the set of approaches used to efficiently integrate suppliers, warehouses and shops, so that products are produced and distributed in the right quantities, in the right places and at the right time, in order to minimise total costs, satisfying the required service levels (Soto, 2010). For the distribution of perishable products, trying to always maintain their quality and safety from the moment it leaves the point of origin, the cold chain is used, which aims to maintain the characteristics of the product until it reaches the end customer. The application of cold is one of the most widespread methods of preservation and is applicable to the food, health and pharmaceutical industries. This method is based on lowering temperatures to inhibit the growth and proliferation of microorganisms and altering agents totally or partially (Zavaleta, 2012). To achieve an ideal cold chain, specialised refrigeration facilities and temperature-regulated transports are required. Maintaining it is fundamental for food safety and therefore all stages of the process must preserve it with great care. If we refer to the conservation temperature, there are two types of cold chain: refrigeration and freezing (Bernad, 2017).

Avoiding breaking the cold chain is one of the main obligations of the logistics manager. According to Mecalux (2019), within the different tasks that comprise the logistics supply chain, the phases that increase the probability of breaking the cold chain are in the warehouse and transport; if the cold chain is broken, this can generate problems such as: The premature deterioration of the goods, The loss of organoleptic properties such as taste and/or appearance, The proliferation of bacteria and microorganisms harmful to humans that reproduce more easily in relatively temperate environments, among others.

According to a study conducted by the GCCA in 2014, it was concluded that the needs and problems for cold chain management are common in the region, problems such as: There are not enough cold chain distribution centres, There is no supply of specialised refrigerated transport, There is a need to improve the implementation and enforcement of food safety regulations, The cold chain for fruits and vegetables is weak, There are no good practices in transport companies and retailers for the proper handling of products that require refrigeration, There is a lack of implementation of good energy efficiency practices to make costs more competitive in refrigeration services, There is a need to strengthen technical training, training for processors, wholesalers and all members of the chain to improve cold chain operations.

Improving food conditions, making use of technologies to freeze and refrigerate food are indispensable tools to ensure food safety, as well as the use of appropriate packaging to prolong and preserve food in storage and transport.

The trends in cold logistics are marked by the challenges facing logistics in general, including market globalisation, cost reduction along the cold chain, strategic integration with the rest of the supply chain activities and maximising the use of capacity and resources. Given this reality, logistics providers with cold chain services must develop strategies that allow them to stay at the forefront of the industry (Solistica, 2018). Also an important point to take into account are the trends in the supply chain according to COVID-19. The coronavirus pandemic brought disruptions to the supply chain, changes in consumption patterns and a need for companies to react and adapt quickly. (Chavez, 2021).

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Agriculture is one of the most important economic activities globally for its contribution to food production and job creation, and agricultural production promotes the emergence and development of agro-industries (Da Silva and Baker, 2013). Globally, the most important agricultural products are cereals, followed by vegetables and fruits. Potatoes and tomatoes contribute 50% of the world's production, so their value is of paramount importance in the global food system. In Mexico, as in other parts of the world, fresh tomatoes are mainly consumed; however, they are also processed industrially for the production of pastas, sauces, purees and juices, among other products.

The red tomato is one of the most important horticultural products in Mexico due to the value of its production and the labour demand it generates, being the main horticultural product for export; in tomato cultivation, techniques have been implemented such as the irrigation sheet that works as a simulator, where climatic data, soil type, irrigation, crop cycle and automatically the program provides information on balances or growth are introduced (Morales, 2017).

The cold chain system offers agricultural producers a logistics and service platform that contributes to reducing the high percentage of losses in the production and marketing stages of perishable fresh produce. In addition, it promotes food safety and improves food quality (Ibidem, p7).

Temperature control is an essential element for the survival of perishable products. In this case, for tomatoes, appropriate cooling is between 8 and 12ºC and it is advisable to apply it quickly after harvesting. The shelf life of the produce, closely related to the state of ripeness at harvesting, is a few days at 20ºC and one to two weeks at 8 or 12ºC. Any uncontrolled exposure to lower temperatures (below 8ºC) or very high temperatures (30ºC), especially in the sun, penalise the quality and the conservation of the produce. For red tomatoes, cold tolerance is recommended at 8ºC (Moras, 2021).

According to the Panorama Agroalimentario (2020), the tomato is considered the number one vegetable, it is a bilocular, subspherical, globular, highly coloured berry, typically with yellowish to red tones due to the presence of the pigments lycopene and carotene. It has a slightly sour taste. It is generally round and flattened in shape, except for some varieties with elongated fruit, such as the saladette. Although they are of different sizes, it is generally a large fruit. China leads the world tomato harvest, its volume (61.5 million tonnes per year) is equivalent to that of the following five producing nations; Table 1 shows each country's production in tonnes of tomato.

Position	Country	Production (tonnes)
1	China	56,423,811
2	India	18,399,000
3	United States of America	13,038,410
4	Turkey	12,600,000
5	Egypt	7,943,285
6	Italy	6,437,572
7	Iran	6,372,633
8	Spain	4,671,807
9	Brazil	4,167,629
10	Mexico	**4,047,171**

Table 1 Countries by World Tomato Production
Source: Adapted from Atlas Big (2021)

Mexico ranks tenth in the world ranking of tomato production; three out of every hundred kilograms of the vegetable produced in the world originate from Mexican fields: it is grown to meet domestic and export demand. Foreign demand for Mexican tomatoes is recorded every month, although due to the seasonal effect on national production and demand from the United States (Mexico's main client), between August and September there is a slight drop in volume. Among the vegetables exported by Mexico, tomato is the most important due to the economic benefit it represents for farmers and traders, with sales of just over 1,690,000 tonnes per year. Adapted from Panorama Agroalimentario (2020).

The tomato supply chain is one of the most important in Mexico, since thanks to tomato cultivation, tomatoes are the third most exported product in the country, making Mexico the world's leading exporter with 1.5 million tonnes per year, 50% of the country's total production (Infoagro, 2019); the tomato supply chain is made up of a series of interrelated links, considering primary activities, see Figure 1:

ISSN-Online: 2524-2105

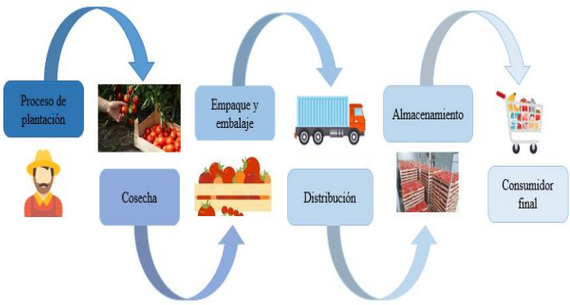

Figure 1 Tomato Supply Chain
Source: Own elaboration adapted from (Consejo Nacional de Productores de Tomate, A.C., 2012)

In order to better understand the situation of the tomato supply chain, a SWOT analysis is carried out, identifying the internal and external characteristics that are divided into Strengths, Weaknesses, Opportunities and Threats.

STRENGTHS:

1. Important supply chain, due to the value of its production and demand.
2. Main horticultural export product.
3. Development of strategies to stay ahead of the cold chain.
4. Increasing demand.
5. Tomato represents great economic importance for growers and traders.
6. Year-round tomato production.

OPPORTUNITIES:

1. emergence and development of agro-industries.
2. New techniques in tomato cultivation.
3. Exploiting demand.
4. Satisfying the needs for the product in question.
5. Reducing costs along the cold chain.
6. Maximising the use of capacity and resources.

DEBILITIES

1. Poor business logistics culture.
2. Inadequate cold chain conditions.
3. Inadequate staff training.
4. Major problems in warehousing and transport; probability of breaking the cold chain.

AMENAZES

1. Breaking the cold chain and therefore facing different problems.
2. Changes in consumption patterns.
3. Trends according to COVID-19.

Problem statement

The tomato cold chain must be maintained throughout the supply chain, from the moment the shipper sends the product until it is delivered to the client or end user. Therefore, the storage, transfer and distribution of the product must be guaranteed so that it does not lose its properties during storage and transport.

In Mexico, tomato is the most important crop due to the economic benefits it represents for farmers and traders, as it is the most important vegetable in production and is distributed throughout the country; however, the most important production area is the northwest. The objective of the cold chain is not to break down during the whole supply chain, as it involves many problems related to transport, storage, packing and packaging, and the care of regulations and good manufacturing practices. For this reason, a cause-effect diagram is made to identify all the possible causes behind the inefficiency in cold chain logistics operations, see Figure 2.

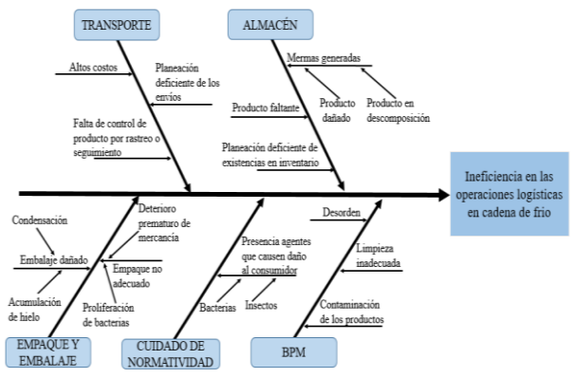

Figure 2 Cause-Effect Diagram
Source: Own elaboration

In Figure 2, the causes can be identified by different blocks that are divided into transport, warehouse, packing and packaging, regulatory care and good manufacturing practices; since all of these categories are where there are problems that possibly cause inefficiency in logistics operations in the cold chain.

ISSN-Online: 2524-2105

Mexico has had a higher logistical growth compared to other developing countries, but even so, there are many challenges and areas for improvement in the cold chain distribution process in both the industrial and commercial sectors, especially in SMEs, whose main concern is to take care of product shelf life.

According to the growth that Mexico has presented, added to the extreme climate of the southern region of Sonora, companies are forced to strategically control all their cold processes, especially in storage and distribution.

Due to all of the above, it is necessary to find a solution to improve logistical efficiency and place the product under the customer's conditions, making the most of the flexibility of the resources available.

Therefore, after analysing all the problems that are generated, the question posed for this research is the following: *What are the best logistical practices in storage, transport and customer service in the tomato cold chain in the southern region of Sonora?*

Objective: *To develop the best logistics practices in storage, distribution and customer service in the tomato cold chain in the southern region of Sonora in order to improve the operational efficiency of the organisations.*

The first benefit of the project is to have duly standardised processes and procedures that comply with the different national and international standards, since in Mexico there are regulations for the storage and distribution of perishable products that need to be chilled or frozen, which require strict compliance, and as a result efficient logistics operations can be generated in the cold chain. The preservation of product quality throughout the logistics chain is an important condition, which will bring benefits, the fact that the product managed in the cold chain is not handled correctly in a given time, will have to go through a process of destruction or loss which leads to break the cold chain, which is what we want to avoid.

Having processes and procedures in place will help to reduce the operational costs of the distribution system, particularly transport, storage and handling costs.

The costs in a cold chain are geared towards maintaining the freshness of the products so that they reach the final consumer in the right condition and fit for consumption.

The direct beneficiaries of the results of the project are all those companies involved in cold distribution systems in relation to the product in question, which is tomatoes, since providing solutions to control the cold distribution system improves the capacity to react and respond, reduces costs, increases the satisfaction of end consumers, improves or implements the traceability of products and deliveries, reduces the handling of products and optimises distribution.

If this project is not carried out, the companies in southern Sonora will continue to operate under the same conditions, which in some cases is inefficient in cold chain logistics operations, generating losses for the companies, both in terms of products and resources, which generates high operating costs and non-compliance with the levels of service and quality provided to the client.

Theoretical foundation

Supply chain

It is a set of functional activities (transport, inventory control, etc.) that are repeated many times along the flow channel, through which raw materials are converted into finished products and value is added for the consumer. Since raw material sources, factories and points of sale are usually not located in the same places and the flow channel represents a sequence of manufacturing steps, logistics activities are repeated many times before a product reaches its market place (Ballou, 2004). According to Roldan (2017), the supply chain's main objective is to satisfy the needs of the end customer in the best possible way. This includes the following purposes: Delivering goods and services on time, Avoiding unnecessary losses or wastage, Optimising distribution times, Proper management of inventories and warehouses, Establishing adequate communication and coordination channels, Coping with unforeseen changes in demand, supply or other conditions.

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Logistics

Logistics is the process of strategically managing the acquisition, movement and storage of materials, parts and finished inventory (and the corresponding information flow) throughout the organisation and its marketing channels, so that current and future profitability is maximised through cost-efficient order processing. (Melero, 2018)

The logistics chain is made up of all those processes involved directly or indirectly in the action of satisfying customer needs. The phases considered key are the following: Supply, Production, Storage, Distribution and Customer Service.

Cold chain

The cold chain is a set of logistical measures to guarantee a constant temperature and other parameters necessary for the correct maintenance of products throughout their transfer from production to the consumer (Pérez, 2021).

It is so called because it is composed of different stages. If any of the points of the cold chain were to be broken or altered, the whole chain would be affected, damaging the quality and safety of the product, facilitating microbial growth, both of spoilage microorganisms and disease-producing pathogens, and the alteration of the food by degrading enzymatic reactions causing undesirable organoleptic characteristics. In the case of having a cold chain that is kept intact during production, transport, storage and sale, the consumer is guaranteed that the product he/she receives has been kept in a safe temperature range in which micro-organisms, especially the most harmful to health if any, have stopped their activity. In addition, an appropriate storage temperature will preserve the organoleptic and nutritional characteristics of the food. Temperature is a critical factor in food production and distribution systems that must be rigorously controlled. Three fundamental stages are involved in the cold chain: Storage in cold rooms or warehouses at the production centre, transport in special vehicles with temperature recording, distribution platform and sales centres.

A determining factor to be taken into account is that if the cold chain is broken in any of its phases, the product must be discarded, since if it is chilled or frozen again, the damage will already be done and we could expose the end consumers to a high risk. In addition to changes and deterioration in the texture, taste or smell of the products, their nutritional properties could also be affected. The most dangerous aspect of breaking the cold chain process is the exposure to food poisoning due to the ingestion of bacteria growing on the products themselves. If the cold chain is broken, even for a short period of time, bacterial nuclei can be reactivated, so that when the food is refrozen, it is already full of bacteria and toxins that can cause food poisoning (Cofrico, 2021).

The importance of the cold chain lies mainly in considering the losses of food products caused by inadequate handling, storage and transport (Nieto, 2014).

SCOR Model

According to the Supply Chain Council (2012) the SCOR model has been developed to describe the business activities associated with all phases of meeting customer demand. The model itself contains several sections and is organised around the six main management processes of Planning, Sourcing, Production, Distribution, Return and Enablement. By describing supply chains using these process building blocks, the model can be used to describe supply chains that are either very simple or very complex using a common set of definitions. As a result, industries can be linked to describe the depth and breadth of virtually any supply chain.

The model is designed to support supply chain analysis at multiple levels.

Performance indicators

A management indicator, or performance indicator, is a way of measuring whether an organisation, unit, project or individual is achieving its strategic goals and objectives. KPIs provide the most meaningful performance information that allows organisations to understand whether or not the organisation is on track towards defined goals. In this way, well-designed performance indicators are vital navigational tools, providing a clear picture of current performance levels and whether the company is where it should be.

ISSN-Online: 2524-2105

At the organisational level, the most effective management indicators are closely linked to strategic objectives and help answer fundamental business questions. Therefore, a good starting point is to identify the questions that decision-makers, managers or external stakeholders need to answer. One or two key performance questions should be identified for each strategic objective (Roncancio,2018).

Methodology to be developed

Identify regulations applicable to the tomato cold distribution process. The Mexican Official Standards (NOM), Mexican Standards (NMX) and ISO standards applicable to tomato cold chain distribution, good cold chain practices, cold transport requirements, tomato packaging and packing requirements were identified, resulting in a list of standards and requirements applicable to cold chain distribution.

Establish the objectives of the cold distribution system. A bibliographic research of different authors on the cold distribution system was carried out, the most mentioned objectives were taken to be able to carry out the design of the technological solution, as a result, a table was obtained with the objectives of the cold distribution system most cited on the different authors.

Identify key processes in cold distribution

After establishing the objectives of the cold distribution system, a theoretical research was carried out on different authors, who mention the most important key processes in cold chain distribution. As a result, a list of key processes was made on the most cited authors associated with the different contributions of the key processes of cold distribution, ranging from storage to distribution and handling.

Establishing cold distribution procedures

Based on previous research, the most important procedures for carrying out cold chain distribution, such as storage, distribution and handling, were established. As a result, a cross-functional diagram of the key processes in the cold chain was drawn up, based on the Deming cycle (PHVA) with the aim of establishing continuous improvement.

Establish a dashboard of key performance indicators

In this step, the key performance indicators of the storage, distribution and handling processes were defined, based on Kaplan and Norton's (2009) scorecard (BSC), in order to measure the performance of these processes. As a result, a scorecard was obtained, which mentions the processes, the indicator, the target, the periodicity, the formula and the person responsible for carrying out the activity.

Results

Identify the regulations applicable to the tomato cold distribution process

Research was carried out on the Mexican Official Standards (NOM), Mexican Standards (NMX) and ISO standards applicable to the cold chain distribution of tomatoes, good manufacturing practices in the cold chain, requirements for cold transport, packaging and packing requirements for tomatoes, and a list of standards and requirements that were met in the process of cold chain distribution of tomatoes was drawn up, see Table 2.

NORMA	DESCRIPTION
NMX-FF-031-1997-SCFI.	Non-industrialised foodstuffs for human consumption - fresh vegetables - tomato
NOM-FF-54-1982.	Non-industrialised foodstuffs for human consumption - fresh vegetables - tomatoes in shell.
NOM-EM-039-FITO-2002	Mexican official standard with emergency character, establishing the requirements for the registration to the program of induction, application and certification of good agricultural and handling practices for the production and packing of fresh tomato for export.
NOM-251-SSA1-2009	Characteristics and specifications for assigning and confirming expiry/reanalysis periods, holding times for bulk food or intermediate food products stored during processing and establishing the necessary storage and transport conditions.
NOM-030-SCFI-2006	Commercial declaration on the label - Specifications.
NOM-050-SCFI-2004	Trade information - General provisions for products.
NMX-EE-59-1979	Packaging - symbols for handling, transport and storage.
NMX-EE-98-1980	Packaging - Shock test.
ISO 3864: 1984	Safety colours and safety signs.
ISO 6780:2003	Pallets for intercontinental material handling - main dimensions and tolerances.
ISO 3676:2012	Packaging - unit load size - dimensions.
ISO 3394: 2019	Tertiary packaging dimensions
NMX-FF-031-1997-SCFI.	Non-industrialised foodstuffs for human consumption - fresh vegetables - tomatoes.

Table 2 Standards Applicable to the Tomato Cold Chain Packing and Packaging Distribution System
Source: Own elaboration (2021)

ISSN-Online: 2524-2105

Good manufacturing practices in cold chain distribution

This point presents a list of good manufacturing practices of the distribution of the cold chain for tomato, mentioning what should be done and why it should be done; it should be kept in mind that the control of the chain starts from harvesting, through processing and packaging, transportation and storage, to the point of sale and the place where the final customer consumes the products.

What to do:

- The cold chain should never be interrupted.
- Food requiring refrigeration should be transported in insulated or refrigerated vehicles.
- Maintain temperature control.
- The transport temperature should be between 0°C and 7°C for refrigerated products and -18°C or lower for frozen products.
- Loading and unloading should be done quickly and the vehicle should be parked as close to the car park as possible.

Why it should be done:

- If the cold chain is interrupted the temperature can rise and allow rapid and progressive reproduction of micro-organisms.
- All dirt in transport vehicles must be removed to avoid sources of further contamination of the food.
- Low temperatures ensure proper preservation of food during transport.
- Slow loading and unloading and keeping the doors open allows for cold losses and temperature increase inside the vehicle body.

Establishing the objectives of the cold distribution system

Bibliographic research was carried out according to different authors on the most important objectives, according to their criteria, which should be applied to the cold distribution process. As a result, a list of different authors with objectives of the cold distribution system was obtained. See table 3.

AUTHORS	OBJECTIVES
Juan Carlos Hernández, Juan Pablo Antún y Angélica Lozano (2013)	- Reduction of inventories through a system of hierarchical distribution centres and satellite cross-docking to meet customer service levels. - Development of innovative alternatives for order processing and customer service. - Batch order processing and limiting delivery spraying in e-commerce. - Development of reverse logistics processes and operations to meet the requirements of recycling standards and public policies. - Introduction of IT innovations in logistics. - Innovation in vehicle technology. - Outsourcing of operations through logistics operators with dedicated fleets. - Preference for the location of supports in logistics centres.
Centro Europeo de Empresas Innovadoras Valencia (2008)	- Reduce delivery times - Reduce transport costs - Establish an efficient reverse logistics system - Optimal utilisation of transport space (full load)
Universidad Nacional Abierta y a Distancia (2015)	- The product reaches consumers in good condition. - Cold transport must guarantee speed, safety and adaptability. - Storage and transport information and communication technologies for logistical operations - Cold chain temperature
Publicaciones Vértice (2008)	- Maximise customer service levels - Minimising distribution costs - Preserving products through good materials handling - Reducing delivery times
Revista Logistec (2012)	- Improve service levels to customers.

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	- Providing added value to customers through transport and distribution services. - Rationalisation of distribution networks. - Exploring shared services. - Reducing distribution cycle time.
Ferrell y Hartline (2011)	- Ensure product availability - Reduce distribution costs - Reduce delivery times - Increase customer satisfaction
Pelayo (2008)	- Product reaches the consumer safely. - Transport in special vehicles - Storage in chambers or cold stores at the production site. - Loading and unloading time during transport
Lhermie, Miquel y Parra (2008)	- Cover the entire target market - Minimise distribution costs - Adding customer service and reverse logistics to the product - Control and coordinate distribution activities in relation to marketing programme

Table 3 Objectives of cold distribution according to different authors
Source: Own elaboration (2021)

The objectives that presented the highest frequency according to the authors cited above were: reduce delivery times and total compliance with deadlines, reduce transport costs, improve customer service, meet the needs of consumers, with these objectives will be the scope that will help to define the guidelines for the design of the technological solution.

Identify key processes of cold distribution

Once the objectives, goals and actions of the cold distribution system had been defined, a bibliographic research was carried out to obtain the most important key processes in cold chain distribution. According to Hurtado (2020), the key processes are those that allow value to be offered to customers to satisfy their needs; where the activities involved and their adequate performance are vital for the business. Table 4 was drawn up with the contributions of the different authors:

AUTOR	KEY PROCESSES
Mosquera López (2016)	- Storage - Transport - Packing and crating - Exporting - Information technology - Logistics operators
Ariza D. (2015)	- Supply - Distribution - Storage - Transport
Juárez C. (2021)	- Storage - Transport - Logistics traceability - Material handling - Cold chain control
Garcia Garcia (2020)	- Distribution - Management - Human resources - Service
Procolombia (2014)	- Measurement - Temperature control - Storage - Packing and packaging - Transport - Information technology - Legal regulation - Training and information
García D. ECOMED (2019)	- Warehousing - Material handling - Transport
Velasco, A. (2020)	- Storage - Transport - Transport - Customer service

Table 4 Key processes of cold distribution according to different authors
Source: Own elaboration (2021)

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In table 16 it can be seen that, according to the contributions of each author, the most important ones that are the most repeated are storage, transport and customer service; due to this, these will be the processes that will be taken into account to later analyse their procedures and design the technological solution.

Storage

Storage is the key to control the logistics process, which consists of the provisional accumulation of stocks, from the proper care of the products to the organisation of their transfer to the points of sale or production (Liat Faena, 2021). The processes involved in warehousing are as shown in Figure 3.

Figure 3 Processes covered by storage
Source: Own elaboration (2021)

Transport

Transport is the operational area of logistics that moves and geographically positions the inventory. Transport is part of logistics, where, together with means and methods, it allows goods to be taken from one place to another (Pérez and Gardey, 2021). The processes covered by transport are as shown in Figure 4.

Figure 4 Processes involved in transport
Source: Own elaboration (2021)

Customer service

According to Corrales (2019), customer service encompasses all those strategies, activities and processes aimed at satisfying the needs of the users; it is the movement of the finished product to the customers. In this area, shipment to the customer's location represents the final destination. Through the customer service process, the timely and geographic location of inventory becomes an integral part of marketing. The processes encompassed by customer service are as shown in Figure 5:

Figure 5 Transport processes
Source: Own elaboration (2021)

Establishing cold distribution procedures

Based on the research on the contribution of the different authors mentioned in the previous point, the procedures to carry out the distribution in the cold chain are established. In the next step of the results, each of the key processes was broken down on the basis of the Deming Cycle (PHVA). Figures 6, 7 and 8 below show these key processes (storage, transport and customer service), represented as Figures in the Deming Cycle containing the PHVA steps of continuous improvement.

Warehousing

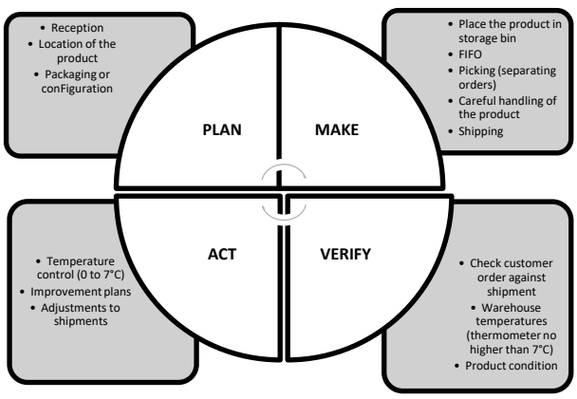

Figure 6 Activities Key Storage Proces
Source: Own elaboration (2021)

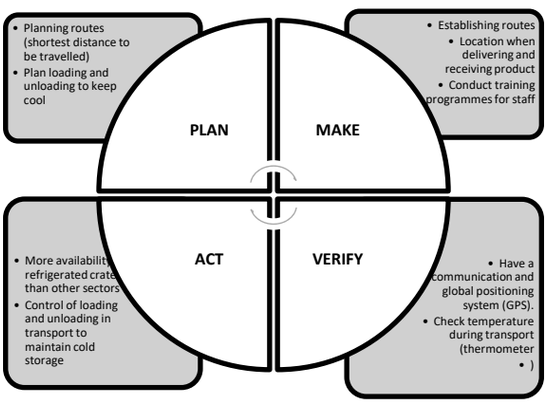

Figure 7 Activities of the Transport Key Process.
Source: Own elaboration (2021)

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Customer service

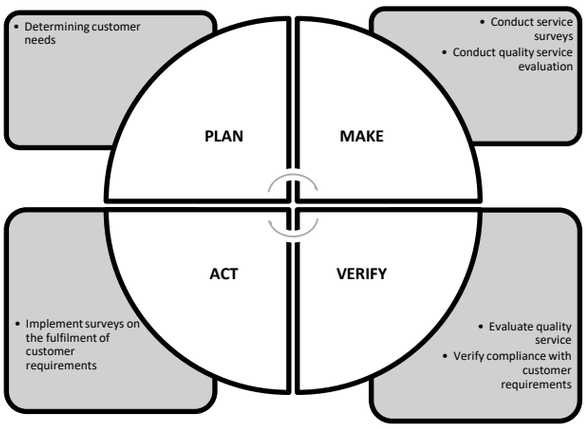

Figure 8 Activities of the Customer Service Key Process
Source: Own elaboration (2021)

Establish cold distribution procedures

Once the procedures and activities of the storage process based on the PHVA cycle had been established, a cross-functional diagram of the process was drawn up, showing the procedures and different necessary activities that interact as a whole, with the aim of setting out how the storage process would be carried out and establishing who is responsible for each procedure. See Figure 9.

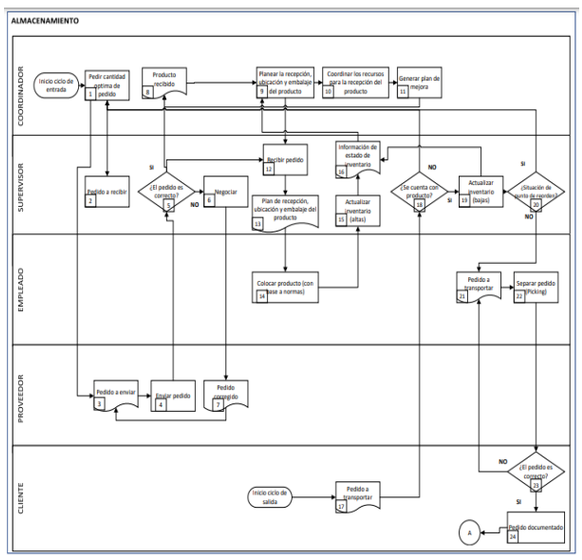

Figure 9 Cross-functional diagram of the cold storage process
Source: Own elaboration (2021)

Cross-functional diagram of the transport and customer service process

The cross-functional diagram of the transport and customer service processes is shown below, with the procedures and activities established in the PHVA cycle, establishing who is responsible for each procedure.

It should be noted that the transport and customer service processes were merged as their activities are related. See Figure 10.

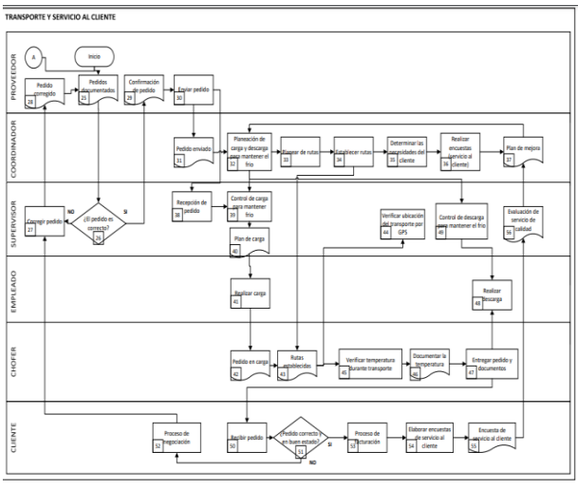

Figure 10 Cross Functional Diagram of the Transport and Customer Service Process
Source: Own elaboration (2021)

Establish a dashboard of key performance indicators

Table 5 below is a dashboard of key indicators for the different processes of warehousing, transport and customer service. The control panel is aimed at obtaining results that have an impact on the objectives, goals and actions, in order to be closer to the goals set and to identify opportunities for improvement.

PROCESS	INDICATOR	GOAL	PERIOD	PERFORMANCE			RESPONSIBLE
ALMACENAMIENTO	COST PER SQUARE METRE	The lowest possible cost	Weekly				Warehouse Coordinator
	PERCENTAGE OF WAREHOUSE UTILISATION	Use the most available warehouse space	Monthly				Warehouse Coordinator
	PERCENTAGE VOLUME OF INCOMING PRODUCT.	Receive the highest quantity of expected product	Weekly				Warehouse Coordinator and Warehouse Supervisor
	PERCENTAGE OF COMPLETED ORDERS	Place the highest percentage of completed orders	Daily				Warehouse Coordinator and Warehouse Supervisor
	PERCENTAGE OF INCORRECTLY PLACED PRODUCT	Place the most product correctly	Weekly				Warehouse Coordinator
	PERCENTAGE OF ERRORS DUE TO VOLUME RECEPTION	Minimise receiving errors	Weekly				Warehouse Coordinator
	PERCENTAGE OF COMPLIANCE WITH COLD AND FROZEN TEMPERATURES	Meet ideal warehouse temperature	Daily				Warehouse Coordinator
TRANSPORTE	CAPACITY UTILISATION	Maximum utilisation of transport capacity	Monthly				Distribution Manager
	TRANSPORT ASSET UTILISATION	Increased utilisation of available transports	Monthly				Distribution manager
	CORRECT DELIVERIES	Achieve the highest number of correct deliveries	Weekly				Distribution Manager
	ON-TIME DELIVERIES	Achieve highest number of on-time deliveries	Weekly				Distribution Manager
	DELIVERY TIME	Achieve shorter delivery times	Weekly				Distribution manager
	COST PER KILOMETRE	Control of distance travelled versus total transport cost	Monthly				Distribution manager
	FUEL USAGE PER KILOMETRE	Control fuel usage	Weekly				Distribution Manager
SERVICIO AL CLIENTE	LEVEL OF CUSTOMER DELIVERY PERFORMANCE	Achieve the highest level of customer delivery performance	Daily				Customer Service Supervisor
	RATE OF RETURN	Lower number of returns	Daily				Customer Service Supervisor
	NUMBER OF COMPLAINTS RECEIVED	No claims	Weekly				Customer Service Supervisor

Table 5 Key indicator dashboard for the cold distribution system *Source: Own elaboration (2021)*

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Using the above indicators is of vital importance to measure the activity and locate the areas of improvement of each of the different processes, the application of these mainly influences costs and customer satisfaction which is also a process that has indicators. Such is the importance of all indicators that if they are not applied, there is no possibility to improve and achieve better efficiency.

Conclusions

The proper application of logistics is of great importance for the performance of any company, as this and previous research has shown. In order to achieve the design of the solutions, a methodology that includes seven steps was followed and therefore conclusions will be presented for each step.

In the first step, the regulations, good manufacturing practices and requirements applicable to the tomato cold chain distribution process were identified, and this step was the fundamental one for the following six remaining steps.

The second step of the method consisted of establishing the strategic objectives, where various authors were consulted and gave their opinion on which were the most important objectives, and the four most frequently mentioned were established, which were: reducing delivery times and total compliance with deadlines, reducing transport costs, improving customer service and satisfying the needs of consumers. One of the advantages of carrying out this step was that by having enough information, it was possible to select these objectives and thus help define the guidelines for the design of the technological solution.

In the third step, once the strategic objectives were established, the key processes were established. As in the previous step, different authors were consulted and the most important key processes were identified, which were warehousing, transport and customer service.

In the fourth step, procedures were generated for each of the key processes, giving them a logical order using the structure of the Deming Cycle (PHVA). Cross-functional diagrams were created for each process (including the two procedures of transport and customer service in one), specifying who is responsible for carrying out each activity in each process, as well as the required documentation. This step was the most time-consuming due to the creation of the diagrams.

Finally, in the fifth step of the method, the key performance indicator (KPI) dashboard was established based on the Kaplan and Norton (2009) scorecard (BSC), which contains the storage, transport and customer service processes, the indicator to be reviewed, the expected goal, review frequency, the formula for each indicator and the person responsible for carrying it out; This also includes the traffic lights to indicate the percentage of compliance of the company and what percentage it should be, this helps to inform about the real situation that is presented and also to motivate the teams responsible for the fulfilment of these objectives reflected and thus constantly progress.

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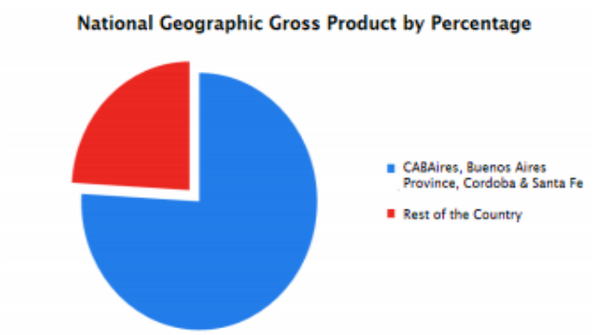

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1047 Avenida La Raza -Santa Ana, Cusco - Peru. Phones: +52 1 55 1260 0355, +52 1 55 6159 2296, +52 1 55 6034 9181; E-mail: contact@rinoe.org www.rinoe.org.

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Journal-Industrial Organization

2524 2105
ISSN 2524 - 2105
www.rinoe.org