ISSN 2410-4019

Volume 12, Issue 32 e20251232 – January – December – 2025

Journal Economic Development

ECORFAN®

Journal Economic Development, Volume 12, Issue 32: e20251232 January - December 2025, is a Continuous publication – ECORFAN -Bolivia. 21 Santa Lucía, CP-5220. Libertadores -Sucre – Bolivia. WEB: www.ecorfan.org, revista@ecorfan.org. Editor in Chief: Chiatchoua, Cesaire. PhD. ISSN 2410-4019. Responsible for the last update of this issue of the ECORFAN Informatics Unit. Escamilla-Bouchán, Imelda. PhD, Luna-Soto, Vladimir. PhD, updated as of December 30, 2025.

Journal Economic Development

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The works must be unpublished and refer to topics of trade, international economic activity, aspects of international trade and finance, international relations and international political economy, general aggregate models, quantitative approach, mixed approach and other topics related to Social Sciences.

Presentation of Content

In the first article we present *The 'Sembrando Vida' program as a driver of local economies: an analysis of the commercialization potential of annatto seed [Bixa orellana L.] in the Chontalpa Region, Tabasco*, by Castro-De la Cruz, Jucelly, Eliseo-Dantés, Hortensia, Madrigal-Eliseo, Jose Luis and Jauregui-Wade, Lucila, with adscription in the Tecnológico Nacional de México Campus Villahermosa, with a second article, *Comparative strategic analysis of the development poles for wellbeing in San Blas Atempa and Ciudad Ixtepec, Oaxaca, Mexico* by Castillo-Leal, Maricela, Pérez-Larrañaga, Héctor, Acevedo-Martínez, Jorge A. and Ríos-y-Vázquez, Othón Cesáreo, with secondment in Tecnológico Nacional de México/Campus Oaxaca, as third article we present *Methodology to measurement of competitiveness in organizations belonging to the auxiliary credit activities of Mexico's financial system: Practical case study SOFOM E.N.R. in Villahermosa, Tabasco* by Romero-Hernández, Anaid, Notario-Priego, Ezequiel, Pérez-Vázquez, Adrián and Can-Salazar, Montserrat, with affiliation at the TecNM-Instituto Tecnológico de Villahermosa, as fourth article we present *Optimal maintenance through statistical failure data in a garbage fleet. A case of study* by Hernández-Sánchez, Hair Yrwin, Melchor-Hernández, César Leonardo, Calderón-Palomares, Luis Antonio and Solís-Jiménez, Miguel Ángel, with adscription at the Tecnológico Nacional de México - Instituto Tecnológico Superior de Huatusco, as last article we present *Analysis of the development of a post-COVID-19 induction manual for a soft drink company in León, Guanajuato, Mexico* by Serrano-Torres, Ma. Guadalupe & Coronel-Sánchez, Edgar Noe, with adscription at the Universidad Tecnologica de León.

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Article

The 'Sembrando Vida' program as a driver of local economies: an analysis of the commercialization potential of annatto seed [Bixa orellana L.] in the Chontalpa Region, Tabasco

Programa 'Sembrando Vida' como dinamizador de economías locales: un análisis del potencial de comercialización de la semilla de achiote [Bixa orellana L.] en la Región Chontalpa, Tabasco

Castro-De la Cruz, Jucelly * [a], Eliseo-Dantés, Hortensia [b], Madrigal-Eliseo, Jose Luis [c] and Jauregui-Wade, Lucila [d]

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Classification:

Area: Social Sciences
Field: Administration and business
Discipline: Administration and management
Subdiscipline: Administration of the fields of education health sports agronomy arts and humanities

https://doi.org/10.35429/JED.2025.12.32.1.1.7
History of the article:
Received: April 19, 2025
Accepted: July 30, 2025

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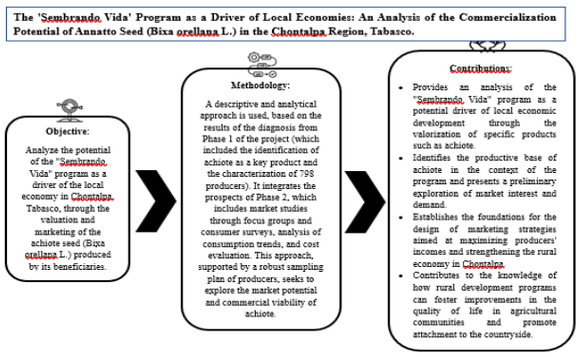
Abstract

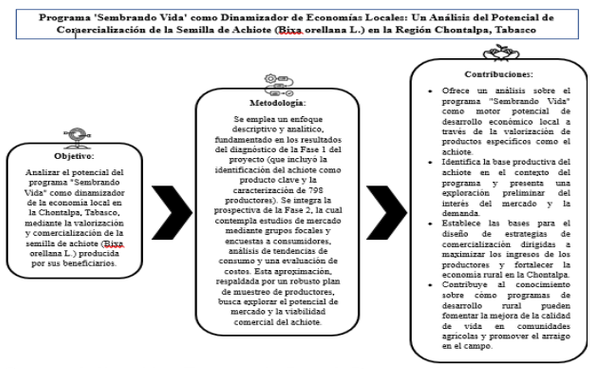
This research analyzes the potential of the "Sembrando Vida" program as an agent for dynamizing the local economy in the Chontalpa region of Tabasco, through the commercialization of annatto seed [Bixa orellana L.]. Using a diagnosis of existing production [derived from Phase 1 of projectc and a preliminary market exploration [projected in Phase 2], opportunities to improve producer income and strengthen the rural economy are identified. This analysis lays the groundwork for the development of a specific commercialization model, contributing to the improvement of the quality of life in rural communities and encouraging people to remain in the countryside.



Marketing, Local economy, Development Regional

Resumen

La presente investigación analiza el potencial del programa "Sembrando Vida" como agente dinamizador de la economía local en la Chontalpa, Tabasco, a través de la comercialización de la semilla de achiote [Bixa orellana L.]. Utilizando un diagnóstico de la producción existente [derivado de la Fase 1 del proyecto y una exploración preliminar del mercado [proyectada en la Fase 2], se identifican las oportunidades para mejorar los ingresos de los productores y fortalecer la economía rural. Este análisis sienta las bases para el desarrollo de un modelo de comercialización específico, contribuyendo a la mejora de la calidad de vida en las comunidades rurales y al fomento del arraigo en el campo.



Comercialización, Economía Local, Desarrollo Regional

Area: Advocacy and attention to national problems

Citation: Castro-De la Cruz, Jucelly, Eliseo-Dantés, Hortensia, Madrigal-Eliseo, Jose Luis and Jauregui-Wade, Lucila. [2025]. The 'Sembrando Vida' program as a driver of local economies: an analysis of the commercialization potential of annatto seed [Bixa orellana L.] in the Chontalpa Region, Tabasco. Journal Economic Development. 12[32]1-7: e11232107.

Introduction

The "Sembrando Vida" program, implemented by the Mexican government in 2019 [Gobierno de México, Secretaría de Bienestar, 2023], aims to combat rural poverty and deforestation, simultaneously promoting economic development and the well-being of small farmers [Ramírez, s.f.].

In the Chontalpa region of Tabasco state, this program has had a remarkable impact, involving over 10,825 farmers and benefiting a much larger population, estimated at 48,712 people. This context of social and productive transformation is the starting point for analyzing how "Sembrando Vida" can act as an effective dynamizer of local economies. In this context, the reality of small agricultural producers in regions like Tabasco is often characterized by the presence of deficiencies in their productive systems, limited access to technologies that optimize their yields and distribution, and economic vulnerabilities that undermine their competitiveness in increasingly demanding markets. These systemic issues have been identified in previous studies conducted in the region, underscoring the need for development proposals aimed at strengthening the primary sector and improving its integration into more efficient value chains [De León-De Los Santos et al., 2018].Furthermore, recent studies have begun to evaluate its impact on aspects such as forest cover and poverty alleviation [Análisis cualitativo de la contribución de "Sembrando Vida", 2024; Mardero et al., 2025; Pérez Ponciano & Rojas, 2025].

Among the diversity of products generated, annatto seed [Bixa orellana L.] has emerged as a crop of particular interest [INIFAP, 2022; Universidad Tecnológica Equinoccial, 2020]. The Chontalpa region is known for its production of this seed, valuable in various industries [Centro de Investigación Científica de Yucatán, 2021]. The first stage of the present research, conducted between January and December 2024, carried out a diagnosis that identified key products and concluded that the commercialization of annatto seed is crucial for improving the quality of life and economic development of the program's producers.

This diagnosis included the identification of the quantity of annatto trees planted per municipality and the species harvested by 798 beneficiary producers in the region.

This article aims to analyze the potential of the "Sembrando Vida" program as a dynamizer of local economies in the Chontalpa, focusing specifically on the opportunities offered by the commercialization of annatto seed. It is argued that, through the development of an efficient commercialization model, this product can generate a significant positive economic impact for producers and the region in general.

Methodology

This analysis is based on an applied research project that adopts a descriptive and analytical approach. The information supporting this study primarily comes from the consolidated results of the first phase of the project, developed between January and December 2024. During this initial stage, an exhaustive diagnosis was conducted in the Chontalpa region, which allowed for the identification of products with the highest commercialization potential generated by the beneficiaries of the "Sembrando Vida" program.

A relevant conclusion of this diagnosis was that the commercialization of annatto seed is a crucial factor for the economic development of local producers. Furthermore, the existing productive base was characterized, identifying the quantity of annatto trees planted per municipality, their precise location, and the type of species harvested, involving a total of 798 producers in the region. This diagnostic information is fundamental for estimating the productive potential of annatto and its consequent capacity to dynamize the regional economy [Chapa & Castillo, 2025].

Complementarily, this article relies on the prospective of the second phase of the project, scheduled to be developed in 2025. This subsequent phase will focus on deepening the understanding of the market and commercial viability. For this, a Market Study is contemplated as the primary objective, which will include the organization of focus groups with consumers. A discussion guide designed to explore consumption habits, perceptions, needs, and interest in annatto seed will be used, with an emphasis on annatto produced in the Chontalpa region under the "Sembrando Vida" program.

Additionally, consumer surveys will be designed and applied to quantitatively identify preferences, purchasing habits, and willingness to pay for annatto seed.

ISSN: 2410-4019
RENIECYT: 1702902

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https://doi.org/10.35429/JED.2025.12.32.1.1.7

The combined objective of these instruments is to comprehensively determine consumer demands and needs. A Consumption Trend Analysis will also be carried out through an exhaustive documentary review and analysis of secondary data, with special emphasis on annatto seed. Likewise, a Cost Evaluation associated with production and commercialization will be conducted to identify opportunities for optimization and increased profitability. For the collection of primary data directly from the identified annatto producers [N ≈ 798], a robust Sampling of Producers.

Producer Sampling

This includes the calculation of a representative sample size [n ≈ 260], using a formula for finite populations that ensures a 95% confidence level and a ±5% margin of error. Stratified random sampling is planned, using the municipalities of the Chontalpa region as strata, to ensure adequate geographical and contextual representation of the producers.

This methodological approach will allow for the collection of detailed information on productive practices, costs, and commercialization perspectives, whose detailed results will be analyzed in later phases of the project and presented in future publications.

Results

The findings from the focus groups conducted with consumers in the Chontalpa region, as part of the preliminary market exploration, offer valuable information on consumption habits, perceptions, and the market potential for annatto seed.

General Habits of Condiment Purchase and Consumption: When inquiring about the most used condiments, annatto was the most mentioned by participants [70%], who consider it fundamental in Tabascan cuisine, followed by habanero chili [60%] and herbs like cilantro and epazote [45%]. Regarding the frequency of condiment purchase, half of the participants [50%] indicated acquiring them once or twice a month, while 30% do so weekly.

Local markets are the preferred place of purchase for most [60%], arguing for freshness and trust in products, followed by grocery stores [25%] for convenience, and a minority [15%] who prefer to buy directly from the producer.

A notable appreciation for the local origin of products was observed, as 70% of participants stated preferring products from Tabasco, mainly due to perceived freshness and support for the regional economy.

Knowledge, Use, and Specific Perceptions of Annatto: Annatto is strongly associated by consumers with its quality as a "natural coloring" [80%], its "unique flavor for cochinita" [65%], and as part of "family tradition" [40%]. A large majority [85%] of participating households use annatto, with a reported frequency of two to three times per week, mainly for dishes such as cochinita pibil [90% of those who use it], tamales [70%], and fish [50%]. The preferred format is paste [60%], followed by whole seed [30%]. Of the 15% who do not use annatto, the main reasons were lack of knowledge on how to cook with it [50% of this group] or preference for industrialized condiments [30%]; however, 70% of those who do not use it would be willing to try it if its uses were explained to them. Annatto is primarily purchased in markets [55%], supermarkets [30%], and directly from local producers [15%]. The most mentioned commercial brands were "El Yucateco" [40%] and "Doña María" [25%], although 35% indicated buying it in bulk without a specific brand. The predominant purchase criteria are price [50%], origin [30%], and intense color of the product [20%].

Perceptions of Annatto from Chontalpa and the "Sembrando Vida" Program: Achiote not only has an intrinsic economic value, but it is also linked to the cultural and gastronomic identity of Tabasco, contributing to the unique flavors of its traditional dishes, as part of a rich culinary heritage that is promoted through gastronomic tourism [Oropeza-Tosca et al., 2024];Regarding annatto of Tabascan origin, 60% of participants stated having tried it, associating it with being "more aromatic" [45% of this group] and "made by peasant families" [30%]. However, 40% do not identify or are unaware of annatto production in Tabasco.

Knowledge about the "Sembrando Vida" program was divided, with 50% knowing about it and associating it positively with farmer support, and 50% not recognizing it [cf. Domínguez & Baltazar, s.f., on the promise of well-being in rural communities].

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Significantly, when presented with the possibility of acquiring annatto produced by beneficiaries of the "Sembrando Vida" program from Chontalpa, 65% of participants indicated that they would buy it. The main reasons for this preference were "support for local producers" [70% of this group] and "perceived superior quality" [40%]. Within this favorable group, there was a willingness to pay a premium of between 10% and 15% over the usual cost of annatto.

Thirty-five percent of participants would not change their purchasing habits, prioritizing price. Regarding the desired information on the packaging of such a product, consumers highlighted an interest in knowing the "producer's story" [50%], the "environmental benefits of the program" [30%], and "traditional recipes" [20%].

Unsatisfied Needs and Improvement Proposals for Annatto: Participants suggested various improvements for annatto available in the market, such as greater availability in easily accessible stores [40%], the offer of smaller and more practical packaging [30%], and clearer information on its culinary uses [20%]. When conceptualizing an "ideal annatto" from Chontalpa, characteristics such as "organic, in paste, with biodegradable packaging" and a narrative that "shows photos of producers and their community" were mentioned. Finally, at the close of the sessions, a desire for greater promotion of local annatto [60%] and the organization of workshops to learn how to cook with it [25%] stood out.

Conclusions

The "Sembrando Vida" program has established a robust socioeconomic platform in the Chontalpa region, Tabasco, generating positive impacts on employment, beneficiary incomes, and the social fabric of rural communities. Based on this, the present analysis has sustained and evidenced that the strategic commercialization of specific products, such as annatto seed [Bixa orellana L.], possesses significant potential to act as an important dynamizer of local economies.

The findings from the first phase of the research project confirm the relevance of annatto as a priority crop within the program and the existence of a considerable productive base, with 798 producers dedicated to its cultivation in the region.

Preliminary market explorations, as a consumer response, consistently reinforce this potential. There is an identified existing demand for annatto and a particular interest in products that not only offer quality and authenticity but also incorporate social value and a clear, traceable origin [Salgado et al., 2024], attributes that annatto from "Sembrando Vida" could effectively capitalize on. The willingness of a segment of consumers to value and potentially pay a premium for these differentiating elements underscores the feasibility of developing an offer with its own identity.

The development of an efficient and profitable commercialization model for annatto seed, which is the central objective of the second phase of the project, is revealed as a crucial step to materialize the potential analyzed here. By improving market access, optimizing distribution channels, and strengthening the organizational and entrepreneurial capacities of producers, substantial increases in their incomes, the generation of additional employment in related activities, and a general strengthening of the regional economy can be expected. These results would not only directly contribute to the objectives of the "Sembrando Vida" program [Ramírez, s.f.] but also foster more sustainable, inclusive, and resilient rural development in the Chontalpa. The implications of this potential analysis are significant for both the design of public policies supporting the rural sector and the strategies that producer organizations may adopt. It is recommended that future interventions and technical support focus on strengthening the management capacities, quality production, and commercial articulation of the "Sembrando Vida" beneficiaries.

Facilitating access to market information, promoting associativity, and developing quality and origin hallmarks can be key strategies [Moreno & Montoya, s.f.]. This initial study, focused on delimiting and arguing the potential of annatto seed, lays the groundwork for subsequent essential research. Future articles derived from this project will address in detail the specific design of the proposed commercialization model, strategies for optimizing the annatto supply chain, and mechanisms for productive articulation and empowerment of producers from a social economy perspective [Chapa & Castillo, 2025; Domínguez & Baltazar, s.f.].

ISSN: 2410-4019
RENIECYT: 1702902

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These complementary works will be fundamental to translate the potential identified in this first analysis into tangible, measurable, and sustainable benefits for annatto-producing communities in Chontalpa.

Annexes

Below is a description of the graphs generated to illustrate the findings and context of the study "The 'Sembrando Vida' Program as a Driver of Local Economies: An Analysis of the Commercialization Potential of Annatto Seed [Bixa orellana L.] in the Chontalpa Region, Tabasco."

Box 1

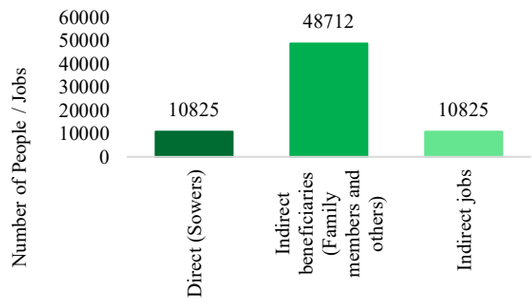

Figure 1

Socioeconomic Impact of the "Sembrando Vida" Program in Chontalpa

Data Source: Own elaboration

Visualizes the number of direct beneficiaries [farmers], indirect beneficiaries [family members and others], and indirect jobs generated by the "Sembrando Vida" program in the Chontalpa region, with the purpose of illustrating the magnitude of the program's basic socioeconomic impact, establishing the context of its scope and influence in the study area.

Box 2

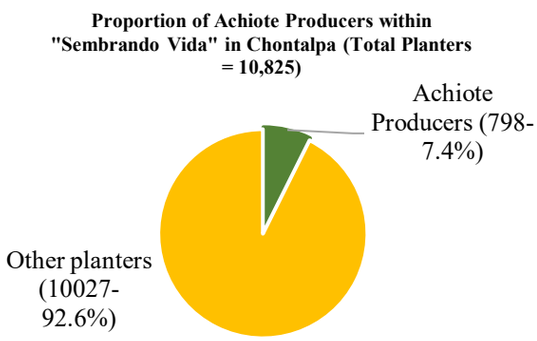

Figure 2

Proportion of Annatto Producers within "Sembrando Vida" in Chontalpa

Data Source: Own elaboration

Shows the proportion of annatto producers [798] relative to the total number of farmers [approximately 10,825] enrolled in the "Sembrando Vida" program in the Chontalpa region.

Box 3

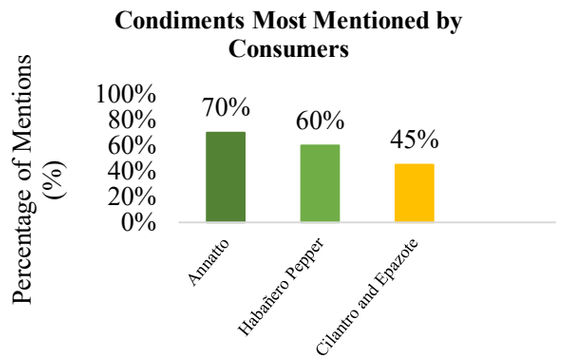

Figure 3

Importance of Local Origin when Buying Condiments

Data Source: Own elaboration

Illustrates the percentage of consumers who stated valuing the local origin of condiments [70%] compared to those for whom this factor is not a priority [30%].

Box 4

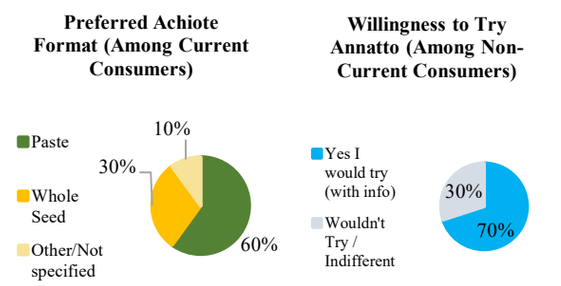

Figure 4

Preferences and Openness towards Annatto Consumption

Data Source: Own elaboration

Details the preferred annatto format [paste 60%, whole seed 30%, other/unspecified 10%] by current consumers.

Subgraph 4b [Willingness to Try]: Shows the percentage of non-current annatto consumers who would be willing to try it if information on its uses were provided [70%].

ISSN: 2410-4019
RENIECYT: 1702902

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Box 5

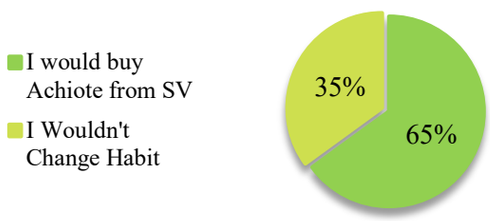

Figure 5

Influence of "Sembrando Vida" Origin on Consumer Purchase Decision

Data Source: Own elaboration

Presents the percentage of consumers who indicated they would buy annatto if they knew it came from "Sembrando Vida" program producers [65%], in contrast to those who would not change their purchasing habits [35%].

Box 6

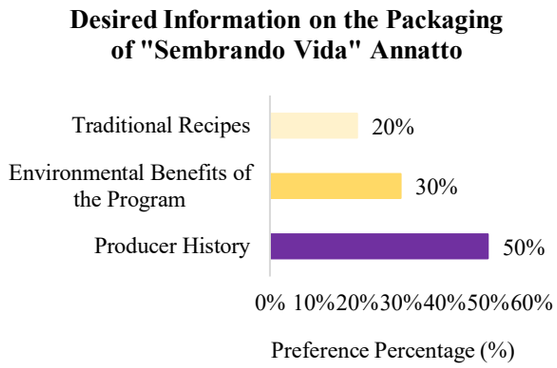

Figure 6

Desired Information on "Sembrando Vida" Annatto Packaging

Data Source: Own elaboration

Shows consumer preferences regarding the information they would like to find on the packaging of annatto from the "Sembrando Vida" program [Producer's story 50%, Environmental benefits of the program 30%, Traditional recipes 20%].

Declarations

Conflict of interest

The authors declare that they have no conflicts of interest. They have no known competing financial interests or personal relationships that might have appeared to influence the article reported in this article.

ISSN: 2410-4019
RENIECYT: 1702902

Author Contributions

Castro-De la Cruz, Jucelly: Contribution to the main research idea, as well as the methodology to be used.

Eliseo-Dantés, Hortensia: Contribution to methodology design and data collection.

Madrigal-Eliseo, Jose Luis: Contribution to methodology design and data collection.

Jauregui-Wade, Lucila: Contribution to methodology design and data collection.

Funding

The research did not receive any funding.

Acknowledgements

The collaboration of the territorial coordination of the Chontalpa zone of the "Sembrando Vida" program and the Tecnológico de Villahermosa is gratefully acknowledged for their support in carrying out this research Project.

Abbreviations

L.: Linnaeus [abbreviation of the botanist Carl Linnaeus, used in the scientific nomenclature Bixa orellana L.]

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ISSN: 2410-4019
RENIECYT: 1702902

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https://doi.org/10.35429/JED.2025.12.32.1.1.7

Journal Economic Development 12[32]1-8: e21232108
Article

Comparative strategic analysis of the development poles for wellbeing in San Blas Atempa and Ciudad Ixtepec, Oaxaca, Mexico

Análisis estratégico comparativo de los polos de desarrollo para el bienestar en San Blas Atempa y Ciudad Ixtepec, Oaxaca, México

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Classification:

Area: Social Sciences
Field: Sociology
Discipline: General sociology
Subdiscipline: Regional development

https://doi.org/10.35429/JED.2025.12.32.2.1.8
History of the article:
Received: April 30, 2025
Accepted: July 30, 2025

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Abstract

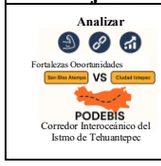
This article performs a comparative analysis between two key municipalities in the implementation of the Poles of Development for Well-Being [PODEBIS] within the framework of the Interoceanic Corridor of the Isthmus of Tehuantepec [CIIT]: San Blas Atempa and Ciudad Ixtepec, both in the state of Oaxaca. Through EFEM and EFIM matrices, as well as a SWOT approach, the local capacities, risks and strategic opportunities of each territory are evaluated. The results show important contrasts in infrastructure, human capital and social vulnerabilities, but also common areas that must be strengthened to achieve sustainable territorial development.

Objective	Methodology	Contributions
		

CIIT, PODEBIS, Territorial development

Resumen

El presente artículo realiza un análisis comparativo entre dos municipios clave en la implementación de los Polos de Desarrollo para el Bienestar [PODEBIS] en el marco del Corredor Interoceánico del Istmo de Tehuantepec [CIIT]: San Blas Atempa y Ciudad Ixtepec, ambos en el estado de Oaxaca. A través de matrices MEFE y MEFI, así como un enfoque FODA, se evalúan las capacidades locales, riesgos y oportunidades estratégicas de cada territorio. Los resultados evidencian contrastes importantes en infraestructura, capital humano y vulnerabilidades sociales, pero también áreas comunes que deben fortalecerse para lograr un desarrollo territorial sostenible.

Objetivo	Metodología	Contribuciones
		

CIIT, PODEBIS, Desarrollo territorial

Area: Advocacy and attention to national problems

Citation: Castillo-Leal, Maricela, Pérez-Larrañaga, Héctor, Acevedo-Martínez, Jorge A. and Ríos-y-Vázquez, Othón Cesáreo. [2025]. Comparative strategic analysis of the development poles for wellbeing in San Blas Atempa and Ciudad Ixtepec, Oaxaca, Mexico. Journal Economic Development. 12[32]1-8: e21232108.

Introduction

The Interoceanic Corridor of the Isthmus of Tehuantepec [CIIT] is one of the most ambitious megaprojects of the current Mexican government. Its main objective is to articulate a logistical, industrial and social network connecting the ports of Coatzacoalcos [Veracruz] and Salina Cruz [Oaxaca], facilitating the inter-oceanic transit of goods. As part of the social component, 10 Development Poles for Well-being [PODEBIS] were designed, four in Veracruz and six in Oaxaca [see table 1], with the intention of dynamising local economies by attracting investment, generating employment and strengthening community capacities.[DOF, 2022].

Box 1

Table 1

Development Poles for Well-being

Entity	Name of PODEBI
Veracruz	Coatzacoalcos I
Veracruz	Coatzacoalcos II
Veracruz	Texistepec
Veracruz	San Juan Evangelista
Oaxaca	Matías Romero Avendaño
Oaxaca	Asunción Ixtaltepec
Oaxaca	Ciudad Ixtepec
Oaxaca	Santa María Mixtequilla
Oaxaca	San Blas Atempa

Source: Gobierno de México, 2023.

In this context, PODEBIS can be understood as strategically selected geographical areas where complementary economic activities are promoted with the aim of boosting economic growth and improving living conditions for the population. Unlike traditional growth poles, PODEBIS integrate social and territorial objectives by seeking not only to boost productivity through agglomeration economies, but also to link historically disjointed regions through infrastructure, connectivity and planning. They incorporate a development approach that prioritises the coverage of basic needs, the active participation of local actors and respect for human rights, territories and community identities [Castillo, 2023].

The Isthmus of Tehuantepec, in addition to its geostrategic importance, is a region marked by historical inequalities, ethnic diversity and community resistance [Tripp, 2019].

Analysing the territorial impact of PODEBIS in this region requires a comprehensive approach that includes both the potential of the project and the tensions that emerge in contexts of high structural vulnerability.

This article focuses on two municipalities selected as PODEBIS sites: San Blas Atempa and Ciudad Ixtepec. Both municipalities have distinctive features that allow for a useful strategic comparison for the evaluation of the programme.

Method

A mixed methodology was used, combining quantitative and qualitative techniques focused on SWOT analysis, the EFIM [Internal Factor Evaluation Matrix] and EFEM [External Factor Evaluation Matrix], as well as a cross-impact matrix approach.

The quantitative phase was based on the use of EFIM and EFEM matrices, which allowed for the numerical weighting of strengths, weaknesses, opportunities and threats, based on information from official sources such as INEGI [2020] and reports from the Oaxaca State Government, as well as the Municipal Development Plans of San Blas Atempa [2022-2024] and Ciudad Ixtepec [2022-2024]. The values and ratings assigned were validated through participatory analysis sessions with key actors from both municipalities.

The qualitative phase included semi-structured interviews and focus groups conducted between 2023 and 2024 with municipal authorities, community leaders, women artisans, young people, and local teachers. These techniques allowed us to capture perceptions, narratives, and community knowledge regarding the CIIT and its influence in the territory.

The findings were organised and interpreted using SWOT analysis, serving as a bridge between the empirical data and the strategic elements identified.

The methodological triangulation between hard data, primary sources and strategic matrices made it possible to establish a robust diagnosis that supports the differentiated recommendations for both territories.

ISSN: 2410-4019
RENIECYT: 1702902

Castillo-Leal, Maricela, Pérez-Larrañaga, Héctor, Acevedo-Martínez, Jorge A. and Ríos-y-Vázquez, Othón Cesáreo. [2025]. Comparative strategic analysis of the development poles for wellbeing in San Blas Atempa and Ciudad Ixtepec, Oaxaca, Mexico. Journal Economic Development. 12[32]1-8: e21232108.
https://doi.org/10.35429/JED.2025.12.32.2.1.8

Strategic diagnosis of San Blas Atempa

Contextual analysis of San Blas Atempa within the framework of the CIIT

San Blas Atempa is a Zapotec municipality in the Isthmus of Tehuantepec with a population of 19,696 inhabitants, of whom more than 97% identify as indigenous [INEGI, 2020]. Its geographical location makes it a potentially strategic territory, as it borders Salina Cruz—the port epicentre of the Interoceanic Corridor of the Isthmus of Tehuantepec [CIIT]—and key railway facilities that are part of the Z line of the interoceanic railway [DOF, 2022].

However, San Blas Atempa faces severe structural limitations that condition its participation in the benefits of the CIIT. The municipality has high levels of social backwardness, particularly in indicators of access to basic services, health and formal employment [Government of the State of Oaxaca, 2024b]. Drinking water and sanitation coverage is limited, many localities do not have paved roads or regular transport, and health institutions are insufficient to care for the population in emergency situations or with chronic conditions [Government of the State of Oaxaca, 2023].

In terms of education, San Blas Atempa lacks higher education institutions within its territory. Young people who wish to continue their studies must travel to Juchitán, Tehuantepec or Ixtepec, which creates inequality of opportunity and contributes to youth migration. The average level of schooling is 6.2 years, below the state average [SEP, 2020]. Despite these shortcomings, the municipality has key social and cultural strengths. These include the persistence of an active Zapotec identity, the use of the language in community and school contexts, and a traditional governance structure based on assemblies and municipal agencies. There are also groups of women artisans, cultural promoters and young people organised in defence of the territory who have generated forms of creative resistance to previous megaprojects [Zibechi, 2012].

San Blas Atempa has also been the scene of significant tensions with the Army and Navy, particularly over the construction of military installations on its territory without prior consultation, which has exacerbated the social conflict surrounding the CIIT [Díaz, 2025].

This situation places the municipality in a position of high institutional vulnerability to the advance of the PODEBIS. In this context, the municipality requires a differentiated approach that prioritises the reconstruction of the social fabric, public investment in basic infrastructure, attention to educational backwardness and the strengthening of local capacities from a perspective of indigenous rights and autonomy.

SWOT matrix for San Blas Atempa

The results of the SWOT analysis of San Blas Atempa are presented below, which served as the basis for the preparation of the EFEM and EFIM matrices.

Box 2

Table 2

Matrix of strengths and weaknesses of San Blas Atempa

Strengths [F]	Weaknesses [D]
- Strong Zapotec identity and preserved indigenous language [INEGI, 2020].	- High social backwardness and multidimensional poverty [Gobierno del Estado de Oaxaca, 2024b].
- Community and traditional governance structures in place [Zibechi, 2012].	- Deficiencies in basic services: drinking water, health care, paving [Gobierno del Estado, 2024].
- Active participation of women artisans and young people in cultural collectives [Díaz, 2025].	- Absence of higher education institutions in the municipality [SEP, 2020].
- Presence of social resistance networks with experience in territorial defence [Zibechi, 2012].	- Low average schooling [6.21 years] and youth migration [SEP, 2020].

Source: Own elaboration

Box 3

Table 3

Opportunities and threats matrix for San Blas Atempa

Opportunities [O]	Threats [A]
- Proximity to CIIT logistics nodes: port of Salina Cruz and inter-oceanic railway [DOF, 2021].	- Possible exclusion from the development process if conditions of structural inequality are not addressed.
- Potential public investment in basic infrastructure through PODEBI [CIIT, 2024].	- Social tensions arising from military installation without prior consultation [Díaz, 2025].
- Possibility of promoting green jobs, cooperativism and social and solidarity economy.	- Risk of cultural displacement and loss of autonomy in the face of the imposition of megaprojects [Zibechi, 2012].
- Strengthening of cultural and community-based tourism if it focuses on Zapotec heritage.	- Climate change and frequent natural disasters in the region [Gobierno del Estado de Oaxaca, 2023].

ISSN: 2410-4019
RENIECYT: 1702902

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Strategic interpretation

- **FO [maxi-maxi]:** Promote community-based tourism and cultural projects that take advantage of the Zapotec identity and the strategic location close to CIIT.
- **DO [mini-maxi]**: Manage public investment and partnerships with external universities to create technical training centres and strengthen human capital.
- **FA [maxi-mini]**: Use existing organisational networks to influence the participatory design of PODEBIS and prevent cultural displacement.
- **DA [mini-mini]**: Implement comprehensive social development programmes with an intercultural approach and active community participation to reduce structural vulnerabilities.

EFEM and EFIM results

The EFEM matrix scores a total of 2.52, indicating a favourable perception of the external environment, albeit with significant risks. The most valued opportunities include the inter-oceanic project, tourism and renewable energy. In contrast, threats include natural disasters, loss of cultural heritage and climate change.

The EFIM matrix gives a value of 2.06, revealing structural weaknesses such as limited access to basic services, poverty and insecurity. However, there are notable strengths such as cultural identity, community resilience and traditional craft skills.

Box 4

Table 4

Synthesised results EFEM-EFIM San Blas Atempa

Type of factor	Total score
External factors [EFEM]	2.52
Internal factors [EFIM]	2.06

Source: Own elaboration

Table 1 shows that the municipality perceives more opportunities than threats in its environment [EFEM = 2.52], although this is only slightly above the average threshold, reflecting a still unstable environment.

In contrast, the EFIM value of 2.06 reveals significant internal weaknesses that could limit its capacity to respond to development challenges. This combination suggests that, although there are favourable external conditions linked to the CIIT, the institutional, productive and social capacities of the territory need to be strengthened urgently so that it can benefit from these opportunities. Strategic diagnosis of Ciudad Ixtepec Contextual analysis of Ciudad Ixtepec within the framework of the CIIT Ciudad Ixtepec, one of the key municipalities in the strategy of the Interoceanic Corridor of the Isthmus of Tehuantepec [CIIT], is located in the Isthmus of Oaxaca region. With a total population of 28,082 inhabitants [INEGI, 2020], it stands out for its more consolidated urban infrastructure compared to other neighbouring municipalities.

In addition to its strategic geographical position, Ciudad Ixtepec is home to one of the most important railway terminals in southern Mexico, positioning it as a relevant logistics hub for interoceanic connectivity [DOF, 2023]. Among the most notable infrastructure projects in its territory is the construction of a new refinery that is part of the CIIT energy plan. This industrial complex aims to strengthen fuel processing and distribution in the region and is linked to the conversion of pipelines and the expansion of railways [CIIT, 2024].

This infrastructure is expected to generate direct and indirect jobs, as well as trigger local production chains in the energy, logistics and services sectors. Ciudad Ixtepec also has one of the most robust educational networks in the Isthmus. It is home to a National Pedagogical University [UPN], a campus of the Isthmus Technological Institute, and several secondary education institutions such as CBTIS 91.

This translates into high educational coverage, particularly at the secondary and tertiary levels [SEP, 2020]. These factors mean that the economically active population [EAP] has a high level of education, which increases its ability to adapt to the technical requirements of the new industrial development model. At the social level, the municipality has an average social lag index, although there are specific areas where extreme poverty and deficiencies in access to drinking water and health services persist [Government of the State of Oaxaca, 2024b].

ISSN: 2410-4019
RENIECYT: 1702902

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https://doi.org/10.35429/JED.2025.12.32.2.1.8

However, its social capital is strong, with civil organisations, cultural groups and cooperatives that have previously worked on productive inclusion processes, which facilitates social organisation for the implementation of the CIIT.

Due to its proximity to the Military Air Base and recent investment in civil airport infrastructure, Ciudad Ixtepec is also emerging as a strategic point for the movement of goods and technical personnel, which reinforces its role as an intermediate city with a focus on logistics and services [Oaxaca State Government, 2023].

In this context, Ciudad Ixtepec represents an example of a municipality with favourable structural conditions for the success of the Development Poles for Well-being [PODEBIS], provided that its persistent social challenges are addressed and active citizen participation in the planning processes is guaranteed.

The SWOT analysis that served as the basis for the preparation of the EFEM and EFIM matrices is presented below.

Box 5

Table 5

Matrix of strengths and weaknesses of Ciudad Ixtepec

Strengths [F]	Weaknesses [D]
- High schooling [average of 9.67 years] and presence of six higher education institutions [SEP, 2020].	- Presence of extreme poverty in 4.4% of the population [Gobierno del Estado de Oaxaca, 2024b].
- Consolidated logistical infrastructure: railway station, federal highway, civilian airport [CIIT, 2024].	- Irregular access to drinking water: 25% of the population without adequate service [Gobierno del Estado de Oaxaca, 2024b].
- High economic participation [98.7% of the employed EAP] and dynamism of the tertiary sector [INEGI, 2020].	- Insufficient health services, with only one general hospital for the entire population. [Gobierno del Estado de Oaxaca, 2024b].
- Organised social capital: cultural collectives, chambers of commerce and growing network of young entrepreneurs [CIIT, 2023]; Díaz, 2025].	- Environmental vulnerability due to contamination of water bodies and areas without proper sanitation [Gobierno del Estado de Oaxaca, 2023].

Source: Own elaboration

Box 6

Table 6

Ciudad Ixtepec's opportunities and threats matrix

Opportunities [O]	Threats [A]
- Headquarters of a Pole of Development for Well-being [PODEBI] with a logistics and industrial vocation within the CIIT. [DOF, 2023].	- Increased urban crime and possible gentrification processes [CIIT, 2024; Gobierno Municipal de Ciudad Ixtepec, 2022-2024].
- Proximity to the Salina Cruz refinery, which opens up possibilities for energy production linkages. [CIIT, 2024].	- Land pressures from sprawl and urban sprawl [Gobierno Municipal de Ciudad Ixtepec, 2022-2024].
- Potential for developing cultural and service tourism given its strategic location and infrastructure [INEGI, 2020].	- Risk of CIIT benefits being concentrated in certain sectors, deepening inequality [Díaz, 2025].
- Development of educational innovation networks, university-industry partnerships and access to federal regional development programmes. [SEP, 2020; CIIT, 2024].	- Possible displacement of the local population if adequate mechanisms for social participation and territorial defence are not implemented [Díaz, 2025].

Source: Own elaboration

Strategic interpretation

- **FO [maxi-maxi]**: Consolidate Ciudad Ixtepec as a pole of educational innovation and intelligent logistics, articulating universities, entrepreneurs and the business sector.
- **DO [mini-maxi]**: Implement social infrastructure programmes with a territorial approach to address poverty and improve basic services.
- **FA [maxi-mini]**: Strengthen mechanisms for citizen participation and urban planning to contain processes of social fragmentation and ecological damage.
- **DA [mini-mini]**: Implement land management policies and participatory environmental monitoring to prevent conflicts arising from uncontrolled economic growth.

EFEM and EFIM results

The EFEM matrix shows a score of 2.83, highlighting opportunities such as economic growth derived from the CIIT, tourism and educational potential. The most relevant threats are the increase in crime and seismic risk.

ISSN: 2410-4019
RENIECYT: 1702902

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In the EFIM, with a value of 2.41, strengths in education, connectivity and economic participation stand out. However, weaknesses persist in health, access to drinking water and extreme poverty.

Box 7

Table 7

Summarised results EFEM-EFIM Ciudad Ixtepec

Type of factor	Total score
External factors [EFEM]	2.83
Internal factors [EFIM]	2.41

Source: Own elaboration

In the case of Ciudad Ixtepec, Table 2 reveals a more robust situation both externally and internally. The EFEM score of 2.83 indicates a clear perception of opportunities, especially linked to economic growth, educational infrastructure, and tourist attractions derived from the CIIT.

In turn, the EFIM value of 2.41 suggests a more consolidated internal structure, although not without social challenges such as extreme poverty and lack of basic services.

Taken together, these values position Ciudad Ixtepec as a municipality with favourable conditions for consolidating a more sustainable and equitable development model, provided that its areas of lag are addressed strategically. 5.

Strategic comparison

A comparison of scores shows that Ciudad Ixtepec has greater internal strengths and better external conditions to consolidate the territorial development promoted by the CIIT. San Blas Atempa, on the other hand, requires a focus on institutional strengthening, basic social investment and community support. This is clearly illustrated in the graph below:

Box 8

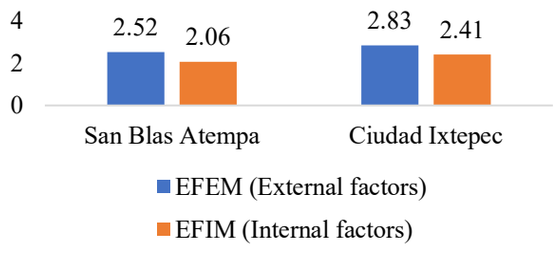

Figure 1

Comparison of strategic matrices EFEM and EFIM

Source: Own elaboration

As can be seen in the comparative graph, the difference in scores indicates that San Blas Atempa needs strategies focused on internal strengthening, while Ciudad Ixtepec should focus on consolidating its progress and preventing social setbacks.

Differentiated strategies by municipality:

Box 9

Table 8

Strategies differentiated by municipality

Municipality	Priority strategic focus
San Blas Atempa	Strengthening basic skills, community cohesion and SSE
Ixtepec City	Consolidating achievements, preventing social deterioration and attracting investment

Source: Own elaboration

Stakeholders and implementation mechanisms

For San Blas Atempa, strategies must be led by the municipal government in coordination with local educational institutions [such as the region's technological institutes and universities], civil society organisations with experience in solidarity-based economics, and federal agencies such as the Secretariat of Welfare and SEDATU. The involvement of community assemblies, health promoters, and artisan cooperatives is also required to foster local roots and ensure the cultural relevance of actions.

In the case of Ciudad Ixtepec, the consolidation of progress should be supported by partnerships with local universities, chambers of commerce, companies in the logistics and tourism sectors, as well as the strengthening of the municipal council as a territorial planning body. The active participation of women, young entrepreneurs, and cultural groups will be key to preventing social fragmentation in the face of the changes that the CIIT will bring.

In both cases, the creation of citizen oversight committees, accountability mechanisms, and digital participation platforms is recommended to ensure transparent, inclusive, and effective implementation of PODEBIS-related projects. Consolidate achievements, prevent social deterioration, and attract investment.

ISSN: 2410-4019
RENIECYT: 1702902

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https://doi.org/10.35429/JED.2025.12.32.2.1.8

Conclusions

PODEBIS represent a historic opportunity to reverse inequalities in the Isthmus, but their success will depend on their ability to adapt to local realities. The comparison between San Blas Atempa and Ciudad Ixtepec shows that there is no single formula for development: it is necessary to recognise each area's own trajectory, strengthen local capacities and ensure citizen participation.

In the context of the Interoceanic Corridor of the Isthmus of Tehuantepec [CIIT], the municipalities analysed present different challenges and opportunities. San Blas Atempa needs urgent social inclusion measures and institutional support to avoid being marginalised from the development process. In contrast, Ciudad Ixtepec must focus on consolidating its achievements, channelling the opportunities of the CIIT towards an inclusive, environmentally sustainable and community-based development model.

It is essential that the CIIT does not reproduce the extractivist logic of previous megaprojects, but rather generates mechanisms for territorial redistribution and social justice. Strengthening local capacities, respect for cultural diversity and participatory territorial planning must be at the centre of any strategy that aspires to truly transformative development in the Isthmus region.

Declarations

Conflict of interest

The authors declare no conflict of interest. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

Author contribution

Castillo-Leal, Maricela: Conceptualisation of the topic, initial drafting of the manuscript.

Pérez-Larrañaga, Héctor: Fieldwork and methodological design.

Acevedo-Martínez, Jorge Antonio: Fieldwork, systematisation of information.

Ríos-y-Vázquez, Othón Cesáreo: Literature review, writing of results.

Availability of data and materials

The data used in this research were obtained using a mixed-methods approach. Quantitative data were collected from official sources and the Municipal Development Plans of San Blas Atempa and Ciudad Ixtepec. Qualitative data were generated through semi-structured interviews and focus groups conducted between 2023 and 2024 with local actors, including community leaders, municipal authorities, women artisans, young people, and educators.

The processed data supporting the conclusions of this study are available from the corresponding author upon reasonable request, respecting the confidentiality agreements established with the participants.

Funding

This work did not receive funding.

Acknowledgements

This work did not receive funding from any institution, company or other entity.

Abbreviations

CBTIS	Industrial and Services Technological High School
CIIT	Interoceanic Corridor of the Isthmus of Tehuantepec
DOF	Official Gazette of the Federation
FODA	Strengths, opportunities, weaknesses, and threats
INEGI	National Institute of Statistics and Geography
Maxi	Maximise
EFEM	External factor evaluation matrix
EFIM	Internal factor evaluation matrix
Mini	Minimise
PEA	Economically active population
PODEBI	Development hubs for well-being
SEDATU	Ministry of Agrarian, Territorial and Urban Development
SEP	Ministry of Public Education
UPN	National Pedagogical University

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ISSN: 2410-4019
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Antecedents

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Journal Economic Development 12[32]1-11: e31232111
Article

Methodology to measurement of competitiveness in organizations belonging to the auxiliary credit activities of Mexico's financial system: Practical case study SOFOM E.N.R. in Villahermosa, Tabasco

Metodología para la medición de la competitividad de organizaciones que pertenecen a las actividades auxiliares de crédito del sistema financiero en México: Caso práctico SOFOM E.N.R. en Villahermosa, Tabasco

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Classification:

Area: Social Sciences
Field: Economic sciences
Discipline: General Economics
Sub-discipline: Economic methodology

https://doi.org/10.35429/JED.2025.12.32.3.1.11
History of the article:
Received: April 30, 2025
Accepted: July 30, 2025

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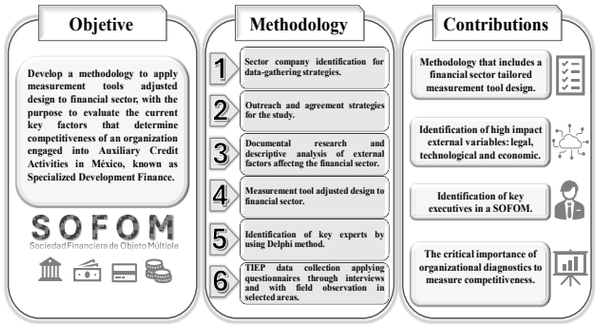
Abstract

In today's business environment, analysing organizational competitiveness has become a critical factor to success and sustainability of companies. In Mexico's financial system structure, exist certain organizations that have revolutionized the financial sector and emerged as alternative funding sources for micro, small, and medium-sized companies, known as Specialized Development Finance, or Auxiliary Credit Activities [SOFOM]. This study focuses on proposing a methodology to help companies in this sector implement sector tailoled measurement tools, with the purpose that these tools will assess their current position relative to external factors, identify key factors of competitiveness that will allow to companies develop optimization strategies and continuous improvement.

Methodology to measure competitiveness of a SOFOM.

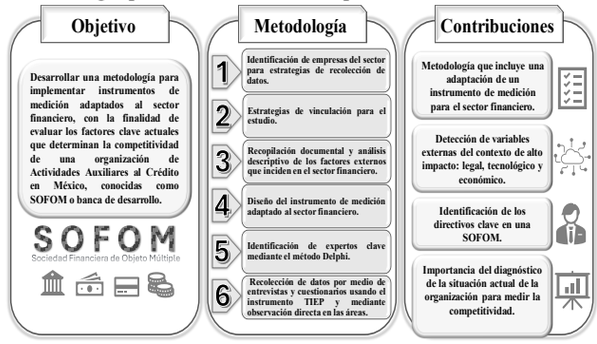


Methodology, Competitiveness, Multi-Purpose Financial Company [SOFOM]

Resumen

En el entorno empresarial actual, el análisis de la competitividad organizacional se ha convertido en un factor crítico para el éxito y la sostenibilidad de las empresas. En México dentro de la estructura del sistema financiero existen organizaciones que han revolucionado el sector financiero y que emergieron como alternativas de fuentes de financiamiento para micro, pequeñas y medianas empresas, denominadas banca de desarrollo o actividades auxiliares al crédito [SOFOM]. El presente estudio se centra en la propuesta de una metodología que permita a las empresas implementar instrumentos de medición adaptados al sector, con la finalidad de identificar la situación actual de la empresa con relación a los factores externos y así poder identificar los factores clave para el logro de la competitividad que les permita generar estrategias de optimización y mejora continua.

Metodología para la medición de competitividad de una SOFOM.



Metodología, Competitividad, Sociedad Financiera de Objeto Múltiple [SOFOM]

Area: Promotion of frontier research and basic science in all fields of knowledge

Citation: Romero-Hernández, Anaid, Notario-Priego, Ezequiel, Pérez-Vázquez, Adrián and Can-Salazar, Montserrat. [2025]. Methodology to measurement of competitiveness in organizations belonging to the auxiliary credit activities of Mexico's financial system: Practical case study SOFOM E.N.R. in Villahermosa, Tabasco. Journal Economic Development. 12[32]1-11: e31232111.

Introduction

This article discusses a methodology for applying a measurement tool that identifies the key factors that make a company competitive in the financial sector.

This methodology is designed so that any company in the sector can implement it.

The proposed measurement tool is an adaptation of the Comprehensive Productivity Assessment Technique [TIEP], originally developed by, which has been adapted with elements relevant to the financial sector, specifically to assess the competitiveness of development banks or credit-related activities.

This study not only validates the usefulness of tools such as PESTEL, DELPHI and TIEP, but also provides a replicable model that allows these organisations to measure their current situation to transform findings into concrete strategies to improve their competitiveness in a complex and highly regulated financial environment, thus contributing to the strengthening of a key segment for financial inclusion in Mexico.

Background context in the study of economic variables, one of the main systems in Mexico is the financial system, which incorporates certain entities that form part of this macro-system [Quintana Adriano, E. A. 2018].

According to, the Mexican financial system is made up of the banking sector, the auxiliary organisations and activities sector, the insurance and surety sector, and the savings and popular credit sector.

Considering the thesis of [Carrillo Pérez 2010], it concludes that within the financial structure, private investment is one of the main drivers of the economy and sources of income for any region.

To identify the organisations studied in this research, the structure within the financial system is shown below:

Box 1

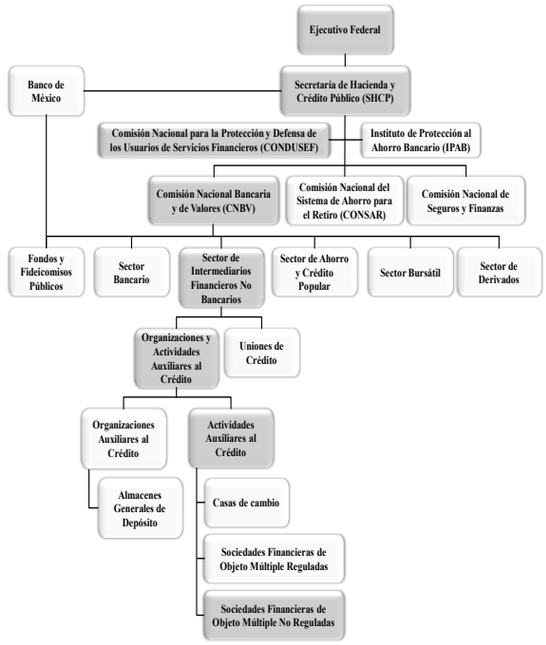


Figure 1

Structure of the financial system in Mexico

Source: Ministry of Finance and Public Credit, [2015].

In the wake of the 2008 crisis in Mexico, new sources of financing emerged to meet microcredit needs, including Multiple Purpose Financial Institutions [SOFOMs] [Galaz & Ruiz, 2012].

It should be noted that these organisations arose from a business opportunity that was not being met by a large part of the population of small and medium-sized enterprises, mainly in non-urban areas. As mentioned above, competitiveness is related to their skills and knowledge of socio-economic, environmental and political issues [Codas Benítez, M. 2012]. These external variables are used to design sustainable strategies aimed at improving the societies in which they operate.

According to, the application of measurement instruments is important for evaluating the parameters that affect productivity and, therefore, competitiveness.

Problem Statement.

There is a need to understand in greater depth the factors that ensure the competitive success of organisations in the financial sector and how they can achieve sustainable business growth. This is why research and proposals are needed to analyse the current situation of organisations to propose models for improvement.

ISSN: 2410-4019
RENIECYT: 1702902

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Justification and importance of the analysis

The results of this research will have significant theoretical implications, with a proposed methodology for measuring the main factors that influence the competitiveness of credit-related organisations and activities in Mexico and how they can achieve sustainable growth, considering the following:

- Relevance of the financial sector.
- Challenges in a changing business environment.
- Impact on sustainable growth.
- Lack of specific research on this topic.

Methodology

Box 2

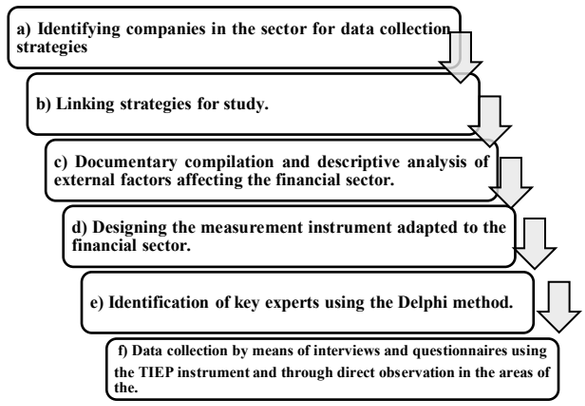

Figure 2

Process of applying the measuring instrument

Source: Author's elaboration [2025]

a) Identifying companies in the sector for data collection strategies

Techniques:

- Consult official registers [CNBV, CONDUSEF, ASOFOM].
- Analyse sectoral databases [Bureau of Financial Institutions, SHCP reports].
- Segment by key variables: size, capital and geographic location.

b) Linkage strategies for study

Establish agreements with the selected organisations to facilitate the research.

Techniques:

- ✓ Manage meetings with management and compliance areas.
- ✓ Draw up confidentiality agreements to protect sensitive data.
- ✓ Coordinate with trade associations, such as the Mexican Association of SOFOMES [ASOFOM] for access to aggregate information.

c) Desk review and descriptive analysis of external factors affecting the financial sector

Conduct a comprehensive review of primary and secondary sources to identify and assess the economic, political, technological, social, legal and environmental factors that impact the financial sector.

Techniques:

- External analysis using the PESTEL tool to identify external variables affecting the field of study.

With the results provided by the PESTEL analysis it is possible to have a favourable view when conducting market research, creating strategies, developing products and making better decisions for the organisation [Amador Mercado, 2022].

d) Design of the measurement instrument adapted to the financial sector.
Techniques:

- Adaptation of the TIEP tool to reflect the particularities of the financial sector obtained in the PESTEL analysis.

Eliseo Dantés et al. [2024] in their book describes the Integrated Productivity Evaluation Technique, hereafter referred to as TIEP, which is based on 10 priority elements in any organisation, either from an intangible or tangible point of view, as both aspects need to be considered when measuring productivity.

- Develop a supporting questionnaire, to guide the tools and their relationship to external variables.

The questionnaire is one of the instruments that are designed for conducting the interview itself and one of the most important factors is the preparation of the interviewers [Muñoz Rocha, 2015].

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e) Identification of key experts using the Delphi method

The Delphi method allows structuring a communicative process of various experts organised in a panel group in order to shed light on a research problem. [García & Lena, 2018].

Techniques:

- Apply the Delphi method to identify the key experts in a Credit Support Activities organisation.

According to López Gómez, [2018], the number of experts may vary, but suggests a minimum of 7 experts and a focus on the quality of the collective.

- Validating initial hypotheses on productivity and competitiveness.

f) Data collection by means of interviews and questionnaires using the TIEP instrument and by direct observation in the areas.

Obtain qualitative and quantitative data on the sector's challenges and opportunities.

Techniques:

- Conduct a semi-structured face-to-face interview with experts in the selected areas.

The interview is a means of gathering data to verify a hypothesis in the research, which allows for the collection of data on the current situation of the company [Muguira, 2025].

Box 3

Figure 3

Semi-structured face-to-face interview.

Source:[Muguira, 2025].

Case study SOFOM E.N.R.

The application of the methodology is carried out in the city of Villahermosa, in the State of Tabasco applying the methodology:

a) Identifying companies in the sector for data collection strategies.

Box 4

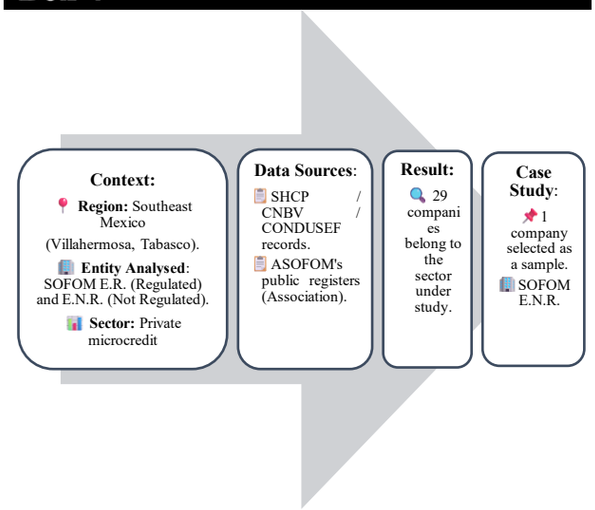

Figure 4

Process of identification of credit support activities in Villahermosa, Tabasco, Mexico.

Source: Author's elaboration [2025]

b) Linkage strategies for study

Box 5

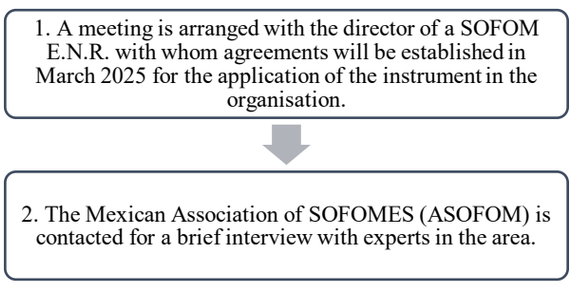

Figure 5

Strategies for linking with SOFOM E.N.R.

Source: Author's elaboration [2025]

c) Desk review and descriptive analysis of external factors affecting the financial sector.

The PESTEL analysis was conducted based on documentary research, where each factor is rated on a scale of 1 to 5, where: 1 = Low impact - 5 = High impact.

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Box 6

Table 1

Detailed PESTEL Analysis for the financial sector

FACTOR	EVAL.	CAL.	%
POLITICAL FACTORS		**22**	
Government regulation of interest rates	Favourable	5	**11.64%**
Political stability	Neutral	3	
Financial inclusion policies	Defiant	1	
Corruption in the financial sector	Favourable	5	
Relations between government and institutions	Neutral	3	
Consumer protection legislation	Defiant	1	
Fiscal incentives for microcredit	Defiant	1	
Government control of external financing	Defiant	1	
Labour reforms impacting hiring	Defiant	1	
Competition laws in the financial sector	Defiant	1	
ECONOMIC FACTORS		**34**	
Inflation	Neutral	3	**17.99%**
Exchange rate	Neutral	3	
Unemployment rate	Favourable	5	
Availability of credit in the market	Neutral	3	
Economic growth of the country	Favourable	5	
Central bank monetary policy	Neutral	3	
Accessibility to international financing	Defiant	1	
Operating costs	Defiant	1	
Stability of the banking system	Favourable	5	
Demand for microcredit by SMEs	Favourable	5	
SOCIO-CULTURAL FACTORS		**31**	
Level of financial education in the population	Neutral	3	**16.40%**
Attitudes towards indebtedness	Favourable	5	
Population growth rate	Neutral	3	
Change in family structure	Favourable	5	
Unemployment	Defiant	1	
Preference for technology in financial services	Defiant	1	
Poverty levels	Neutral	3	
Income inequality	Neutral	3	
Rural-urban migration	Defiant	1	
Savings culture vs. immediate consumption	Neutral	3	
Culture of conformity	Neutral	3	
TECHNOLOGICAL FACTORS		**30**	
Access to financial technology platforms	Defiant	1	**15.87%**
Security and data protection technologies	Neutral	3	
Automation of financial processes	Favourable	5	
Innovations in mobile applications	Neutral	3	
Investment in technology infrastructure	Favourable	5	
Artificial intelligence for credit analysis	Defiant	1	
Internet availability in rural areas	Neutral	3	
Use of cybersecurity in financial transactions	Neutral	3	
Development of digital payment systems	Defiant	1	
Ability to monitor payments in real time	Favourable	5	
ECOLOGICAL-ENVIRONMENTAL FACTORS		**26**	
Financing policies for sustainable projects	Defiant	1	**13.76%**
Impact of climate change on local businesses	Defiant	1	
Micro-credit initiatives for green projects	Neutral	3	
Natural disasters affecting operations	Favourable	5	
Environmental standards	Defiant	1	
Energy consumption of offices and systems	Neutral	3	
Environmental impact of business travel	Neutral	3	
Social pressure for sustainable practices	Defiant	1	
Resource scarcity in rural areas	Neutral	3	
Changes in agriculture affecting customers	Favourable	5	
LEGAL FACTORS		**46**	
Data Protection Act compliance	Favorable	5	**24.34%**
Changes in lending regulations	Favorable	5	
Financial consumer protection laws	Favorable	5	
Legal liability for customer defaults	Favorable	5	
Employment regulations for employees	Neutre	3	
Tax regulations	Favorable	5	
Credit agreement regulations	Favorable	5	
Anti-money laundering compliance	Favorable	5	
Unfair competition law	Neutre	3	
Legal requirements for opening branches	Favorable	5	
	TOTAL	**189**	**100%**

Source: Author's elaboration [2025]

d) Design of the measurement instrument tailored to the financial sector

Integrated Productivity Evaluation Technique [TIEP]

Eliseo Dantés et al., [2024], mentions that the first step we must take as evaluators is to have a systemic and integral approach, if this aspect does not exist, we must really consider that we will have biases.

Proposed elements.

1. Conceptual approach to the company:

Box 7

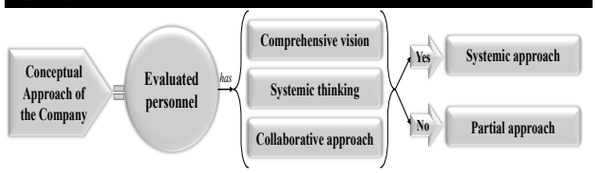

Figure 6

Description of the company's conceptual approach.

Source: Author's elaboration *[2025]*

Box 8

Table 2

Proposed evaluation for the financial sector of the firm's conceptual approach

Element	Evaluation in the financial sector
Systemic approach	✓ Assess that all areas have strategies aligned with the integral vision of the organisation. ✓ Assess that there is coordination between areas with systemic thinking. ✓ Evaluate that there is fluid communication between areas with a collaborative approach.

Source: Author's elaboration [2025]

2. Knowledge of processes:

Box 9

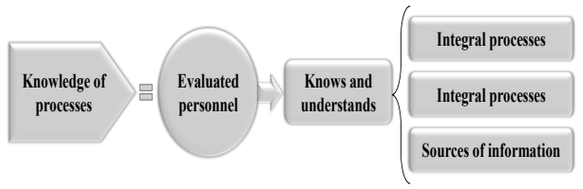

Figure 7

2. Process knowledge

Source: Author's elaboration [2025]

ISSN: 2410-4019
RENIECYT: 1702902

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Box 10

Table 3

Proposal for an assessment of process knowledge for the financial sector.

Element	Evaluation in the financial sector
Integral processes	✓ Assess knowledge and understanding of interconnected operational processes between areas.
Comprehensive evaluation	✓ Assess the alignment between areas with the organisation's vision.
Sources of information	✓ Assess knowledge of the origin of information in all processes and its integration with internal and external data.

Source: Author's elaboration [2025]

3. Social scope of the organisation:

Box 11

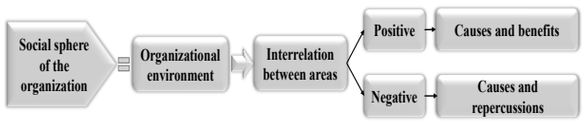

Figure 8

3. Social scope of the organisation

Source: Author's elaboration *[2025]*

Box 12

Table 4

Assessment proposal for the financial sector of the organisation's social field.

Element	Evaluation in the financial sector
Organisational environment	✓ Assess the interrelationship and coordination between areas, their causes and benefits or repercussions. ✓ Assess operational efficiency and adaptation to change. ✓ Assess trust between hierarchical levels.

Source: Author's elaboration [2025]

4. Planning management:

Box 13

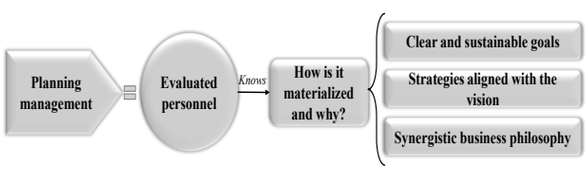

Figure 9

4. Planning management

Source: Author's elaboration [2025]

Box 14

Table 5

Proposed evaluation for the financial sector of the Planning Administration.

Element	Evaluation in the financial sector
Internal policies and organisational culture	✓ Assess whether they have guidelines for operating ethically and compliantly, aligned with their vision and objectives.
Project planning	✓ Assess whether they plan, anticipate and evaluate to increase profitability with clear action plans.
Indicator monitoring KPI's	✓ Assess whether the company has key performance indicators in place, adjusting tactics accordingly.

Source: Author's elaboration [2025]

5. Management participation:

Box 15

Figure 10

5. Management participation

Source: Author's elaboration [2025]

Box 16

Table 6

Proposed assessment for the financial sector of managerial involvement.

Element	Evaluation in the financial sector
Tangible resources	✓ Assess the physical and financial components that support operations.
Intangible resources	✓ Assessing non-material components that influence performance and external perception.
Leadership commitment	✓ Assess the degree of senior management involvement in operational strategies.

Source: Author's elaboration [2025]

6. Organisational Creativity and Innovation:

Box 17

Figure 11

6. Organisational Creativity and Innovation

Source: Author's elaboration [2025]

ISSN: 2410-4019
RENIECYT: 1702902

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https://doi.org/10.35429/JED.2025.12.32.3.1.11

Box 18

Table 7

Proposal for the evaluation of organisational creativity and innovation in the financial sector.

Element	Evaluation in the financial sector
Responsiveness to challenges	✓ Assess skills to identify opportunities and threats and capacity to implement solutions.
Continuous improvement	✓ Assess systemic process optimization and quality and efficiency standards.
Cross-cutting application	✓ Evaluate the integration of innovation at all hierarchical levels.

Source: Author's elaboration [2025]

7. Knowledge of the client[s]:

Box 19

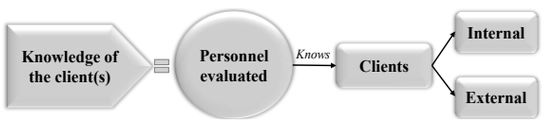

Figure 12

7. Knowledge of the client[s]

Source: Author's elaboration [2025]

Box 20

Table 8

Proposed assessment of customer knowledge for the financial sector [s].

Element	Evaluation in the financial sector
Cross-cutting strategy	✓ Assess whether all areas in addition to promoters, coordinators and credit have knowledge of the clients and the processes being used.
Understanding customers	✓ Assess whether all areas understand the customer's needs, behaviours and risk profile.
Omnichannel	✓ Assess whether there is integration of channels, physical, digital or telephonic.

Source: Author's elaboration [2025]

8. Technological development:

Box 21

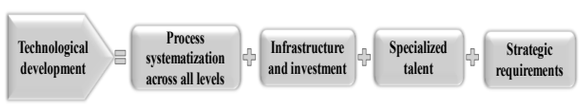

Figure 13

8. Technological development

Source: Author's elaboration [2025]

Box 22

Table 9

Proposal for a financial sector assessment of technology development.

Element	Evaluation in the financial sector
Use of technology	✓ Assess the use and knowledge of basic technology tools. ✓ Assess the % of automated processes. ✓ Assess technology certifications.
Culture of innovation	✓ Assess whether they encourage a pro-technology mindset at all levels.

Source: Author's elaboration [2025]

9. Macroeconomic knowledge:

Box 23

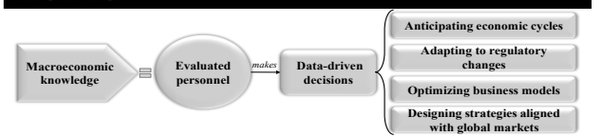

Figure 14

9. Macroeconomic knowledge

Source: Author's elaboration [2025]

Box 24

Table 10

Proposed assessment of macroeconomic knowledge for the financial sector.

Element	Evaluation in the financial sector
Anticipation of economic cycles	✓ Assess knowledge and understanding of macroeconomic trend analysis in order to generate strategies.
Adaptation to regulatory changes	✓ Evaluate the implementation of new regulations derived from the monitoring of fiscal and monetary policies.
Optimisation of business models	✓ Assess the adaptability of product supply and profitability, derived from inflation, interest rate, trade balance and exchange rate conditions.
Strategy design	✓ Assess national and global macroeconomic knowledge at all levels and design strategies.

Source: Author's elaboration [2025]

10. Integral development of human talent:

Box 25

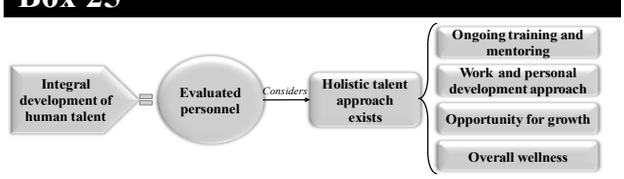

Figure 15

10. Integral development of human talent

Source: Author's elaboration [2025]

ISSN: 2410-4019
RENIECYT: 1702902

Romero-Hernández, Anaid, Notario-Priego, Ezequiel, Pérez-Vázquez, Adrián and Can-Salazar, Montserrat. [2025]. Methodology to measurement of competitiveness in organizations belonging to the auxiliary credit activities of Mexico's financial system: Practical case study SOFOM E.N.R. in Villahermosa, Tabasco. Journal Economic Development. 12[32]1-11: e31232111.
https://doi.org/10.35429/JED.2025.12.32.3.1.11

Box 26

Table 11

Proposal for the financial sector to evaluate the integral development of human talent.

Element	Evaluation in the financial sector
Ongoing training and mentoring	✓ Assessing the vision for strategic investment in intellectual capital ✓ Assessing skills training in the financial sector.
Work and personal development approach	✓ Assess integration of professional goals with individual development plans.
Opportunity for growth	✓ Assess whether a clear merit-based promotion and internal mobility structure is in place.

Source: Author's elaboration [2025]

Two new elements are proposed to be added to the TIEP tool, derived from the PESTEL analysis, which identifies that the legal environment has a greater impact on the financial sector, since the TIEP does not consider the legal aspect. The new elements are presented below:

11. Legal compliance preparation and knowledge:

All areas of a financial organisation must know and understand the applicable guidelines and regulations, processes and customer relations. Failure to understand these could lead to errors and even legal non-compliance, which directly affects the company's ability to meet the requirements of funding companies and valuation companies [Galaz & Ruiz, 2012].

Box 27

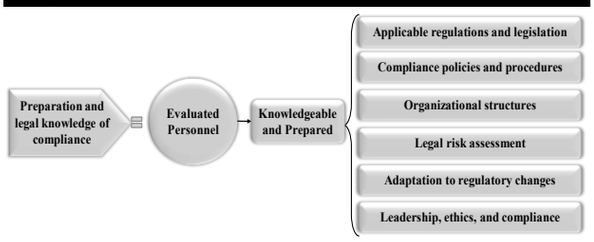

Figure 16

11. Preparation and legal knowledge of compliance

Source: Author's elaboration [2025]

11. Corporate governance:

Corporate governance has become critically important in today's financial sector, where the adoption of best practices not only generates value and competitive advantages, but also responds to market regulatory requirements [Galaz & Ruiz Urquiza, 2009].

Box 28

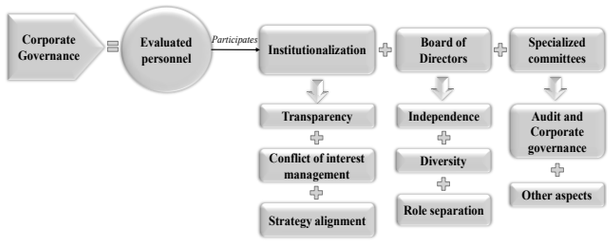

Figure 17

12. Corporate governance

Source: Author's elaboration [2025]

Design of the TIEP measurement tool:

It is important to consider that each company is different, so the weight of the element may vary, and it is recommended to adapt it to the specific needs of the organisation.

Below is how the scores are assigned to each factor for SOFOM E.N.R.

:

Box 29

Table 12

TIEP [Integrated Productivity Evaluation Technique].]

	Economic Variable		Political Variable		Environmental Variable		Variable Culture		Technologic Variable		Variable Social	
Element	Weight	Ev.	Weight	Ev.	Weight	Ev.	Weight	Ev.	Weight	Ev.	Weight	Ev.
1. Conceptual approach to the company.	0.22	E	0.00	E	0.05	E	0.20	E	0.10	E	0.25	E
2. Knowledge of the processes.	0.23	E	0.18	E	0.14	E	0.20	E	0.15	E	0.10	E
3. Social scope of the organisation.	0.12	E	0.10	E	0.14	E	0.25	E	0.05	E	0.34	E
4. Planning management.	0.25	E	0.25	E	0.25	E	0.10	E	0.05	E	0.10	E
5. Management participation.	0.25	E	0.20	E	0.05	E	0.14	E	0.05	E	0.31	E
6. Creativity, organisational and open innovation.	0.12	E	0.10	E	0.05	E	0.17	E	0.25	E	0.31	E
7. Knowledge of the client[s].	0.14	E	0.10	E	0.35	E	0.10	E	0.05	E	0.26	E
8. Technological development.	0.14	E	0.05	E	0.05	E	0.10	E	0.45	E	0.21	E
9. Macroeconomic knowledge.	0.20	E	0.25	E	0.25	E	0.18	E	0.05	E	0.07	E
10. Integral development of human talent.	0.12	E	0.10	E	0.05	E	0.2	E	0.35	E	0.18	E
11. Legal preparation and knowledge of compliance.	0.23	E	0.26	E	0.05	E	0.14	E	0.18	E	0.14	E
12. Corporate governance.	0.25	E	0.15	E	0.05	E	0.25	E	0.05	E	0.25	E

Source: Author's elaboration [2025], based on TIEP., Eliseo Dantés et al., [2024]

Questionnaire design

For the application of the questionnaire, it is suggested to avoid generic or ambiguous questions, questions for a questionnaire should be short, simple, clear and precise [García Alcaraz et al., 2006].

ISSN: 2410-4019
RENIECYT: 1702902

Romero-Hernández, Anaid, Notario-Priego, Ezequiel, Pérez-Vázquez, Adrián and Can-Salazar, Montserrat. [2025]. Methodology to measurement of competitiveness in organizations belonging to the auxiliary credit activities of Mexico's financial system: Practical case study SOFOM E.N.R. in Villahermosa, Tabasco. Journal Economic Development. 12[32]1-11: e31232111.
https://doi.org/10.35429/JED.2025.12.32.3.1.11

Box 30

Table 13

Examples of generic vs. specific questions applicable to the financial sector.

Generic question	Specific question
What do you think of the company's vision?	How have you adapted the company's vision in the face of regulatory changes?
Do you know the processes in your area?	What changes have you implemented in your processes due to the current volatile economy?
What do you consider the working climate of the company to be like?	How does labour turnover impact the retention of key talent?
Do they know their customers?	How has insecurity in the state affected your risk analysis strategies?
Do they train their staff?	What certification programmes have you created to adapt to the CNBV 2024 compliance regulations?

Source: Author's elaboration [2025].

e) Identification of key experts using the Delphi method.

A meeting is held in March 2025 in which a meeting is held with 5 expert managers, identifying the following areas:

Compliance Officer, General Management, Legal, Credit, Portfolio, Companies, Funding, Treasury, Accounting, Human Resources and Materials and IT and Systems, who are part of the senior management of the company.

Box 31

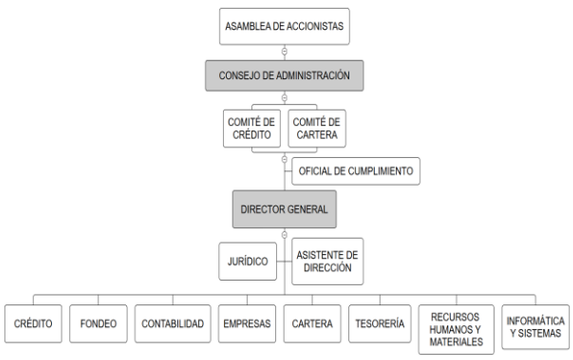

Figure 18

Organigram SOFOM E.N.R.

Source: SOFOM E.N.R. [2025].

f) Data collection by means of interviews and questionnaires using the TIEP instrument and by direct observation in the areas.

It is suggested that the interviews be conducted in a maximum of 60 minutes, in order to allow managers to feel comfortable and have the time to participate at ease.

Box 32

Table 14

Structure of the Scheduled Interview Agenda

Time	Activity	Method
0 to 10 minutes	Presentation of the study	-
10 to 15 minutes	Structured questionnaire	Quantitative
25 to 50 minutes	Discussion of responses	Semi-structured interview
50 to 60 minutes	Closing the interview	-

Source: Author's elaboration [2025].

To apply the tool, a Gantt chart is drawn up. This is a graphical and visual aid used for planning, in this case with the aim of applying the tools to the selected areas of the organisation [Terrazas Pastor, 2011].

The application of the tool is scheduled over a period of 16 weeks, beginning with interviews at management level and followed by direct observation of how the areas operate.

Box 33

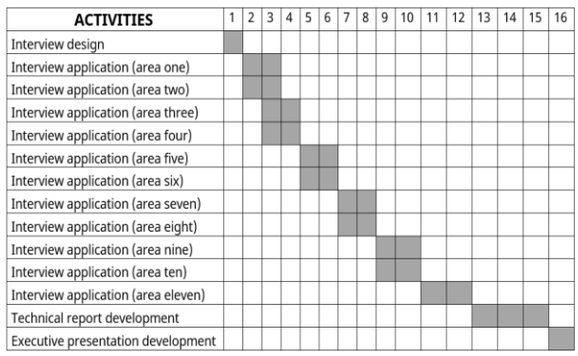

Figure 19

Instrument application schedule

Source: Author's elaboration [2025].

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https://doi.org/10.35429/JED.2025.12.32.3.1.11

Once the data has been obtained using the TIEP instrument, a comprehensive analysis must be carried out with the aim of validating the information, verifying the quantitative data through statistical data with qualitative data through interviews, in order to identify biases in the responses obtained [López & Eliseo, 2017], The results must then be interpreted in order to finally design an improvement proposal with models that include strategic solutions applicable to organisations in the sector and actions based on the findings collected.

Results

The study proposes a methodology for measuring the current competitiveness of a SOFOM E.N.R. in Villahermosa, Tabasco. The key findings were:

Box 34

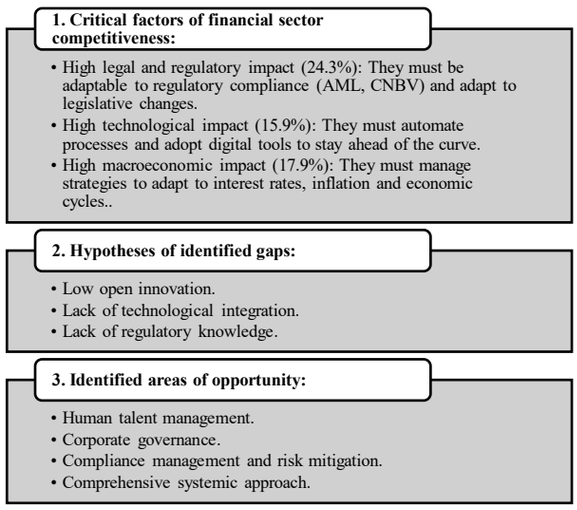

Figure 20

Results obtained in the research

Source: Author's elaboration [2025].

Conclusions

This study demonstrates that the competitiveness of credit-related activities in Mexico depends critically on three interconnected pillars: regulatory adaptability, technological transformation, and strategic talent management.

The results reveal that SOFOMs that adopt a comprehensive approach based on innovation, macroeconomic analysis, and corporate governance will not only mitigate operational risks but will also be able to capitalise on opportunities in markets underserved by traditional banks, thereby differentiating themselves from the competition.

The proposed methodology is supported by a PESTEL analysis, which confirms that productivity in this sector is directly linked to the interrelationship between areas and the legal context. This allows for the adaptation of measurement tools such as the TIEP to evaluate critical variables, provided that the particularities of the external environment are taken into account.

The case study in Villahermosa shows that, in the face of the advance of fintech, SOFOMs must evolve from simple credit providers to inclusive financial solution managers, institutionalising their operations to comply with increasingly demanding regulations. This work lays the foundation for applying these findings in other regions of Mexico, using key performance indicators [KPIs] to measure productivity in a dynamic and highly competitive market.

Future research will analyse the specific results of the methodological application, with the potential to generate key factors for competitiveness that are transformative for the financial sector.

Declarations

Conflict of interest

The authors declare that they have no conflict of interest. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

Contribution of authors

Romero-Hernández, Anaid: Documentary compilation of instruments, adaptation of measurement tools and methodology.

Notario-Priego, Ezequiel: Supervision.

Pérez-Vázquez, Adrián: Supervision.

Can-Salazar, Montserrat: Contribution of ideas for the adaptation of the TIEP.

Availability of data and materials

Publicly available.

Funding

No funding.

ISSN: 2410-4019
RENIECYT: 1702902

Romero-Hernández, Anaid, Notario-Priego, Ezequiel, Pérez-Vázquez, Adrián and Can-Salazar, Montserrat. [2025]. Methodology to measurement of competitiveness in organizations belonging to the auxiliary credit activities of Mexico's financial system: Practical case study SOFOM E.N.R. in Villahermosa, Tabasco. Journal Economic Development. 12[32]1-11: e31232111.
https://doi.org/10.35429/JED.2025.12.32.3.1.11

Acknowledgements

We would like to thank SOFOM E.N.R. in Villahermosa, Tabasco, Mexico, the organisation where the interview was conducted, which will enable the instrument to be applied, and which is the main source for this article.

Abbreviations

ASOFOM	Asociación de Sociedades Financieras de Objeto Múltiple en México A.C. [Association of Multiple Purpose Financial Companies in Mexico].
CNBV	National Banking and Securities Commission.
CONDUSEF	Comisión Nacional para la protección y Defensa de los Usuarios de Servicios Financieros [National Commission for the Protection and Defence of Financial Services Users].
KPIs	Key Performance Indicators.
PESTEL	Political, Economic, Social, Technological, Ecological and Legal.
SOFOM	Sociedad Financiera de Objeto Múltiple.
TIEP	Integrated Productivity Assessment Technique.

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ISSN: 2410-4019
RENIECYT: 1702902

Romero-Hernández, Anaid, Notario-Priego, Ezequiel, Pérez-Vázquez, Adrián and Can-Salazar, Montserrat. [2025]. Methodology to measurement of competitiveness in organizations belonging to the auxiliary credit activities of Mexico's financial system: Practical case study SOFOM E.N.R. in Villahermosa, Tabasco. Journal Economic Development. 12[32]1-11: e31232111.
https://doi.org/10.35429/JED.2025.12.32.3.1.11

Journal Economic Development 12[32]1-7: e41232107
Article

Optimal maintenance through statistical failure data in a garbage fleet. A case of study

Mantenimiento óptimo mediante datos de fallas estadísticas en una flota de camiones de basura. Un caso de estudio

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Classification:

Area: Engineering
Field: Engineering
Discipline: Industrial engineer
Subdiscipline: Industrial planning

https://doi.org/10.35429/JED.2025.12.32.4.1.7
History of the article:
Received: May 30, 2025
Accepted: August 30, 2025

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Abstract

The main focus of this study is to obtain an optimal maintenance to a garbage fleet. To achieve this, statistical failure is examined, analyzed and compared with the actual costs that the city council pays for the maintenance service. This article presents a proposal for analyzing failure data from a fleet of KENWORTH [M-T370] garbage fleet. The objective is to identify and implement strategies that reduce operating costs and extend the vehicle lifespan through optimal maintenance.

Objetives	Methodology	Contribution
To obtain an optimal maintenance study based on statistical failure data using a mathematical model.	Statistical Failure data analysis. Sensitivity analysis. Comparison of actual costs with those obtained from the model.	To obtain an optimal maintenance analysis applied to a garbage fleet in order to identify and implement strategies that minimize maintenance costs.

Failure, Optimal maintenance, Industrial planning

Resumen

El enfoque principal de este estudio es obtener un mantenimiento óptimo para una flota de vehículos de basura. Para lograr esto, se examinan y analizan estadísticamente las fallas, y se comparan con los costos reales que el ayuntamiento paga por el servicio de mantenimiento. Este artículo presenta una propuesta para analizar los datos de fallas de una flota de vehículos de basura KENWORTH [M-T370]. El objetivo es identificar e implementar estrategias que reduzcan los costos operativos y prolonguen la vida útil de los vehículos mediante un mantenimiento óptimo.

Objetivos	Metodología	Contribución
Obtener un estudio de mantenimiento óptimo basado en datos estadísticos de falla utilizando un modelo matemático.	Estadística deAnálisis de datos de fallas. Analisis de sensibilidade. Comparacion de costos reales con los obtenidos con el modelo matematico.	Obtener un analisis de mantenimiento óptimo aplicado a una flota de camiones de basura para identificar y aplicar estrategias que permitan minimizar los costos de mantenimiento.

Falla, Mantenimiento óptimo, Planeación industrial

Area: Development of strategic leading-edge technologies and open innovation for social transformation

Citation: Hernández-Sánchez, Hair Yrwin, Melchor-Hernández, César Leonardo, Calderón-Palomares, Luis Antonio and Solís-Jiménez, Miguel Ángel. [2025]. Optimal maintenance through statistical failure data in a garbage fleet. A case of study. Journal Economic Development. 12[32]1-7: e41232107.

Introduction

The maintenance consists of a series of techniques that seek to keep equipment and facilities in operation for as long as possible to achieve maximum availability and performance. The maintenance is expected to reduce the frequency of unscheduled interruptions. The maintenance currently plays a fundamental role in any industrial activity and represents an important challenge for the productivity and competitiveness of companies. In this sense, utilities seek to optimize the maintenance of their equipment by maximizing availability and minimizing costs. The maintenance ensures component and system reliability, in addition to increasing system capacity through the use of more reliable components. Reliability and cost are two important aspects of a vehicle fleet. [Muñoz Choque, 2021].

In [Cordero & Estupiñan 2018]. fleet maintenance is the process of keeping all vehicles of an organization in good working order so that they can be used safely and efficiently, which produces better results in vehicle tests and inspections conducted by the Federal Motor Carrier Safety Administration [*FSMA*], responsible for regulating truck safety. This article presents the results obtained from the application of Reliability Centered Maintenance [*RCM*] strategies to the fleet of hydro tank trucks. The maintenance is also based on probabilistic models; the implementation of maintenance management software [*CMMS*]; performance indicators [*RAMS*], statistical distribution, etc.

In [Conde Luna & Mosquera Muñoz, 2022], the lack of management in fleet maintenance; the lack of records format and the lack of control over incidents related to fleet maintenance result in low availability and maintainability of vehicles. The results of quantitative scientific strategies applied to industrial maintenance are presented. The methodology is applied to components to determine historical failures and statistical maintenance data, establishing protocols and roadmaps for maintenance management. The application of the procedure is evaluated by means of indicators [*RAMS*]. Using reliability tools; failure mode analysis; effects [*FMEA*] and root cause analysis [*RCA*].

The results of this research include an evaluation of the maintenance function, allowing the identification of equipment, critical components and subsystems, as well as the quantification of their economic impact and providing the basis for effective technical and training actions.

In [Carrasco & Rodrigo, 2014], proposes the determination of a maintenance policy applied to a fleet of mining trucks, where part of the basis of the model is based on the time of use. The methodology used considers a marginal cost criterion, which is incurred by the maintenance activities of the components analyzed.

The objective of the model corresponds to the minimization of costs considering the variation due to the part of the general costs where the system is considered in series.

Only the costs considered for fixed maintenance activities are taken, which are calculated based on the cost of the equipment of each of the units, considering the time and cost of the workshop, which are obtained from a linear function for all periodic maintenance [*MP*] interventions, given by the equation: $C_{FIJO} = C_{Transporte} + C_{Detención}$. Part of the variable costs per component consists of spare parts and inputs of the activity performed specifically given by a periodic maintenance [*MP*] or the cost of corrective maintenance [*MC*]. Time, emergencies, spare parts and availability of each unit of heavy machinery are taken into account.

To define a finite time horizon, a maintenance policy is established, which is defined by an interval between *MP* and time [*t*]. With a probability of 50% the reliability of the equipment will be deficient, defining the mean time between interventions and the mean time between failures [*MTBF*], obtaining the following cost equation: $MTBF\ [T]\ T\ Xr\ [t] + [1 - R\ [T]\ x \int R\ [t]\ dt = T > 0$. The result of the research is the minimization of maintenance costs in the equipment and the increase of the number of interventions, giving as a solution the optimal maintenance.

ISSN: 2410-4019
RENIECYT: 1702902

Hernández-Sánchez, Hair Yrwin, Melchor-Hernández, César Leonardo, Calderón-Palomares, Luis Antonio and Solís-Jiménez, Miguel Ángel. [2025]. Optimal maintenance through statistical failure data in a garbage fleet. A case of study. Journal Economic Development. 12[32]1-7: e41232107.
https://doi.org/10.35429/JED.2025.12.32.4.1.7

In [Melchor Hernández, Rivas Dávalos, Coria & Maximov, 2014], a model is presented to optimize the maintenance policy of electrical equipment. Historical data on failures in this equipment are used. The two-parameter Weibull distribution function and scheduled maintenance are used, a cost function is minimized to determine the optimal maintenance. The objective is to minimize the cost function, determining the period [T] and the number of times [N] the equipment should be maintained.

The model used is based on an imperfect maintenance policy with minimum repairs for each statistical failure.

The total expected cost includes the costs of: minimum repair, scheduled maintenance and the replacement cost of the equipment, where the replacement cost will always be greater than or equal to the scheduled maintenance.

Model

The Municipality of Cordoba, Veracruz, Mexico; is an public institution in charge of the welfare of the citizens. Among its functions are maintaining the cleanliness of the city, through garbage collection. It also has a maintenance workshop divided into five different sections [mechanical, electrical, lubrication, machining and welding] responsible for repairing the aforementioned equipment. Repairs performed in the workshop are based on the various subsystems of the truck [engine, hydraulic system, electrical system, suspension and braking system]. There are currently 33 garbage collection vehicles, of which 20 are under repair and 13 are in operation for 33 routes in the city.

The model used in this research is based on the failure history of the 33 vehicles, with a sample of 24 years. In order to determine the optimal maintenance, the optimal number and the optimal period of maintenance is sought.

The cost of current corrective maintenance is used as a basis [$M\ C_R$]. The corresponding minimum repair costs C_1 and scheduled cost C_2, are considered constant within the mathematical model, since they reflect the current values of the maintenance costs incurred in the workshop.

On the other hand, the replacement cost C_3 is the only one that changes, because this type of corrective maintenance is performed in external workshops. Therefore, its value depends on the used material and labor costs of the external workshop. The current internal maintenance cost is related to the number of workers involved in the execution of the maintenance tasks. As The maintenance costs increase, the number of personnel required to perform the activities increases proportionally. For estimation purposes in this study, the approximate minimum monthly salary in Mexico for the year 2025, which is $12,000 pesos per worker, is considered as a reference.

The distribution function [1] is used to represent the statistical failure behavior of the equipment [Melchor Hernández, Rivas Dávalos, Coria & Maximov, 2014].

$$\lambda(t,T)=\left[\frac{T}{TBASE}\right]^{\beta}\frac{\beta}{\alpha}\left[\frac{t}{\alpha}\right]^{\beta-1} \quad [1]$$

Where:

t= Statistical time of failure.
T= Optimal maintenance period.
*T*BASE= Maintenance programmed by the company.
β= Shape parameter.
α= Scale parameter.
$\lambda\ [t,T]$= Probability function of failure occurrence.

The model used is based on an imperfect maintenance policy with minimal repairs. Equation [2] is used to obtain the total cost of optimal maintenance.

$$C(N,T)=\frac{1}{NT}\left[C_1\sum_{j=0}^{N-1}\int_0^{NT}\lambda(t,T)dt+(N-1)C_2+C_3\right] \quad [2]$$

Where:

C_1 = Minimum repair cost.
C_2 = Scheduled maintenance cost.
C_3 = Equipment replacement cost.
N= Number of optimal maintenance.
T= Period of optimal maintenance.
C[N,T]= Cost of optimal maintenance.
$\lambda\ [t,T]$= Probability function of failure.

ISSN: 2410-4019
RENIECYT: 1702902

Hernández-Sánchez, Hair Yrwin, Melchor-Hernández, César Leonardo, Calderón-Palomares, Luis Antonio and Solís-Jiménez, Miguel Ángel. [2025]. Optimal maintenance through statistical failure data in a garbage fleet. A case of study. Journal Economic Development. 12[32]1-7: e41232107.
https://doi.org/10.35429/JED.2025.12.32.4.1.7

Methodology

To obtain the optimal maintenance, the failure history of the 33 vehicles with a sample of 24 years [from 1998 to the beginning of 2023] will be used for their analysis and classification.

Table 1 shows the data corresponding to the 33 vehicles analyzed; the first column presents the chronological order in which the 33 vehicles were put into service, starting with the first vehicle that entered into operation and concluding with the last vehicle; the second column indicates the year in which each vehicle entered into operation; the third column corresponds to the year in which the vehicles were retired, or if not, whether they remain in operation; and the fourth column presents the years in which the unit was in operation or if not, whether it remains in operation.

Box 1

Table 1

Table of vehicle fleet data [KENWORTH M-T370].

Fleet of vehicles [KENWORTH M-T370] on service and withdrawn.			
Vehicle unit	**Number of year of service**	**Number of year of retirement**	**Time of service[Years]**
Vehicle 1	1998	2022	24
Vehicle 2	1998	2022	24
Vehicle 3	1998	2022	24
Vehicle 4	1998	2022	24
Vehicle 5	2000	2023	23
Vehicle 6	2000	2023	23
Vehicle 7	2000	2023	23
Vehicle 8	2000	2023	23
Vehicle 9	2002	2023	21
Vehicle 10	2002	2023	21
Vehicle 11	2002	In operation	In operation
Vehicle 12	2006	In operation	In operation
Vehicle 13	2006	In operation	In operation
Vehicle 14	2006	In operation	In operation
Vehicle 15	2009	In operation	In operation
Vehicle 16	2011	In operation	In operation
Vehicle 17	2011	In operation	In operation
Vehicle 18	2011	In operation	In operation
Vehicle 19	2011	In operation	In operation
Vehicle 20	2014	In operation	In operation
Vehicle 21	2014	In operation	In operation
Vehicle 22	2014	In operation	In operation
Vehicle 23	2014	In operation	In operation
Vehicle 24	2019	In operation	In operation
Vehicle 25	2019	In operation	In operation
Vehicle 26	2019	In operation	In operation
Vehicle 27	2019	In operation	In operation
Vehicle 28	2019	In operation	In operation
Vehicle 29	2019	In operation	In operation
Vehicle 30	2019	In operation	In operation
Vehicle 31	2019	In operation	In operation
Vehicle 32	2019	In operación	In operation
Vehicle 33	2019	In operation	In operation

Source: Own elaboration

Table 2 shows the failure classification data of the retired vehicles. Column 1 presents the classification of the vehicles starting from the first vehicle that entered service [1998] to the last vehicle that entered service [2002]. Column 2 shows the cumulative years of the vehicles.

For example: row 1 and 2 show vehicles 1-4 that have 1 and 2 cumulative years of service [1998-1999], respectively, and so on, successively until the sample is reached. Column 3 shows the number of accumulated failures in the years of operation, and finally column 4 shows the number of vehicles retired per year.

From 2002 onwards, the 10 vehicles accumulate consecutive years [5, 6,..., years] of service; from the year 2022 onwards, the first retirements occur as shown in row 21. In this row 2 vehicles are retired, as well as in row 23, 3 vehicles are retired, for a total of 5 retired vehicles shown in row 24.

Box 2

Table 2

Table arranged from historical failure data N=24 years and 10 retired vehicles.

Fleet of vehicles [KENWORTH M-T370] on service and withdrawn			
Sample [10 vehicles]	**Number of years accumulated**	**Number of accumulated failures**	**Number of retirees**
Vehicle 1-4	Year 1	7	0
Vehicle 1-4	Year 2	15	0
Vehicle 1-8	Year 3	29	0
Vehicle 1-8	Year 4	34	0
Vehicle 1-10	Year 5	42	0
Vehicle 1-10	Year 6	42	0
Vehicle 1-10	Year 7	47	0
Vehicle 1-10	Year 8	49	0
Vehicle 1-10	Year 9	49	0
Vehicle 1-10	Year 10	52	0
Vehicle 1-10	Year 11	52	0
Vehicle 1-10	Year 12	67	0
Vehicle 1-10	Year 13	67	0
Vehicle 1-10	Year 14	76	0
Vehicle 1-10	Year 15	78	0
Vehicle 1-10	Year 16	86	0
Vehicle 1-10	Year 17	86	0
Vehicle 1-10	Year 18	89	0
Vehicle 1-10	Year 19	94	0
Vehicle 1-10	Year 20	94	0
Vehicle 1-10	Year 21	97	2
Vehicle 1-8	Year 22	57	0
Vehicle 1-8	Year 23	57	3
Vehicle 1-5	Year 24	29	5
Total	24	1416	10

Source: Own elaboration.

To perform the sensitivity analysis of the model performance, 3 case studies were established in 3 subsystems [engine, electrical system, hydraulic system] of the 5 divided subsystems of the vehicle fleet.

Table 3 shows the ordered failure data of the engine subsystem. Column 1 shows the subsystem of the analyzed area [engine]. Column 2 shows the number of failures occurring for each year, with a cumulative total of 602 failures and; column 3 presents the frequency with which each number of failures is repeated per year.

ISSN: 2410-4019
RENIECYT: 1702902

Hernández-Sánchez, Hair Yrwin, Melchor-Hernández, César Leonardo, Calderón-Palomares, Luis Antonio and Solís-Jiménez, Miguel Ángel. [2025]. Optimal maintenance through statistical failure data in a garbage fleet. A case of study. Journal Economic Development. 12[32]1-7: e41232107.
https://doi.org/10.35429/JED.2025.12.32.4.1.7

Box 3

Table 3

Area test [engine], the total failures and failure times are taken in the period in which the sample is repeated.

Area engine	Number of failures	Number of times the number of failures in the cumulative year matched
Failures in the engine area of the 10 vehicles in the 24 years accumulated	2	1
	9	1
	18	1
	25	2
	26	2
	35	2
	40	1
	44	3
	47	2
	51	2
	54	1
	60	3
	64	1
	67	1
	60	1
Total	**602**	**24**

Source: Own elaboration

The first case study was designed considering the following real costs applied in the engine subsystem. C_1:$20,000, C_2:$30,000 all in Mexican pesos. The value of the cost of C_3: varies as follows: $250,000, $300,000, $350,000, $400,000, $450,000. In addition, the interval of the current initial maintenance time To=12 months is considered.

Table 4 presents the optimal values of: T, N, the optimal maintenance cost and, the current corrective maintenance cost $[M\ C_R]$. Case 1 shows a $C_3/\ C_2$ ratio of $8.33, so the model suggests maintenance [T] every 14.11 months. For case 3, the $C_3/\ C_2$ ratio is $11.66, so the model suggests giving maintenance [T] every 13.01 months. For the last case, the $C_3/\ C_2$ ratio is $15.00, so the model suggests maintenance [T] every 12.28 months. As can be seen, the more expensive the $C_3\ /\ C_2$ ratio, the more frequent the maintenance. Furthermore, the optimal maintenance cost obtained by the model is lower in all cases than the actual corrective maintenance.

Box 4

Table 4

Case 1.- Engine subsystem results. $C[N,T]$ for different cost values C_1, C_2, C_3.

Case	*Cost* $M\ C_R$	*C [N,T]*	*N*	*T*	C_1	C_2	C_3
1	48,000	38,006	17	14.11	20,000	30,000	250,000
2	48,000	39,722	21	13.50	20,000	30,000	300,000
3	48,000	41,197	25	13.01	20,000	30,000	350,000
4	60,000	42,496	29	12.61	20,000	30,000	400,000
5	60,000	43,661	33	12.28	20,000	30,000	450,000

The second case study presents the actual costs of the electrical system subsystem. C_1: $3,500, C_2: $20,000, the value of C_3: varies as follows: $45,000, $60,000, $70,000, $85,000, $90,000, for each case respectively. In addition, the initial current maintenance time interval To=12 months is considered.

Table 5 presents the optimal values of: T, N, the optimal maintenance cost and, the current corrective maintenance cost $[M\ C_R]$. Case 2 shows a $C_3/\ C_2$ ratio of $3, so the model suggests maintenance [T] every 32.93 months. For case 4 the $C_3/\ C_2$ ratio is $4.25, so the model suggests maintenance [T] every 30.44 months. For case 5 the $C_3/\ C_2$ ratio is $4.5, so the model suggests maintenance [T] every 30.00 months. As can be seen, the more expensive the $C_3/\ C_2$ ratio is, the more frequent maintenance is required. In addition, the optimal maintenance cost obtained by the model is lower in all cases than the actual corrective maintenance.

Box 5

Table 5

Case 2.- Electrical subsystem results. $C[N,\ T]$ for different cost values C_1, C_2, C_3.

Case	*Cost* $M\ C_R$	*C [N, T]*	*N*	*T*	C_1	C_2	C_3
1	12,000	9,159	4	35.05	3,500	20,000	45,000
2	12,000	9,762	6	32.93	3,500	20,000	60,000
3	12,000	10,191	8	31.50	3,500	20,000	70,000
4	12,000	10,555	10	30.44	3,500	20,000	85,000
5	12,000	10,707	11	30.00	3,500	20,000	90,000

Source: Own elaboration

The third case study was designed considering the following real costs applied in the hydraulic system subsystem. C_1: $9,500, C_2: $18,500. The value of C_3 varies as follows $69,000, $99,000, $120,000, $130,000, $136,000, for each case respectively. In addition, the interval of the current initial maintenance time To=12 months is considered.

Table 6 presents the optimal values of: T, N, the optimal maintenance cost and, the current corrective maintenance cost $[M\ C_R]$. Case 1 shows a $C_3/\ C_2$ ratio of $3.72, so the model suggests maintenance [T] every 18.32 months. For case 5 the $C_3/\ C_2$ ratio is $6.87, so the model suggests maintenance [T] every 12.52 months. As can be seen, the more expensive the $C_3/\ C_2$ ratio is, the more frequent maintenance is required. In addition, the optimal maintenance cost obtained by the model is lower in all cases than the actual corrective maintenance.

ISSN: 2410-4019
RENIECYT: 1702902

Hernández-Sánchez, Hair Yrwin, Melchor-Hernández, César Leonardo, Calderón-Palomares, Luis Antonio and Solís-Jiménez, Miguel Ángel. [2025]. Optimal maintenance through statistical failure data in a garbage fleet. A case of study. Journal Economic Development. 12[32]1-7: e41232107.
https://doi.org/10.35429/JED.2025.12.32.4.1.7

Box 6

Table 6

Case 3.- Hydraulic subsystem results. $C[N, T]$ for different values of costs C_1, C_2, C_3.

Case	*Cost* $M\ C_R$	*C [N, T]*	*N*	*T*	C_1	C_2	C_3
1	24,000	23,602	3	18.32	9,500	18,500	69,000
2	36,000	29,780	6	14.41	9,500	18,500	99,000
3	36,000	31,497	7	13.66	9,500	18,500	120,000
4	36,000	32,947	8	13.04	9,500	18,500	130,000
5	48,000	34,251	9	12.52	9,500	18,500	136,000

Source: Own elaboration

Results

As can be seen, the current corrective maintenance cost $[M\ C_R]$ is equivalent to the monthly cost of the number of workers required. As the replacement cost C_3 increases, the number of personnel required to perform maintenance activities also increases proportionally. For example in Table 4, the current corrective maintenance cost $[M\ C_R]$ is $48,000 equivalent to 4 workers. In comparison to case 5 which presents a cost of $60,000 corresponding to 5 workers. This difference is due to the fact that the replacement cost in case 5 is higher, which implies a greater demand for personnel to perform the maintenance activities. In the case of Table 5, it can be observed that in all cases the current corrective maintenance cost $[M\ C_R]$ is $12,000 equivalent to the monthly cost of 1 worker, this is due to the fact that the replacement cost of the 5 cases is not too high, which implies a lower demand for personnel to perform the maintenance activities. The optimal maintenance cost obtained is lower in all cases, for example in Table 5 the model recommends modifying the revision interval from 12 to 30.00 months, which allows reducing the total maintenance cost from $12,000 to $10,707.

Conclusions

In this work, an analysis was presented to determine the optimal moment to apply maintenance according to the critical areas of the equipment, as well as the appropriate frequency of intervention, considering the costs associated with maintenance. The analysis focused on three subsystems [electrical system, hydraulic system and engine] by using a mathematical model, it is possible to interpret the behavior of the failures throughout the operating period.

The results obtained allow establishing objective criteria for making decisions related to preventive maintenance, the optimal number of maintenance and the optimal period, with the purpose of minimizing the total costs and maximizing the reliability of the vehicle fleet.

Availability of data and materials

The Matlab software was used, which is an element analysis tool that helps us to applied the optimal maintenance of a vehicle garbage fleet through the analysis of failure data.

Declarations

The authors of this article declare that they have no conflicts of interest. They have no competing financial interests or known personal relationships that could have influenced the work presented in this article.

Author contribution.

Hernandez-Sanchez, Yrwin Hair: Contributed with the idea of the project, to the study of the documented research for publication, supported in the writing of the article and data analysis.

Melchor-Hernández, César Leonardo: Elaborated the structure of the article, reviewed the writing and analyzed the data.

Calderón-Palomares, Luis Antonio: Contributed to the study of the documented research for the publication, as well as to the data analysis.

Jiménez-Solis, Miguel Ángel: Carried out the research design, defined the type of research and participated in writing the article.

Financing

This work has been funded by SECIHTI [1322820] and the Higher Technological Institute of Huatusco.

Abbreviations

AMFE	Failure mode and effects analysis.
CMMS	Computerized maintenance management system.
FSMA	Federal Motor Carrier Safety Administration.
MC	Corrective maintenance.

ISSN: 2410-4019
RENIECYT: 1702902

Hernández-Sánchez, Hair Yrwin, Melchor-Hernández, César Leonardo, Calderón-Palomares, Luis Antonio and Solís-Jiménez, Miguel Ángel. [2025]. Optimal maintenance through statistical failure data in a garbage fleet. A case of study. Journal Economic Development. 12[32]1-7: e41232107.
https://doi.org/10.35429/JED.2025.12.32.4.1.7

M Cr	Corrective maintenance Real.
MO	Mean time.
MP	Periodic maintenance.
MTBF	Mean time between failures.
N	Number of time.
N[M-Op]	Optimal maintenance number.
NT	Maintenance cost number.
RAMS	Reliability, availability, maintainability, and safety.
RCA	Root cause analysis.
RCM	Reliability-centered maintenance.
T	Time.

Acknowledgments.

To the Higher Technological Institute of Huatusco [ITSH] and the postgraduate and research Subdirectorate.

To the teaching staff of the ITSH postgraduate subdirectorate, for the support provided in the research.

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Antecedents

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ISSN: 2410-4019
RENIECYT: 1702902

Journal Economic Development 12[32]1-19: e51232119
Article

Analysis of the development of a post-COVID-19 induction manual for a soft drink company in León, Guanajuato, Mexico

Análisis de la elaboración de un manual de inducción post-covid-19, de una empresa refresquera de León, Guanajuato, México

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Classification:

Area: Social sciences
Field: Negotiation and management
Discipline: Administration and management
Subdiscipline: Business administration

https://doi.org/10.35429/JED.2025.12.32.5.1.19
History of the article:
Received: October 19, 2025
Accepted: December 30, 2025

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Abstract

The aim of this research is to analyze the development of a post-COVID-19 induction manual for a soft drink company in León, Guanajuato, Mexico. Considering that the way of working has changed in almost all organizations, the methodology is qualitative; field research was conducted in a soft drink company, and the entire process was carried out to develop an induction manual taking into account the changes brought about by COVID-19. As a result, the necessary techniques were applied to create the manual for the soft drink company considering the changes caused by the pandemic. It is concluded that, administratively, especially in the human resources area, nothing can function the same way; there is a before and after the pandemic.

Objective	Methodology	Conclusion
Analyze the development of a post-COVID-19 induction manual for a soft drink company in León, Guanajuato, Mexico.	The methodology is qualitative; field research was conducted in a soft drink company, and the entire process was carried out to develop an induction manual	In the human resources area, nothing can function the same way; there is a before and after the pandemic

Manual, Induction, Company

Resumen

La presente investigación tiene por objetivo analizar la elaboración de un manual de inducción post covid-19 de una empresa refresquera en León, Guanajuato, México. Considerando que la forma de trabajar cambio en casi todas las organizaciones, la metodología es cualitativa, se hizo la investigación de campo en una empresa refresquera y aquí se realizó todo el proceso para desarrollar un manual de inducción considerando los cambios que se dieron por el COVID-19. Como resultado se aplicaron las técnicas necesarias para realizar el manual para la empresa refresquera considerando los cambios surgidos por la pandemia. Se concluye que administrativamente en especial en el área de recursos humanos nada puede funcionar igual, hay un antes y después de la pandemia.

Objetivo	Metodología	Conclusión
Analizar la elaboración de un manual de inducción post covid-19 de una empresa refresquera en León, Guanajuato, México	La metodología es cualitativa, se hizo la investigación de campo en una empresa refresquera y aquí se realizó todo el proceso para desarrollar un manual de inducción	En el área de recursos humanos nada puede funcionar igual, hay un antes y después de la pandemia

Manual, Inducción, Empresa

Area: Advocacy and attention to national problems

Citation: Serrano-Torres, Ma. Guadalupe Coronel-Sánchez, Edgar Noe. [2025]. Analysis of the development of a post-COVID-19 induction manual for a soft drink company in León, Guanajuato, Mexico. Journal Economic Development. 12[32]1-19: e51232119.

Introduction

Throughout the world, in Latin America, in Mexico, in Guanajuato, and especially in the city of León, the way companies are managed and run has changed as a result of COVID-19. Such is the case with the creation of an induction manual for a soft drink company. Induction manuals provide support for following a process so that the person recruited, selected, and hired can develop exceptionally in a short period of time. The company's interest in research to remain at the forefront is one of the objectives for the development of this research project for an induction manual, considering the changes caused by the aforementioned pandemic. Ortega [2024].

In this study, an induction manual was created, developing an algorithm necessary for the proper functioning of the induction process and reflected in the induction manual for the soft drink company in León, Guanajuato.

As this is the employee's first contact with the company, it is necessary for the induction programme to be supported by senior management and conducted with an attitude of respect and cordiality, so that their productivity, identification, performance and confidence are influenced by this initial contact.

New employees can bring new skills, talents and opportunities to the organisation, but much of that initial enthusiasm, creativity and commitment can be lost if the induction process is poor.

Mendoza, T. [2013] states that when a person joins a new organisation, regardless of their experience in the position to be filled, it is of radical importance to have developed a good induction process that will first and foremost make them feel welcome. The image that a company projects as a result of induction is very positive and generates feelings of security in new employees.

This research article was prepared for the soft drink company on a personal basis to address the company's induction needs, taking into account its human, material, financial and technological resources. It also takes into account the changes in the way the company operates after COVID-19.

This research is organised into a summary, introduction, methodology, results and conclusion.

Theoretical framework

To delve into the topic, we will start with the basic concept of induction and the minimum requirements it must include:

General induction consists of the process in which staff are provided with general information about the organisation they have joined. To this end, a member of staff will guide them through the steps they need to know. In order to carry out the induction, a suitable and welcoming place is chosen to inform participants about: first, basic information about the organisation, such as its vision, mission, organisational values, history, organisational regulations, organisational structure, organisational philosophy, what the organisation does [Bretones & Rodríguez, 2008; Flores et al, 2019], the rights, duties and responsibilities within the organisation, and other information deemed appropriate.

Now we will talk about induction in general. If this process is carried out properly, that is, a good general induction will allow the individual to know and comply with the organisation's regulations [Barón et al., 2019], and the organisation to meet its established objectives, all thanks to the fact that the staff who have been hired identify with the organisation. This is achieved through the successful integration of the employee into their new job [Restrepo, 2011]. Some organisations bring together the managers or specialists from each area to carry out the induction process, from the highest level of management to middle management.

There is now another type of induction, which is specific. This focuses on a particular area of the company where special attention is required due to the processes that take place there. Tejedor, V. [2022] mentions that this is where the human resources manager makes a specification, provides more information and clarifies any doubts about the position that the new employee will hold in a specific area in order to develop their potential to the fullest. For the soft drink company, we used specific induction due to the nature of the business, the number of employees, the size of the business, and the general and specific needs and considerations of the managers.

ISSN: 2410-4019
RENIECYT: 1702902

Serrano-Torres, Ma. Guadalupe Coronel-Sánchez, Edgar Noe. [2025]. Analysis of the development of a post-COVID-19 induction manual for a soft drink company in León, Guanajuato, Mexico. Journal Economic Development. 12[32]1-19: e51232119
https://doi.org/10.35429/JED.2025.12.32.5.1.19

Methodology

A qualitative methodology was used to carry out this research because the induction manual was applied and developed with the support of the soft drink company in accordance with its interests and needs for the growth and development of its staff. The company provided all the information necessary to develop the products that emerged to carry out a complete induction process for new employees.

The manual was prepared as follows:

1. Collection of information for the development of the manual.

The company under study provided all the necessary and essential information for new staff and began to develop the induction manual for the soft drink company.

2. Structuring of the induction manual index

In collaboration with the person responsible on behalf of the company, the information obtained was separated to list the topics that should be included in the induction manual.

3. Preparation of the induction manual.

Once all the information was available, the manual was prepared, always taking into account the needs and important points that the company's managers requested to be included in the content of the induction manual for the company. This included descriptive images. Once the entire document had been drafted, it was submitted for review, comments, correction and authorisation of the manual.

Results

We will now respond to each objective section of the methodology used to develop this research: The research was carried out in a soft drink bottling company in its automotive department, specifically in the soft drink delivery trucks.

2. Table of contents of the manual

I. Introduction
II. Welcome message
III. Background
IV. Company products
V. Company philosophy
VI. Objectives
VII. Algorithm
VIII. Flow chart
IX. Induction Policies
X. Organisational Chart
XI. Internal Work Regulations
XII. Employer Obligations
XIII. Employee Obligations
XIV. Legal Benefits
XV. Department Induction
XVI. Job Activities
XVII. Reference Images of Automotive Workshop Positions
XVII. Health and Safety
XVIII. Conclusions and Recommendations

3. The following is the outline of the induction manual.

I. Introduction

This induction manual has been prepared so that when new employees join the company, they feel oriented in the facilities, know the benefits of belonging to our large family, and are better integrated with their team and workplace.

The content of this manual includes a welcome message, the company's background, the organisational values so that they feel in tune with us, the organisational chart, a presentation of the products that are manufactured here, the general induction procedure, internal regulations, the rights and obligations of the employer and the employee, employee benefits and allowances, health and safety measures, and, finally, induction to the position and job activities.

II. Welcome message

Welcome to the soft drink company. Circumstances in life or the threads of fate have brought you to us. You should consider yourself very fortunate, because here you will find a great atmosphere and a good work team, although that depends largely on you and your willingness to cooperate with all of us. We would also like to congratulate you on joining your new job. We hope you enjoy your time in our work environment. We are a Mexican company dedicated to the production of soft drinks with a wide variety of flavours and an exclusive focus on our market.

ISSN: 2410-4019
RENIECYT: 1702902

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III and IV. Company background and products

Below, we will present your induction manual so that you can begin to familiarise yourself with your new environment and learn about each area and function of our facilities. 'New challenges are coming, and we are happy to be able to experience them together, as we are very excited to work with a talented person like you.'

Sincerely, Human Resources Department.

V. Company philosophy

Mission

To contribute to the well-being of consumers in Mexico and other countries with refreshing beverages of the highest quality, always seeking to exceed the expectations of our customers, shareholders, and employees.

Vision

To be one of the leading companies in the national soft drink market, with a highly integrated, efficient, motivated, well-paid team committed to organisational values.

Values

- Respect and humane treatment.

Recognition of the value, dignity and rights of each person within the work environment.

- Honesty.

Commitment to expressing directly and clearly what we think and do. This arises as a natural consequence of an effort to be ethical and personally consistent.

- Spirit of service.

Having a constant attitude of willingness, commitment and empathy to meet the needs of others, whether they are customers, colleagues or superiors, with warmth, efficiency and respect.

- Teamwork.

Encouraging collaboration, communication and cooperation among employees to achieve common goals, leveraging individual strengths for the benefit of the group and the company.

- Ability to achieve more with less.

The ability to be efficient and productive, using available resources [time, money, materials, etc.] intelligently and responsibly to obtain the best possible results.

- Individual development.

Commitment of the organisation and its employees to the personal and professional growth of each employee.

- Competitiveness based on innovation and modernisation.

Driving growth and market position through new ideas, technological improvements and constant adaptation to change.

- Total quality and continuous improvement.

Ongoing commitment to doing things right from the start, always seeking to exceed standards, optimise processes and meet or exceed customer expectations.

VI. Objectives

General objective

Ensure the effective and efficient integration of new employees into the Refresquera Company, providing clear and structured guidance on the company's processes, values and policies, in order to ensure complete understanding and optimal performance from the start of their duties.

Specific objectives

- Familiarise New Employees with the Organisational Culture: Ensure that employees understand and adopt the company's values, mission and vision, creating a sense of belonging and commitment.
- Provide Information About our Products: Inform employees about the different types of products [soft drinks, sparkling water and still water], their characteristics and product quality standards.
- Establish Clear Rules and Procedures: Provide specific guidelines on conduct policies, safety, and operating procedures, ensuring that all employees follow best practices and maintain product quality.

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- Facilitate Adaptation and Productivity: Reduce the adaptation time for new employees, allowing them to be productive in the shortest possible time through comprehensive and accessible guidance.
- Promote a Collaborative Work Environment: Foster a positive and collaborative work environment where employees feel supported and motivated to contribute to the success of the company.

Strategies

Familiarise new employees with the organisational culture:

- Hold welcome sessions that include a presentation of the company's history, mission, vision and values.
- Organise integration and team-building activities that reinforce a sense of belonging and camaraderie.
- Create a mentoring programme where experienced employees guide new ones, sharing experiences and knowledge.

Provide detailed information about the products:

Develop specific information modules on the characteristics and quality standards of the wide variety of beverages offered by the Refresquera Company.

- Provide visual material and product samples during induction for a practical and tangible understanding.
- Offer guided tours of the production areas to observe the manufacturing process first-hand.
- Establish clear rules and standards.
- Design detailed manuals and guides that describe the company's operating procedures and policies step by step.
- Conduct regular workshops and training sessions on safety and hygiene regulations.
- Implement a continuous feedback information system to adjust and improve procedures as necessary.
- Facilitate adaptation and productivity
- Create a personalised induction plan that includes a schedule of activities and training specific to the position.
- Provide the necessary resources and tools so that employees can perform their duties efficiently from day one.
- Set clear goals and expectations from the outset, with ongoing monitoring and support from supervisors.

Promote a collaborative work environment:

- Encourage open and transparent communication at all levels of the organisation.
- Create spaces and opportunities for collaboration and the exchange of ideas among employees.
- Recognise and reward employee achievements and contributions to keep them engaged and committed.

VII. Algorithm

Table 1. Induction process algorithm

What is done? How is it done? Who does it?

Advance preparation. The necessary materials to be used for the induction process are prepared. Human Resources Assistant.

Welcome. Human Resources staff introduce themselves to new staff and give them a welcome message. Head of Human Resources.

Induction video playback. Employees are guided to the induction room and shown an induction video containing the background and philosophy of the company. Human Resources Assistant.

Product presentation. The products manufactured by the Refresquera Company are presented in person. Human Resources Assistant.

General instructions on the Internal Work Regulations. Some general instructions on the Regulations are given.

Human Resources Assistant.

Delivery of Regulations. The Regulations are delivered in person so that employees can read them and familiarise themselves with them. Human Resources Assistant.

Talk on benefits and perks. Employees will be told about the benefits and perks offered by the company. Human Resources Assistant.

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Tour of the facilities. Tour showing points of interest for employees. Head of Recruitment and Selection.

Employees are taken to their corresponding department. At the end of the tour, employees are taken to their corresponding department.

Head of Recruitment and Selection.

Box 1

Table 1

Algorithm for the induction process.

What should be done?	How is it done?	Who does it?
Preliminary preparation.	The necessary materials to be used for the induction process are prepared.	Human Resources Assistant.
Welcome.	Human Resources staff introduce themselves to the new staff and give them a welcome message.	Head of Human Resources.
Induction video screening.	Employees are guided to the induction room and shown an induction video which contains the background and philosophy of the company.	Human Resources Assistant.
Product presentation.	The products manufactured by the Company will be presented in physical form.	Human Resources Assistant.
General guidelines on internal work regulations.	Some general information about the Regulations will be provided.	Human Resources Assistant.
Distribution of regulations.	A physical copy of the Regulations will be provided so that you can read them and familiarise yourself with them.	Human Resources Assistant.
Talk on benefits and perks.	They are told about the benefits and perks offered by the company.	Human Resources Assistant.
Tour of the facilities.	Tour showing points of interest for employees.	Head of Recruitment and Selection.
Employees are taken to their respective departments.	At the end of the tour, employees are taken to their respective departments.	Head of Recruitment and Selection.

Source: own elaboration.

The table above details the induction process that will be applied to new employees and that was developed in this research.

V. Flow chart of the induction process, as shown in Table 2.

Box 2

Figure 1

Flow chart of the induction process

Source: own elaboration.

The figure above describes the steps for carrying out the induction process in a very clear and precise manner.

VI. Induction Policies.

The induction process policy is as follows:

- The Human Resources department shall be responsible for publicising and delivering the induction programme
- All new staff joining the organisation shall receive the induction course, which shall provide them with the necessary information to enable them to identify with the company.
- The Human Resources department must provide information on everything related to the organisation, background, company products, mission, vision, values, organisational chart, company benefits, internal regulations, employee rights and obligations, employer rights and obligations, and health and safety measures.

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- The induction programme must be subject to change in order to keep it up to date and improve it.

VII. Organizational chart

The organisational chart of the soft drink company is now presented, specifically for the automotive maintenance department and service for the units that deliver soft drinks to shops and self-service stores. It should be noted that the research was carried out in this specific department.

Box 2

Figure 2

Organisational chart of the soft drink company, automotive department.

Source: own elaboration.

VII. Internal regulations.

Article 1. - For the application and interpretation of these Regulations, the following definitions are established:

a] Refreshment Company

b] Union. – Union of workers in the Industry of Bottled Carbonated Waters, Soft Drinks, Natural Waters, Beers and Packaged Beverages in General, Similar and Related Products of the Mexican Republic.

c] Workers. – Refers to individuals who provide their personal services to the Company.

d] Regulations. – These Internal Work Regulations.

e] Law. – Refers to the provisions of the current Federal Labour Law.

Article 2. – The Union and non-unionised personnel recognise that the Company has the exclusive power to organise, direct, administer and supervise the work for which unionised personnel are hired and that, therefore, it is the exclusive responsibility of the Company, through its representatives and trusted employees, to give orders or instructions for the proper performance of the work.

The Union, through its Legal Representatives, shall have direct involvement in dealing with the Company on matters related to the correct application of the collective agreement, individual employment relationships, these regulations and the Law, when referring to the interests of workers who hold union control positions.

Article 3. – These regulations, drawn up by mutual agreement between the representatives of the Company, the union representing the workers and the non-unionised staff who sign below, are binding on all parties. The Company reserves the right to issue, verbally or in writing, any technical or administrative rules necessary for the proper performance of duties, in accordance with the provisions of Article 422 of the law.

The company designates the management to review compliance with the following regulations.

These regulations shall also be binding on the employees of companies providing services within the company.

V. Employer obligations

The obligations of employers are as follows: [Paragraph amended D.O.F. 19 December 2024].

• I.- Comply with the provisions of the labour regulations applicable to their companies or establishments;

• II.- Pay workers their wages and compensation in accordance with the regulations in force in the company or establishment;

• III.- To provide workers with the tools, instruments and materials necessary for the performance of their work in a timely manner, ensuring that they are of good quality and in good condition, and to replace them as soon as they cease to be efficient, provided that the workers have not agreed to use their own tools.

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The employer may not demand any compensation for the natural wear and tear of work tools, instruments and materials;

• IV.- Provide a secure place for the storage of work instruments and tools belonging to the worker, provided that they must remain in the place where the services are provided, without the employer being entitled to retain them as compensation, guarantee or any other reason. The registration of work instruments or tools must be carried out whenever the worker so requests;

• V.- Provide a sufficient number of seats or chairs with backrests available to all workers in the service, commercial and similar workplaces, for the performance of their duties or for periodic rest during the working day. In the case of periodic rest, seats or chairs with backrests shall be located in specific areas designated for this purpose within the workplace facilities. The same provision shall be observed in industrial establishments when the nature of the work permits it;

[section amended D.O.F. 19 December 2024].

• VI.- Treat workers with due consideration, refraining from verbal or physical abuse;

• VII.- Issue every fifteen days, at the request of the workers, a written statement of the number of days worked and the wages received;

• VIII.- Issue to the worker who requests it or leaves the company, within three days, a written statement relating to their services;

• IX.- Grant workers the time necessary to vote in popular elections, recall processes, and to perform jury, electoral, and census services, as referred to in Article 5 of the Constitution, when these activities must be performed during their working hours;

- Comply with occupational health and safety rules and regulations.
- Protect the integrity of its employees.
- Inform about the dangers and risks of the workplace and/or activity.
- Ensure the protection of the company's personnel and property.
- Provide safe and hygienic conditions for the performance of work.

VI. Employee obligations

ARTICLE 21. – Employees shall have obligations inherent to the positions they hold, and these shall be performed in accordance with these Regulations, the Collective Labour Agreement, the Individual Employment Contract, the provisions issued by management or its representatives or the company in general, and the provisions of Article 134 of the Law, as well as those mentioned below by way of example and without limitation.

a] Comply with the working hours assigned to them according to their position, unless otherwise specified in writing or special permission is granted.

b] To appear at work in a neat and tidy manner, wearing the uniform provided by the Company.

c] To be in good physical condition [motor coordination] to work [not under the influence of alcohol, drugs or medical treatment]. In the event of this occurring, the employee must agree to undergo drug testing.

d] Maintain good conduct during work, showing consideration and respect for all colleagues and refraining from using obscene language.

e] Submit to the Company or its representatives any certificates of incapacity, ST7 discharge certificates, confirmation notices, birth certificates, breastfeeding notices and other documents provided by the IMSS.

f] Clean the machinery and/or delivery equipment at the beginning or end of the workday or when there is a break in the workday, doing so during the workday. In cases where the truck is delivered to another area [Sales to Traffic, Administration to Workshop, etc.], it must be checked upon receipt and any anomalies reported.

g] Notify the Company or its representatives of any irregularities that arise in the course of work in relation to machinery, vehicles, products, computer equipment and, in general, any difficulties encountered at work.

h] Observe the provisions of these Regulations and comply with technical or administrative orders issued by the company through its representatives, without prejudice to their rights.

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i] Maintain and help to maintain the good condition of the building, machinery and furniture, refraining from placing inscriptions, drawings or any foreign objects on them that could harm the interests of the company.

j] Return the tools and equipment provided to them to carry out their work in good condition and complete at the end of their work. Anyone who violates this provision will be penalised in proportion to the damage and/or seriousness of the offence and will be required to pay the cost of the lost or destroyed equipment.

k] Store vehicles, tools and materials in the places designated for this purpose.

l] Ensure the correct use of the programmes or software that the company makes available for the performance of their job duties.

m] In the raw material and manufacturing warehouse areas, wear a cap and face mask.

n] In the manoeuvring yard, wear reflective vests and safety shoes.

o] In warehouse areas or where the use of a safety helmet is justified.

p] Wear the uniform in accordance with your role, in line with the established guidelines.

q] Provide the service for which you were hired based on the functions of the area, regardless of the physical location of the plant where you perform them. This includes sales and promotion staff.

r] Adhere to the dress code authorised by the company.

- Comply with the safety rules set out in the Internal Work Regulations.
- Attend training on safety and civil protection issues.
- Take care of and maintain the company's facilities in good condition.
- Report on your state of health
- Seek comprehensive health care.
- Report on risks or unsafe conditions.

VII. Department induction

Department induction [automotive workshop].

Once your general induction has been completed successfully, it is time to begin your specific induction for the department to which you were hired.

Below is the specific induction process for the automotive workshop department:

When a new employee joins the department, all employees gather to introduce themselves to their new colleague, stating their name and position.

They are shown their workstation so that they can begin to familiarise themselves with it and with the colleagues they will be working with.

They are given a tour of the entire workshop so that they can differentiate between the different work areas and their locations.

They are assigned the tools they will be working with and the place where they should be stored.

They are shown the storage area so that they can locate where to request the spare parts or materials they will need and so that the person in charge of the storage area can locate the new employee and give them the necessary materials. They are taken to the dining room where they can eat their meals during their break. There are microwave ovens and refrigerators for storing their food. In the same refrigerators, there are different soft drinks that are produced here at the Refresquera Company. You can drink any of our beverages for consumption within the dining room or work area, but they must not be taken outside the company premises. Remember to consume your food only within the dining room. Once the process is complete, employees are given some instructions:

1. The person in charge is the automotive workshop manager. If he is not available, the person in charge is his workshop assistant.

2. All colleagues must treat each other with respect.

3. They must always wear their identification badge.

4. They must walk within the yellow safety lines.

5. They must always wear their uniform.

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6. They have one hour for lunch.

7. They are given a monthly punctuality bonus of $250.

8. If an employee is late three times in a row, they are penalised with the withholding of one day's pay and lose the right to the punctuality bonus for the month in which the events occurred.

VIII. Job duties

Workshop manager

- Perform and schedule maintenance activities.
- Perform preventive and corrective maintenance.
- Control monthly expenses.
- Control fuel consumption.
- Perform maintenance checks.
- Physical and electronic handling.
- Process warranties.
- Request spare parts.
- Follow up on external repairs.

Fuel control

- Refuelling.
- Supervise the refuelling of each unit.
- Safeguard the keys to the fuel storage facilities.
- Supervise and create strategies to prevent fuel theft and loss.
- Control reports of anomalies, follow up on them and resolve them.
- Record data in logbook [unit number, current mileage, litres dispensed, fuel pump receipt number, employee number, etc.].

Mechanic in charge of petrol

- Assist in the maintenance of the vehicle fleet.
- Attend to work orders relating to the preventive and corrective maintenance of RINSA's petrol vehicles.
- Perform preventive and corrective service on car engines and other petrol-powered units.
- Service engines, suspensions, transmissions and differentials.
- Calibrate engines.
- Interpret electrical diagrams.
- Maintain brake systems.

Diesel mechanic

- Assist in the maintenance of the vehicle fleet.
- Attend to work orders related to the preventive and corrective maintenance of Rinsa diesel vehicles.
- Perform preventive and corrective service on bus and/or tractor-trailer engines.
- Service engines, suspensions, transmissions, and differentials.
- Calibrate engines.
- Interpret electrical diagrams.
- Maintain the brake system.

Motorcycle mechanic

- Receive the unit to be serviced at the workshop.
- Check the unit.
- Check for faults.
- Request spare parts vouchers.
- Take the voucher for the order to the warehouse area.
- Faults/punctures/lights/mechanical service.
- Installing spare parts.
- Checking that the spare parts are suitable.
- Delivering motorcycles.
- Foreign motorcycle service.
- Rescue of units en route.
- Requesting spare parts by means of a work order.

Lubricator

- Order oils, filters, and greases.
- Dispatch oils and petrol to staff.
- Select each oil for its respective unit.
- Report unit [truck, motorcycle].
- Request lubricators through a work order.
- Keep workplace clean and tidy.

Mechanic

- Keep the RINSA vehicle fleet in working order.
- Establish a preventive maintenance programme.
- Attend to and carry out corrective maintenance when necessary.
- Requisition materials and other items used in the vehicle maintenance workshop.

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- Lead the work team so that it meets the objectives set out in the schedule.
- Take inventory of the materials and tools available in the workshop.
- Request the materials or products to be used during the work period from the spare parts warehouse.
- Support the work team in carrying out activities if the necessary personnel are not available.
- Validate the work performed by the personnel in charge.
- Deliver the units to the personnel or driver in charge of them.
- Report on the actions taken
- Ensure that the work area is kept clean and tidy.

Electric car

- Receipt of entry into service.
- Check of the automotive unit.
- Lights, gears, alternators.
- Report faults to the unit.
- Order spare parts.
- Install spare parts.
- Check that the spare parts are working.
- Report that the unit is ready for use.

Electrical assistant

- Receive units for service.
- Check the automotive unit.
- Lights, gears, alternators.
- Report faults to the unit.
- Order spare parts.
- Install spare parts.
- Check that the spare parts are working.
- Report that the unit is ready for use.

Panel beater assistant

- Assist in the repair of the vehicle fleet.
- Attend to work orders in accordance with the established schedule.
- Prepare the work area, including cleaning the surface, protecting the area that will not be worked on, and ensuring that the work area is well ventilated.
- Inspect the vehicle to assess the condition of the existing paint, identify damaged or corroded areas, and determine the best way to proceed with the laminate.
- Properly prepare the vehicle's surface. This may involve lightly sanding the existing paint to create a rough surface that will facilitate the adhesion of the laminate.
- The automotive laminator cuts the laminate into sheets of the appropriate size for the specific area of the vehicle to be covered. They then adjust the laminate to fit the shape and curves of the vehicle perfectly.
- The laminator carefully applies the laminate to the vehicle's surface, ensuring that any air bubbles are removed and a smooth, even finish is achieved.
- Finishing and care: the automotive laminator performs the final touches, such as trimming excess laminate, smoothing edges, and polishing the surface for a shiny, professional finish.

IX. Reference images of automotive workshop positions.

At Empresa Refresquera, it is vitally important that you are familiar with your workstation and those of your colleagues for better orientation. Below are images of the different workstations in the automotive workshop:

Image 12. Dining room

This is where you can eat your meals during your break time. Inside, there are refrigerators with our soft drinks, which you can help yourself to during your working hours.

Image 13. Forklifts

This is the forklift area. When you do not need a forklift or when you have finished using it, this is where you should park it.

Image 14. Mechanics' lanes

Here you will find the mechanics' lanes, which are necessary for the installation and removal of equipment.

Image 15. Warehouse

In the warehouse area, you will find all the parts and spare parts necessary to perform maintenance on any vehicle or equipment, or any other process you may need to carry out.

Image 16. Electrical workshop

Here, the staff specialises in diagnosing, repairing, and maintaining the electrical and electronic systems of vehicles.

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Image 17. Paint and body shop

In the paint and body shop, we repair the bodywork and apply paint to restore the appearance and protect the vehicle.

Employee benefits and allowances

As a formal company in Mexico, we at the soft drink company must provide our employees with the benefits established by the Federal Labour Law, including a Christmas bonus, holidays, holiday pay, social security, profit sharing, among others. In addition to the benefits required by law, the bottling company offers additional benefits such as medical insurance and monthly incentives.

Statutory benefits:

Christmas bonus:

An annual payment equivalent to at least 15 days' salary, according to the Federal Labour Law, although here at the soft drink company it is 30 days.

Holidays:

An annual period of paid leave, with a minimum of 6 working days in the first year, according to the Federal Labour Law.

Holiday bonus:

An additional payment to the holiday salary, equivalent to 25% of the salary corresponding to the holidays, according to the Federal Labour Law.

Social security:

Medical coverage and financial benefits provided by the Mexican Social Security Institute [IMSS].

Infonavit:

Access to housing loans through the National Workers' Housing Fund Institute.

Afore:

Retirement fund managed by a retirement fund administrator.

Profit Sharing [PTU]:

Distribution of company profits among employees, according to the Federal Labour Law.

Weekly Day of Rest:

One day of rest for every six days worked, according to the Federal Labour Law.

Benefits Above and Beyond the Law:

Grocery Vouchers:

Additional benefit that employers grant to their workers with the aim of improving their living conditions. These vouchers can be exchanged for food, basic necessities and, in some cases, food-related services.

Savings Account:

Employees can save periodically through salary deductions, with the possibility of accessing loans with attractive interest rates.

30-day bonus:

Although the bonus is a statutory benefit, what makes it special here at Empresa Refresquera is that it is a 30-day bonus instead of the 15 days stipulated by law.

Support for death of a direct relative:

We hope it never happens, but in the event of the death of a family member, financial support of $9,000.00 pesos is provided for funeral expenses.
Days off for death:

As mentioned above, we hope it never happens, but in the event of the death of a family member, employees are given two days off.

Free uniforms:

Your uniform is provided free of charge and you are required to wear it every day during your entire workday.

Safety induction for automotive workshop staff.

Industrial safety refers to the set of rules, principles and measures designed to prevent accidents and occupational illnesses in industrial environments.

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It seeks to protect workers, property and the environment from the risks associated with industrial activity, minimising the likelihood of incidents and their consequences.

XVII. Key concepts in industrial safety:

Risk: The likelihood of a dangerous event occurring and its possible consequences.

Hazard: A potential source of harm, such as a faulty machine or a toxic substance.

Risk assessment: The process of identifying, analysing and evaluating the risks present in the work environment.

Preventive measures: Actions implemented to eliminate or control hazards and reduce the likelihood of accidents.

Personal protective equipment [PPE]: Items such as helmets, gloves, goggles, etc., that protect workers in case of exposure to hazards.

Training: Providing workers with the knowledge and skills necessary to perform their tasks safely.

Regulations: The set of laws, regulations and technical standards that establish safety standards in the industrial field.

Industrial hygiene: A set of measures aimed at preventing occupational diseases by controlling environmental factors such as noise, lighting, chemicals, etc.

Ergonomics: Adapting work to the capabilities and limitations of workers to prevent injuries and improve productivity.

Safety culture: A work environment where safety is valued and prioritised by all members of the organisation.

Accident investigation: The analysis of incidents to identify their causes and prevent them from happening again.

Occupational health: A field that seeks to protect the physical and mental integrity of workers, protecting them from occupational hazards.

Physical, mental and social well-being: A complete state of health that goes beyond the absence of disease, including aspects such as personal satisfaction and social relationships.

Occupational hazards: Conditions or factors at work that can cause illness, injury or damage to health.

Occupational risk prevention: Measures and actions aimed at eliminating or reducing risks in the workplace.

Working conditions: Aspects of the work environment that can affect the health and safety of workers, such as lighting, ventilation, ergonomics, among others.

Occupational disease: Illness contracted as a result of exposure to risk factors at work.

1.1.1.1 Importance of industrial safety:

Protection of workers' health and safety: Minimises the risk of work-related injuries, illnesses and deaths.

Cost reduction: Reduces economic losses associated with accidents, such as compensation, damage to equipment and production delays.

Improved productivity: A safe and healthy environment increases worker efficiency and morale.

Regulatory compliance: Avoids penalties and fines for non-compliance with safety laws and regulations.

Environmental protection: Industrial safety also considers the prevention of environmental damage caused by industrial activities.

In summary, industrial safety is a comprehensive approach that seeks to create a safe and healthy work environment for all workers, protecting their well-being and contributing to the success of the company.

Occupational health refers to the complete state of physical, mental and social well-being of workers, not just the absence of disease, and focuses on the prevention of occupational risks and the promotion of a safe and healthy working environment.

ISSN: 2410-4019
RENIECYT: 1702902

Serrano-Torres, Ma. Guadalupe Coronel-Sánchez, Edgar Noe. [2025]. Analysis of the development of a post-COVID-19 induction manual for a soft drink company in León, Guanajuato, Mexico. Journal Economic Development. 12[32]1-19: e51232119
https://doi.org/10.35429/JED.2025.12.32.5.1.19

1.1.1.2. Importance of occupational health:

Occupational health is essential for the well-being of workers and the smooth running of businesses. A safe and healthy working environment promotes:

Higher productivity: Healthy and motivated workers are more productive.

Cost reduction: Fewer accidents and occupational illnesses mean lower compensation and medical care costs.

Better working environment: A safe and healthy environment contributes to a better working environment and employee satisfaction.

Legal compliance: Companies have an obligation to comply with occupational health and safety laws and regulations.

In short, occupational health is a comprehensive approach that seeks to protect workers from occupational hazards and promote a work environment that promotes their physical, mental and social well-being.

Employer responsibilities.

- Comply with occupational health and safety rules and regulations.
- Protect the integrity of their employees.
- Inform employees about the hazards and risks of the workplace and/or activity.
- Ensure the protection of company personnel and property.
- Provide safe and hygienic conditions for the performance of work.

Employee responsibilities.

- Comply with the safety rules set out in the Internal Work Regulations.
- Attend training on safety and civil protection issues.
- Take care of and maintain the company's facilities in good condition.
- Report on their state of health.
- Seek comprehensive health care.
- Report on risks or unsafe conditions.

1.1.1. 3. Means of reporting unsafe conditions or acts.

Immediate supervisor: They should be the first point of contact for reporting unsafe conditions or poor hygiene, so that they can then carry out a risk analysis with the safety supervisor to establish corrective and preventive measures.

Industrial safety supervisor: Like the immediate supervisor, they can receive reports of unsafe conditions and acts directly from employees in order to establish countermeasures. Health and Safety Committee: The Health and Safety Committee is a group of both operational and administrative employees whose responsibilities include investigating accidents and establishing preventive and corrective measures.

In the workplace, risk factors are elements, situations or circumstances that can cause harm to the health of workers or damage to facilities.

These agents can be of various kinds and are classified into different categories, such as physical, chemical, biological, ergonomic, psychosocial, and environmental.

Types of risk agents:

Physical: Noise, vibrations, radiation [ionising and non-ionising], extreme temperatures, poor lighting, etc.

Chemical: Toxic, corrosive, irritant, carcinogenic substances, etc., present in the workplace.

Biological: Viruses, bacteria, fungi, parasites, etc., which can cause infections, diseases or allergies.

Ergonomic: Inadequate workplace design, repetitive movements, forced postures, manual handling of loads, etc.

Psychosocial: Work-related stress, harassment, violence, lack of support, excessive workload, etc.

Environmental: Extreme weather conditions, pollution, lack of ventilation, etc.

Examples of risk agents in different contexts:

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- Working at height: Falls from heights, blows from falling objects.
- Working with machinery: Entrapment, cuts, blows, burns.
- Working in confined spaces: Lack of oxygen, hazardous atmospheres.
- Working in healthcare: Exposure to biological agents, needle sticks, handling of chemicals.

1.1.1.4. Importance of identifying and controlling risk agents:

It is essential to identify and assess the risk agents present in each workplace in order to implement appropriate prevention and protection measures. Occupational risk management is essential to ensure the health and safety of workers and to prevent accidents and occupational diseases.

To date, analyses of safe working practices in automotive workshops indicate the following personal protective equipment that you can use:

Safety glasses: Protect the eyes against particles, shavings, dust and chemicals.

Hearing protectors: Necessary when working with noisy machinery or in environments with high decibel levels.

Safety gloves and sleeves: Protect the hands from cuts, abrasions, burns and chemicals. Safety footwear: With steel toe caps to protect feet from falling heavy objects and non-slip soles to prevent slipping.

Safety helmet: Protects the head from blows and falling objects.

Appropriate work clothing: Protects against dirt, sparks and chemicals.

Masks and face protection: Necessary for work that generates dust, vapours or gases.

Knee pads: Protect knees when performing work in a kneeling position.

Regarding the handling of tools and equipment:

Regular inspection: Before using any tool or equipment, ensure that it is in good condition and undamaged.

Knowledge of operation: Familiarise yourself with the correct use of each tool and piece of equipment before using them.

Proper use: Use tools and equipment only for the task for which they were designed.

Storage: Store tools and equipment in designated, safe locations.

Order and cleanliness: Keep the work area clean and tidy to prevent accidents due to tripping or falling.

Prevention of occupational hazards:

Falls, slips and trips: Keep the floor clean and dry, avoiding spills and accumulations of objects.

Musculoskeletal injuries: Teach correct postures for lifting heavy objects and avoid repetitive movements.

Burns and cuts: Use appropriate protective equipment and handle tools and materials with caution.

Exposure to chemicals: Handle chemicals with care, using appropriate PPE and storing them correctly.

Electrical hazards: Inspect electrical cables and connections, and avoid contact with water.

Working environment:

Cleanliness and tidiness: Keep the workshop clean and tidy to prevent accidents and facilitate work.

Signage: Use clear and visible signage to identify hazard areas, emergency exits, and safety equipment locations.

Temperature and ventilation: Maintain an adequate temperature in the workshop [between 17 and 27 degrees] and ensure good ventilation to prevent the accumulation of gases or vapours.

Ongoing training: Provide ongoing training on occupational health and safety to all employees.

ISSN: 2410-4019
RENIECYT: 1702902

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Use of protective equipment: Ensure that all employees use the appropriate PPE at all times.

For Refresquera Internacional [RINSA], it is vital to have delivery units to deliver products to the various distribution and sales points. These delivery units must be in optimal physical, mechanical and aesthetic condition to meet demand in a timely manner.

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All automotive workshop activities carry risks that can injure or damage people or objects. Whether you work as a panel beater, welder, mechanic, electrician, body repairer, supervisor, etc., you must not overlook the dangers and risks. In an automotive workshop, common accidents include blows, cuts, falls, electrical contacts, burns, flying particles, and exposure to loud noises. Accidents related to the handling of tools, chemicals, and exposure to toxic gases such as carbon monoxide are also frequent.

Most common accidents and risks:

Bumps, cuts, and crushing: Using heavy tools and handling parts can cause bumps, cuts, and crushing.

Falls and slips: Slippery floors, oil, or clutter can cause falls.

Electrical shocks: Handling machinery and electrical systems can cause burns and electric shocks.

Exposure to chemicals: Solvents, oils, and other chemicals can cause skin irritation and respiratory problems.

Exposure to toxic gases: Engine exhaust gases, such as carbon monoxide, are dangerous if there is poor ventilation.

Overexertion: Lifting heavy objects or maintaining awkward postures for long periods of time can cause injuries.

Burns: Contact with hot surfaces or the use of welding equipment can cause burns.

Particle projection: Tools such as grinders or sanders can project particles that damage the eyes or skin.

Fires and explosions: The presence of flammable materials and welding sparks can cause fires.

Noise: Constant noise from engines and tools can cause hearing problems.

Road accidents: Accidents while travelling to or from work are also a risk.

Prevention:

To prevent these accidents, it is crucial to: Keep the workplace tidy and clean: A tidy workshop reduces the risk of falls and trips.

Use personal protective equipment: Safety goggles, gloves, knee pads, masks and appropriate clothing are essential.

Train workers: Teaching staff about risks and how to prevent them is vital.

Ventilate adequately: Ensure good ventilation to reduce the concentration of toxic gases.

Perform regular maintenance: Checking and maintaining machines and equipment in good condition reduces the risk of breakdowns and accidents.

Implement signage: Indicate hazards and risk areas with clear signs.

1.1.1. Emergency protocol:

Knowledge of evacuation routes: Identify emergency exits and safe areas in case of fire or other emergencies.

Use of fire extinguishers: Know the location of fire extinguishers and how to use them correctly.

First aid: [exclusive to brigade members] Have basic first aid knowledge and know how to respond to an accident.

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Communication: [exclusively for brigade leaders] Establish an effective communication system to report emergencies and request assistance.

Evacuation protocol

An effective evacuation protocol can mean the difference between life and death in an emergency situation. Therefore, it is crucial that organisations and individuals familiarise themselves with the evacuation protocols applicable to their environment.

General steps during an evacuation.

Remain calm: It is essential to avoid panic and follow the instructions of evacuation leaders and brigade members.

Suspend activities: Stop any dangerous activities and focus on the evacuation.

Use evacuation routes: Follow marked routes and avoid obstructions.

Assist others: If possible, assist people with disabilities.

Gather at assembly points: Once outside the building, proceed to designated safety zones. Wait for instructions: Remain in the safety zone until authorities indicate it is safe to return.

In the event of an earthquake: Protect yourself and do not attempt to leave during the event; wait and then evacuate the premises.

Fire protocol

A fire protocol is a set of actions and procedures that must be followed to respond effectively to a fire, with the aim of protecting lives and minimising damage. This protocol includes prevention, detection, alarm, evacuation and extinguishing measures. Below are some key steps:

Prevention:

Risk identification: Recognise and assess potential fire hazards in the environment, such as flammable materials, heat sources, faulty electrical installations, etc. Smoking is prohibited.

Safe storage: Keep flammable materials in suitable containers and away from heat sources.

Order and cleanliness: Keep workspaces and circulation areas clear to prevent the accumulation of waste that could serve as fuel.

Maintenance: Check and maintain electrical installations, equipment, and fire detection and extinguishing systems in good condition.

Signage: Place clear and visible signage to indicate evacuation routes, emergency exits, and the location of firefighting equipment.

Alarm detection:

Detection systems: Install smoke and/or heat detection systems that activate an alarm in the event of a fire.

Alarm manual: Ensure that manual alarm stations are available and accessible so that anyone can activate the alarm in an emergency.

Notify others: Immediately report the fire to the emergency services and people nearby.

Evacuation:

Remain calm: Avoid panic and remain calm to facilitate an orderly evacuation.

Follow evacuation routes: Use the designated and signposted evacuation routes, heading to the established meeting point.

Protect yourself from smoke: If there is smoke, cover your nose and mouth with a damp cloth and crawl under the smoke to find an exit.

Do not return: Once you have evacuated the building, do not return for any reason until the authorities indicate that it is safe to do so.

Extinguishing:

Fire extinguishers: In the event of an incipient fire, use appropriate fire extinguishers to try to extinguish it, provided it is safe to do so.

Turn off equipment: Turn off electrical equipment and close gas valves to prevent the fire from spreading.

ISSN: 2410-4019
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After the fire:

Safety: Wait for instructions from the authorities before returning to the building and avoid entering areas affected by the fire.

Damage assessment: Allow specialised personnel to assess the structure of the building and the damage caused by the fire.

Information: Stay informed about the actions to be taken and the recommendations of the authorities.

X. Conclusions

This manual is intended to be used as an effective guide for the induction process for new employees. This will help new recruits to the organisation feel more comfortable and oriented in their new working environment.

The manual is expected to be updated regularly, due to internal changes within the company and external changes, which may be economic in Mexico and worldwide. This manual is intended as a proposal, and it is entirely up to the company to decide whether or not to implement it as a new induction process.

Conflict of interest

The authors declare that they have no conflict of interest. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

Contribution of the authors

The first author contributed to the development of the article, the state of the art, the methodology, the conclusions and the arrangement of the results. The second author was responsible for obtaining the results, preparing the graphs and drafting the induction manual. Both authors contributed to the preparation of this research article.

Availability of data and materials

The data obtained as results are made available to anyone who requires them and are available to any researcher from other universities who requests them by email.

Funding

To carry out this research, the Technological University of León contributed by allocating time in hours for the completion of this research article, which is extremely important for raising awareness among entrepreneurs, the government, and public and private companies to invest in innovation in the country and in companies.

Acknowledgements

Our sincere recognition and gratitude to the University of León UTL for its support in terms of the time allocated to carry out this article. Thank you very much for all your support, especially to the research department. Thank you very much.

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ISSN: 2410-4019
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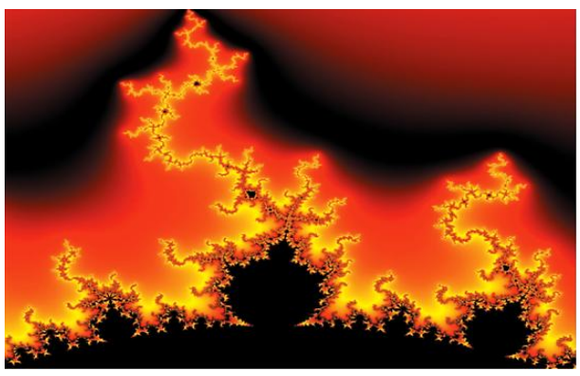

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Acknowledgements

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Abbreviations

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ANN	Artificial Neural Network

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