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Journal of Business Development Strategies

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The works must be unpublished and refer to topics of economics of research and experimental, development technology, economics consumer, behavior history of economic, thought economical, methodology resource, planning budget and, development planning and other topics related to Social Sciences.

Presentation of the Content

In *Issue 23*, is presented an article *Market research for internet sale's in the municipality of Landa de Matamoros, Querétaro*, by MORADO-HUERTA, Ma. Guadalupe, IBARRA-PÉREZ, Juan, SOTO-SEVILLA, Sergio and MARROQUÍN-DE JESÚS, Ángel, with adscription at Universidad Tecnológica de San Juan del Río, in the next article *Digitalization and its impact on operational efficiency, competitiveness, and growth: MEFE-MEFI strategic analysis of the department of economic-administrative sciences at the Instituto Tecnológico de Nuevo León*, by RÍOS-CASTILLO, Maricela, HERNÁNDEZ SALDÍVAR, Elisa, DELGADO-TORRES, Claudia Lizethe and DELGADO-TORRES, Laura Patricia, with adscription at Tecnológico Nacional de México - Instituto Tecnológico de Nuevo León, in the next section *Assessment of the sustainability of the coffee production system in the south sierra coast of Oaxaca*, by SALAZAR-VELASCO, Marlen Yadira, CASTAÑEDA-HIDALGO, Ernesto, LÓPEZ-VAZQUEZ, Esteban and MIGUEL-VELASCO, Andrés Enrique, with adscription at Tecnológico Nacional de México - Instituto Tecnológico de Oaxaca, in the next section *Analysis of the competitiveness of MSMEs in the trade sector of the San Martín Texmelucan Region, for the establishment of financial strategies*, by AGUILAR-PÉREZ, Esmeralda, with adscription at Tecnológico Nacional de México - Instituto Tecnológico Superior de San Martín Texmelucan.

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Market research for internet sale's in the municipality of Landa de Matamoros, Querétaro**Investigación de mercados para la comercialización de internet en el municipio de Landa de Matamoros, Querétaro**

MORADO-HUERTA, Ma. Guadalupe†*, IBARRA-PÉREZ, Juan, SOTO-SEVILLA, Sergio and MARROQUÍN-DE JESÚS, Ángel

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Abstract

The purpose of the study is to identify the characteristics of market behavior in the context of Internet distribution in the municipality of Landa de Matamoros, this, in order to provide an overview that allows companies that wish to enter the area to make decisions. and that also makes it possible to make decisions about the business portfolio that can be derived from the characteristics of the clients, their levels of consumption and their loyalty to existing brands.

237 surveys were applied in the towns of Lagunita, La Vuelta and El Aguacate, this in a random sampling to people ranging from 16 to 50 years old who were in their homes or businesses at the time of its completion, attending to the sociodemographic profile variables, user experience, type of service, brand loyalty, current evaluation.

It was identified that the Federal Institute of Telecommunications provides national and municipal information that allows identifying a macro panorama of market behavior, the contribution of this research being at the micro data level, contributing to the analysis of the microenvironment of small and medium-sized companies in the turn in analysis.

User, Internet, Behavior

Citation: MORADO-HUERTA, Ma. Guadalupe, IBARRA-PÉREZ, Juan, SOTO-SEVILLA, Sergio and MARROQUÍN-DE JESÚS, Ángel. Market research for internet sale's in the municipality of Landa de Matamoros, Querétaro. Journal of Business Development Strategies. 2023. 9-23:1-9.

Resumen

El propósito del estudio radica en identificar las características del comportamiento del mercado en el contexto de la distribución del internet en el municipio de Landa de Matamoros , esto, para poder brindar un panorama que permita tomar decisiones a las compañías que desean ingresar a la zona, y que además posibilita la toma de decisiones en torno a la cartera de negocios que puede desprenderse respecto a las características de los clientes, sus niveles de consumo y su lealtad a las marcas existentes.

Se aplicaron 237 encuestas en las localidades de Lagunita, La Vuelta y el Aguacate, esto en un muestreo aleatorio a personas que van de los 16 a los 50 años que se encontraban en sus hogares o negocios al momento de la realización de esta, atendiendo las variables de perfil sociodemográfico, experiencia de uso, tipo de servicio, lealtad a la marca, evaluación actual.

Se identificó que el Instituto Federal de Telecomunicaciones proporciona información nacional y a nivel municipal que permite identificar un panorama macro del comportamiento del mercado, siendo la aportación de esta investigación a nivel micro datos, aportando a los análisis del micro entorno de las pequeñas y medianas empresas del giro en análisis.

Usuario, Internet, Comportamiento

† Researcher contributing first author.

Introduction

The topic that concerns us in this article is market research in the telecommunications sector at the micro-regional level, a useful tool in decision-making for micro-enterprises seeking to set up in small towns in our country and which is directly related to the multi-stage model of Internet access, which explains how access to this service occurs, either by imitation or by necessity. It also adds that the adoption of this technology is primarily due to the localities with less development possibilities and that it implies a form of communication and relationship with the surrounding environment.

Thus, the study is descriptive in nature since it does not propose a hypothesis to be proven, however, it is a contribution to knowledge at the local level and the dynamics adopted by the distribution of the Internet after access was given to more companies for its use for commercial purposes. Consequently, the opening of the laws regarding the distribution and commercialization of internet generates new business models at micro and medium enterprise level, this through connection bridges that allow the arrival of the signal to various locations.

On the other hand, the sections of the article comprise the theoretical framework, in which a synopsis of the context of the research is made, as well as the importance of market research applied to various disciplines; this is followed by the data analysis that explains each of the variables that comprise the instrument; finally, there are the conclusions where a reflection is made regarding the findings in the commercial context, and the development of the localities, as well as the opportunities that microenterprises have in view of the market's behavior.

Theoretical framework

Marketing today plays an essential role in the survival of organizations; regardless of global trends and the causes of the pandemic that recently immobilized humanity in the common ways of receiving information through local media and transitory to everyday life; after this period of stagnation, it also brought optimistic effects by revolutionizing this discipline that is traditionally dedicated to "satisfying needs in a profitable way" this, in the approach of Kotler and Keller (2021, p. 5). In the same vein, Armonstrong and Kotler (2013, p. 5) point out that this discipline "is the management of profitable relationships with customers", as well as "is the provision of goods and services to meet the needs of consumers".

In Benassini's approach (2009, p. 26), "market research is the gathering, recording and analysis of all facts about problems related to the activities of individuals, companies and institutions in general". In the specific case of private companies, market research helps management to understand their environment, identify problems and opportunities, as well as to evaluate and develop marketing action alternatives. This assertion makes it possible to glimpse the need to penetrate the environment that surrounds us because it represents a society in constant evolution that requires interpreting these needs in order to contribute with marketing strategies that can be implemented in the environment.

Among other viable tools, it is useful the "Boston Consulting Group Matrix that allows you to give a more accurate location of the situation in which you are to adapt to new demands" (Hernández, 2014, p. 25), thus recognizing the orientation of consumers as a target market and subject of analysis to strategically consider the position in the market and the level of attractiveness of products or services.

In the same vein, it is necessary to mention that the Internet from the point of view of Sevilla (2020), is "a decentralized set of interconnected communication networks that use the TCP/IP family of protocols, ensuring that the heterogeneous physical networks that compose it function as a single logical network, with worldwide reach" (page 2). (p. 2). As Turban (2006) points out, it is a global network of computer networks, often referred to as the "Net". It connects the computing resources of commercial organizations, government, and educational institutions using a common computer communications protocol, TCP/IP. Both authors converge that this means of communication has been so rushed, that it provides the opportunity for connectivity to any being in the world, desiring the facilities from a low cost in any of the available applications to incorporate in turn the different corporations.

According to WEBINDEX report (2014), "the means and freedoms to fully utilize the Web are within the reach of only one in seven people on the planet". Figures that with the technological development and demand for Internet services, have been increasing at a dizzying pace, being mostly perceived as a result of the pandemic only three years to date.

Regarding the "World Wide Web", MDN Web Docs (2022) describes it as "an interconnected system of public web pages accessible through the Internet". MDN Web Docs (2022) describes it as "an interconnected system of public web pages accessible through the Internet". Therefore, the Web is corroborated as one of the applications created on the Internet.

Estimates by Vazquez (2014, as cited in Evans, 2011), indicated that by 2015, there would be a world population of 7.2 billion people who would have 25 billion connected devices, that is, an average of 3.47 connected devices per person, while the estimated population by 2020, there would be a world population of 7.6 billion people who would have 50 billion connected devices, that is, an average of 6.58 connected devices per person. What better way to dimension the paradigms and challenges facing humanity in a technological environment.

Consequently, and according to the publication of the Forbes Mexico website (2021) in its section called Future, "during the last five years, 22 million people have joined the Internet in Mexico, this because of the Covid-19 pandemic", which confirms a growth in the demand for technological services in a hasty manner.

Mexico currently has 129 million inhabitants, 80.9% of whom live in urban areas. The number of mobile devices connected in the country is 115.4 million, which constitutes 89.1% of the population, so that 92.01 million people are connected to the Internet, in addition to 100 million active profiles in social networks as Alvino (2021) points out, which represents that 1.25 number of users have more than one profile per social network.

The current state of the internet in Mexico, highlights that currently 100.6 million Mexicans are internet users through any device, which represents 78.6% of the total population. In addition, it is noteworthy that the main device on which Internet connections are generated are cell phones, since 96.5% of the population uses their cell phones to do so, that is, 123.5 million Mexicans (Rodriguez, 2023).

As described by the Whistleout site (2022), the types of internet in Mexico are as follows:

- a) Internet connection via telephone,
- b) Internet connection via ADSL
- c) Internet via cable TV
- d) Internet via fiber optics
- e) Internet at home

It is emphasized that the use of optical fiber is an important element in the transmission of information, which is a thin strand no thinner than a hair that is made of glass or silicon, the fiber cable is composed of the mantle, coating, jacket, tensors, core. What is transmitted are light pulses that indicate the bits and also the light intensity indicate the bit difference (Martin, 2015).

Mentions Ortega (2018) that "optical fiber is a thin strand of glass or fused silicon (whose thickness is approximately 0.1 mm) through which information is transmitted in the form of light pulses"; the technological advances described, are perhaps only the beginning of a period of navigation and communication throughout the planet, facilitating interconnection activities before any area of knowledge that leads to transcend multidisciplinary scopes the so-called information age, in which the development of societies is being perfected with the use of information technology, mass media leading to globalization.

Method

According to Mantilla (2015), the market research process refers to the objective and systematic process in which information is generated to assist in making marketing decisions.

Hence the decision to provide through this research an overview of what decisions are being made by this market segment, since since the year 2020 the connection needs in rural areas increased due to social distancing.

In this context, this study provides a scenario of identification of connection needs, as well as preferences to the so-called digital divide, which is a generic concept focused on the availability and material access of the population to the Internet in infrastructure conditions (Toudert, 2019).

The sample is taken in the localities of La Vuelta, El Aguacate and Lagunita, contemplating people between 30 and 50 years of age, which according to the statistics of the National Institute of Statistics and Geography (2020) are in the population range of 15 to 54 years with a record of 1314 people.

Calculating the sample based on a confidence level of 90%, which is reached with a total of 226 people, applying 237 surveys. With respect to data collection, an instrument was created that contemplates the following variables: sociodemographics, internet service contracting conditions, type of service, usage experience and loyalty to current brands.

Considering that according to the multifaceted model of internet access by Van Deursen and Van Dijk (2015), there are motivational conditions for accessing this service, as well as material access, followed by the user's skills.

Therefore, this research would be feeding information for the decision making of those companies that now commercialize internet in the area, which would be part of the material access variables of the aforementioned model.

The analysis is carried out at a descriptive level with the objective of showing the conditions of the service buyers' decisions.

Data analysis

Sociodemographic profile

The profile of the user of the Internet in these localities tends to be 46% Single and 47% Married, the rest in free union.

The study was carried out in the localities of El Aguacate, Lagunita, La Vuelta, which represent 11% of the population at the municipal level, which amounts to 18,794 inhabitants according to the INEGI census. The concentrated response rate is 76% in Lagunita, 15% in La Vuelta and 9% in El Aguacate.

One percent of the study population has an income of less than \$1,000 pesos, 51% has an income between \$2,500 and \$3,000 pesos per month and 39% has an income of more than \$4,000.00 according to the study presented. Taking into account the data from the Government in Data Mexico (2023) the average monthly salary in the fourth quarter of 2022 was \$3,360.00, in agreement with the study marked, marking a slight difference between what was stated by the people interviewed.

24.2% of the entire municipality has access to the Internet in 2022 according to Data Mexico (2023).

Name of locality	Total population	Population from 15 to 64 years old
El Aguacate	442	273
La Lagunita	926	585
La Vuelta	728	456
Total	2096	1314
Sample	242	226

Table 1 Population of surveyed localities

Source: INEGI (2020)

Terms of service

Criteria	Description										
Internet Service Usage	For home use including homework, use of network-connected devices 44%.										
Time of Service Usage	For business 46% and in both places 10%.										
Installation Costs	The use of internet service was concentrated in the pandemic and with it the following results: less than one month 17%; between one and six months 30%; from six months to one year 47%; and with more seniority 13% between one and three years.										
Payment per Month	Installation costs range from a minimum of \$550.00 pesos to a maximum of \$5,500.00 pesos.										
Market share by company	<table border="0"> <tr> <td>BSNetworks</td> <td>17%</td> </tr> <tr> <td>Roka 7</td> <td>19%</td> </tr> <tr> <td>Intelcom</td> <td>19%</td> </tr> <tr> <td>MY PC</td> <td>29%</td> </tr> <tr> <td>Other</td> <td>16%</td> </tr> </table>	BSNetworks	17%	Roka 7	19%	Intelcom	19%	MY PC	29%	Other	16%
BSNetworks	17%										
Roka 7	19%										
Intelcom	19%										
MY PC	29%										
Other	16%										

Table 2 Service conditions

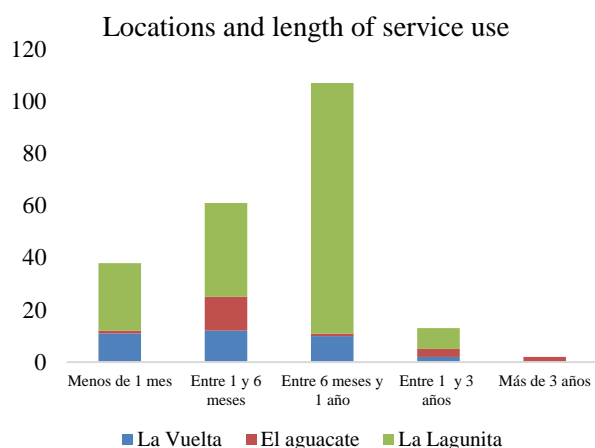
Source: Own elaboration

Table 2 shows the behavior of the current conditions of the Internet service, including the use given to the connection, the time of use in reference to the time in which the survey was conducted, the cost of installation given the material access to the network and how much is intended to pay for the service.

This information concentrates some of the elements that make up the multistage accessibility model described by Van (2015). In this analysis of the variable, the term "Internet appropriation" is added, which occurs on a territorial scale according to the size of the population, and depends on age, interests and in this case needs, which then obey that according to the territorial proportion, the geographically larger area would have greater connection conditions than smaller areas.

The use of the internet in this case is for communication needs, exclusively for domestic and business use to connect with transactions, use of social networks, and in some cases for "code sales" as it is called for the resale of internet access for a certain period of time.

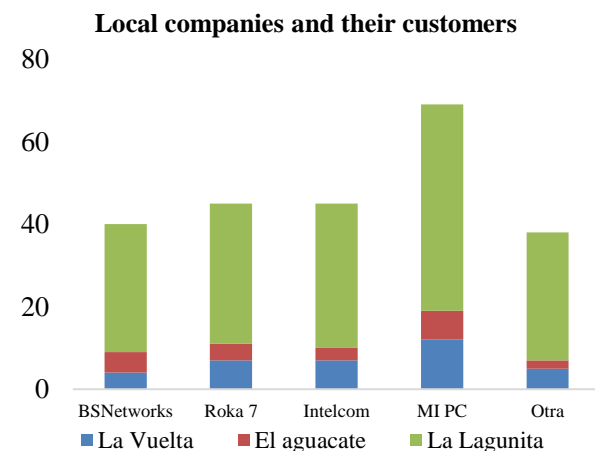
In addition, the probability of becoming a user, in this case and as shown in a variable below, smaller localities are more likely to have the service for reasons of coexistence and complementarity, as is the case of the locality of El Aguacate, which is the one that shows the greatest agreement with Graphic 1.



Graphic 1 Locations and length of time using the service

Source: Own elaboration

At the time of the survey and according to the sample that was taken, the users registered the greatest affluence of Mi PC, Roka 7, Intelcom, BSNetworks and another (Telmex).



Graphic 2 Local companies and their number of customers

Source: Own elaboration

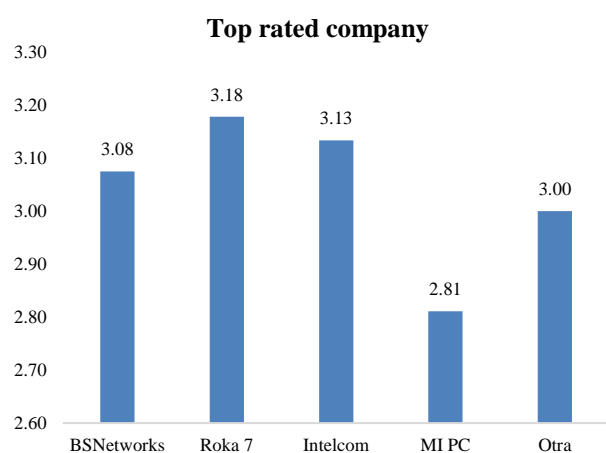
"In the case of the antiquity with which these arrived to the localities we have that in the first instance Intelcom was installed, followed by BsNetworks, to give way to MiPC and finally Roca7" this according to an interview with the owner of a telecommunications company in the area. (Chacón, F., personal communication, April 24, 2023).

Chacón (2023) mentions that these local internet providers can offer different types of connections, among the most common and well-known are fiber optics and ADSL. At the same time, these businesses make use of wholesalers such as these internet distributors, which in turn make use of wholesale services such as Telmex, Total Play or Axtel, IENTC and Marcatel.

According to data from the Federal Communications Institute (2022), the municipality of Landa de Matamoros has 123 fixed internet accesses with a preponderance in the market of the company América Móvil.

The most recognized brands at national level are Total Play, Grupo Televisa, Telmex and Megacable.

User experience



Graphic 3 Top rated company

Source: Own elaboration

The Federal Institute of Telecommunications (2022) conducts a study that describes the metrics of Satisfaction of Telecommunications Services, which have a scale similar to the NPS where the scale of 75 indicates a low evaluation, from 75 to 90 as medium, and from 90 to 100 as high. Considering satisfaction and quality, Total Play receives the highest evaluation with the highest number of mentions.

At the micro data level, as illustrated in Graphic 3. Best rated company, the evaluation of satisfaction with the current service indicates that Roka 7 has the best score, followed by Intelcom, BS Networks, Other and Mi PC.

Type of service

Criteria	Description														
Packet Type	A distinction is made between the basic, standard, high and SME plan. Of these, the most popular is the basic plan with 78% of the 237 surveys applied.														
Path through which the signal is received	97% receive the signal via antenna, which indicates that a specific installation is involved.														
Additional services provided	<table border="0"> <tr> <td>0 NA</td> <td>79%</td> </tr> <tr> <td>1 Security Systems</td> <td>1%</td> </tr> <tr> <td>2 Code sales</td> <td>3%</td> </tr> <tr> <td>3 Software</td> <td>3%</td> </tr> <tr> <td>4 Maintenance, software</td> <td>10%</td> </tr> <tr> <td>5 Maintenance and equipment</td> <td>4%</td> </tr> <tr> <td colspan="2">49% only contract Internet service.</td> </tr> </table>	0 NA	79%	1 Security Systems	1%	2 Code sales	3%	3 Software	3%	4 Maintenance, software	10%	5 Maintenance and equipment	4%	49% only contract Internet service.	
0 NA	79%														
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49% only contract Internet service.															

Table 3 Type of Service

Source: Own elaboration

The type of service is a reflection of the user's skills, since these define the additional services that can be consumed, that is, the use that the use of the connection has and that are derived from factors such as imitation, and that models purchasing behavior by imitating and adopting consumption trends, as stated by the cognitive theory proposed by Tejada (2005), which highlights this multi-stage model mentioned above.

These skills can be those focused on searching in browsers, filling out questionnaires, among others. This is why in Table 3. Type of service, we observe that contracting is reduced to the connection service in the basic plan. On the other hand, the contracting of additional services is derived in the time horizon, since the equipment requires maintenance.

Current evaluation

Company	Price	Customer service	Unloading speed	Security
BSNetworks	3.88	3.50	3.58	3.48
Roka 7	3.91	3.67	3.78	3.60
Intelcom	3.67	3.16	3.27	3.18
MY PC	3.07	2.64	2.55	2.61
Other	3.76	3.21	3.26	3.16
BSNetworks	3.40	3.40	3.18	3.49
Roka 7	3.69	3.60	3.36	3.66
Intelcom	3.24	3.24	3.13	3.27
MI PC	2.48	2.36	2.43	2.59
Other	3.13	3.24	3.05	3.26

Table 4 Current evaluation shows the perceived performance of the service provided through the contracting of Internet services, with emphasis on price, customer service, downloading, security, coverage, signal and packages

The perception of adequate performance may be influenced by brand loyalty and by the knowledge and experience acquired by people who use the same brand.

Thus, the overall average shown indicates that Roka 7 is the best evaluated company, having a competitive position in terms of customer service with a score of 3.66, followed in second place by BSNetworks.

Brand loyalty

Company	MP	P	PB	NP	Average
BSNetworks	15%	15%	23%	17%	17%
Roka 7	9%	16%	31%	25%	20%
Intelcom	9%	24%	19%	19%	18%
MY PC	60%	26%	13%	19%	30%
Other	9%	19%	13%	19%	15%

Table 5 Brand loyalty
Source: Own elaboration

Loyalty in the marketing context is the dedication that a customer feels towards a brand that pushes him to buy its products and/or services on a constant basis, regardless of competitors, price or convenience.

In terms of this research, there is a consistency in the relationship between brand loyalty and customer satisfaction, since the company with the highest position in service is Roka 7 and likewise in the loyalty indicator.

Followed on this occasion by Intelcom, which is one of the oldest companies in the area. In this case we can speak of an emotional connection with the Roka 7 brand, since it is managed by people from nearby locations, which increases the perception of security and quality when receiving the service.

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Conclusions

The Economic Commission for Latin America and the Caribbean in its book "digital economy for structural change and equality" (2013), points out that there is a relationship between internet access and per capita income having a higher incidence among municipalities that do not have internet, adding that access to education also suffers a significant impact.

In the commercial context, with the results obtained, the regional microenterprises can study the level of competitiveness in comparison with the rest of the companies, verifying the indicators in which they are strong.

Adding that the entry of fiber optic comes to add better quality in the internet conditions in addition to the investment or infrastructure needs are essential for a greater presence in the market.

According to the behavior of the market, and given the vision of the microenterprise, it is possible to turn to business models aimed at the hiring of consulting services for online purchases, services properly requested with the network such as financial services, remittances, among others. In addition, there is the generation of micro-enterprises with global presence thanks to the expansion of advertising through social networks.

In addition, this type of businesses that have emerged after the pandemic, have been conveniently placed in the interests of users since it is acquired as a primary need for communication, however after the increase in supply and technological trends will require marketing efforts focused on factors of stability in the connection linked to advertising actions that allow linking the perceived benefit and the offered.

On the other hand, it is worth mentioning that this type of studies can be enriched by describing the infrastructure characteristics of the companies, as well as by measuring the skills of internet use to give a broader picture of the market behavior and the existing supply Mohsenipour et al (2023).

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Digitalization and its impact on operational efficiency, competitiveness, and growth: MEFE-MEFI strategic analysis of the department of economic-administrative sciences at the Instituto Tecnológico de Nuevo León

Digitalización y su impacto en la eficiencia operativa, competitividad y crecimiento: análisis estratégico MEFE-MEFI del departamento de ciencias económico administrativas en el Instituto Tecnológico de Nuevo León

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Abstract

This study aims to analyze the impact of digitalization in strengthening the operational efficiency, competitiveness, and growth of the Department of Economic-Administrative Sciences at the Technological Institute of Nuevo Leon, using the strategic analysis MEFE and MEFI to evaluate the influence of its internal factors and external. Thus, we determine the current strategic position of the department, developing an action plan to improve the digitalization profile. Through the IE matrix, the scores from the EFE and EFI matrices are integrated, providing a clear understanding of the department's strategic position in the current educational context. The main contribution of the study lies in its ability to offer a detailed and strategic perspective that can be used to strengthen the department's digitalization initiatives, ensuring that it remains at the forefront of educational innovation and effectively responds to the demands of Nuevo Leon's dynamic business environment.

Este estudio tiene como objetivo analizar el impacto de la digitalización en el fortalecimiento de la eficiencia operativa, competitividad y crecimiento del Departamento de Ciencias Económico Administrativas del Instituto Tecnológico de Nuevo León empleando el análisis estratégico MEFE y MEFI para evaluar la influencia de sus factores internos y externos. Así, determinamos la posición estratégica actual del departamento, desarrollando un plan de acción para mejorar el perfil de digitalización. A través de la matriz IE, se integran las puntuaciones de las matrices EFE y EFI, proporcionando una comprensión clara de la posición estratégica del departamento en el contexto educativo actual. La contribución principal del estudio radica en su capacidad para ofrecer una perspectiva detallada y estratégica que puede ser utilizada para fortalecer las iniciativas de digitalización del departamento, asegurando que se mantenga a la vanguardia de la innovación educativa y responda efectivamente a las demandas del entorno empresarial dinámico de Nuevo León.

Strategic analysis, Educational digitalization, Operational efficiency
Resumen

Análisis estratégico, Digitalización educativa, Eficiencia operativa

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Introduction

Digitalization, with an impact comparable to that of the Industrial Revolution, has profoundly reshaped business and education dynamics. This transformation has become a strategic requirement for differentiation and success in the 21st century. Its importance lies in the ability of organisations to maintain their relevance in a globalised and technologically advanced marketplace, driving innovations and improvements in operational efficiency.

Thus, companies that choose not to prioritise digitalisation place themselves in a precarious position, running the risk of facing obsolescence and competitive disadvantage. This refusal to adapt to digital trends not only relegates them to the sidelines in terms of competition, but also impedes optimal and efficient operations, thus limiting their growth potential and responsiveness to unexpected market changes (Porter & Heppelmann, 2015).

Digitisation in higher education refers to the integrated use of digital technologies to transform educational services and processes, improving accessibility, personalisation of learning and administrative efficiency. This process includes the adoption of online learning, open educational resources and learning management systems, which together extend the boundaries of the traditional classroom and democratise education (Díaz et al., 2022). Its relevance is manifested in the creation of flexible and adaptive learning environments that support the development of essential digital competences.

In higher education, digitisation has revolutionised the paradigm of learning and teaching. The integration of technologies such as e-learning, open educational resources and learning management systems has extended the boundaries of the classroom, allowing wider and more democratised access to education. Recent research illustrates how digitisation has contributed to the creation of more flexible and adaptive learning environments, thus supporting the development of skills relevant to the digital age and fostering a culture of continuous learning that is indispensable in today's labour market. However, the transition to digitised educational environments is not without its challenges. (Díaz et al., 2022)

The digital divide, the quality of online pedagogy and cyber security are concerns that academics and institutions must address. The success of digitisation in higher education depends not only on technological infrastructure, but also on the ability of institutions to adapt their curricula and pedagogical methods to the new digital modalities.

Problem to be solved

Digitalisation has substantially reshaped industries and the education sector is no exception. The Department of Economic and Administrative Sciences at the Instituto Tecnológico de Nuevo León (ITNL) faces the challenge of integrating digital technologies into its operations and curriculum to improve operational efficiency, competitiveness and labour relevance, as well as enrolment growth. Although the COVID-19 pandemic in 2020 served as an unexpected catalyst for radical transformation in higher education, change has been forced especially in public educational institutions where economic, technological and human resources are not easy to adapt to contextual needs, leading to rapid but often improvised adaptation in order to ensure the continuity of the teaching-learning process.

Thus, faced with the closure of the campus and the impossibility of conducting face-to-face classes due to national health regulations in relation to the pandemic, ITNL found it necessary to adopt emerging technologies and accelerate curricular digitisation and technological training of its teachers, making them critical elements for educational success in an unexpected situation. The rapid adoption of online learning platforms has not only been essential to maintain educational momentum, but has also driven an unprecedented wave of teacher training and upgrading, as teachers have had to familiarise and master digital tools and online pedagogical methodologies to maintain the quality and effectiveness of knowledge delivery.

Digitisation, once a complementary facet of education, has come to occupy a central role, highlighting the resilience and flexibility of institutions and teaching staff in the face of the unprecedented challenges of the current era. (García et al., 2021).

However, the transition to a more digital educational environment requires a comprehensive assessment of how external and internal factors can facilitate or impede this process. Thus, the central problem of this study lies in: To analyse the impact of digitalisation on strengthening the operational efficiency, competitiveness and growth of the Department of Economic Administrative Sciences at ITNL, employing MEFE and MEFI strategic analysis to assess the influence of its internal and external factors.

Hypothesis

The application of MEFE and MEFI in the Department of Economic and Administrative Sciences will reveal key areas for the adoption of strategies that will improve its digital transformation, positively impacting its efficiency, competitiveness and growth.

The originality of applying the External Factor Evaluation Matrix (EFEM) and Internal Factor Evaluation Matrix (IFEM) analysis to analyse the impact of digitalisation in a higher education institution lies in its concrete and contextualised approach. Unlike other techniques that might be more generalist or less structured, MEFE and MEFI allow for a detailed analysis of external and internal factors, providing a strategic framework that can reveal unique insights and facilitate informed decisions in academia. This strategic analysis technique brings to the subject a systematic approach to identify how digitisation can be harnessed for educational institutional development and growth.

The introduction of this study addresses digital transformation as a disruptive and catalytic force that redefines operational efficiency, competitiveness and growth in academia. It is therefore necessary to identify and analyse the specific characteristics and implications of digitalisation in higher education. We will clarify the central problem of how digitisation can be strategically integrated into ITNL's CEA Department to improve its performance and hypothesise that a meticulous application of the MEFE and MEFI methodologies will reveal a strategic path for its implementation.

In the section "Digital Contextualisation in Higher Education: Impacts and Perspectives", previous research and theories regarding the digital phenomenon are discussed, followed by the presentation of the section entitled "Methodology" where it is outlined how MEFE and MEFI will be applied to collect and analyse data. The article will conclude with an analysis of the findings and strategic recommendations that will highlight the adaptability and forward-looking vision that ITNL and in particular its CEA Department will need to maximise the opportunities that the digital age brings.

Digital contextualisation in higher education: impacts and perspectives

In addressing the issue of digitisation in higher education, the academic literature offers a wide range of studies examining its multifaceted effects. Alenezi et al. (2023) in their article "The Need of Integrating Digital Education in Higher Education: Challenges and Opportunities" explore the dichotomy of digitisation, arguing that while it offers accessibility and new channels of communication, it also presents challenges in the form of distractions and superficiality of student engagement. This balance between advantages and disadvantages is crucial to understanding operational efficiency in higher education.

On the other hand, Trombly (2020) in his work "Learning in the time of COVID-19: capitalizing on the opportunity presented by the pandemic" discusses how digitisation has enabled universities to expand their educational offerings beyond the physical boundaries of the campus. This has not only increased operational efficiency by facilitating access to learning anytime, anywhere, but also improved competitiveness by allowing institutions to reach a wider and more diverse global audience.

In "A SWOT analysis on acceptance of mooc in Malaysian higher education: the learners' perspective" by Albelbisi et al. (2022), it is highlighted how online education platforms, such as MOOCs (Massive Open Online Courses), have fostered unprecedented growth in higher education by democratising access to knowledge.

However, Albesini also points out that digitisation requires an overhaul of traditional teaching and learning models as well as institutional infrastructure to keep up with modern expectations.

With the increasing prevalence of learning analytics, Madrid & Oller (2023) argue convincingly about how big data and analytics can improve strategic decision-making, personalise the learning experience and optimise resource allocation, which is crucial for operational efficiency and institutional growth.

Competitiveness in higher education is also influenced by technological innovation, as explained by Christensen et al. (2011) in "The Innovative University: Changing the DNA of Higher Education from the Inside Out". They argue that institutions that embrace disruptive innovation not only survive, but thrive in an increasingly competitive educational environment, as they are better able to adapt to rapid market changes.

Finally, Zambrano & Meza (2022) reflect on the broader societal impact of digitisation, indicating that while digital technologies have offered opportunities for growth and expansion, they have also raised questions about equity and access, challenging institutions to consider how digitisation can best serve society as a whole.

On the other hand, digitisation has established itself as a fundamental pillar of operational and administrative competitiveness within academic departments, acting as a key enabler for process optimisation and improved decision-making (Madrid and Oller, 2023). With the implementation of learning management systems and integrated databases, academic departments have achieved greater efficiency in resource management, student tracking and curriculum management. In addition, advanced analytics and digital collaboration tools have enabled a more agile and effective response to the demands of the educational environment, increasing the ability to adapt to emerging trends and meet the needs of a diverse student body, as discussed by Esteban et al (2022).

These digital innovations not only improve internal operations but also place educational institutions in a more competitive position globally, broadening their reach and attractiveness in the international educational market.

These studies offer a mosaic of perspectives that illustrate the complexity of the impact of digitisation on higher education. Operational efficiency, competitiveness and growth are viewed through the lens of accessibility, innovation and equity, providing an in-depth understanding of the challenges and opportunities presented by the digital age in academia.

Methodology to be developed

The methodological design of the study on the impact of digitisation on ITNL's CEA Department combines MEFE and MEFI methodologies to provide a detailed strategic analysis of external and internal factors. It is both descriptive and analytical research, as suggested by Yin (2014) in his work on case studies, as it allows for an in-depth exploration of contemporary phenomena within their actual contexts. By applying a mixed approach, this study aligns with the methodology proposed by Hernández et al. (2010), integrating qualitative and quantitative methods for a holistic understanding of digitisation. Primary data collection will be conducted through interviews, following Taylor & Bogdan's (1984) guidelines for qualitative research, where an unguided Focus Group interview will be conducted with teachers and administrative staff of the department, while the documentary analysis will follow the systematic method of content analysis described by Krippendorff (2022). The sample, selected through non-probabilistic sampling, reflects Patton's (2001) recommendation for qualitative studies focusing on relevance and depth. Regarding data analysis, quantitative techniques specific to MEFE and MEFI analysis will be applied, emphasising triangulation for data validation, as promoted by Flick (2018), ensuring the consistency and reliability of the findings.

Strategic analysis MEFE (external factor evaluation matrix)

The MEFE methodology is a strategic approach that, as indicated by Serna (2013), allows for a systematic assessment of how factors such as legislative changes or technological innovations impact educational organisations. This tool, applied to the CEA Department, facilitates the identification of opportunities, such as emerging trends in education, which can be exploited to improve academic offerings and digital infrastructure, as suggested by David (2008) and Galindo (2004).

About threats, the MEFE enables the recognition and mitigation of adverse factors, such as budget cuts or academic competition, along the lines of Vargas (2003) in his analysis of organisational strategies. The weighting and rating of these external factors is based on a scale of relevance and influence, an approach explained in detail by Hill & Westbrook (1997) in "SWOT Analysis: It's Time for a Product Recall"; and finally, the cumulative score provides a comprehensive perspective of the strategic state of the Department.

In the MEFE analysis, opportunities and threats represent key elements of an organisation's external environment that can significantly influence its performance and strategy. Here is what each represents:

Opportunities, defined by Johnson, Scholes & Whittington (2011), are those external factors that can be leveraged to achieve or exceed intended strategic objectives. This includes aspects such as government policies that promote the integration of digital technologies in education, highlighting the importance of keeping up with emerging educational trends and technological advances that facilitate learning and administration, as discussed by Cabrera & Bonache (2004).

These are positive external factors that the organisation can capitalise on to achieve its strategic objectives. Opportunities may present ways to strengthen the organisation's competitive position, improve its efficiency, increase its market share, or address other key areas for growth and success.

In the academic context, opportunities could include emerging trends in education, technological advances, changes in labour market demands, favourable government policies, strategic alliances, among others. Recognising and taking advantage of these opportunities can help the organisation adapt, innovate and remain relevant in a changing environment.

Threats, on the other hand, are elements of the environment that could prevent the achievement of objectives, such as budget cuts or unfavourable legislation, and require careful management. According to Ponce (2007) understanding these threats is essential to develop strategies to mitigate their impact and maintain organisational stability in the long term. In academia, this could mean adjusting to new regulations or seeking alternative forms of funding to ensure the viability of programmes and projects. Threats are negative external factors that could hinder or damage the organisation's performance. Threats are aspects of the environment that the organisation needs to manage or mitigate to avoid adverse impacts on its long-term stability and objectives.

In an academic department's environment, threats could include unfavourable regulatory changes, funding cuts, increased competition, evolving student needs that do not align with current offerings, among others.

Identifying and understanding these threats is crucial to develop strategies to minimise their impact and to prepare the organisation to respond effectively.

In MEFE analysis, opportunities and threats are essential tools for understanding an organisation's external environment. By identifying and assessing these factors, the organisation can develop more informed and targeted strategies to maximise opportunities and minimise or counteract threats.

Following Ponce's (2007) recommendations, these are the steps to apply it to the Department:

1. **Identification of External Factors:** Compile a list of external factors relevant to the Department, such as economic trends, changes in educational legislation, technological innovations, and competitive movements in the higher education market.
2. **Assigning Weightings:** Each external factor is weighted according to its relative importance to the Department, on a scale of 0.0 (not important) to 1.0 (very important).
3. **Assignment of Ratings:** Each external factor is assigned a rating based on the effectiveness of the Department's current response to that factor, on a scale of 1 (poor response) to 4 (superior response). Leaving the scales 4 and 3 to measure opportunities and strengths, and for threats and weaknesses to assess them with values of 2 and 1, the latter being the most critical.
4. **Multiplication of Weightings and Ratings:** Multiply the weighting of each factor by its rating to obtain a weighted score.
5. **Sum of the Weighted Scores:** Add all weighted scores together to obtain the total for the Department, which can range from 1.0 (lowest) to 4.0 (highest).
6. **Analysis and Interpretation:** Evaluate the total score to determine whether the external environment is generally favourable or unfavourable for the Department.

Subsequently, once the internal and external environment has been evaluated, the Internal-External Evaluation (IE) matrix is constructed as a nine-cell table that facilitates the determination of the corporate strategy based on the analysis of internal and external elements. This tool uses as a basis the weighted total score data derived from the EFE and EFI matrices to position the company or its various strategic business units in a specific place within the matrix.

As discussed by David (2011), this matrix provides a dual framework to not only diagnose the overall strategic situation of a company, but also to assess and compare the individual performance of each of its divisions or business units.

Like the BCG matrix, the IE matrix is also used to graphically represent a company's divisions, which has earned it a place among the portfolio analysis tools (David, 2011); however, the IE matrix differs from the BCG matrix in key aspects such as the configuration of the axes and the amount of information required, with the IE matrix being more detailed.

The IE matrix is built on two fundamental dimensions: the total values of the EFI matrix on the horizontal axis and those of the EFE matrix on the vertical axis. Each strategic business unit should make its own EFI and EFE matrix to contribute to the overall analysis of the company, as described in the strategy literature (Johnson, Scholes & Whittington, 2011; David, 2011).

In structuring the Internal-External Evaluation (IE) matrix, the weighted totals translate into an accurate assessment of the strategic position of each division of the company. As detailed by David (2011), an EFI matrix score ranging from 1.0 to 1.99 indicates an internal weakness, located on the horizontal axis of the IE matrix, while a score of 2.0 to 2.99 reflects average internal capability, and a score of 3.0 to 4.0 demonstrates considerable internal strength. In parallel, on the vertical axis, a weighted EFE matrix total ranging from 1.0 to 1.99 is perceived as low, 2.0 to 2.99 is considered medium, and 3.0 to 4.0 is categorised as high, implying a strong external influence.

4	3	2	1
3	I	II	III
2	IV	V	VI
1	VII	VIII	IX
	Grow and build		
	Resist and contain		
	Eliminate or harvest		

Table 1 ITNL CEA Department's IE Matrix.
Source: Wheelen & Hunger (2012), Strategic Management and Business Policy: Toward Global Sustainability. Pearson

The IE matrix, as analysed by Wheelen & Hunger (2012), is segmented into three key strategic zones. Divisions in the top quadrants I, II and IV are oriented towards growth and build strategies, applying intensive tactics such as market penetration and vertical and horizontal integration. For those in a middle position (quadrants III, V and VII), stabilisation and maintenance strategies are recommended, where market penetration and product development are often a priority. Finally, divisions in the lower weighting zone (quadrants VI, VIII and IX) tend to focus on harvesting or divestment strategies, seeking to optimise the business portfolio towards more advantageous positions, close to the upper left quadrant of the IE matrix.

Results of the MEFE matrix of the Department of Economic and Administrative Sciences of the Instituto Tecnológico de Nuevo León

The results obtained reveal a promising outlook in terms of opportunities, with a subtotal of 1.78, highlighting the inherent strength of its environment and education initiatives. The results reflect a favourable strategic position to capitalise on trends in technological innovation and Monterrey's dynamic entrepreneurial ecosystem, both with a top score indicating the high potential of these opportunities to positively influence the department. Developments in online and distance education, along with emerging technologies in the business sector, are factors that the department can leverage to enhance its educational offerings and align with modern expectations for teaching and learning.

In contrast, the threat analysis presents a subtotal of 0.79, suggesting that although significant risks exist, their impact is mitigated by the strong opportunities identified. It is critical to address government education policies and federal funding constraints, which received the lowest rating, pointing to the urgent need for adaptation strategies. Accreditation regulations and academic competition, along with the implications of the COVID-19 pandemic, present challenges that the department must carefully manage to maintain its competitiveness and educational quality.

	Factor	Value	Calification	Weighted result
OPPORTUNITIES	O1. Trends in Technological Innovation	0.08	4	0.32
	O2. Monterrey's Entrepreneurial Ecosystem	0.07	4	0.28
	O3. Developments in Online and Distance Education	0.07	4	0.28
	O4. Emerging Technologies in the Business Sector	0.06	4	0.24
	O5. Changes in Student Demand	0.06	3	0.18
	O6. Collaborations with Industry	0.06	3	0.18
	O7. Developments in Innovative Teaching Methodologies	0.05	3	0.15
	O8. Influence of International Education Organisations	0.05	3	0.15
SUBTOTAL		0.5		1.78
THREATS	A1. Government Education Policies	0.09	1	0.09
	A2. Federal Funding for Education	0.07	1	0.07
	A3. Academic Competence	0.07	2	0.14
	A4. Accreditation and Quality Education Regulations	0.06	2	0.12
	A5. Impact of the COVID-19 Pandemic	0.06	2	0.12
	A6. Social and Cultural Pressures	0.05	2	0.1
	A7. Ethical and Legal Aspects of Digitisation	0.05	2	0.1
	A8. Local and Global Labour Market Dynamics	0.05	1	0.05
SUBTOTAL		0.5		0.79
		1		
TOTAL MEFE				2.57

Table 2 MEFE matrix of the ITNL CEA Department
Sourc: Own elaboration based on interviews with key teaching and administrative staff

Thus, with a total MEFE of 2.57, the CEA Department is in a slightly advantageous position to advance its digitisation, but must be proactive in managing threats to ensure its continued progress and success. Its score places it slightly above the average of 2.5 and hints at the importance of threat management.

Results of the MEFI matrix for the Department of Economic and Administrative Sciences of the Instituto Tecnológico de Nuevo León

The MEFI matrix for the Department of Economic and Administrative Sciences of the Instituto Tecnológico de Nuevo León highlights both internal strengths that can be capitalised on and weaknesses that require strategic attention.

With a weighted total of 2.44, the results show a positive trend in the internal potential of the department to address digitisation. Among the strengths, the department's privileged location in an area of technological innovation and the high faculty training by professional services, both with the highest rating and weighting, stand out, reflecting the department's ability to integrate and take advantage of technological advances and advanced teaching expertise. The specialisation in the last semester stands out as a differentiating element that allows rapid adaptability to market needs, while the agreements with industry and the dual education model are valuable resources that strengthen the academic link with the business sector.

In contrast, weaknesses highlight critical areas that require significant improvement, such as the shortage of specialised software and insufficient technological infrastructure, which limit the development of essential practical skills. Resistance to change and limitations in teacher technology training pose additional challenges in the transition to more modern, digital teaching methods. Restricted funding and the centralised curriculum design process are factors that could hinder the timely and effective updating of academic programmes. These critical points, along with the lower training of unionised teachers, require decisive intervention to ensure that the department not only maintains its relevance, but also positions itself as a leader in business education in today's digital context.

	Factor	Value	Calification	Weighted result
STRENGTHS	F1. Location in the Technological Innovation Zone	0.08	4	0.32
	F2. Teachers by Professional Services with high qualification	0.07	4	0.28
	F3. Specialisation in last semester	0.08	4	0.32
	F4. Federal Funding	0.06	3	0.18
	F5. Growing Student Demand for the degree programme	0.06	3	0.18
	F6. Academic Agreements with Industry	0.06	3	0.18
	F7. Dual educational model in the last semester	0.05	3	0.15
	F8. Unionised basic teachers	0.05	3	0.15
SUBTOTAL		0.51		1.76
WEAKNESSES	D1. Shortage of specialised software	0.07	1	0.07

D2. Insufficient technological infrastructure for student demand	0.06	1	0.06
D3. Resistance to change	0.04	1	0.04
D4. Limitations in technological training for teachers	0.06	1	0.06
D5. Technological gap in the classroom	0.06	2	0.12
D6. Funding Limitations for Updating	0.07	2	0.14
D7. Centralised Process of Curriculum Design	0.06	2	0.12
D8. Less Training of Unionised Teachers	0.07	1	0.07
SUBTOTAL		0.49	0.68
		1	
TOTAL MEFI			2.44

Table 3 ITNL CEA Department MEFI Matrix

Source: Own elaboration based on interviews with key teaching and administrative staff

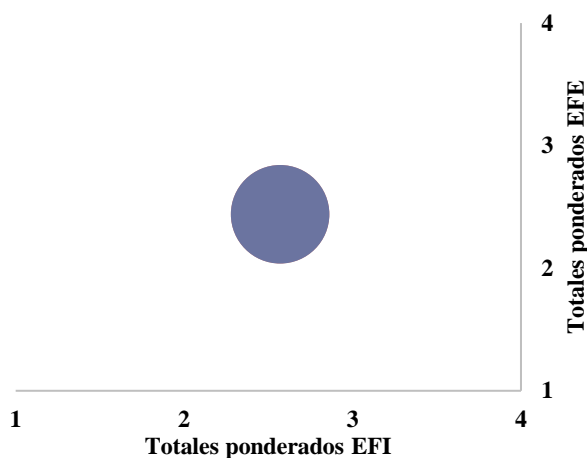
A score of 2.44 on the MEFI matrix, slightly below the midpoint of 2.5, suggests that the Instituto Tecnológico de Nuevo León's Department of Economic and Administrative Sciences has a balance of internal strengths and weaknesses that influence its ability to adapt and grow in the context of educational digitalisation. This assessment highlights that the department possesses a number of operational and strategic strengths that are almost aligned with standard practices, but still faces significant challenges that need to be addressed to reach and exceed the optimal performance threshold.

To move beyond the current score and above average, it is recommended that an action plan be implemented that focuses on technology modernisation, curriculum process review and streamlining, and continuous professional development for teaching staff. By addressing these key areas, the department will not only improve its MEFI score, but also strengthen its position in an increasingly competitive and digitised educational environment.

Development of the EI Matrix

The EI matrix of the Department of Economic and Administrative Sciences was constructed using the consolidated scores of the EFE and EFI matrices, which respectively assess the external and internal factors that impact the organisation.

With a score of 2.57 on the EFE matrix, significant opportunities and threats in the department's environment were identified, while the EFI matrix, with a score of 2.44, reflected the strengths and weaknesses of its internal capabilities. These results were cross-referenced in a nine-quadrant scheme to position the department in the IE matrix, placing it in quadrant V with a weighted value of 2.505, representing a medium strategic situation. This positioning is based on a balanced assessment of how external conditions and internal capabilities align with the department's current objectives and strategies, providing a framework for formulating strategic action plans and allocating resources to improve its competitive and operational situation.



Graphic 1 IE Matrix

Source: Own elaboration based on data from the MEFE and MEFI tables

This position suggests that the department has a mix of moderate operational and strategic strengths, but also faces challenges that require attention to avoid compromising future progress and development.

Conclusions

The following recommendations are based on maximising the strengths and opportunities, while minimising the weaknesses and threats identified in the matrices, in order to improve operational effectiveness, competitiveness and enrolment growth in the department of Economic and Administrative Sciences (EAS). The following strategic actions are proposed based on the MEFE and MEFI analysis:

Actions Based on the MEFE Matrix:

1. **Develop Online and Distance Education Programmes:** Take advantage of trends in technological innovation and developments in online education (O1 and O3) to expand the educational offer and reach a wider audience.
2. **Strengthen Collaboration with Industry:** Utilise existing collaborations with industry (O6) to develop internship and apprenticeship programmes, thereby increasing the attractiveness of the programmes offered.
3. **Pedagogical Innovation:** Invest in developments in innovative teaching methodologies (O7) to improve educational quality and attract students interested in modern and effective learning methods.
4. **Strategic Marketing:** Employ Monterrey's entrepreneurial ecosystem (O2) as a marketing point to highlight unique networking and professional development opportunities for students.

Actions Based on the MEFI Matrix:

5. **Technology Upgrade:** Address the shortage of specialised software (D1) and the technology gap in the classroom (D5) by investing in new technologies and teacher training.
6. **Infrastructure Upgrade:** Improve the technological infrastructure (D2) to meet student demand, which could increase retention, attract new students and improve the employability of graduates by developing technological skills that are relevant to the labour market.
7. **Continuous Teacher Training:** Overcome limitations in technological teacher training (D4) by offering continuous professional development programmes in new technologies and pedagogical methods.

8. **Flexibilisation of Curricular Design:** Revise the centralised process of curricular design (D7) to allow for greater agility and adaptability in the updating of study programmes, ensuring their relevance and attractiveness to prospective students and ensuring labour relevance upon graduation through the design of the career speciality.

By implementing these actions, the CEA department could significantly improve its competitive positioning and attractiveness to prospective students, which in turn could translate into growth in enrolment and greater effectiveness in its operation. It is crucial that these strategies are accompanied by continuous evaluation to ensure that they are aligned with the long-term goals of the department and the Institute as a whole, as well as the changing needs of the educational environment and the labour market.

Recommendations from the EFI Matrix:

1. **Consolidation Strategies:** Given that the department is in an average position, consolidation strategies, such as continuous improvement of quality and efficiency in educational and administrative processes, are critical.
2. **Enhancing Strengths:** It must capitalise on its current strengths, such as partnerships with the business sector and strategic location, to improve its position in the EI matrix.
3. **Address Weaknesses:** It is essential to address weaknesses, such as technology infrastructure and faculty training, to move the department into a more favourable quadrant.
4. **Professional Development:** Implement professional development programmes for teachers, with special emphasis on educational technology and innovative teaching methods.

5. **Strategic Funding:** Seek alternative sources of funding to overcome the limitations of federal funding to invest in technology infrastructure and educational software, such as partnerships with the business sector, funded research projects, among others.

Thus, while the department is not in a critical position, it is not in an ideal position to lead in an increasingly competitive and digitised educational environment. Adopting strategies focused on consolidating and strengthening key areas would improve its rating in the EI matrix and thus its competitive and operational capacity in the future.

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Assessment of the sustainability of the coffee production system in the south sierra coast of Oaxaca

Valoración de la sostenibilidad del sistema de producción de café en la sierra sur costa de Oaxaca

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Abstract

The sustainability of specialty coffee production in four municipalities in the Sierra Sur Costa region of Oaxaca is evaluated. The methodology used in the study was mixed. First, a documentary review of the theoretical approach to sustainable development and the background of coffee production in Oaxaca was carried out. In the second stage, exploratory questionnaires were designed and applied to 55 producers in the municipalities of Candelaria Loxicha, Pluma Hidalgo, San Agustín Loxicha and San Juan Ozolotepec (Hernández, Fernández & Baptista, 2006). Subsequently, a physical and quality analysis was made of 127 samples of specialty coffees from the Sierra Sur and Coast of Oaxaca collected in the UNTAO dry coffee mill. It was found that the main variables that explain the sustainability of the specialty coffee value chain in the environmental-productive, human-social and economic dimensions are the type of wet mill, production yields per hectare, the price agreed upon in the commercialization of parchment coffee, and the commercialization and organization networks.

Value chain, Sustainability, Specialty coffee

Resumen

Se evalúa la sostenibilidad de la producción de café de especialidad de cuatro municipios la región Sierra Sur Costa de Oaxaca. La metodología utilizada en el estudio fue de corte mixto. En un primer momento, se llevó a cabo una revisión documental del enfoque teórico de desarrollo sostenible y de los antecedentes de la producción de café en Oaxaca. En el segundo, se diseñaron y aplicaron cuestionarios exploratorios dirigidos y orientados por redes (Hernández, Fernández & Baptista, 2006) a 55 productores de los municipios de Candelaria Loxicha, Pluma Hidalgo, San Agustín Loxicha y San Juan Ozolotepec. Posteriormente, se hizo un análisis físico y de calidad de 127 muestras de cafés de especialidad de la Sierra Sur y Costa de Oaxaca acopiados en el beneficio seco de café UNTAO. Se encontró que las principales variables que explican la sostenibilidad de la cadena de valor de café de especialidad en las dimensiones ambiental-productiva, humano social y económica son: el tipo de beneficio húmedo, los rendimientos de producción por hectárea, el precio pactado en la comercialización de café pergamino y las redes de comercialización y organización.

Mercados, Agropecuario, Exportar

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Introduction

Sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (UN, 1987). In essence, sustainable development in coffee farming is a process of change in which there is a rational use of the resources of the territory where the productive activity takes place, decent working conditions to achieve food subsistence, efficient infrastructure and training expenditures, fair prices and harmonious governance to achieve social welfare (UN, 2015).

According to the Food and Agriculture Organization of the United Nations (FAO, 2018), a common vision for sustainable food and agriculture is created based on three dimensions: 1) Environmental dimension; 2) Social human dimension and 3) Economic dimension and in turn five key principles are formed: (a) Increase productivity, employment, added value; (b) Protect and boost natural resources; (c) Improve livelihoods; (d) Enhance resilience of people, communities and ecosystems; (e) Adapt governance to new challenges.

The analysis of coffee farming in Mexico and Oaxaca is of great importance because it is an economic activity that generates thousands of jobs and generates benefits for consumers and different actors in the value chain. Due to its importance, coffee transactions represent 0.66% of the national agricultural GDP and 1.3% of the production of agro-industrial goods" (CEDRSS, 2018).

In the Mexican Republic, 14 states are recognised as bean producers, "Approximately 85% of the coffee produced in Mexico is arabica variety and 15%, robusta. The government is promoting robusta production because of its resistance to coffee rust and its consumption in soluble and capsule coffee" (INFORURAL, 2020). According to data from the Agrifood and Fisheries Information Service (SIAP, 2019), the national production volume of cherry coffee in 2019 was 910,063 tonnes; showing an increase of 7.0% compared to 2018.

There are almost 710,000 hectares planted in the country and of these, only 88.6% are harvested, which shows a latent abandonment of the plots and leads to reflect on the causes of this situation.

State	Surface (ha)		Production (ton)
	Sown	Harvested	Retrieved
COLIMA	2,693	2,684	3,316
CHIAPAS	252,744	231,611	367,789
GUERRERO	45,384	40,729	38,465
HIDALGO	23,084	22,738	29,224
JALISCO	3,487	3,487	4,791
MEXICO	546	508	576
MORELOS	27	26	36
NAYARIT	16,197	7,559	6,491
OAXACA	136,150	111,197	75,724
PUEBLA	69,222	64,005	154,709
QUERETARO	199	199	8
SAN LUIS POTOSI	16,202	16,196	9,539
TABASCO	358	358	418
VERACRUZ	143,256	128,031	218,976
TOTAL	709,548	629,325	910,063

Table 1 Area sown, harvested and production of cherry coffee (National)

Source: Prepared with data from the Servicio de Información Agroalimentaria y Pesquera (SIAP, 2019)

Of the fourteen producing states, those with the highest production volume are Chiapas with a share of 40.4% of total production, Veracruz is in second place with 24.1%, Puebla is in third place with a share of 17% and Oaxaca is in fourth place with 8.3%.

Between 2018 and 2020, production remained constant, being mostly arabica. Of the production, 73% is normally exported to the United States and Europe (USDA, 2020) through large and small importers and the rest is used for domestic marketing and self-sufficiency consumption of small producers and their families, since in the country "about 90% of producers have areas of less than five hectares" (Bartra, 2006) and are therefore based on family farming (CEDRSS, 2018).

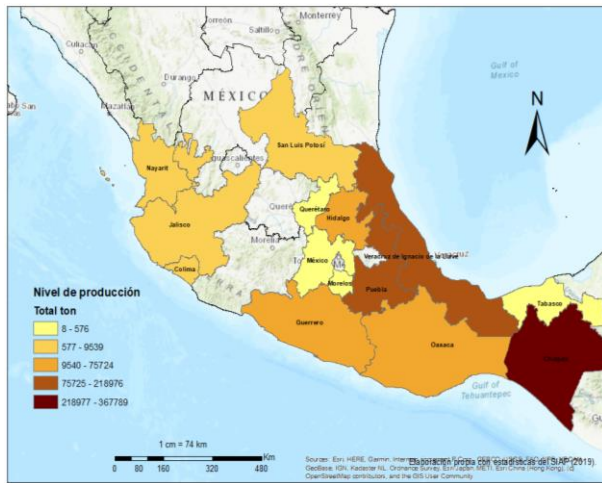


Figure 1 Map of coffee production levels in Mexico
 Source: Prepared with information from SIAP (2019)

The production yield per hectare varies according to the location of the plots in the states, as well as climatological aspects, altitude and varieties planted. Among the states with higher yields are Puebla, Veracruz, Chiapas and Morelos, associated with greater technological innovation than in other states and better control and scheduling of the production process, from renewals to fruit cutting.

The states with lower yields are: Querétaro, San Luis Potosí, Jalisco and Oaxaca. It is inferred that the first three could be due to natural factors such as soil type, altitude and rainfall, diseases and lack of technological innovation. The case of Oaxaca stands out, a state that historically had a production of more than eight tonnes per hectare until the 1980s and after the coffee crisis between 1989 and 1994, its yield per hectare has been declining in recent decades due to the effects of climate change, the emergence of pests and diseases, lack of technological innovation, increased production costs and the incorporation of organic coffee certification systems, which in itself has been directly shown to generate a decrease of up to 20%.

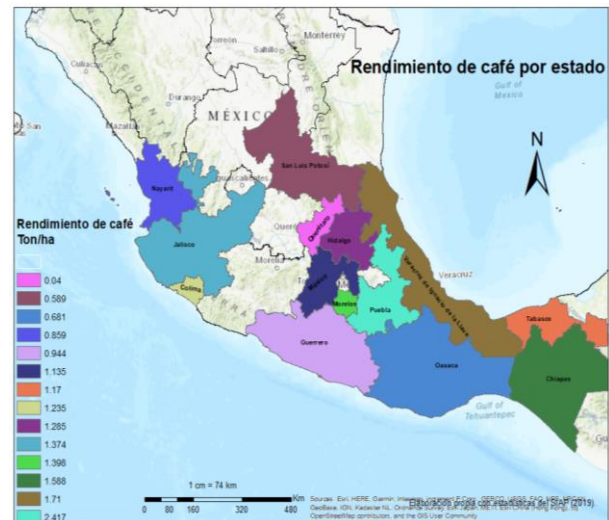


Figure 2 Coffee yield map by state, Mexico
 Source: Prepared with data from SIAP (2019)

In Mexico, as worldwide, there are large imbalances in the level of production, production costs, transport and industrialisation. According to data from SADER (2020) "approximately 35% of Mexico's coffee production is high altitude coffee of high quality, located at 900 m above sea level or higher. Another 43.5% grows between 600 and 900 meters above sea level. Newly planted areas have shifted to more pest-resistant varieties such as Oro Azteca, Marsellesa, Costa Rica 95, Sarchimor and varieties from Nicaragua and Guatemala. The new pest-resistant varieties require full sun; however, several cooperatives are working to produce traditional shade-grown varieties" (INFORURAL, 2020).

Mexican shade-grown coffees in agroforestry zones, with good altitude and humidity, are known for their high quality and the creation of organoleptic attributes. In cupping competitions for excellence in cupping, as well as in company cuppings, coffees with attributes and good acidity have been found from the states of Veracruz, Chiapas, Oaxaca, State of Mexico and Puebla.

The variation in world prices continues to affect commercial transactions in Mexico. Prices in recent years have fluctuated between 40 and 45 pesos per kg of parchment coffee.

Despite the differences in costs, the price of conventional Arabica coffee is governed by the quotations on the New York stock exchange, as well as by the fluctuations caused by the supply of producers and coffee organisations, consumer demand and the interest of large importers and distributors in the different types of coffee and their origins by state, which means that the price of coffee is constantly changing (CEFP, 2001).

The production situation of the coffee system in Oaxaca

In the production system of Oaxaca, located in the South of Mexico, as the fourth largest coffee producing state in the country, the opportunities of natural capital for the benefit of the coffee value chain are realised, due to "the great variety of ecosystems, animal and plant species and microorganisms; genetic variability of wild and cultivated species" (CONABIO, 2019) due to its agrobiodiversity, multiculturalism and the rugged geography of its territory, which leads it to be considered an ideal place for the development of microclimates and for agroecological and traditional management in the production of aromatic coffee.

According to statistics from the National Institute of Statistics and Geography (INEGI), there are an estimated 56,291 coffee-producing family units (INEGI, 1997) in seven regions of Oaxaca: Cañada, Costa, Istmo, Mixteca, Papaloapan, Sierra Sur and Costa, with a planted area of 136,000 ha (SIAP, 2018). Although some farmers' organisations have estimates of producers according to their areas of influence, there is no updated census of coffee producers at the state level.

In Oaxaca, coffee was introduced approximately in the last decades of the 19th century in the Sierra Sur-Costa region. The largest plantations were established in what is now known as La Providencia in Pluma Hidalgo, where 40,000 coffee plants were initially planted, and in the following years, relatives and friends of the initial group of entrepreneurs took over the expansion of production to other regions of the state (Pérez Akaki, 2013).

During the 19th century, Oaxacan coffee production came second to Veracruz (Bartra, Cobo & Paz, 2011), and later, due to the coffee boom in the Chiapas soconusco, between 1940 and 1950 Oaxaca occupied third place. In the 1990s, during the coffee crisis, Oaxaca came to occupy fourth place in coffee production, a situation it will remain in until 2020. Among the main causes are attributed to the decrease in production, budget cuts in agricultural programmes, the emergence of pests and diseases "such as the coffee berry borer and rust" (INEGI, 2016), and water erosion resulting from the passage of Hurricane Paulina along the coast.

According to the latest data recorded by the Ministry of Agriculture and Rural Development in 2018, 136,098 ha of coffee were planted in Oaxaca, 41% of which were located in the Sierra Sur-Costa region. In the state, 48% was harvested and in the Sierra Sur-Costa region only 13%. State production reached 31,409 tonnes, and that of the region 1,292 tonnes. The average yield for the state was 0.47 ton/ha and for the Sierra Sur-Costa region 0.2 ton/ha, which is very low compared to the rest of the regions of the state and other producing states in the country.

Despite the fact that in the different coffee-producing regions of Oaxaca, producers share common problems derived from the world price crisis, as well as production systems that reinforce social inequalities (Silva, 2006), Oaxaca continues to be an agro-exporter with high demand for coffee in the national and international market, which is why it is located in the first places in coffee exports to Canada, the United States and Austria, according to reports from the state's Ministry of Economy.

Oaxaca has been recognised since its insertion in the agro-export chain of aromatic coffee as a state with lands with a "quality comparable to El Soconusco in Chiapas" (Bartra, Cobo & Paz, 2011), especially those of the Coast and Sierra Sur.

Therefore, as a strategy to boost marketing and recover the quality of coffee produced in Oaxaca, in 2020, the Mexican Institute of Industrial Property (IMPI) declared the area of production comprising 30 municipalities in the Sierra Sur and Costa regions of Oaxaca as a Protected Designation of Origin (DO) for Café Pluma: "Candelaria Loxicha, Pluma Hidalgo, San Agustín Loxicha, San Baltazar Loxicha, San Bartolomé Loxicha, San Francisco Ozolotepec, San Gabriel Mixtepec, San Juan Lachao, San Juan Ozolotepec, San Mateo Piñas, San Miguel del Puerto, San Miguel Panixtlahuaca, San Pablo Coatlán, San Pedro el Alto, San Pedro Pochutla, Villa de Tututepec de Melchor Ocampo, Santa Catarina Juquila, Santa Catarina Loxicha, Santa María Huatulco, Santa María Ozolotepec, Santa María Temascaltepec, Santiago Xanica, Santiago Yaitepec, Santos Reyes Nopala, Tataltepec de Valdés, Putla Villa de Guerrero, San Pedro Mixtepec, San Marcial Ozolotepec, San Sebastián Coatlán and San Jerónimo Coatlán" (DOF, 2020). It must be said that the extent of the improvement in the economic benefits for the population is not yet visible. According to the testimonies of the producers themselves, the DO will hardly reflect higher incomes for their families, because the procedures to obtain the certificate are very costly. Moreover, there is no difference in the selling price of coffee because of its origin, as buyers respond to different market segments and look for better prices.

The study area

The study area is located in the Sierra Sur-Costa of Oaxaca. Due to its geographical location, the region has rugged terrain, with "an influx of humid winds from the Pacific and Atlantic Ocean" (Canseco, 2019), considered an ideal place for the development of microclimates due to the sea level that ranges between 1200 and 1600 m.a.s.l., as well as for the development of agroecological and traditional management in the production of aromatic coffee. The territorial coverage of this study considers four municipalities that have an important affluence of water as it crosses the middle part of the Copalita River and is in a strategic location in relation to the coastal zone: Pluma Hidalgo, Candelaria Loxicha, San Agustín Loxicha, San Juan Ozolotepec and San Pedro el Alto.

The municipality of Pluma Hidalgo has three types of climates in particular, sub-humid, warm and semi-humid humid; the average annual rainfall is 1500 mm cubic (DOF, 2020). Pluma Hidalgo crosses the Sierra Madre del Sur, among its mountains are the Cerro de la Pluma, Cerro León and Cerro de las Nieves (INAFED, 2019). Its altitude is between 600 to 1600 m.a.s.l. above sea level (INEGI, 2019). It has three types of climate: sub-humid, warm and semi-warm humid; the average annual rainfall is 1500 mm cubic metres (DOF, 2020).

Candelaria Loxicha is located between the hills Perico, el Chilar, Miramar and Cerro Cruz, with sufficient water from the rivers: Molino, San Juan, Culebra, Milpa, Los Peces, Cuajinicuil and Sol (INAFED, 2019). With a temperate climate with summer rains and an altitude between 0 and 2200 m.a.s.l., the best altitude for coffee production is between 1300 and 1600 m.a.s.l.; with a temperature between 15 and 30 degrees Celsius.

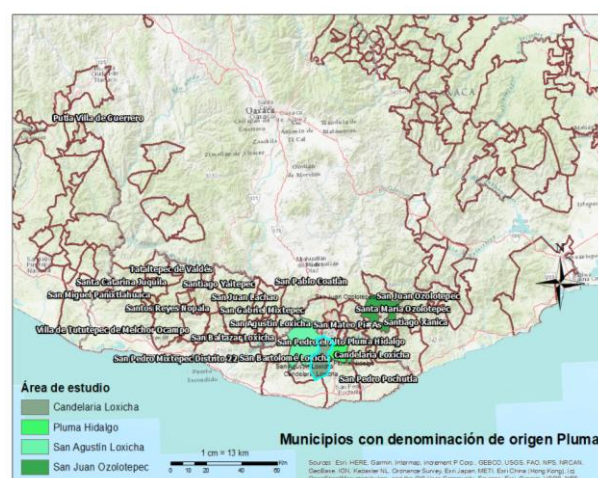


Figure 3 Map of the study area

Source: Own elaboration with data from SIAP (2019)

San Agustín Loxicha is located in the Sierra Sur mountain range, surrounded by the Cerro de la Bruja, Cerro de la Grana and Cerro Cantor (INAFED, 2019). It also has sufficient water from the Copalita River, Yogondoy River and Sapo River. The average altitude is 1820 m above sea level.

Candelaria Loxicha and San Agustín Loxicha are between 18 and 22 °C (García et al., 2017).

While San Juan Ozolotepec is located in the Sierra de Miahuatlán, between the mountains of Cerro Pelón, Cerro Sirena, Cerro Corona, El Balcón and Cerro de Agua, between 1200 to 3700 m.a.s.l. (INEGI, 2019), with water available from small streams that are not of great flow such as La Cofradía Santa Cruz, La Plaga and Yuviaga. The municipality is characterised by four climates: temperate sub-humid with summer rains (58.05%), semi-warm humid with abundant summer rains (23.62%), semi-cold sub-humid with summer rains (14.71%) and warm sub-humid with summer rains (3.62%) (INAFED, 2019).

San Pedro el Alto is located in the "coastal zone of San Pedro Pochutla, at an altitude of 2,300 metres above sea level, at coordinates 16°02' north latitude and 96°28' west longitude" (INAFED, 2019). The temperature range is between 12-22 °C. Water supply comes from the Copalita, San Miguel, San Marcial and Molino rivers, with intermittent supply from the Carrizal, Santa Ana and Valdeflores streams.

Methodology and techniques for the generation of information

In order to assess the sustainability of coffee production in the Sierra Sur region of Oaxaca, variables in three dimensions were evaluated: environmental production, human social and economic.

Human social dimension	Productive environmental dimension	Economic dimension
Age	Location of the plot	Cost of production ha.
Sex	Area cultivated with coffee	Type of marketing
Indigenous affiliation	Yield per hectare	Market segment
Schooling.	Plant ages	Price
Work experience in coffee.	Renewal of plants	Coffee quality
Training in specialty coffee production	Varieties of coffee grown, presence of coffee plants	
Membership of a farmer organisation or grouping	Water availability	
	Pests and diseases	
	Type of wet milling.	

Table 2 Dimensions and variables assessed

Source: Variables adapted to FAO (2018) dimensions of sustainability

Sample definition

Three eligibility criteria were used to define the study population, these are inclusion, exclusion and elimination (Arias-Gómez et al., 2016); which comply with the process of ensuring that the findings are representative and that the results can be extrapolated to other municipalities in the same micro-region.

Considering the inclusion criterion as a starting point, the finite population of coffee producers from the Sierra Sur Costa de Oaxaca that appear in the Producers' Register of the Production for Wellbeing Programme (SADER, 2021) in the four study municipalities are included. There are 2,495 producers registered in the coffee system.

The formula proposed by Ronald Walpole was used to calculate the sample size for the mean "If used as an estimate of μ , one can have a confidence of $(1 - \alpha)$ 100% that the error will not exceed a specified amount e when the sample size is". (Walpole, 1992):

$$n = \left(\frac{z_{\alpha} \sigma}{e} \right)^2 \quad (1)$$

$(1 - \alpha)$ = level of confidence

$$z_{.025} = 1.96$$

An interval was also estimated for the mean with a confidence level of $1 - \alpha = 0.95$. In the application of a previous study it was established that the standard deviation (σ) is 1514 kg in total production per producer, using a margin of error of 400 kg.

$$n = \left(\frac{(1.96)\alpha}{\frac{2}{400}} \cdot 1514 \right)^2 \quad (2)$$

$$n = 55.03$$

Thus, 55 questionnaires were applied to a subset of producers who have participated in training processes for the production of speciality coffees or who have started marketing small quantities of green and roasted coffee to direct buyers based on the quality results of their coffee.

As an exclusion criterion and in order to save time and resources, producers who are not participating in the commercialisation of their coffee for national distribution or export are excluded, in such a way that 60% of the interviewees interact with the dry processing link for the transformation of parchment coffee to green coffee and establish interaction networks and commercialisation strategies.

As a second instrument, for the analysis of quality and price in the governance dimension, cupping results of 128 coffee samples from the dry mill of the National Union of Agricultural Workers (UNTAO, 2020) were reviewed.

Results

Social human dimension

Regarding the social and human capital linked to coffee production, it was found that 55% are men and 45% women, figures that coincide with the ownership data of the five municipalities in the Padrón de Productores para el Bienestar 2021. According to the Women's Coffee Alliance (AMUCAFE) (IWCA 2021), more and more women are joining the different links in the sector's chain, from the field to marketing and processing.

The average age of the interviewees is 52 years, with a standard deviation of 18.5 years, conditions similar to those reported by García-Domínguez et al. (2021) for the case of the Mixe region and Ramírez-Gonzales (2006) study in Puebla. It is identified that despite the fact that there is a generalised decrease in the number of young people due to generational change (García-Domínguez et al., 2021, Aguirre et al., 2016; Jiménez-Barbosa et al., 2018), 100% of the people interviewed show interest in continuing training to improve the quality of the coffees.

The indigenous identity of the producers interviewed is 18%, which is low compared to other studies in coffee producing areas in Oaxaca, and this is due to the fact that almost three quarters of those interviewed are originally from Pluma Hidalgo, which is a municipality that emerged with the coffee boom in the 19th century (Gonzales, 2012) and is therefore not a town with indigenous ancestry.

The level of education is positively or negatively associated with the adoption of technologies and knowledge (Rodríguez-Urrego, 2019) and therefore with the competitiveness of the sector (Muñoz and Santoyo, 2010). Of the participants, 21% are illiterate, most of whom are over 60 years old, 35% have incomplete or complete primary education, 24% have complete or incomplete primary education, 6% have high school and 14% have higher education. It is worth mentioning that these data do not coincide with the figures for the bulk of producers, due to the fact that 14% of the producers involved in specialty coffee production have university education or are part of training and technical accompaniment teams, as well as producers who migrated to train and are now promoting their parents' plots towards the production of specialty coffees.

88% of the small producers responded that they had no relations with peasant or agricultural organisations; however, the participant observation identified that most of them sympathise with small local organisations, many of them collect coffees, manage training courses, provide guidance on coffee management and marketing strategies.

Among the local groups and organisations with which producers establish cooperation, collaboration, training and/or marketing relationships are: the "Unión de San Pedro el Alto" group, UPIZ SUR de San Agustín Loxicha, Jacaralito, UNECAFE, Unión de Productores de Café de Especialidad Pluma, S.P.R. de R.L., the group of organised producers of San Juan Ozolotepec, groups of producers in San Agustín Loxicha, Caravela Coffe, Red Label Coffe.

Environmental dimension of production

The location of the plots is part of the comparative advantages as a starting point for value generation. It was found that 71% of the producers have their plots in Pluma Hidalgo, 11% in San Juan Ozolotepec, 5% in San Agustín Loxicha and 4% in Candelaria Loxicha. The comparative advantages provided by the territories facilitate the scaling up of goods (Dussell, 2008).

In this sense, the territorial organisation of rurality is where "productive and transformation processes that contain historical processes underlying the value chain are developed" (Rionda and Ramírez, 2008). Territoriality addresses biotic and abiotic, social and cultural aspects, as well as management modalities (Delgadillo, 2002).

Producers in the study area have differences in the size of their plots, 5% have more than 50 ha, which can be considered farms, 3% have 15-30 ha, 13% have more than five ha, and 80% have between 0.5% and 2 ha. However, statistics from the Padrón de productores bienestar (2021) show that the average area planted by small producers is 1.9 ha in Candelaria Loxicha, 2.2 ha in Pluma Hidalgo, 1.5 ha in San Agustín Loxicha, 2 ha in San Juan Ozolotepec and 1 ha in San Pedro el Alto. According to the Diagnosis of the Strategy for Technical Accompaniment of Production for Well-being in the Coast-Pochutla Region, in Pluma Hidalgo, the plots are 100% private property, in contrast to San Pedro el Alto, where 100% are communal. In Candelaria Loxicha and San Agustín Loxicha, communal and ejido land can be identified.

	Candelaria Loxicha	Pluma Hidalgo	San Agustín Loxicha	San Juan Ozolotepec	San Pedro el Alto
Mean	2.0	2.2	1.5	2.0	1.0
Standard error	0.1	0.3	0.1	0.4	0.1
Median	1.0	1.0	1.0	1.0	1.0
Mode	1.0	1.0	1.0	1.0	1.0
Standard deviation	1.7	3.2	2.2	3.2	0.8
Range	10.0	18.0	18.0	15.0	3.0
Minimum	0.0	0.0	0.0	0.0	0.0
Maximum	10.0	18.0	18.0	15.0	3.0
Sum	439.8	214.6	1154.7	151.0	115.8
Count	220.0	96.0	767.0	75.0	115.0
Confidence level(95.0%)	0.2	0.6	0.2	0.7	0.1

Table 3 Area sown

Source: Prepared with information derived from questionnaires to 55 producers in the Sierra Sur - Coast of Oaxaca

According to questionnaire responses, the average yield for the 2020-2021 harvest was estimated at 1.7 quintals/ha, which is lower than the figure established for financial profitability. The municipality of San Agustín Loxicha had the highest yield with 2.2 quintals/ha, followed by the municipalities of San Pedro el Alto with 1.9 quintals/ha, San Juan Ozolotepec with 1.78 quintals/ha, Candelaria Loxicha with 1.07 quintals/ha, and finally Pluma Hidalgo with 1.38 quintals/ha (Table 4).

The municipality with the lowest yield is Pluma Hidalgo, producers attribute this to climate change, the effects of tropical storms and hurricanes, the abandonment of plots due to low prices, the drop in production after the emergence of the rust plague and the changes in temperature associated with the passage of hurricane Paulina in 1997.

No. Producers	Mun.	plot size (ha)	Sup. sembr(ha)	Prod. 2020-2021 (quintal)	Rend. (quintal/ha)
2	Candelaria Loxicha	2	1.5	3.69	1.07
39	Pluma Hidalgo	18	5	5	1.38
3	San Agustín Loxicha	6	0.9	2.8	2.2
6	San Juan Ozolotepec	2.1	1.5	3.1	1.78
5	San Pedro el Alto	8.2	2.8	5	1.9
55		7.26	2.34	3.918	1.792

Table 4mPlot size, area sown and sample production

Source: Producers determine the equivalence of a quintal to a 47 kg sack

The yield of coffee production per hectare affects sustainability because it reflects financial profitability. In the publication Productivity and potential profitability of coffee (*Coffea arabica* L.) in the Mexican tropics by Espinosa-García et al., (2016) shows that "coffee cultivation is profitable when more than 4500 kg of cherry coffee per ha. is produced" (p. 2011). (p. 2011), which is equivalent to at least 450 kg of parchment coffee, which converted to quintals of fifty kg corresponds to seven sacks of parchment coffee per hectare.

In terms of information on plants, it was found that there is an introduction of different varieties in all the producers' plots. Eighty-one percent of the farmers reported having the Typica or Criollo Pluma variety, 47% have Bourbon Rosado, 43% have the Marsella variety, 23% have some plants from Costa Rica and Geisha. The least represented plants in the growers' plots are Mundo Novo, Oro Azteca, Colombia, Sarchimor, Robusta, Caturra Rojo and Garnica. Varieties are of great importance in improving coffee quality.

The Mexican varieties identified by Escamilla et. al (2015) in Mexico are: Pluma and Tipica 947 as higher quality, Garnica Iquimique with high productivity and Oro Azteca and Garnica F5 as rust resistant. According to reports by Ramírez (2022) in San Pedro el Alto "31% of the varieties used are rust tolerant, 69% grow Típica and Borbón" (Ramírez, 2022), while in Pluma Hidalgo 90% of the varieties used are rust tolerant, the rest are old Typica and Borbón plants.

Plant age and renewal periods are also important. Like all living beings, plants have an age of maximum production, then "maximum productivity between 6 and 8 years of age, after which the plant gradually deteriorates and its productivity decreases to levels of low profitability" (Arcilla Pulgarin, 1993). In Pluma Hidalgo, Candelaria Loxicha and San Pedro el Alto, the oldest plants are more than fifty years old. In Pluma Hidalgo there are plantations that have not been renewed for 30 years and in Candelaria for 10 years. San Agustín Loxicha is the municipality with plants between 12 and 40 years old, where valuable efforts are being made to renew coffee. The youngest plants are located in San Juan Ozolotepec, where individual efforts have also been made to renovate plants.

Municipality	Plant ages (years)	Last renewal time (years)
Pluma Hidalgo	70, 60, 50, 40, 20, 15, 10, 5, 3, 2, 1	30, 10, 5, 2 and 1
San Pedro el Alto	60, 40, 30, 20, 10, 5, 3, 2, 1	20, 10, 5, 2 and 1
Candelaria Loxicha	50, 40, 30, 10 and 5	10, 3 and 1
San Agustín Loxicha	40, 20, 12 and 4	4 and 1
San Juan Ozolotepec	20, 10, 15 and 5	5 and 1

Table 5 Age and renewal of plants

Source: Elaborated with information derived from the application of questionnaires to 55 producers in the Sierra Sur - Coast of Oaxaca

Regarding vegetation, fauna and diversification in the plots, in Pluma Hidalgo the existence of plants and fruit trees is reported, such as: banana, cacao, avocado, guanabana, lemon, orange, mandarin, mamey, lime, loquat, nopales, lemon tea, pineapple, mango, and depending on the microclimate various trees: cuajunicuil, mahogany, macuil, cuil, guanache, macahuite, palo de piedra, palo puto, mahogany, cedars, etc.

In Candelaria Loxicha there are cacao, guanabana, banana, lemon and pitagaya, in the lower parts, in the higher parts pine, oak and oyamel forests. The fauna among the coffee plots are armadillo, parakeet, deer and squirrel. In San Agustín Loxicha in the lower parts there are lime, orange, guava, mango and soursop trees. In San Juan Ozolotepec there is maize, beans, avocado, potato, among others, as well as mesophyll and pine forest; while the fauna present in the plots are squirrels, opossums, gophers, white-tailed deer, foxes and rabbits.

Among the main production problems reported are: the emergence of pests and diseases (81%), economic resources to face production costs (67%), the growth of weeds (34%), low governmental support with technological packages (32.7%), lack of knowledge in the selection and reproduction of their seeds (30.6%), lack of training in the processes of production, and lack of knowledge in the selection and reproduction of their seeds (30%). 6%), lack of training in wet milling processes (6.10%), erosion and/or loss of soil nutrients (6.10%), climate change (6.10%), little technological innovation in production (6.10%), differences in the way of cutting and harvesting the fruit (4.10%), lack of knowledge of new wet milling processes (2%), lack of plantation management (2%), other problems (2%).

In terms of phytosanitary problems, rust (*Hemileia vastatrix*) was present in 90% of the plantations reported in the study. The coffee berry borer is the pest affecting 70% of the plots. Since the CBB spread in Oaxaca 30 years ago, it is now seriously affecting a large part of the crops throughout the state. Meanwhile, rooster's eye affects 45% of the plots and the borer (4%). According to the Oaxaca State Plant Health Committee, "43.16% of the cultivated coffee area in the state of Oaxaca is affected by CBB" (CESVO, 2019; Zavala, 2019).

Regarding harvesting, up to three periods were identified, which is attributed to differences in height, position with respect to the sun and amount of shade. Plots with higher temperatures are harvested first and mesophilic forest areas last. In Pluma Hidalgo the period extends from November to February.

In Candelaria Loxicha and San Agustín Loxicha it is from December to February. In San Juan Ozolotepec from January to March. In Finca Chelin de Candelaria Loxicha, the domestication of the plant was identified in order to achieve a single maturation and thus save harvesting costs.

In the Sierra Sur Costa region, three wet milling processes are used in the production of speciality coffees: washed, natural and honey. More than 90% of the producers carry out washed coffee processes, which consists of the elimination of impurities, followed by pulping, fermentation in wooden vats or water drums and in some cases they use carbonic maceration fermentation, adapting a hose with a small can to release oxygen and maintain an ambient temperature in the fermentation process. Few producers use natural or honey processes.

Economic dimension

Management costs, which include payments for cleaning and shade management per hectare, are between \$3000 and \$5000, depending on the slope of the plot.

Harvesting costs range from \$8,000 to \$15,000 per cut per hectare, and can be two cuts or more depending on whether selective cutting is used and the type of wet milling, as well as the distance from the plot to the farm or the farmer's house.

In terms of production and marketing costs, the highest costs are presented in the payment of daily wages to workers during the harvesting period, followed by the purchase of fertilisers and manure, as well as labour for plant renovation and wet milling. Only 4% of the interviewees spent on transport outside the community, maquila service, threshing and export service.

Eighty-six percent of the producers mentioned that the biggest costs they incur are labour costs for harvesting cherry coffee.

Regarding the types of marketing, 62% of the producers market their coffee in parchment, 2% in green coffee and 46% in roasted and ground coffee.

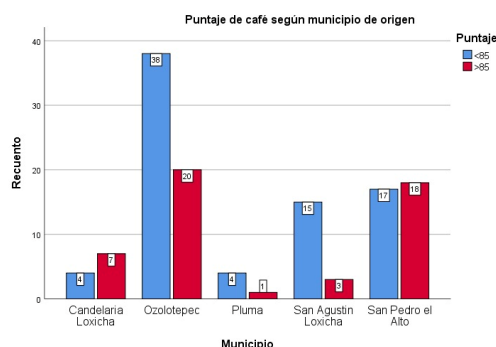
The selling price of parchment coffee in the 2019-2020 harvest ranged between \$2,200.00 and \$2,500.00 per quintal of conventional coffee (46 kilograms) and \$3200 for a quality coffee, which is equivalent to an average of 48, 55 and 70 pesos per kg respectively. In the 2021-2022 harvest, the price of parchment coffee per kilogramme of speciality coffee ranged between 75 pesos and 110 pesos depending on price fluctuation at the time of sale and the bargaining power of producers.

Producers in San Juan Ozolotepec, Candelaria Loxicha and San Agustín Loxicha market their coffee mostly in parchment presentation. Producers in San Pedro el Alto market green coffee and producers in Pluma Hidalgo are in the different segments, parchment coffee, roasted and ground coffee and speciality coffee.

In terms of the main marketing problems, 82% of the producers responded that the low prices are not enough to cover the expenses that are invested, and 26% responded that they do not know the cup quality of their coffee, because they have not carried out a cupping process to find out their scores. Twenty-four per cent responded that there is a lack of government support and 20 per cent that there is a lack of innovation in the processes.

In the same way, small producers establish relationships with other small producers and day labourers in the planting and harvesting processes.

In terms of quality analysis, information from the UNTAO dry mill cupping laboratory was analysed for 60 tonnes of coffee through 128 samples from the territorial coverage of the study, and the following results were found regarding quality in the five municipalities of analysis:



Graphic 1 Cup score (crop 2021)

Source: Results of cupping of coffees from the municipalities of San Agustín Loxicha, Pluma Hidalgo, Candelaria Loxicha, San Pedro el Alto and San Juan Ozolotepec, analysis carried out in the cupping laboratory of the dry mill Unión Nacional de Trabajadores Agrícolas (UNTAO) S.P.R de R.L

For a coffee to have the potential to be marketed as a speciality coffee on the international market, a cupping score above 85 is required, according to interviews with international buyers.

Of 127 samples analysed originating from five municipalities in the Sierra Sur, 61% were found to be below 85 cup points and 39% above 85 points, reflecting the high quality of the bean. These scores are above the reports presented by the Strategy for Accompanying Production for Wellbeing (2022), because they are part of batches of coffees from producers who have at least three years participating in the export of their coffees to the United States, Germany and Canada.

The municipalities with the best yields in the transformation process from parchment coffee to green coffee are in the municipality of Candelaria Loxicha. While the beans with the least defects and the largest size are found in San Pedro el Alto, San Agustín Loxicha and San Juan Ozolotepec. The average export percentage is 75%. Likewise, the coffees with the best cup quality scores are found in Candelaria Loxicha, showing that the samples from the municipalities analysed are above 85 points, which makes them elegant or speciality coffees.

According to the price analysis for the 2021 speciality coffee harvest and marketing cycle, the most highly valued coffee is from Candelaria Loxicha, specifically from Finca Chelin, which reaches \$5.20 dollars per pound on average, which translates into \$228 pesos per kilogramme. This is followed by the municipalities of San Pedro el Alto, San Agustín Loxicha with a projected average price of \$154 pesos per kilogramme. In third place are the coffees of Pluma Hidalgo, San Juan Ozolotepec and Candelaria Loxicha outside of Finca Chelin's production, with a price of between \$110 and \$125 pesos per kilogramme green. By 2022, the differential with respect to the price paid in 2021 was \$125 to \$200 per kilogramme.

Annexes

Appropriate tables and sources.

Acknowledgement

Indicate if they were financed by any Institution, University or Company.

Conclusions

In the human-social dimension, it was found that the average age of producers involved in the value chain of high quality coffees is 52 years compared to 58 years for the bulk of producers, which indicates that younger people are becoming interested in alternative coffee segments to conventional coffee.

There are also more women involved in the production processes of speciality coffees than women in the bulk of conventional production.

Indigenous identity is not directly linked to coffee production in the municipalities of Pluma Hidalgo and San Juan Ozolotepec. The educational background of the producers has a positive effect on technological and process innovation in the wet milling of coffee.

In the productive environmental dimension, it is identified that the conditions of the extension of the planted plot, varieties, nutrition, diseases and age of the plants directly affect coffee yields, the main variable for productive environmental sustainability.

The best yields are found in San Agustín Loxicha, San Juan Ozolotepec and San Pedro el Alto.

In the economic dimension, it was identified that the main factors affecting commercialisation are price differentiation and the existence of organisational and commercialisation networks. It was found that the municipalities with the highest yields are the most organised for commercialisation, and that they provide traceability to their lots and microlots. The producers of San Juan Ozolotepec are a group of producers who market their parchment coffee directly in the dry mill in the city of Oaxaca, which allows them to negotiate a better price than in local marketing. Producers from the San Pedro el Alto Union export their coffee directly in green coffee to Canada. The producers of San Agustín market their coffee in parchment in the community and in the dry mill for export, with the importer's condition that there is transparency in the price paid to the producer. Pluma Hidalgo producers market their coffee mostly in the roasted and ground segment in the domestic market, with the added value of bean quality and bag packaging.

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Analysis of the competitiveness of MSMEs in the trade sector of the San Martín Texmelucan Region, for the establishment of financial strategies

Análisis de la competitividad de las MiPyMes en el sector comercio de la Región de San Martín Texmelucan, para el establecimiento de estrategias financieras

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Abstract

This article presents the results of the research carried out in the first quarter of 2023 using SMEs in the San Martín Texmelucan region as a study factor. The general objective of the research was to know the degree of competitiveness that MSMEs in the San Martín Texmelucan region specifically in the trade sector, which has around 1711 companies registered with the Mexican Business Information System (SIEM). The methodology that was carried out was developing mixed research, the data collection technique was a questionnaire of 46 closed questions with a Likert scale, 582 surveys were applied to different companies in the region of San Martín Texmelucan. The most important contribution made was to develop strategies to increase the competitiveness of MSMEs in the trade sector in the San Martín Texmelucan region.

Competitiveness, SMEs, financial strategies

Resumen

En el presente artículo se presentan los resultados de la investigación realizada en el primer trimestre de 2023 tomando como factor de estudio a las PyMes de la región de San Martín Texmelucan. El objetivo general de la investigación fue conocer el grado de competitividad que las MiPyMes de la región de San Martín Texmelucan específicamente del sector comercio, que tiene alrededor de 1711 empresas registradas ante el Sistema de Información Empresarial Mexicano (SIEM). La metodología que se llevó a cabo fue desarrollando una investigación mixta, la técnica de recolección de datos fue un cuestionario de 46 preguntas cerradas con escala de Likert, se aplicaron 582 encuestas a diferentes empresas de la región de San Martín Texmelucan. La contribución más importante que se realizó fue desarrollar estrategias para incrementar la competitividad de las MIPYMES del sector comercio de la región de San Martín Texmelucan.

Competitividad, PyMes, Estrategias financieras

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Introduction

The lack of access to finance generates a shortage of financial resources in MSMEs, generating a limited purchasing power that impacts on the investment of new technologies, and also the fact that the owners and proprietors of MSMEs do not have financial training leads to a poor management of resources, which impacts on the competitiveness of the company. The term MSMEs is an acronym that comes from "Micro, Small and Medium Enterprises" and these companies play an important role in the productive sector of nations, both in industrialised countries and in less developed countries, as is the case of Mexico (Ministry of Economy, 2022).

According to data from INEGI (2019), micro, small and medium-sized enterprises are of great importance in Mexico's development, as they represent 52% of the gross domestic product (GDP) and are responsible for 72% of jobs.

Strategy is a procedure for decision making and/or action in the face of a given scenario. This, seeking to achieve one or more previously defined objectives (Westreicher, 2020).

And the financial strategy according to Roncancio (2022) is a plan aimed at optimising financial resources. The most successful strategies contain three central elements: in-depth knowledge of financing, characteristics, terms, conditions and analysis of alternatives.

Therefore, the general objective of this research was to know the degree of competitiveness of MSMEs in the SMT region, specifically in the commerce sector, which has around 1711 companies registered in the Mexican Business Information System (SIEM); however, the research will be carried out with 582 companies. This research allows MSMEs to obtain guidance on the importance of financial strategies, to create relationship links between MSMEs in the commerce sector and the different groups that exist in the region to support decision-making, promoting their degree of competitiveness, raising awareness of the importance of good internal control to improve the effectiveness and optimisation of resources.

This article is made up of 5 sections, initially presenting the methodology that was developed, and then presenting the results, conclusions, bibliographical references and acknowledgements.

Methodology

The research carried out was mixed, the information was collected through a questionnaire of 46 sections that was applied to 582 MSMEs, to determine how they approach the issue of competitiveness and financial strategies. Among the most important results with respect to the analysis of MSMEs is the size of the enterprise.

As can be seen in Figure 1, 45% of the surveyed enterprises have an average of 1 to 5 employees, which indicates that the commerce sector in San Martín Texmelucan has approximately 261 micro-enterprises.

Número de empleados	Número de empresas	Porcentaje(%)
Sin contestar	6	1%
0 empleados	11	2%
1-5 empleados	261	45%
6-10 empleados	183	31%
Más de 10 empleados	78	13%
NC	43	7%
Total	582	100%

Figure 1 Number of employees
Source: Data from surveyed companies



Figure 2 Determination of the type of company
Source: Data from surveyed companies

Results

The results obtained in the research carried out in the first quarter of 2023 are as follows. To determine the factors that delimit the competitiveness of MSMEs in the commerce sector in the region of San Martín Texmelucan.

As we can see in figure 3 of the MSMEs surveyed, 191 businesses are aware of the actions taken by their competitors, in order to be in constant movement, and must be aware of the continuous improvement and be a competent business.

	Number of companies	centage (%)
1	24	4.12%
2	37	6.36%
3	92	15.81%
4	171	29.38%
5	191	32.82%
NC	41	7.04%
No answer	26	4.47%
Total	582	100%

Figure 3 Verification of customer service evaluation methods
Source: Data from surveyed companies

Have methods in place to evaluate customer service

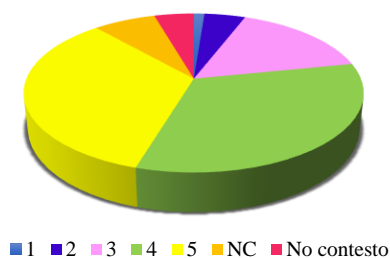


Figure 4 Verification of customer service evaluation methods
Source: Data from surveyed companies

Level of performance satisfaction

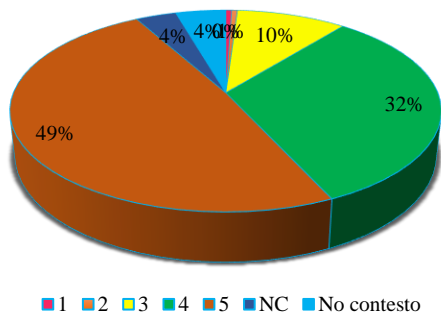


Figure 5 Verification of the level of satisfaction
Source: Own elaboration

	Number of companies	Percentage (%)
1	3	0.52%
2	8	1.37%
3	53	9.11%
4	154	26.46%
5	306	52.58%
NC	32	5.50%
No answer	26	4.47%
Total	582	100%

Figure 6 Verification of the level of performance satisfaction
Source: Data from the surveyed companies

It is obtained as a result that 52.58% of the companies in the commerce sector located in San Martín Texmelucan belong to the classification of micro-enterprises, the factors with the greatest impact on the competitiveness of MSMEs are price, quality and financial resources.

To determine the degree of competitiveness of MSMEs in the commerce sector in the region of San Martín Texmelucan.

It is determined that the degree of competitiveness is medium since between 40 and 45% of the enterprises perceive themselves at a satisfactory level while the rest lack strategies that allow for the continuous improvement of their business.

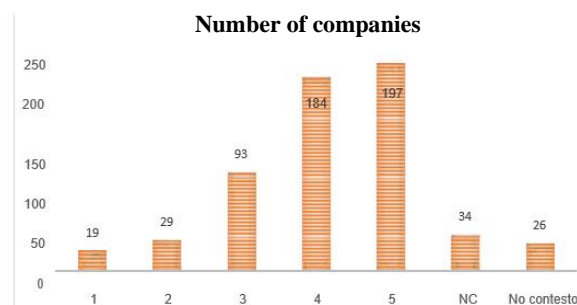


Figure 7 Verification of the level of performance satisfaction
Source: Data from surveyed companies.

33.85% of the businesses put into action Benchmarking (comparison between companies) which allows them to make a continuous improvement in their business and to face their competitors.

Variable	Conceptual and operational definition	items	Indicators
The competitiveness of MSMEs in the commerce sector in the San Martin Texmelucan region.	Competitiveness is the ability of an individual or company to position itself ahead of its competitors, achieving a better position in relation to them.	24a. I have effective methods for evaluating the appropriateness of the price of my products or services. 24b. I have effective methods to evaluate the quality of my products or services. 24c. I have effective methods to get to know my customers, their needs and preferences.	Increased liquidity.

Figure 8 Variable and conceptual definition and indicators for the research hypothesis
Source: Data from the surveyed enterprises.

Results of specific objective 3

To develop strategies to increase the competitiveness of MSMEs in the commerce sector in the San Martin Texmelucan region.

Financial strategies.	Financial strategy encompasses a set of key areas such as investment, capital structure, financial risks, profitability, working capital management and management.	33c. Customers choose us because we offer the best price. 36b. In my company we are concerned about all the money our customers owe us. 40d. I establish a network of relationships with other companies with the goal of win-win.	Lower indebtedness.
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Figure 9 Definition of financial strategies
Source: Data from the surveyed enterprises

Strategies to increase the competitiveness of MSMEs in the commerce sector in the San Martin Texmelucan region.

1. Strengthen managerial leadership
2. Conflict management and resolution skills.
3. Conduct continuous and permanent training
4. Establish techniques to determine the level of customer satisfaction.
5. Create and/or adhere to internal policies to improve stability and work environment.

Thanks

We are grateful to the Instituto Tecnológico Superior de San Martin Texmelucan for the facilities provided for the development of this project, as well as to the Tecnológico Nacional de México for the financing of the Project Key 18323.23-PD.

Conclusions

It is concluded that with the establishment of financial strategies the competitiveness of MSMEs in the commerce sector in the region of San Martin Texmelucan will improve.

Since the majority of MSMEs are empirical and run the risk of disappearing due to lack of information and training.

In terms of financing, it is recommended to obtain capital through loans, encourage savings in private initiative instances, as it allows obtaining credit in the future, the proper use of credit cards as this generates a credit history, which allows that in a given period a credit can be granted that helps to grow the business, another form of financing is to seek government support, for example, government support in the form of a non-refundable grant.

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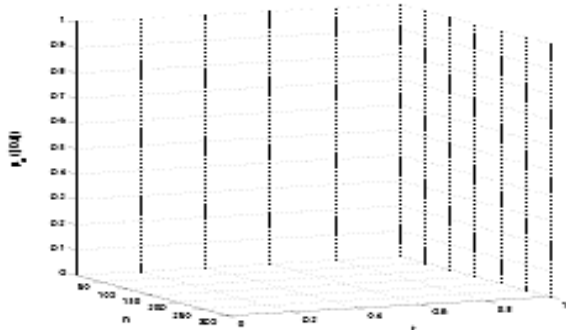
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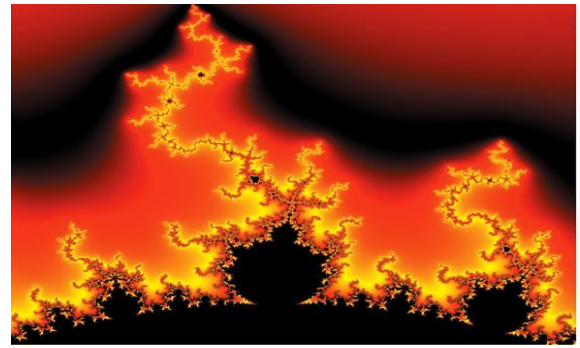


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