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# **Journal of Business and SMEs**

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## **Presentation of Content**

In the first article we present, *Accounting processes and their impact on the profitability of companies*, by QUEZADA-PACHECO, Vanessa Mariuxi, SOTO-AGUILAR, María Magdalena and ORELLANA-ULLOA, Milca Naara, with ascription in the Universidad Técnica de Machala, as next article we present, *Administrative audit tool as support for the ISO 27001 standard towards managing the quality of information in SMSEs, 2021*, by RUÍZ-TAPIA, Juan Alberto, RUÍZ-VALDÉS, Susana, CRUZ-SOLÍS, Ivett del Rosario and ALCÁNTARA-CRUZ, Félix Héctor, with ascription in the Universidad Autónoma del Estado de México, as next article we present *Diagnosis of financing capacities in companies in the food sector dedicated to the production of dairy products in the South of Sonora*, by RUIZ-PÉREZ, Roberto, LANDAZURI-AGUILERA, Yara, MORENO-MILLANES, María Dolores and FIGUEROA-MENDIVIL, Daniela Saraí, with ascription in the Instituto Tecnológico de Sonora, as next article we present, *Disparities in Oaxaca's economic development: a regionalization proposal*, by CHÁVEZ-SARMIENTO, Christian, RÍOS-CASTILLO, Maricela, MIGUEL-VELASCO, Andrés E. and CASTILLO-LEAL, Maricela, with ascription in the Instituto Tecnológico de Oaxaca.

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## Accounting processes and their impact on the profitability of companies

### Procesos contables y su incidencia en la rentabilidad de las empresas

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#### Abstract

The objective of the following study is to analyze the importance of accounting processes and the impact that financial statements have on the profitability of companies through a qualitative and descriptive approach, in which it is described how important it is for companies the carrying out an efficient accounting process that leads to the correct execution of the financial statements, so that it allows the managers to make better decisions, through the different criteria of authors on the subject of study it was possible to have as the Accounting processes are of great importance for every company, since by means of the efficiency that is had, the quality of the information that will be presented in the financial statements will be given, which leaves us as a conclusion that both the accounting processes and the financial statements allow to detail the financial information that is obtained by transactional operations in this way to know in a real way the company situation.

#### Resumen

El objetivo del siguiente estudio es analizar la importancia de los procesos contables y la incidencia que tienen en los estados financieros en la rentabilidad de las empresas mediante un enfoque cualitativo y descriptivo, en el que se describe cuán importante es para las empresas la realización de un eficiente proceso contable que conlleve a la correcta ejecución de los estados financieros, de modo que permita la toma de mejores decisiones a los gerentes, por medio de los diferentes criterios de autores, sobre el tema de estudio se pudo llegar a tener como los procesos contables son de gran importancia para toda empresa, ya que por medio de la eficiencia que se tenga, se dará la calidad de la información que se presentará en los estados financieros lo cual nos deja como conclusión que tanto los procesos contables como los estados financieros permitan detallar la información financiera que es obtenida por las operaciones transaccionales de esta manera conocer de forma real la situación de la empresa.

**Accounting processes, Financial statements, Companies**

**Procesos contables, Estados financieros, Empresas**

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**Introduction**

Through this work, we will proceed to know and analyze the accounting processes that are carried out in every company, as well as the incidence that exists between the accounting processes and the financial statements.

It will be possible to know the effect that the different operations that companies carry out in adherence to accounting principles can produce.

It is mentioned that accounting information is of great importance and very useful so that the necessary decisions can be expressed and made for the good of the company; since accounting helps to make decisions, show where and how the money is spent, or what have been the commitments that have been contracted, in order to evaluate performance and give the financial implications to be able to choose the processes [1].

Financial impediments allow the prediction of future effects on decisions and know where to direct the attention that should be given to problems, imperfections and especially inefficiencies that occur today.

This research addresses an aspect that is very timely in each of the companies, it should be mentioned that in some companies the lack of clarity and the formality of the accounting that is given according to the International Financial Reporting Standards for companies.

According to IAS 1 it is indicated that the standard establishes a game full of the financial statements which are:

- Balance sheet.
- Statement of income.
- Statement of changes in equity
- Statement of cash flow and notes.

In this way, the objective of this work is to analyze the accounting processes and the impact they have on the financial statements, which will be carried out by means of a bibliographic study on the subject of study.

**Development****The accounting processes**

Accounting processes are considered as a variety of financial activities which begin in accordance with the transaction and end at the time the accounting books are closed, which may vary according to the cycle established for the accounting organization [2].

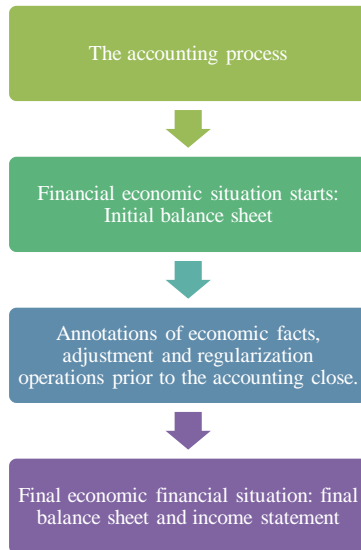
These works are carried out by means of an automated accounting system at the end of a cycle, which presents detailed reports. These records convey what is the real condition of the company and its purpose, from which decisions are made so that the next period is planned.

Accounting procedures are recognized as an operation that is carried out on a daily basis in the particular system of accounts, that is, it is the record of operations that are carried out in the accounting system, the same that are referred to the accounts, accounts, credits, liabilities, assets and capital, so it is a summary of the operation that occurs in debits, credits, accounts receivable and payable, the journal, account determination and finally the trial balance [3].

The information and control that is given in the accounting process establishes that an adequate measurement, management and control of the accounting processes that occur in companies be carried out through which the problems that they present, those problems that are related can be recognized with the different areas. In the same way, it allows administrators a possibility to make the best decisions in a large panorama of the information that is updated [4].

The accounting process is carried out through accounting and is carried out annually and begins on January 1 of each year, through the initial or starting situation and ends with the information given from the annual accounts that are recorded as of December 31 [5].

In the same way, it is possible to argue about the accounting processes, which are the steps, guides or instructions that are used to carry out the management and analysis of accounts that are given in the financial statements [6].



**Figure 1** The accounting process  
Source: [6]

It should be mentioned that long-term income statements allow you to analyze both income and expenses and at the same time determine if these are necessary or unnecessary for the production of your company.

The accounting processes can capture, transmit and process the precise information in the decision-making process of the different users of the same [7].

The theoretical analysis refers to the accounting process as a beginning that occurs in a structure, the same that is connected by means of daily records and transactions, the same that are reflected in the accounting books of the companies.

Advantages and disadvantages of accounting processes.

Companies require control of the economic operations that are being carried out, with the sole purpose of being able to evaluate performance and present the information they generate [8].

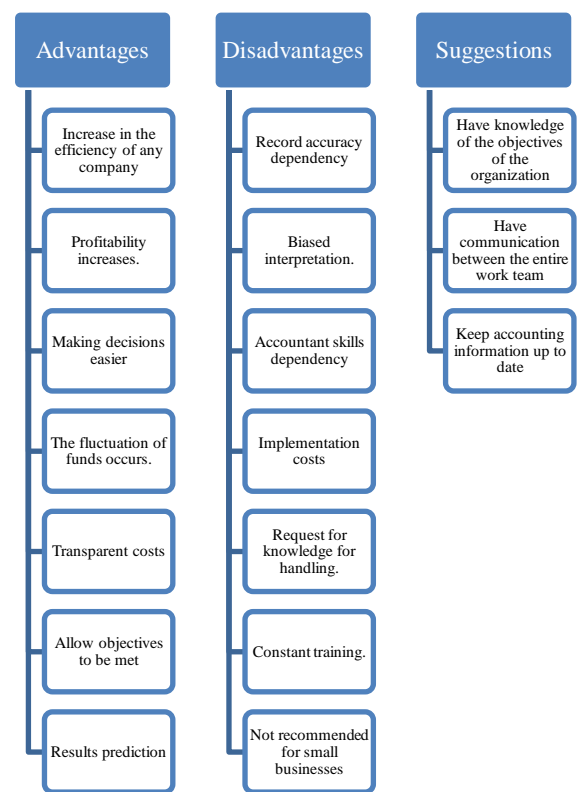
By means of financial accounting and accounting procedures, it is determined how the basic practice that companies carry out at their different levels is carried out.

Small and medium-sized companies present the need in a smaller way than larger companies, but these present themselves in a similar way by requiring adequate and updated information to make the best decisions [9].

However, managing related processes through accounting can pose some challenges and problems, which represents a big commitment of responsibility.

Accounting processes are considered a role of great importance in companies since they allow reliable information to be obtained and in the same way it contributes to better decisions being made [10].

Next, the main advantages and disadvantages in the accounting processes of any company are presented.



**Figure 2** Advantages and disadvantages of accounting processes  
Source: Own elaboration

Financial accounting procedures are used as a guarantee that some processes need so that they can be carried out in a specific way, and thus minimize the losses and mistakes. The procedures Accountants also help determine how companies can report and record financial statements [11].

Standardization is the key that allows the administration of the accounting function, ensuring that the tasks that are required are carried out and are not forgotten, the procedures also allow new personnel to be trained.

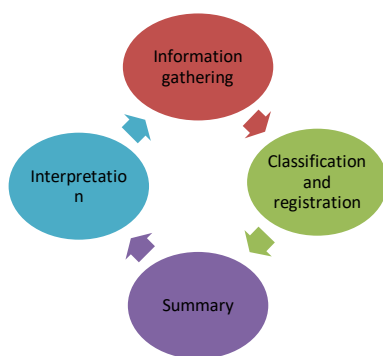
In this way, accounting procedures are considered as a tool that provides important information on the conduct and management of the business, depending on the financial issue.

What should be made known is the importance given to the management of accounting processes and their implementation in companies or businesses, in this way the accounting information will be analyzed and interpreted in the best way.

It is necessary to consider four basic phases of the accounting process, which are:

- To register.
- Sort out.
- Summarize
- Interpret financial data.

In this way, the accounting information has to be communicated in an adequate way to the indicated parties after the analysis. The accounting reports have to be prepared and then distributed, for which they have to include the basic income statement and the balance sheet, in the same way they have to have additional information that allows including the accounting indices, graphs, diagrams and the flow statements. Of funds. The following image shows the processes to be followed.



**Figure 3** Phases of the accounting process

Source: Own elaboration

**Information Collection:** this is considered a basic phase of the accounting process where transactions are recorded chronologically and systematically in the database.

The accounting records, on the other hand, are the books and documents that come to participate to make the financial statements, which include the records of the diaries, ledgers, liabilities, assets and other supporting documents such as checks and bills.

After collecting the accounting information, which is a component or element that is interrelated, so that it acts in an optimal way through an objective or the purpose they have in common, in such a way the collection of information should be reliable and safe [12].

**Classification and registration:** this phase groups and orders similar items under the same category, name or designated account, this phase uses a systematic analysis of the recorded data of each transaction grouping them into a single part [13].

**Summary:** this phase synthesizes the data, after the accounting periods, which can be monthly, quarterly, semi-annually or annually. Said data must be presented in a way that is easy to understand and can be used by external and internal users [13].

**Interpretation:** this phase performs an analysis of financial data, being a critical tool, which allows decision-making [13].

This final function allows the data that is recorded to be interpreted so that end users can make meaningful judgments regarding financial conditions. Additionally, it empowers the realization of plans in the future framing the policies to create financial plans that generate growth. The interpretation of the data is carried out by the accountants of each company, in order to pass detailed information to the directors of the entity, and these in turn make the correct decisions for it.

Financial Statements within the accounting process.

Financial statements provide information on performance, financial situation and changes that occur on it. The financial situation of any company is useful for the great variety of users who need it when making economic decisions, since it is oriented to detect the financial effect produced by the realization of events that occurred in the past [14].

The interpretation and analysis of the financial statements is given by means of a set of techniques that are applied to different statements, the same that are made by means of the accounting information that allows diagnosing the economic and financial situation of the company in order to de this way to be able to make the correct decisions and solve the weak points that have been detected [15]. The financial statements of an accounting process are the following:

### Balance sheet

The balance sheet provides the general description of assets, liabilities and stockholders' equity. The date should be placed at the top of the balance sheets at the time of their preparation, which generally takes place at the end of the fiscal year [16].

The balance equation is recognized as the asset as well as the liability, such as equity or debt, these can be retained earnings and additional paid capital. Assets are listed according to balances in the order of liquidity, while liabilities are listed according to the order they are paid. Liabilities that are short-term or current are expected to be paid in the same year, while liabilities that are long-term or non-current (debts) will be paid after one year.

A balance sheet is recognized as a statement of the financial position that a company has where it establishes the assets, liabilities and capital in a specified time.

In other words, the balance sheet allows the net value of each business to be displayed, the company will be obliged to include the balance sheets, income statements and cash flow statements through the financial reports that are delivered to shareholders and regulatory and tax authorities. The preparation of the balance sheets is optional for sole proprietors and partnerships, but it becomes useful to be able to monitor how the company is doing.

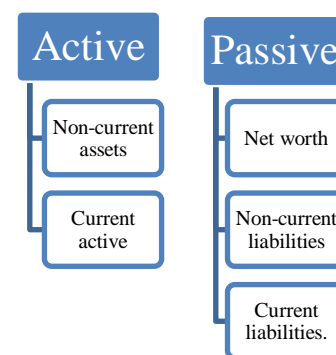
It has not been reported on the variation over the period of time, but on the situation in a certain time, it can be understood as a photo of the financial and economic structure at a time, which is usually at the end year, which allows it to be compared with the balance sheets of other years.

Companies, as well as people in the domestic economy, present the need to be able to keep an order to organize in an efficient way what belongs to them and what they owe. For this reason, it is thanks to accounting that accounting balances are used.

When speaking of net worth, it can be calculated as an asset minus the liability, the same one that represents the contributions of both the shareholders and the owners; additionally, the results that are not distributed [17].

In the same way, when there are negative results, that is, lost, this will reduce the net worth. The net worth or stockholders' equity shows the ability of a company to be able to finance itself.

The general structure that makes up the balance sheet are assets, liabilities, and equity, the formulation is defined by a format where most of the cases obey criteria that are personal on the use of the accounts, which is why their presentation it is not standard [18]. The structure of the Balance Sheet is presented below.



**Figure 4** Balance sheet structure

Source: Own elaboration

### Statement of income

The income statement, is also known by the name of income statement or profit and loss account, the same one that collects the income and expenses that the company has had in a period, through it the financial results are presented product of the actions and transactions of every company during a given period. The statement goes so far as to quantify the amounts of income that are generated and the expenses incurred, as well as the gains or losses that occur [19].

Through the income statement, performance is measured in a given period, it is mentioned in the accounting that the profit is reflected through income less expenses. The section of operations that is recorded by the income and expenses of a company come from operations that are main [20].

A highly important figure in the income statement is earnings before tax, which summarizes earnings before tax and financing costs.

In other parameters, the non-operating section of the income statement even includes financing costs such as expenses that are given for interest.

The income statement is known as the essential part of the financial statements, the same ones that are published in the organization, since they represent in a generalized way both the net and gross earnings of a fiscal year.

The income statement can be presented on one page or it can also be combined with comprehensive income information. In this case, the format presented in the report is called the comprehensive income statement. This is one of the five financial statements that are given in accounting [21].

#### Income - Expenses = Net Profit

INCOME STATEMENTS	
HAS TO	TO HAVE
SHOPPING LOSSES EXPENSES	INCOME LOSSES SALES

**Figure 5** Profit and loss accounts

Source: [21]

This indicates that the income transforms the profit according to the subtraction of the expenses, which helps to have a very quick vision of which ones are generated by the most important expenses of the company. It is in this way that, it is possible to detect where it is easier to be able to save unnecessary costs.

Thus, investors proceed to study the income statement and through analysis determine what a company is worth; on the other hand, it allows debtors to know how easy it is for companies to return the money.

#### Cash flow statement

The Statement of Cash Flows is the financial statement of the accounting that informs which is the origin of and how the cash is used [22].

The cash flows are presented in a format called cascade and this information is presented according to the year of its formulation and the previous one. A column is also included for cross-memory annotation.

The information contained in the cash flow statements reflects both the payments and the collections made by the company in the year, which are intended to provide great information on the collections and payments during the year.

Cash flows are the inflows and outflows of cash and other equivalent assets. They are considered cash to the treasury that is affected in the banks of entities, as well as to the bank deposits at sight. Those financial instruments that can be converted into cash are considered cash provided that the following requirements are met:

- The maturity at the time of acquisition, which should not exceed three months.
- That there is no significant risk of the variation of the value.
- They should be considered as a part of the management that is usual for the treasury.

When companies obtain money, they proceed to generate positive flows and this is achieved in three different ways:

- For customer collections (this is a business operation).
- By means of capital contributions delivered by partners, which may be through banks or creditors.
- Through the sale of assets that are no longer in use.

The statement of cash flows is calculated as follows:

Cash flow statement	
(+) Operations activities flow	\$
(+) Investment activities flow	\$
(+) Financing activities flow	\$
(=) <b>Cash flow for the period</b>	<b>\$</b>
Initial effective balance	\$
Initial effective balance	\$

**Figure 6** Cash flow statement

Source: Own elaboration

The following are the objectives of the statement of cash flows:

- Provide the information in a timely manner for the management, this will allow to make the decisions that allow to help the operations of their companies.
- Provide information on activities and items, where the cash has been spent.
- Obtain cash flows that are passed in order to create the forecasts.
- Determine what is the capacity that companies have to be able to meet obligations with shareholders or third parties.
- It allows making decisions about the investments that will be made in the short term when there is a surplus of the cash that is available.

## Methodology

The research methodology that was carried out was recognized as a specific stage of the work that was given as a part of the theoretical position and which led to the selection of techniques and methods on the procedure that is intended for the realization of the tasks that will link to the investigation [23].

This process was totally necessary in the investigation, for which reason it has been chosen to continue and be able to obtain a large amount of information that allowed us to meet the objectives set.

This type of research was carried out through a qualitative study, which required a continuous analysis of the data, which allowed it to be determined which strategies should be followed, this means what can be adapted to what it was discovered while the data was being collected.

With the above, I can describe what type of flexible designs are given for the case of analysis in companies, through an excellent design it can provide what are the necessary tools to be able to diagnose what the problem is and seek solutions according to the facts and studies.

The development of this research had a qualitative approach, the same one that I selected in order to understand what is the perspective that researchers have, through the qualitative approach it was presented to the researcher Some suggestions to be able to become familiar with the subject of the analysis of the subject, the advantages that this offers are open to information, which can be controlled in the process of expansion, which goes hand in hand in terms of the evolution of the study, a foundation is maintained that goes according to the experience and intuition that the researcher has in order to ultimately be able to guide and learn about those experiences that have been lived and about the various processes, which eventually promotes the generation of knowledge and theories to solve problems in a comprehensive way.

Another element that was used in the research that has a qualitative approach is the literary review since it allows to detect the concepts that had not been thought in the first instance, these in turn allow to nourish various ideas and various points of view according to the problem being analyzed allows us to announce which errors may be made by other researchers.

On the other hand, exploratory research is carried out when the objective consists of knowing in depth what is the nature of the phenomenon studied.

This type of research focuses on investigating and analyzing aspects in a concrete way about reality that until now have not been analyzed in depth. In a basic way, it is an exploration that allows the investigations to be directed to the analysis of the topic in question [24].

While descriptive research selects various questions, variables, and concepts, it is It measures each of these independently for the sole purpose of being able to describe them.

Descriptive research operates at the time you want to delineate the features that are specific and discovered due to exploratory investigations. Such description is done using qualitative methods in a higher state of description [25].

Through these studies it is intended to specify which are the most important properties for people, communities, groups or other phenomenon. Through this investigation, it will be possible to know how accounting processes affect the financial statements.

## Results

After analyzing the research topic, it can be had as a result that accounting processes are of great importance for every company, since through the efficiency that is had, the quality of the information that will be presented in the financial statements will be given, which, because of business management, are prepared, presented and shown schematically through equity and movement accounts.

It can be noted that the incidence of accounting processes in the financial statements is of great importance, and that these allow an overview of the results to be obtained, analyzing and comparing the data from previous periods.

## Conclusions

The accounting processes are carried out with the sole purpose of being able to record those economic transactions in a specific period, through the accounting books which can be both physical and electronic

Financial statements provide useful and understandable information for companies, these are recognized as accounting reports, which allow to detail the financial information that is obtained by transactional operations and allow to know in a real way the situation of the company, thus demonstrating the reasonableness of the results at the end of a financial year.

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## Administrative audit tool as support for the ISO 27001 standard towards managing the quality of information in SMSEs, 2021

### Herramienta de auditoría administrativa como apoyo para la norma ISO 27001 hacia la gestión en la calidad de la información en las PYMES, 2021

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#### Abstract

The problem is raised in which the drawbacks that Small, Medium-sized Enterprises (SMSEs) currently have that do not have an Information Security Management System (ISMS) in place are evidenced, the possible risks that are caused by various practices and the treatment of each one to minimize the negative impact. The objective of this research was to create a computer tool for conducting an administrative audit using the ISO 27001 standard in information quality management for (SMSEs), aiming to reduce computer risks and proposing a risk treatment plan. The methodology consists of determining the scope of the project that is limited by the control objectives obtained from ISO 27001:2013 standard. The project is structured by phases: the objectives of the ISMS to be developed, the reference framework from which the project dimensions and the proposed technological solution are measured, the theoretical and reference framework from which they are measured. the dimensions of the project to develop and implement it in an SMSEs. The contribution is a computer application with the aim of preventing vulnerabilities and threats to the quality of the security system. The information was collected and analyzed, documenting the results, generating a proposal for other SMSEs.

#### Resumen

El problema consiste en evidenciar los inconvenientes que tienen las Pequeñas, Medianas Empresas (PYME) que no cuentan con un Sistema de Gestión de Seguridad de la Información (SGSI), los posibles riesgos que se originan por diversas prácticas y el tratamiento de ellos para minimizar su impacto negativo. El objetivo fue desarrollar una herramienta informática para realizar una auditoría administrativa utilizando la norma ISO 27001 en gestión de la calidad de la información para (PYMES), para reducir los riesgos informáticos y proponer un plan de tratamiento de riesgos. La metodología consiste en determinar el alcance del proyecto que está limitado por los objetivos de control obtenidos de la norma ISO 27001:2013. El proyecto se estructura por fases: los objetivos del SGSI a desarrollar, el marco de referencia a partir del cual se miden las dimensiones del proyecto y la solución tecnológica propuesta, el marco teórico y de referencia desde el que se miden. las dimensiones del proyecto para desarrollarlo e implementarlo en una PYME. El aporte es una aplicación informática con el objetivo de prevenir vulnerabilidades y amenazas a la calidad del sistema de seguridad. La información fue recolectada y analizada, documentando los resultados, generando una propuesta para otras PYMES.

#### Computer application, ISO 27001, SMSEs

#### Aplicación informática, ISO 27001, PYMES

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## Introduction

Nowadays it is becoming easier for all the electronic information of an organization to be stolen or modified by multiple individuals, or even by organizations that have the objective of taking as much information as possible for their own benefit. For this, information security policies are constantly being created to prevent future and possible theft of information. Thinking of the different ways in which you can get away or that there is an opportunity for theft. As the use of the Internet is on the rise, more and more companies allow their users, partners and suppliers to access their information systems. Therefore, it is necessary to know which company resources need protection in order to control access to the system and the rights of users of the information system. In addition, due to the growing trend towards a nomadic lifestyle today, which allows people to connect to information systems almost from anywhere, so they are asked to take part of the information system with them outside. of the secure infrastructure of the Organization.

Currently, attacks and threats against information security in SMSESs do not take very seriously the risk involved in keeping all this information unprotected and do not have the security policies recommended by international standards. It is assumed that most of the Organizations in their IT departments do not have tools that help the people in charge of these areas to protect the information deposited in the Information Systems, so it is believed that there is a lack of technological knowledge to protect information from threats and attacks from both internal and external factors.

Social dynamics and technological growth have allowed SMSESs to apply the means and resources at their disposal to have timely information systems, which allow defining indicators, streamlining processes, design and monitor the degree of progress of lines of action, methods, techniques, and strategies, use resources efficiently and observe the changes we face in our environment for proper decision making. For all those involved in the organization, it is necessary to consider the information described above, to have elements of judgment that allow supporting or modifying an action plan proposal and that allows achieving the mission, vision and objectives established in the own organization.

It is necessary to know the importance of having quality in the information system in the administration of enterprise to generate reliable, valid, timely and accurate data that allow to support decision-making, which is why it is a necessity in the current context emphasizes the usefulness of computer tools and their implementation within enterprise because it allows optimizing elements and resources by carrying out in a timely, proper and more productive and efficient way a task that requires time, high costs and physical and mental effort.

It becomes necessary for those organizations, in which they have obviously forgotten the importance of human resource management, to solve the problem they face by implementing an information system on the dynamics of use of Enterprise resources with workers, that an Organization counts; The care of resources is essential, their allocation must be optimal and careful and the operational control of the process must be in charge of people committed to the ability to address the problem.

If we consider the enterprise entity as a properly organized structure, in which decision-making is applied on a large scale, in the different areas existing within it; it becomes a priority to identify the requirements that information systems must have on the administration of organization, since each area works in a different way, so the level of attention will vary depending on the analyzes carried out from the known information.

Therefore, the issue of information security quality for SMSESs is presented here.

Currently there are various risks in which information can be lost or extracted without the necessary security measures that affect organizations, however, this may be because there are not enough controls to meet these needs or they are not carried out cape.

Policies, procedures and controls are proposed more specifically to avoid loss of information as well as a good backup and protection of data since today it is very important to collect information and also make good use of it because security in networks and systems it is not a game since to be sure in the first place, it must be confidential, have competent people in addition to carrying out various controls that precisely help us to keep our databases and networks secure, additionally, keep our data updated software and hardware, as well as avoiding the loss of data, the theft of sensitive and confidential information or the disclosure of user data that can cause serious losses, both financial and credibility.

This research starts from the identification of risks, threats or vulnerabilities in the quality of information security to which an SMSE is exposed and which are caused by various situations within these organizations, proposing measures and controls, with the objective of maintaining the integrity, confidentiality and availability of information for a positive operation within the Organization.

At present, the information that organizations possess and generate is of vital importance and significance, in most Organizations not to mention that in all, confidentiality contracts are even signed where employees or former employees cannot speak about said information.

Therefore, it is necessary for organizations to have adequate control over the information and also to be able to control the handling of the information by the collaborators.

This computer tool is aimed at people related to the information technologies of an SMSE, either because of the responsibility assigned to them in relation to computer assets or because of the benefits they obtain from them. In addition, it is aimed at organizations that need to be careful to protect their information in order to offer them a proposal on how to avoid any risk of attacks within the Organization.

## **Theoretical framework**

### **Quality of the information**

Quality assurance begins with the actions that are carried out during planning such as the set of procedures, techniques and tools during the life cycle, audit activities such as technical reviews or inspections, optimizing previously defined criteria and the functions of management information, more oriented to documentation and development of tests.

Information systems make it possible to measure what is valuable, recognize the strengths and weaknesses that an SMSE has, compare it with other organizations, identify common indicators that measure the same with a high degree of reliability, which can be read and interpreted based on the degree development and evolution of both systems and organizations. Information security quality is the set of technical, operational, organizational and legal measures that allow organizations to safeguard and protect information. The concept of information security should not be confused with that of computer security, since the latter is only responsible for security in the computer medium, but the information can be found in different media or forms, and not only in computer media. The quality of information security (Wendy, Wang, 2019) is responsible for guaranteeing the: Integrity: property of safeguarding the accuracy and complete state of information assets, Availability: property of the information being accessible and usable by request from an authorized entity, and Confidentiality: property that determines that the information is not available or disclosed to unauthorized individuals, entities or processes.

Currently, companies have experienced high growth in information leakage, where confidential documents are exposed outside the company. The greatest challenge to control the leakage of information in companies are employees, since voluntarily or involuntarily, they cause information leakage. This creates a bad image or corporate reputation, since the inability to control attacks or leakage of critical information is questionable. Information security management is an important issue to guarantee the integrity of the information in the systems. These standards focus on a set of vulnerabilities or risks, internal and external, that must be addressed through the application of an associated set of controls.

These controls are physical or administrative safeguards suggested in the standards, aimed at avoiding or mitigating risks.

Currently, the different organizations face world-class competition, quality becomes an important differentiating point, in addition to increasing general customer satisfaction, reducing costs and optimizing resources. Products or services that have quality certificates are preferred by buyers because they convey security and trust. This is also a valuable attribute for overseas marketing strategies. The concept of total quality aims to seek excellence in everything that man, society and organizations do. This concept also applies to the development of information systems based on information processing equipment and man-made programs.

### **Existing software**

The ISOTools Excellence Software for ISO / IEC 27001: 2013 for the Information Security Management System or ISMS is composed of different applications that, when put together, work so that the information handled by Organizations does not lose any of its properties. important: availability, integrity and confidentiality. In an internal software development scenario, an organization that claims to be certified or maintain a certification must take care of certain aspects of software development.

An IS standard (Tofan, 2019) is structured by a set of controls grouped into domains. The main reference for IS standards, ISO 27001 (Gilliam, 2009), is recognized as the most widespread standard throughout the world (Buecker, 2019). Other commonly mentioned models and also with a broader coverage than just security are the ITIL (Official ITIL) and COBIT (ISACA) standards]. Information security management must meet a clear objective: reduce the level of risk to which the SMSE is exposed. Having adequate security within the information management systems within SMSE is of great importance because, it avoids having any hacking and loss of information of valuable criteria due, to better implement the ISMS it is important to carry a control and this is where the audits come in where they review what is being done well and badly and for this to apply improvement and / or changes within the computer part of the Organization.

Unauthorized access to systems and infrastructures is another of the main risks to avoid. Much of this unauthorized access could be prevented if systems and applications were properly updated. Updating is considered a fundamental part of good management and corporate responsibility, since it provides greater security and denotes continuous improvement work that benefits the application and the user.

Organizations must take a proactive approach in order to identify and protect all of their most important assets. Establishing an information security risk treatment plan allows the Organization to evaluate what it wants to protect and use it as a support element to make the decision to identify different security measures. Comprehensive information security risk assessment enables an Organization to assess potential risks in the context of its needs. It is very important to keep in mind that the purpose of information systems and the data they contain is to support the Organization's processes, which in turn support the Organization's mission. Information is a fundamental element that contributes to the Organization's ability to sustain its operations.

To carry out the implementation of the ISO 27001 standard, the use of a specific risk management program is an excellent option that allows considerable cost and time savings on the one hand, and, on the other, the ability to carry out a exhaustive control of all the phases of the process, as well as of the results and the identification of possible points to improve and risks for the company. Implementing and certifying the ISO 2700 standard, for the SGCSI (Information Security Quality Management System) of the organization, it can be shown in a particular way that the entity meets all the minimum requirements to ensure security of the information. Organizations must have an Information security management model or system based on globally recognized security standards, in order to establish and maintain security aligned to the needs and strategic objectives of the organization, composed of an organizational structure, with roles and responsibilities and a coherent set of policies, controls, processes and procedures, which allow it to adequately manage the risks that may threaten the confidentiality, integrity, availability, authenticity, traceability and non-repudiation of the security of information.

To achieve an adequate quality of information, it is essential that organizations establish a structured, clear and rigorous methodology for the assessment and treatment of security risks, with the aim of: knowing the real state of the security of the information assets to through which business information is managed, identify and assess threats that may compromise information security and determine the security mechanisms and measures to be implemented to minimize the impact in case of possible losses of reliability, integrity and availability of the information.

Organizations handle large volumes of data belonging to third parties which must be treated in accordance with the requirements of the law, guaranteeing customers that their information is secure under the highest quality standards related to information security. Technologies and communications are becoming increasingly important in organizations due to the support they provide to the systematization and organization of information. However, due to various vulnerabilities and threats, Information Systems can put at risk the integrity, confidentiality and availability of the quality of the information, for which the risks must be managed to minimize damage to the organization through the prevention and reduction of the impact of security incidents. Currently, most companies that implement ISMS use tools such as spreadsheets to perform GAP analysis to determine the degree of compliance with the requirements set forth in the NTC-ISO-IEC-27001 standard.

The implementation of an ISMS allows the organization to carry out a risk analysis; identifying threats, vulnerabilities and impacts on Organizational activity, continuous improvement in security management, guarantee of business continuity and availability, reduction of costs related to incidents, increase in customer trust levels, increase of the commercial value and improvement of the image of the organization, comply with current legislation on the protection of personal data, information society services, electronic commerce, intellectual property and in general, that related to the security of information.

This implementation of the quality of the information is through a software tool accompanied by techniques for Data Visualization, makes it easier for people to interpret the information and make decisions for the management of quality systems in information security. To develop this computer tool, it was necessary to know technical and legal concepts that are directly related to the subject and have a theoretical and legal support that allows clarifying definitions in order to respond to the requirements of the project. Nowadays, companies and people tend to systematize the tasks they carry out repetitively to optimize time and make decisions intelligently, that is why management systems are not alien to this situation and computer tools must be implemented that allow data analysis and easy understanding by users at all levels. In order to carry out a simple analysis, it is easy to find templates in Excel that allow these diagnoses in an easy way, which is why a computer application is made to facilitate this process.

### **ISO 27001: 2013 standards**

This standard is the international standard for information security management. Defines how to implement an independently assessed and certified information security management system. This enables you to more efficiently secure all financial and confidential information in a way that reduces the possibility of it being accessed illegally or without authorization. With ISO / IEC 27001: 2013, commitment and compliance with global best practice can be demonstrated, demonstrating to customers, suppliers and stakeholders that security is essential to the way the Organization operates.

The ISO / IEC 27001: 2005 standard is an internationally recognized standard, which specifies the requirements to establish, implement, operate, monitor, review, maintain and improve an Information Security Management System (ISMS), considering the risks of business (Official ISO 27000). In other words, it proposes a methodology to implement the ISO, specifying the requirements for the application of security controls to an ISMS. This standard segment security into eleven domains and proposes a set of controls within them.

Most organizations base their operations on computer systems. This situation is manifested through the IS standards, which present the security problem as a set of controls that represent guarantees for the different security vulnerabilities. On the other hand, it should be considered that there are also national regulations that do not necessarily align with international standards, which means that the organization must comply with both requirements. This is further aggravated, if it is considered a governmental organization, which also must comply with internal government regulations. This puts the organization in a problem as to which standard to apply or what level of compliance to achieve with the standards it is interested in achieving.

Given this situation, the incorporation of new systems within an organization that is certified according to a standard or that is on the way to do so, is an important decision, since the incorporation of systems that do not comply with the standard could lead it to lose the certification. . This phenomenon forces us to consider the effects or requirements of the standards in new systems developments, therefore, the controls established within the standards have an impact on the different stages of Software development.

ISO, (International Standardization Organization), is the body in charge of promoting the development of international manufacturing, trade and communication standards for all industrial branches. The main function is to seek standardization of product and safety standards for businesses, companies and organizations at an international level. The standards created by ISO are voluntary, they do not have the authority to impose their standards on any country since ISO is a non-governmental body and does not depend on any other international body. The ISO 27001 Standard is an international and open standard, the purpose of which is to establish a series of minimum requirements that an Information Security Management System (ISMS) must comply with in an organization, public or private, big or small. Companies are looking for efficient means that allow them to ensure and manage the security of information and the means that process it. The ISO 27000 series is the one that meets all the information security standards, the most important of which are the ISO 27001 and ISO 27002 standards.

The main difference between these two standards is that 27001 is based on continuous security management, supported by the identification of risks over time. It is a standard that organizations must certify. It contains a series of requirements that an organization must meet, to be in accordance with good practices. Today it is the most popular security certification applied by companies of all kinds at a universal level. Standard 27002 is a good practice guide that describes a succession of control and management objectives that should be recommended to provide security in the organization. It is a non-certifiable standard. The ISO 27003 standard provides instructions on how to approach management planning to implement the ISMS. The ISO 27004 standard provides a series of best practices to be able to measure the result of an ISMS. The ISO 27005 standard contains various general recommendations and guidelines for information security risk management. The ISO 27006 standard responds to a guide for certification bodies in the formal processes that must be followed when auditing ISMS. The ISO 27007 standard is a guide to auditing the ISMS. The ISO 27799 standard is a guide to be implemented in the healthcare industry. The ISO 27035 standard provides a best practice approach for managing security incident information for organizations.

The standards allow organizations to present and certify a level of quality to the general public, demonstrating that they have the appropriate controls and techniques to ensure the treatment of the data and information with which it is treated. At first they were considered of great interest to large companies, and ISO 27000 standards are currently being studied by medium-sized companies worldwide. This standard is applicable to any organization that has information systems. By complying with the legal data protection regulations, it is possible to reduce problems with customers and users. It offers a guarantee of business continuity based on the Contingency Plan. Increase the commercial value of the company and partners; as well as a great improvement in the image of the organization. Increase in the levels of trust of suppliers, customers, shareholders and partners.



Information Security Management Systems according to the ISO / IEC 27001: 2013 standard must be continuously improved following the philosophy by applying the PDCA cycle methodology (Plan, Do, Verify and Act), (Aldya: 2019) this is done when software, hardware, etc. are updated. A computer security management system (ISMS) guarantees the confidentiality, integration and availability of the data.

## Method

The project is developed with a quantitative approach, where the different properties of the variables involved in the project will be quantified. The variables involved in the project are: information security organization, asset management, human resource security, physical and environmental security, communications and operations management, security controls, access, acquisition, development and maintenance of information systems, management of information security incidents, business continuity management and compliance with legal requirements, policies, security standards and the audit of the information systems.

It is a descriptive research because it measures the variables to generate data. The research is non-experimental and cross-sectional, the variables are studied in a defined time, where the most appropriate way to measure said set of variables was determined to be able to give an overview of the state of the information security controls and if they comply with ISO / IEC 27001 of 2013 and observe the quality of information.

To create the software for the Information Security Quality Management System (SGCSI) and measure the maturity model, the following was taken into account:

## Gap Analysis (GAP) in ISO 27001

A gap analysis (GAP) is a method of evaluating performance differences between a company's information systems or software applications to determine if business requirements are being met and, if not, what steps to take to ensure they are met successfully. Gap refers to the space between "where we are" (now) and "where we want to be" (the goal to be achieved).

A deficiency analysis can also be called a needs analysis. In the case of our research, a gap analysis was applied using a SWOT matrix (Strengths, Opportunities, Weaknesses, Threats) determining what we lack and the necessary resources to achieve the goals. Objectives based on the requirements of ISO 27001.

A gap analysis (GAP) or deficiency analysis therefore consists of an analysis of compliance with both the requirements of ISO 27001 and its controls. It is therefore something similar to an initial audit similar to the best auditing practices in an organization (Amogh Phirke, 2019), so you can have an idea of the degree of implementation of the ISO 27001 standard in the organization can serve to a double objective. Establish the starting point to implement the standard and evaluate the necessary effort as well as have a reliable tool to develop an ISO 27001 implementation plan, also to maintain a tool for evaluating the degree of implementation of the standard during the implementation process and evaluate the degree of progress of the project

## Risk analysis vs gap analysis

An analysis of compliance with requirements and controls of ISO 27001 should not be confused with a risk analysis. The compliance analysis identifies what requirements and controls included in the standard we have implemented in the organization and to what degree. On the other hand, a risk analysis offers as a result, the information security controls that are really needed to implement. In other words, a risk analysis establishes the justification for the controls that must be implemented for information security.

Depending on the size and scope of the project, a gap analysis can be performed before starting the implementation of the standard in order to assess the initial situation and plan the necessary resources for the project. Previously, the GAP analysis standard was helpful when preparing the statement of applicability. However, in the current version ISO 27001: 2013 it is necessary to previously perform a risk analysis to determine the real scope of the controls to be implemented.

To obtain an initial audit report on compliance with the standard, a GAP gap or deficiency analysis can be performed before starting the project applied to the generic requirements of the standard. Based on a risk analysis, it is possible, through the analysis of compliance with the controls, to obtain the report to establish the plan for their application and their compliance status, in addition to helping us in the preparation of the Declaration of Applicability.

For the performance of the GAP deficiency analysis on information security, it may be advisable to use a maturity model for the evaluation of compliance. The most common maturity models such as NIST, CITI-ISEM, COBOT, SSE / CM and CERT / CSO propose a model of 5 to 6 levels of maturity or compliance. These maturity models commonly used as tools for IT service management are used to assess how well management processes are performing with respect to internal controls. This model is adapted to establish an audit model that allows us to measure your current level of maturity against the requirements of a specific standard, in this case ISO27001.

As a result, the GAP deficiency analysis will reveal best practices to the internal controls of the Information Security Management system. Maturity levels are not an objective, but rather are a means of evaluating the adequacy of internal controls against the objectives of the management system.

Among the advantages of performing a deficiency analysis using a maturity level model are the following:

- Provides a template for a complete safety program.
- Provides appropriate information to managers to implement security controls.
- Leads towards the use of best practice standards (ISO 27001).

In this model, both the existence or non-existence and the degree of implementation of the 11 controls (domains) that comprise the ISO27001 can be evaluated. The following 6 maturity levels were taken into account to develop the application in its management report:

(Level 0), Non-existence: there is no recognition of the need for the control or requirement.

(Level 1), Ad-hoc: There is some recognition of the need for internal control or requirement. It is applied for a specific problem or task, not generalizable.

(Level 2), Executed - Controls exist but are not documented.

(Level 3), Defined - Controls are in place and adequately documented.

(Level 4), Manipulable and measurable: There is internal control over the application of controls and compliance with the requirement.

(Level 5), Optimized: There is internal and continuous control over the application of controls and compliance with requirements. The effectiveness of the controls is measured by establishing improvement objectives.

To carry this out, a list of questions was used to obtain the level of compliance of the organization under different scenarios according to the defined maturity levels. This allows setting a maturity level for each of the 11 controls. This was solved by developing the questions used in the ISO 27001 standard controls to obtain their maturity values.

### **Evaluation criteria**

If they assigned values according to the maturity levels from 0 to 5 for each control, obtaining for each control an average level of maturity that will be determined by:

Medium Level Compliance = Total score of each Control / Number of total controls

This formula will deliver an average value for each control between 0 and 5, with which the controls and their compliance can be classified among the following values:

Maturity score below 1.65: Does not comply.

Maturity score between 1.66 and 3.25: Partially compliant.

Maturity score above 3.26: Compliance with requirements of the Standard.

All of the above influenced the development of software to measure the quality of Information Security in an Organization and to know if it meets the maturity levels required in the ISO 27001 Standard.

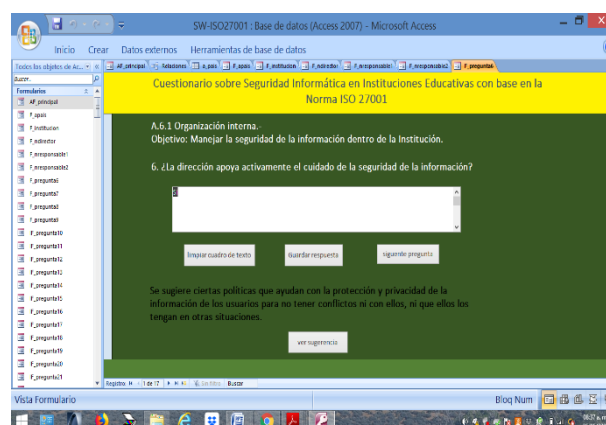
### Development of the computer application

The software made allows the establishment of information security measures in any type of organization. For this, it has a modular system that allows the entry of information through the collaboration of managers, area managers and support staff. It is fed back with information and allows the person in charge of information security to carry out an analysis and obtain immediate reports that, when analyzed by the Directors, will allow taking adequate measures to minimize the risks to which the critical assets of the organization are exposed, in its different aspects in information security. Senior managers have realized that information is a critical resource, and perhaps the most important of the organization and for this reason it must be treated appropriately like any other asset in the organization.

Information security is based on the availability, integrity and confidentiality of information assets. There is a manual that provides the logic with which the software has been designed and its technological components on which it works correctly, as well as its proper installation. In the computer application that was developed, photos, videos, documents and notes can be uploaded by USB or by cell phone. The documents that can be obtained are: Policies, Measures, Procedures, Controls, Risks, Suggestions, a Book containing information on each point of the ISO 27001 Standard to clarify any doubts about it in more detail. Documents can be registered for a possible audit, each of the control points of the ISO 27001 Standard can be printed separately, agreements can be signed and saved through the union of the Adobe Reader application, they can be send documents by email for each of the points of the Standard, you can have reports on service providers, you can obtain reports for the Organization's Management, you can obtain missing follow-up reports for each point of the Standard, the different analyzes and reports allow timely decisions to be made for the different people involved.

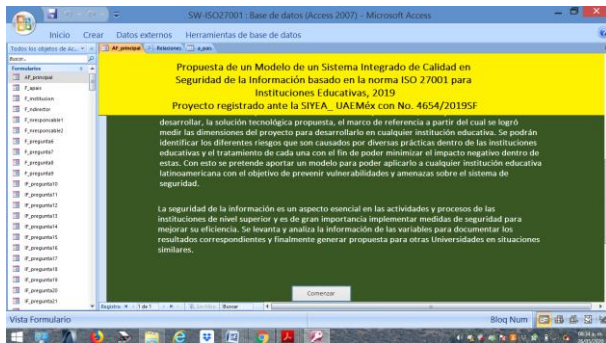
The design of the database is carried out, taking into account the structure of the controls provided in the ISO-IEC-27001: 2013 standard. This computer application was developed for the information requested in ISO 27001. It is an application so that each user can capture their information related to the questions of the questionnaire for SMSEs with ISO 27001 and also allows to view suggestions.

It starts with a screen where it says security warning, then click on AF\_principal and presents an introduction, after having read that, click on the button: Start. (See Figure 1). In this development, the responses of both public and private organizations were taken as a basis so that the responses obtained can be taken as an example. (Here the names of the Organizations and those responsible were intentionally deleted). In each question you can see suggestions for Policies, Measures, Controls and Procedures (See Figure 3), to exit the suggestions click on return to survey to continue capturing the information related to the Organization. It continues with the 151 questions (See Figure 2) and finally in suggestion 151 you can also see a book with the theoretical framework on the content of the ISO 27001 Standard (See Figure 4), to complement all the information, bibliographic references, glossary as well as consult the credits of the authors and research assistants involved. To exit the application, click on finish capture. You also have the option of printing the information captured in detail for each item or in summary.



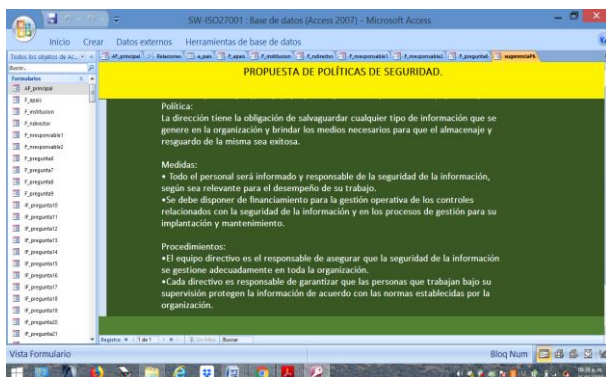
**Figure 1** Start screen of the computer application

Source: Own elaboration



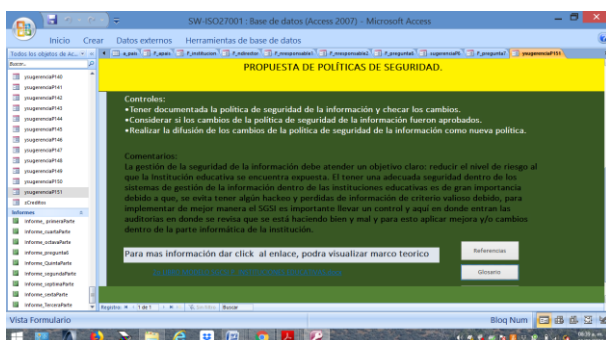
**Figure 2** Example of questions from the 151-item questionnaire

Source: Own elaboration



**Figure 3** Example of Policies, Measures, Controls and Procedures in each of the questions.

Source: Own elaboration



**Figure 4** Example of proposal for review of the book link also containing the theoretical framework on the content of the ISO 27001 Standard.

Source: Own elaboration

## Results

The construction of a theoretical reference was developed, which starts from the quality of information security to the standards to be studied and the requirements of the tool to be developed. Information collection techniques formats were applied and designed: content analysis and unstructured observation; The analysis of the results delimited the project towards the implementation of fundamental stages for the process of development and implementation of the ISMS.

The selection of international quality standards for information security was made, common aspects were identified that characterize them and allow describing their purposes and way of working. In this way advantages and disadvantages were known. The development of the methodology section corresponds to the description of the technical and theoretical strategies applicable to the scheme required for the development of the software. With the theory, the definition of the methodology to be applied in the selection of characteristics and component elements of the software model was established, moving from theory to practice (Ionna Topa, 2019). The software architecture that corresponds to the implementation of the software model was designed.

## SW reports

The reports available to the software are: Project planning, Document on the scope of the SGCSI, Initial Diagnosis, Quantitative Diagnosis of SGCSI, Information Security Policy, Information Security Policies, Roles and Responsibilities, Management of ISMS Risks, Risk Treatment Software (Own development to manage risks), Documentation, ISMS Risk Management, Risk Treatment (Own development to manage risks), Audit reports for review by Management. The statistics report presents a comprehensive view of the Organization showing the status of information security for each of the control points or if you prefer a particular report on any of the control objectives in particular.

## Conclusions

The software implementation process implies commitment on the part of the entire organization, so if only the ICT department is involved, this does not lead to the successful implementation of the ISMS. It is necessary that the corresponding roles and tasks be assigned to each of those involved in the organization. Each and every one of the people must be linked to actively participate in the development of quality for the security system, because in one way or another the information is accessible to all those involved. The total commitment at the time of implementing an ISMS must have its knowledge by the managers, to minimize dependency and the way to see this process as a responsibility not only of the ICT department.

It is necessary to know the risks to which the organization is exposed and through an analysis establish the treatment that is considered most appropriate. Remembering that a risk analysis is a process that allows identifying the threats and vulnerabilities of an organization with the aim of generating controls that minimize the effects of risks, which implies determining what or which assets to protect, from what or from whom protect them and how to do it. Some of the main information security risks in organizations are: targeted attacks and exploitation, internal file and database theft, reckless browsing by employees, Phishing, Use of smartphones, tablets and other devices, reckless use of WiFi, weak security keys, misuse of technology, theft of assets such as technological devices, private security systems and CCTV (closed circuit television, computer viruses, theft of confidential information, financial fraud, damage to the image of the organization, modification of files and databases, information leaks, fraud and data theft, vulnerability on the web.

Some organizations describe a "risk analysis", where they have only subjectively evaluated some threats on the assets they know best, without having a clear idea of their value and on the other hand without constituting the totality of the organization's assets. Knowing what can happen and the consequences that this event would generate are key aspects when defining a good security strategy.

The analysis of the proposed variables allowed the software to be better structured, as well as the most appropriate way of defining the ideas that were had for the programming of said software. The possibility of assigning managers in the SMSE was raised to enter only the appropriate information to the software with respect to the functions of those involved. After analyzing the various situations that could arise when entering the information in the software, the use scheme was raised with the ICT manager for his knowledge and experience that gives added value, this in order to be a support and help to capture the requested data in terms of information security, thus obtaining the creation of aids in the software to enter only the requested information and obtain good results in the final reports.

Therefore, it is concluded that the development of the software meets the expectations of functionality and quality parameterization in information security because it has been formulated under the parameters of the ISO 27001: 2013 standard. This software development complies with carrying out an analysis of the quality of information security, this being the basis for establishing an SGCSI in this SMSE, as well as for any Organization that wants to establish measures for the security of its information. The support modules presented as part of the solution in this software, were defined by several investigations that, in addition to confirming the complexity associated with the selection and application of standards, allowed to respond to the objectives set, through different methods, of computer security, formal techniques for data collection, statistical analysis of reports, and the determination of standards evaluation criteria for the consolidation of the modules.

The software model presented for the implementation of the ISMS is a tool that offers risk analysis, specific suggestions, methodological documentation, frequent review, handling of non-conformities. In the software developed, tasks of information collection, data analysis, understanding and application of theories were carried out, among others, which allowed the exchange of knowledge and skills. The final product constitutes a software and tool for the facilitation and consolidation of goals that describes processes to support the implementation process of the Quality System in Information Security measures. With the computer application presented in this document, different statistics, procedures, policies, types of controls, security measures for the control of the information and the systems that are a key piece in the organizations for the decision-making of the managers of the organization. After analyzing the computer risks that organizations currently have to live with, the following results were achieved: proposing policies, measures, procedures and controls for the use, statistics, control and safeguarding for the quality of the information security of the systems in the organization at the time of implementing a computer application of the ISMS, to protect the risks to which they are subjected and at the same time propose solutions that follow up on possible present and future problems that may arise.

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## Diagnosis of financing capacities in companies in the food sector dedicated to the production of dairy products in the South of Sonora

### Diagnóstico sobre las capacidades de financiamiento en empresas del sector Alimentario dedicadas a la elaboración de productos lácteos del Sur de Sonora

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#### Abstract

Objectives. The objective of the research is to elaborate a methodological proposal of a reference framework that facilitates the diagnosis of what are the financing capacities of the Food sector dedicated to the elaboration of dairy products from the South of Sonora for the detection of areas of opportunity that increase their possibilities of permanence in the market. Methodology. The research is documentary-theoretical in nature. For the characterization of the variables, the National Survey on Productivity and Competitiveness of Micro, Small and Medium Enterprises was used as a reference. The methodological approach applied was qualitative since the phenomenon under study was contextualized under the existing literature. Contribution. Among the main findings, it was found that microentrepreneurs choose more to finance themselves with fintech, pawn shops or Sofomes; On the governmental side, it was found that there is a concern to encourage regional economic growth. For future research, the collection of surveys could be carried out to evaluate the perception of microentrepreneurs regarding current financing options.

**Public financing, Private financing, Government support**

#### Resumen

Objetivos. El objetivo de la investigación es elaborar una propuesta metodológica de un marco de referencia que facilite el diagnóstico de cuáles son las capacidades de financiamiento del sector Alimentario dedicadas a la elaboración de productos lácteos del Sur de Sonora para la detección de áreas de oportunidad que incrementen sus posibilidades de permanencia en el mercado. Metodología. La investigación es de corte documental-teórica, para la caracterización de las variables se utilizó como referencia la Encuesta Nacional sobre Productividad y Competitividad de las Micro, Pequeñas y Medianas Empresas. El enfoque metodológico aplicado fue cualitativo puesto que se contextualizó el fenómeno objeto de estudio bajo la literatura existente. Contribución. Entre los principales hallazgos se encontró que los microempresarios optan más por financiarse con fintech, casas de empeño o Sofomes; en la parte gubernamental, se encontró que existe una preocupación por incentivar el crecimiento económico regional. Para futuras investigaciones se pudiera llevar a cabo la recolección de encuestas para evaluar la percepción de los microempresarios respecto a las opciones de financiamiento vigentes.

**Financiamiento público, Financiamiento privado, Apoyos gubernamentales**

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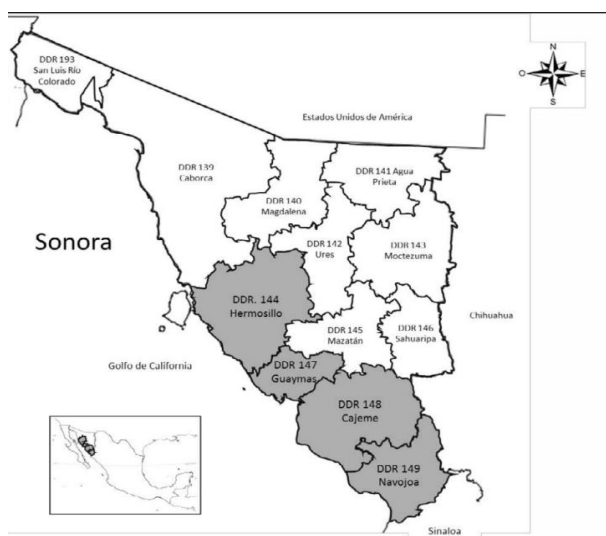


## Introduction

The needs of current markets have caused dynamism in the way companies manage their resources, the competitiveness factor is decisive for their permanence in the market (Valbuena, 2013). That is why this research wishes to diagnose the current situation of financing capacities in Micro and Small companies in the South of Sonora.

Similarly, Querol, Aparici and Ginés (2021) mention that companies can achieve better development in a region through: carrying out collaborations that generate positive impacts between the public and private sectors; increasing competitiveness; facilitating access to the use of new technologies, among the most important.

Under this context, it is necessary to identify the main characteristics of the state and the municipalities under study. According to the Confederation of National Chambers of Commerce, Services and Tourism (CONCANACO SERVITUR, 2018) Sonora has a population 2,662,480 people in terms of Gross Domestic Product contribute 3.3%, 50.52% of the population are women and the rest are men. Regarding education, the 15-year-old population has an average of 10 years, and the national average is 9.2 years, which indicates that it is above the average.



**Figure 1** Map of Sonora

Source: Moreno, Salazar y Rojas (2018)

Regarding the classification of the companies in this research, it was decided to take those listed in the National Statistical Directory of Economic Units (DENUE) under the search for the food sector, dairy products companies with the main characteristic of 0 to 10 employees located in the three municipalities main areas of Southern Sonora.

According to publications made by Medina, M., Reynaga, R., Caval, M., and Pacheco, R. (2008), organizations are in need of adequate financial planning of their activities, since with this the preparation and fulfillment of financial strategies, goals and objectives is facilitated; With the obtaining of this information, it is possible to generate a frame of reference to give a correct follow-up, a design of actions to be followed and the evaluation of the results obtained.

In response to the current contingency, in research carried out by Soto, Escalante, Méndez and León (2021) they point out that for organizations to reduce the problems related to COVID-19, they must comply with the health provisions set out by the different accredited bodies in the matter. This can achieve a statistically significant improvement in productivity.

With these premises, the following statement of the problem arises, which mentions that companies that do not obtain adequate financing for their economic possibilities may have their growth negatively affected and tend to be less productive; That is why the present research wishes to elaborate a methodological proposal of a frame of reference that facilitates the diagnosis of what are the financing capacities of the Food sector dedicated to the elaboration of dairy products from the South of Sonora for the detection of areas of opportunity that increase your chances of staying in the market. This problem has been addressed by various authors such as Rojas (2017); Lamb (2012); Ferraro, Goldstein, Zuleta and Garrido (2011); and Lecuona (2009).

Similarly, Aguilar (2021), mentions that the impacts that climate change has on current problems in the short, medium and long term must be considered, since according to data revealed the use of resources such as water, biodiversity , energy sources, among others, directly and indirectly affect the development of different economic activities. That is why public policy intervention with a gender perspective is required in order to achieve a sustainable balance.

Based on this premise, the following research question arises:

To what extent is elaborating a methodological proposal for a frame of reference that facilitates the diagnosis of what are the financing capacities of the Food sector dedicated to the elaboration of dairy products from the South of Sonora for the detection of areas of opportunity that increase its possibilities? of permanence in the market of the Food sector dedicated to the production of dairy products from the South of Sonora?

For the preparation of the following research, variables such as: Government support programs, access to public financing, access to private financing, and Main concerns of entrepreneurs regarding the performance of their income and medium-term forecast will be considered.

The objective of the research is:

Prepare a methodological proposal for a reference framework that facilitates the diagnosis of what are the financing capacities of the Food sector dedicated to the production of dairy products from the South of Sonora for the detection of areas of opportunity that increase their chances of permanence in the market.

This research shows preliminary results, since as a result of the pandemic the survey phases had not been concluded.

**Theoretical framework**

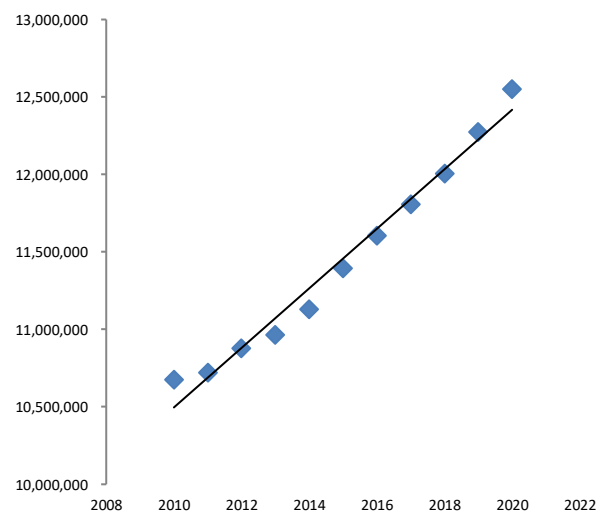
The theoretical framework provides a reference on what other researchers have found regarding the proposed research, that is, the framework is elaborated on the main variables under study. The phenomenon to be studied is contextualized below.

Orueta, Echagüe, Bazerque, Correa, García, García and Rodríguez. (2019) mention that small and medium-sized companies, specifically in Latin America, play a role of capital importance, since they together represent 90% of the total of existing companies; they generate a little less than 50% of the Gross Domestic Product and finally, they concentrate between 50% and 75% of total jobs. That is why strengthening these types of organizations generates long-term benefits for society.

Considering the social – environmental part of the organizations, Morzan and Quiliche (2021) mention that local companies that wish to develop must consider reducing the emissions that are generated, significantly reducing the use of natural resources that are used for the elaboration of the products that they offer to the market and, finally, give a fair treatment to the employed personnel. With these actions it is possible to achieve a harmonious production and help to achieve an orderly growth of the sector in which it is desired to enter.

*Dairy food industry*

Specifically, this article wishes to address from the perspective of the dairy food industry, which is very important not only because of its basic food supply factor, but also because of its economic contribution.



**Graphic 1** Annual Milk Production 2010 a 2020  
*Source Own elaboration with data from the National Chamber of Milk Industry (2021)*

As can be seen, milk production has shown a solid upward trend maintained during the last ten years, this is due to the fact that staple foods have an inelastic demand (Urrutia, Troncoso and Villalobos, 2006). Only in the last year there is a growth trend of 2.26%.

Similarly, in publications made by Loera and Banda (2017) report that Mexico is within the first twenty places in terms of milk production (sixteen), which is equivalent to three percent of global production and is the main importer of powdered milk.

The main products produced with this input are: pasteurized and ultra-pasteurized milk, cheeses, cream, butter, powdered milk and yogurts. National Chamber of Milk Industries (2021).

#### *Government Programs*

In research carried out by Moctezuma, López and Mungaray mention that government support programs oriented towards economic entities that promote science and technology have a direct correlation with competitiveness and productivity. This in turn is strengthened if companies generate links with the academy of the regions where they are inserted.

According to Higuera, (2005) Mexico has a very unequal level of development, the gap between rich and poor is wide. Derived from this problem, the government at the three levels (Municipal, State and Federal) has been determined to implement support programs that improve the living conditions of society, as well as social welfare. That is why they implement programs aimed at achieving economic development in marginalized regions.

The purpose of government programs is to redress economic injustices, creating better opportunities for well-being. When the supports are oriented towards companies, they can be more competitive; That is why Porter (1979) cites that the strategies that companies take considering the level of competitiveness can improve performance and thus produce a better economic spillover in the region.

Similarly, Sarmiento (2008) found that competitiveness is a process in which organizations adapt according to market conditions, that is, depending on the dynamism of the markets, different demands arise, in such a way that companies that are adapt more easily will be more competitive. This is done through a process of learning and negotiation, the so-called knowledge gap.

That is why Porter (1980) emphasizes that entrepreneurs must be able to establish relationships with suppliers and thereby achieve lower production costs; Another way is by investing in cutting-edge technology that favors production processes, making them more efficient; In this sense, the relationship with customers is also important to stimulate increased sales of products or services. According to Chiavenato (2009), competitiveness is the foundation for organizations to achieve success.

To achieve the objective set in the research, certain key variables were determined, such as: government programs, access to public financing and private financing.

#### *Public Financing*

One of the main justifications for which the government grants financing to companies is because it increases their possibilities for innovation and thus their competitiveness, thereby causing a stimulus towards the economic development of the regions (Pastor, Rodríguez and Ramos, 2017). When companies grow, the government also does it by capturing a greater number of taxes.

Some of the characteristics of financing through government support, according to Rendón (2021) are: a) obtaining a part of the financing amount; b) the protocols to obtain the resource are subject to specific dates in the year, that is, it is seasonal; c) the amounts are capped and these caps are established by each agency according to the bag granted to distribute; and finally d) if the requirements established by the financing grantor are not met, they will not be credit subject.

Some examples of public funding are:

Financing Programs	Characteristics
Programa de Apoyo Financiero para Microempresas Familiares 2021, Crédito a la Palabra	It is a support program for family microenterprises in different modalities such as: Family microenterprise, Solidarity support to the word, Solidarity women and Fulfilled companies.
Programa Nacional de Microempresas	Its objective is to support entrepreneurs in a first stage with training, advice, and in a third stage financing for equipment.
Programa de proyectos productivos	Its objective is to encourage small entrepreneurs who do not have access to credit to develop productive activities in popular or rural areas. It seeks to increase the application of social development policies through income diversification.
Parques Industriales	It supports micro and SMEs to move to smart business spaces where they can develop cluster programs and obtain economic benefits from it.

**Table 1** Sources of Public Funding

Source: Prepared with data from the Ministry of Economy (2021, 2012)

### Private Financing

According to the Invest and Loan portal (2019), one of the main characteristics of organizations that use this type of financing to fund their operations is the speed with which they deliver cash flow.

Logreir, Hernandez, Bonett M., and Sandoval (2018) cite that for microenterprises to continue operating in a normal way, they require access to different sources of financing; However, due to the nature of the size of the organizations and their ignorance of them, they tend to use providers and private banks as an option to obtain resources. Within the evidence found, it was detected that banks require too many requirements to access loans, leading companies to take informal loans.

Although most of the instruments to obtain financing have advantages and disadvantages, it is considered that microenterprises should be trained on the options available to them so that they can make a better financing option. For this, it is necessary to have adequate advice that allows the organization to optimize the resources obtained and thereby contribute to its development (Logreira, 2017).

Type	Concept
Lenders.	They are informal loans that are generally used by informal companies because of the speed with which they are granted.
Friends and relatives.	It refers to when the grantor of the resource has a relationship or kinship with the one who receives the loan.
Angels Investors.	They are entrepreneurs who, derived from the excess capital they possess, finance jointly or individually projects for companies that are generally newly created. They have high experience in business management.
Venture capital.	They are aimed at innovative companies that demonstrate financial viability. One characteristic is that they can obtain large amounts of financing and have the experience of investors.
Incubators and accelerators.	They provide knowledge, facilities, and money. Its purpose is to encourage entrepreneurs to develop their business ideas.
Banks.	It is the most common option, you can obtain financing for the amount you occupy, different loan and payment schemes are managed, which are according to the needs of the clients.

**Table 2** Types of Financing

Source: Own adaptation with data from Rojas (2017), Velecela (2013) and BBVA (n/d)

In results presented by Lecuona (2009) they mention that in Mexico SMEs almost do not ask for financing from commercial banking financial institutions, this is due to: a) the high mortality rate of SMEs; b) Unreliable information of the companies; c) high costs; d) uncompetitive market structure; e) informality of companies, among others.

### Methodology

The research is documentary-theoretical, since the scientific method was used for the planning, collection, analysis and interpretation and presentation of the results obtained (Rizo, 2015); Similarly, for the characterization of the variables, the National Survey on Productivity and Competitiveness of Micro, Small and Medium Enterprises was used as a reference.

The methodological approach applied was qualitative since the phenomenon under study was contextualized under the existing literature.

For data collection, the following was prepared: first the state of the art on the problem under study was elaborated, then we proceeded to search in different databases for information related to the selected variables, as well as official pages or recognized organizations. After that, the information found was systematized for the preparation of the document and, finally, expected results were contrasted based on the literature reviewed.

### Study subject

The subject of study are the microenterprises belonging to the dairy industry, which have up to 5 employees in the municipalities of Cajeme, Guaymas and Navojoa, which are the most representative municipalities in Southern Sonora. In particular, the research focused on the scope of the financing capacities of microenterprises in the country.

### Materials

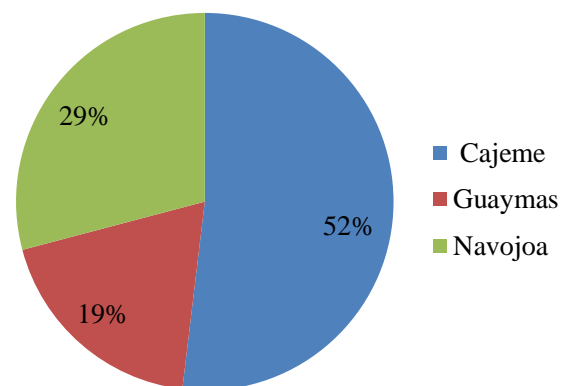
The materials used were the National Survey on Productivity and Competitiveness of Micro, Small and Medium Enterprises (ENAPROCE) which was used to determine the size of companies; in the same way, the National Statistical Directory of Economic Units (DENUE) was used, which offers the identification data, location, economic activity and size of the companies.

### Results

Among the main results derived from this research, it was found that in the South of Sonora (municipalities of Guaymas, Cajeme and Navojoa) the companies that are dedicated to the elaboration of dairy products with a micro size and that have in their facilities with up to 5 employees:

There is a total population of 79 companies, of which 41 are installed in Cajeme, being the one with the highest concentration, which is due to the fact that it is the second largest municipality in the state, only behind capital: Hermosillo.

In second place is Navojoa with 23 companies and in third place Guaymas with a registered population of 15 according to the National Statistical Directory of Economic Units (2021).



**Figure 3** Concentration of dairy production companies  
Source: Own elaboration with data from DENUE (2021)

Regarding the descriptive statistics, it was found that of the total sample, 69% of the companies are dedicated to the production of ice cream and popsicles and the rest are dedicated to the production of dairy derivatives and fermented products.

Regarding the roads in how the companies are located, it was found that 51 of them are on the street; 17 are on avenues; 7 are located on boulevard and the rest are located on private roads, roads, and walkways.

Regarding the type of human settlement, it was found that the thickness of the companies is in colonies, that is, 85% of the total of companies; while the remaining 15% is found in subdivisions, towns and villages.

Regarding whether they had an internet site, it was found that no company had an official page. Similarly, only 7.5% of companies have an email where they can be reached.

Regarding the incorporation to the DENUE, it was found that 40 of the 79 companies analyzed were incorporated since July 2010, that is, they have been operating for more than 10 years; While 11 of them were incorporated in December 2014, that is, they have been operating for more than six years and finally 28 companies were registered in November 2019, they are celebrating two years with their incorporation.

Regarding the results found with Public Support Programs, it was found that universities act as a catalyst (Agudo, Chaparro, Pacual and Iglesias, 2011). to link microentrepreneurs with the environment, either through incubators, realization of professional stays, social service or by supporting research and development activities.

On the other hand, studies reveal that Mexican microentrepreneurs have a negative perception of private banking since, as they do not have a defined financial structure (because they are generally managed piece-wise by family members) they increase their liquidity risk, thereby causing them to interest rates are high. In the same way, the conditions of the credits are limited in terms of the amounts and payment periods. (Pavón, 2010). It is for this reason that they opt for other alternatives such as borrowing from family and friends.

It was also found that not having the documentation required by financial institutions, as well as the high commissions they charge, make it difficult to access this type of financing, leaving out a large part of microentrepreneurs. (Ramírez-Cortés, Ruiz-Reynoso and Sandoval-Trujillo, 2018).

Regarding access to public financing, it was found that in recent years the previously called SME fund has been used the most, however deficiencies have been found since the structure in which it operates has not been the most convenient. It is also mentioned that the fact of not investing in innovations and development, as well as the use of franchises, leads to a deterioration for companies. (Góngora, 2007).

Currently, 60,000 credits to the word support have been delivered, however the impacts that these could generate have not yet been evaluated. The estimated amount of government investment is one thousand six hundred million pesos. (Usla, 2021)

Regarding the main concerns of the entrepreneurs, it was found that the difficulty in charging their clients, the personnel hiring processes and the lack of financing are the main problems that afflict them. (Foret, 2020).

## Conclusions

Among the main findings, it was found that most of the concentration of microenterprises dedicated to the production of dairy products is located in the Municipality of Cajeme, which is consistent with the principles of demographic density and state economic importance. Some points to consider and that represent a red focus for these organizations is the fact that they do not have virtual contact mechanisms, that is, they do not have official communication pages or email for contact (According to data from DENUE, 2021). It is an area of notable opportunity, especially due to the technological era that we live today and the increase in e-commerce.

Regarding financing, different deficiencies were found, among which stand out the fact that the conditions of private loans are detrimental to microentrepreneurs, due to the high rates they are charged, commissions, information requirements and the fact that they are not to be able to check credit histories.

That is why microentrepreneurs choose more to finance themselves with fintech, pawn shops or Sofomes Marcos, L. (2021); On the governmental side, it was found that there is a concern to encourage regional economic growth. For this reason, the need to encourage entrepreneurs to develop productive activities especially in rural and popular regions.

For future research, an instrument could be carried out that collects what is the particular perception of microentrepreneurs regarding current financing options and if they would be willing to take any of those offered by the market with current conditions.

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## Disparities in Oaxaca's economic development: a regionalization proposal

### Disparidades en el desarrollo económico de Oaxaca: una propuesta de regionalización

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#### Abstract

The state of Oaxaca is one of the states of Mexico with a very low level of economic development, within it its municipalities present strong problems of disparities in their development, these disparities are reflected through variables such as income, education and health. This research makes use of an analytical regionalization method that seeks to contribute to the reduction of disparities between the municipalities of the state through their spatial grouping by optimizing criteria; likewise, to contrast the proposed regionalization, other alternatives such as a cluster-type regionalization and the traditional regionalization that already existing in the state are evaluated through the multicriteria analysis method. The analysis of the results shows that the proposed regionalization contributes to the reduction of disparities in economic development, also with the grouping of the created regions a positive spatial dependence between the municipalities is originated and the disparity between the regions.

**Economic development, Regionalization, Spatial analysis**

#### Resumen

El estado de Oaxaca es uno de los estados de México con un nivel de desarrollo económico muy bajo, al interior del mismo sus municipios presentan fuertes problemas de disparidades en su desarrollo, estas disparidades se ven reflejadas a través de variables como lo son el ingreso, la educación y la salud. En esta investigación se hace uso de un método de regionalización analítico que busca contribuir a la reducción de las disparidades entre los municipios del estado a través de su agrupación espacial mediante la optimización de criterios; así mismo, para contrastar la regionalización propuesta, a través del método de análisis multicriterio se evalúan otras alternativas como una regionalización tipo clúster y la regionalización tradicional ya existente en el estado. El análisis de los resultados muestra que la regionalización propuesta contribuye a la disminución de las disparidades en el desarrollo económico, también con la forma de agrupación de las regiones creadas se origina una dependencia espacial positiva entre los municipios y se reducen a su vez la disparidad entre las regiones.

**Desarrollo económico, Regionalización, Análisis espacial**

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## Introduction

The capitalist system as we know it today, has been in constant development and evolution going through several phases such as free competition, imperialism and neocapitalism, within the latter has developed what is now known as globalization; this last stage commonly known as globalization has been the most aggressive of capitalism and the one that has contributed the most to reproduce and increase the disparities in the economic development of regions and countries in the world. Economic disparities are usually the result of production and exchange processes between regions, countries or municipalities and occur when one or some of the members are at a disadvantage (Cuervo & Morales, 2009).

At the global level, the disparities in the economic development of regions and countries can be observed through the Human Development Index (HDI) developed by the United Nations Development Program (UNDP) and which stands as one of the most complete indicators since it is measured through three dimensions that are income, health and education. According to the OECD in a report carried out in 2013 Mexico was classified as a country with a high HDI with a coefficient of 0.739, at the state level there is the Federal District (0.831), Nuevo León (0.790) and Baja California Sur (0.785) with the highest levels of development, at the other extreme are Chiapas (0.647), Oaxaca (0.666) and Guerrero (0.673) with the lowest levels of development (UNDP, Municipal Human Development Index, Mexico, 2013); With respect to the state of Oaxaca, the disparities in development are aggravated and are more evident since in this same report more than 50% of the total of its municipalities present a very low level of development, about 30% have a medium level, 11% register a high level and only 9% have a very high level of development.

In this context of economic crisis (expressed through disparities) that is being experienced, regionalization stands as an interesting alternative to face these problems. Thus, regionalization has been constituted as a mechanism of economic integration with the aim of promoting internal development and inserting itself into the international system (Laredo & Di Prieto, 2001).

In Oaxaca the regionalizations carried out have been carried out from political and cultural criteria, downplaying the importance of the economic factor, there is a lack of scientific work that proposes the creation of new regions with the aim of encouraging the levels of development of the municipalities of the state. With the use of an analytical regionalization method based on the optimization of criteria selected through a rigorous process, it is intended to contribute to the reduction of disparities in the levels of development existing between the municipalities of the state by stimulating a more balanced economic development; in turn, because regionalizations of an analytical nature usually obey specific research or policy objectives, it can contribute efficiently to the generation of a specific strategy to address the problem based on the common characteristics of the municipalities that make up a region, with this type of information you can also create public policies, regional programs or projects to attack the problem based on the strategy developed.

## Methodology

For the development of this analysis 4 different but complementary types of methodologies were used, for the establishment of the proposed regionalization a mixed heuristic regionalization method called "regionalization algorithm" was used; Likewise, in order to establish a contrast between the existing regionalization, the proposed regionalization and one of the cluster type, the scenario method is used, which is complemented by the multi-criteria analysis method to be able to evaluate the regionalization alternatives analyzed. Finally, econometric instruments and spatial analysis are used to analyze regionalization as the best alternative to reduce disparities in the economic development of the municipalities of the state of Oaxaca. There are different methods to carry out regionalizations, however from the field of regional science a good method for the statistical analysis of data from a spatial (geographical) perspective requires the aggregation of basic spatial units (areas) into larger units (regions) this in order to preserve greater plausibility, minimize differences in population, reduce the effects of outliers or inaccuracies in the data or simply to facilitate the description and visualization of information through maps (Duque, Ramos, Surinach, & Jordi, 2006).

In this research a regionalization algorithm known as "Max P Regions" is used, this has as its main hypothesis that the design of homogeneous and contiguous regions only makes sense if there are disparities between the areas, this would justify the design of more than one region and would show evidence of spatial dependence which in turn would justify the requirement of spatial contiguity in the formation of new regions.

Because there is currently a type of regionalization widely known and used in the state of Oaxaca, it is important to take into account this element since for many years it has been used as a reference for scientific analysis. It is important not to rule out this regionalization without first having established an analysis through it; to establish parameters and the same conditions before the regionalizations to be analyzed, the scenarios are constructed, which are an instrument that helps to create a context for planning and programming which allows to choose between development options (Yori, Hernández & Chumaceiro, 2011).

For the development of this research, the methodological steps that will be addressed for the construction of the different scenarios are those mentioned by Yori, Hernández, & Chumaceiro (2011) who refer to the methodology developed by Bas, this series of steps is as follows:

1. Decide the system on which to work (variables and relationships).
2. Decide the time space for scenarios (time of occurrence).
3. Deciding how many scenarios you want to build (three or four is ideal).
4. Determine the main variables that will structure the scenarios and discuss assumptions about the future.
5. Define the value that the variables will take in each scenario considered.
6. Decide on specific events that may occur during the temporal space of scenarios.
7. Create a job title for each scenario.
8. Outline the scenarios.

One of the essential and final phases of the scenario method is the evaluation of the same, which will provide the elements that are necessary for decision-making on which scenario is the one that best suits the requirements of this study, as an element to provide an objective evaluation of the different scenarios that will be proposed, in this research, the methodology called Multicriteria Analysis will be used. For this analysis, a specific method called "Importance of Criteria through Intercriteria Correlation" known as CRITIC is used; this is a discrete method since it is based on a limited series of alternative solutions, it is also quantitative since the evaluation or weightings of each criterion is through indicators and the calculation of the specific weights of each criterion is based on the use of statistical tools.

In this method, a decision/weighting matrix is constructed, which according to Muñoz & Romana (2016) must always contain the following elements:

1. Decision criteria: identified by can be defined as the conditions or parameters that allow to discriminate alternatives and establish the preferences of the decision-maker, are reference elements on which the decision is made.  $C = (C_1, C_2, \dots, C_n)$
2. Weights: the so-called weights or weights are measures that allow the decision-maker to determine the relative importance of each criterion. To each criterion a weight must be assigned, this is done by a vector of weights, being the number of criteria; the weights should reflect the importance of the criterion in the decision. For Muñoz & Romana in decision-making there will always be criteria of greater relevance than others, however, this should not translate into those of lesser relevance should not be considered.  $[w] = [w_1, \dots, w_n]nw_i C_i$

3. Alternatives as alternatives are considered to the different approaches to solve the problem posed, for the problems of discrete multicriteria decision the alternatives will be defined as a finite set of solutions, strategies, actions, decisions etc. possible that have to be analyzed during the process of evaluation and resolution of the problem. Each alternative should clearly show how it solves the problem and how it differs from the other alternatives. The set of alternatives is represented by, where each set of alternatives must be different and mutually exclusive.  $A = (A_1, A_2, \dots, A_m)A_i$

Through the weighting matrix, the CRITIC method evaluates through the value of the standard deviation of the normalized criteria and the correlation coefficients which are used to determine a contrast between criteria; this method is then an analytical procedure that allows, through weightings for each criterion, to incorporate the two aforementioned elements, the intensity of the contrast and the conflict, both essential parts contained in the structure of the decision-making of a problem.

Starting from the way in which Aznar and Guijarro (2012) explain this method, we have in a synthesized way that:

$$w_j = S_j(\sum 1 - r_{jk}) \quad (1)$$

Being:

$w_j$  = weight or weighting of the criterion  $j$

$S_j$  = standard deviation of the criterion  $j$

$r_{jk}$  = Correlation coefficient between the criteria and  $jk$

In their book Aznar and Pebble, they mention that the weight of a criterion will be greater the higher its standard deviation and the more "different information" of the other criteria it provides (lower correlation coefficient between columns).

To develop a comparison between the different criteria in the CRITIC method, they must first be made comparable to each other, this is done through a process of standardization or normalization of data which has the goodness of transforming the different types and units of measurement to magnitudes between or and 1, thus making them comparable.

The standard deviation for each criterion is estimated based on the following formula:

$$S_j = \sqrt{\frac{\sum_{j=1}^n (X_j - \bar{X})^2}{n - 1}}$$

Similarly, the formula for calculating the Pearson correlation coefficient is as follows:

$$r_{jk} = \frac{cov(j, k)}{S_j S_k}$$

Because multi-criteria analysis uses the spatial correlation levels of their municipalities to be able to calculate the weighting coefficient and thus choose the best alternative, the regionalization that is selected could observe to some degree spatial dependence; To carry out this analysis, spatial analysis from spatial econometrics (EE) will be used, which mentions that spatial dependence or autocorrelation can be defined as the existence of a functional relationship between what happens at one point in space and what happens elsewhere, which is explained mainly for reasons of human interaction with its physical-environmental environment. From the above, Varonio, Bianco and Rabanal (2012), point out that a spatial autocorrelation implies that the value of a variable is conditioned by the value that that variable assumes in a neighboring region. Moreno and Vayá (2004) show the most common statistics in the analysis of spatial dependence at the global and local level, these statistics allow to contrast the presence or absence of a spatial dependence scheme; that is, to contrast whether the hypothesis that a variable is distributed completely randomly in space is fulfilled or if, on the contrary, there is a significant association of similar or dissimilar values between neighboring regions Statistics at the local level arise because a global dependency test may not detect dependence in all units of the analyzed space.

The most commonly used global and local statisticians are usually the Moran statistic and the New-Gi tests.

Finally, it is necessary to predict the behavior that economic development (HDI) can take in each of the regions of the alternative that was the most appropriate, for this a time series analysis is performed, which time is one of the most important tools in econometrics, the value and importance given to this type of analysis lies in its ability to make forecasts and in the power and accuracy that these possess. The predictive capacity of a time series is directly related to the seasonality of it, this concept refers to a stochastic or random process which is a collection of random and ordered variables in time (Gujarati, 2010), The projection or forecast is made through an integrated autoregressive of moving averages known as ARIMA.

## Results

Exploratory scenarios are those that start from the analysis of past and present trends and that in turn will try to lead us to a probable and desirable future (Gastó, 2005); the two scenarios that are created in this research to contrast with the existing one, are precisely of the exploratory type and will seek to improve the existing conditions between the variables analyzed.

The two scenarios built on the basis of analytical methods seek to contribute to the system on which we are going to work and this system is based on trying to reduce disparities in the economic development of the municipalities through a new integration of them; however, Max P regionalization is the one that focuses most on achieving this objective since it focuses on reducing the heterogeneities of the variables or elements it seeks to optimize.

Addressing in a flexible way the methodological steps for the construction of scenarios of the methodology developed by Bas, these are structured as follows:

1. System: the system on which these scenarios will work is the one mentioned in the previous paragraph, in this one it is sought to reduce the disparities in economic development through the formation of new regions based on an analytical method.
2. Temporality: the temporal space on which the scenarios develop is determined by the temporality of the variables used for their creation; at first it is considered that its term of occurrence is from the year 2015 onwards, this due to the availability of data.
3. Number of scenarios: the number of scenarios built is 2, however, the analysis incorporates the already existing state regionalization.
4. Main variables: the Human Development Index (HDI), the Municipal Functional Capacities Index (ICFM), the Total Gross Production per employed personnel (PBTpo) and the Value Added on average per employed personnel (VAPpo) are considered for the construction of the scenarios.
5. Value of the variables: in the construction of these scenarios the value that the variables must take will not be determined by those that were used for their choice, to meet this point a multicriteria analysis is carried out.
6. Title of the scenarios: Traditional regionalization, Max P Regionalization and Cluster Regionalization.
7. Outline of the scenarios: the design of the scenarios will be geographical, showing in each of them the regions in which it will be divided and the member municipalities.

### *Variable selection*

In this research, the variables chosen for the construction of the regions were social, political/governmental and economic, precisely due to the existence of data through different indicators and their existence at different points in time. this analysis will begin by showing and explaining each of the selected indicators, as well as their relevance and quality.

As a social variable, the Human Development Index (HDI) was selected, this indicator according to the Municipal Human Development Report 2015 called "Transforming Mexico from the local", tries to measure well-being based on the dimensions of health, education and income. Health is about measuring the joy of both a long and healthy life, education quantifies access and income is obtained resources for a dignified life.

To consider the performance of each municipal government in the construction of the scenarios, for the political/governmental variable, the Municipal Functional Capacities Index (ICFM) was taken, calculated for the first time in 2016 and created as well as the HDI by the United Nations Development Program (UNDP); there is a strong relationship between the development of a municipality and the capacities that its governments have to meet the needs of its population, this indicator measures precisely those capacities in administrative terms which are developed through involving relevant actors, diagnosing, formulating policies and strategies, budgeting, managing and evaluating.

With respect to the variables of an economic nature, two were the selected indicators, these are incorporated from the perspective of giving weight to economic activity, as a criterion for shaping the regions, but at the same time relate this activity with the employment levels of the municipalities; to achieve this, the selected indicators were the following: Total gross production per total employed personnel and Value added on average per person employed

#### *Multi-criteria analysis*

As already mentioned above, once the scenarios are structured, it is time for them to enter a phase of evaluation of them to be able through an objective and rigorous analysis to decide which of the three alternatives is the best. The multicriteria analysis is the tool used to make the decision of the best possible alternative, this will be carried out through an adaptation made for this research of the method of Importance of the Criteria through the Correlation of InterCriteria (CRITIC).

The CRITIC method seeks to evaluate the alternatives, in order to help in the decision-making process, through the analysis of the value of the standard deviation of the criteria and their correlation coefficients. In the CRITIC methodology, the standard deviation is used as a measure of the amount of information of each criterion, therefore, the greater this, the greater the amount of information each of them will provide; however, for this analysis the standard deviation of the criteria is approached differently, since this is a measure that quantifies the dispersion of the data, in this case a greater dispersion would mean greater disparity between the HDI samples for each region analyzed, what is then sought is a low standard deviation for each established criterion.

As for the correlation coefficients of the criteria, which seek to analyze if several criteria are correlated with each other and thus unify them, therefore, the ideal would be to find low correlation coefficients; For this analysis on the contrary, since the spatial correlation coefficients will be used, it is expected that the coefficients will be high since this would mean that by increasing the economic development of a municipality, it will also tend to increase the development of neighboring municipalities correlated to it.

The last important element of the CRITIC method is the calculation through the standard deviation and correlations of a coefficient of weights or weighting of the criteria, this coefficient is used to evaluate the different alternatives and select the one that best suits the objective pursued. In the traditional method it is expected that the coefficient of weights associated with the criteria is high, which would translate into high standard deviations with low correlation coefficients, what is sought then is to select that alternative with the highest weighting coefficients; however, for this adaptation the opposite is sought, a coefficient of associated weights would reflect a low standard deviation (dispersion of the HDI) and high coefficients of spatial correlation between the municipalities, therefore the best alternative will be the one that results with the lowest value of this coefficient.

The decision-making process begins with the analysis of the standard deviation of the regions (criteria) that make up each regionalization (alternatives), in Table 1 you can see the results obtained.

Standard deviation matrix									
Alternatives	Associated criteria (regions)								
	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7	Region 8	Average S
Traditional Regionalization	0.0537	0.055	0.1915	0.075	0.0649	0.0516	0.0412	0.0912	0.0780
Max P Regionalization	0.0571	0.0472	0.067	0.126	0.0512	0.0981	0.0712	0.0541	0.0715
Cluster Regionalization	0.0768	0.0915	0.0509	0.0533	0.0606	0.1772	N/A	N/A	0.0851

**Table 1** Standard deviation matrix of criteria  
Source: Own elaboration

In the above matrix it is observed that the lowest HDI standard deviation belongs to region 7 of traditional regionalization with a coefficient of 0.0412, while the highest coefficient is from region 3 with a value of 0.1915 also belonging to this type of regionalization; the most favorable coefficient of Max P regionalization was that of its region 2 with a value of 0.0472 and the highest standard deviation was presented by region 4 with a value of 0.126; finally, for cluster regionalization the lowest value was 0.0509 and the highest was 0.1772, representing its regions 3 and 6 respectively.

Since these coefficients in isolation do not generate enough information to know which of the alternatives presents the least dispersion with respect to the HDI of their respective regions that integrate them, the average coefficient of standard deviation has to be analyzed, in this sense it is shown that the coefficient obtained by the Regionalization Max P rises with the best result since it yields a value of 0.0715, while traditional regionalization obtains the second best result with 0.0780 and the last cluster regionalization with 0.0851. The result obtained here shows that the second alternative is one in which the grouping of their municipalities in the established regions provides a better integration which contributes to the reduction of the dispersion of the HDI data analyzed.

Now, since the simple analysis of the dispersion of the data is not enough, the spatial correlations obtained for each region of the proposed three-year periods will be analyzed (Table 2), as already mentioned before, the expected result is high correlation coefficients since this would reflect that the HDI levels of the analyzed regions would increase as that of the municipalities with whom they have a geographical contiguity increases.

Alternatives	Matrix of spatial correlations								
	Associated criteria (regions)								
	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7	Region 8	Average Rs
Traditional Regionalization	0.405	0.28	0.293	0.147	0.475	0.394	0.231	0.604	0.354
Max P Regionalization	0.432	0.294	0.44	0.768	0.17	0.141	0.404	0.194	0.355
Cluster Regionalization	0.133	0.648	0.327	0.389	0.494	0.287	N/A	N/A	0.379

**Table 2** Matrix of spatial correlations of the criteria  
Source: Own elaboration using the GeoDa software for the calculation of the coefficients

Starting with the alternative of the traditional regionalization of the state of Oaxaca, in the matrix of spatial correlations it can be observed that the highest coefficient is from its region 8 while the lowest is that of region 4, with values of 0.604 and 0.147 for each of them; in regionalization Max P the highest value is .768 in region 4 and the lowest is 0.17 in region 5; with respect to cluster-type regionalization this has region 2 with the highest coefficient of the entire matrix, which takes a value of 0.648, its lowest value belongs to region 1 with a standard deviation of 0.133.

As in the previous matrix, the result that is relevant to decision making is the average value of each of the alternatives. While traditional regionalization and Max P take very similar average values in their spatial correlations, with 0.354 and 0.355 respectively; it can be observed that the cluster region was the one that showed the best average value, with a spatial correlation coefficient of 0.379; however, the differences between the results of the alternatives are minimal, so it can be inferred here that the final impact of any of these regionalizations with respect to the spatial correlation of the HDI of the municipalities will be almost the same.

Finally, in order to be able to lean on the choice of any of the three alternatives analyzed here, the solution that provides the best balance between the expected result of the standard deviation and the spatial correlation of the HDI will have to be sought. The weighting coefficient or associated weights is the calculation used to measure and evaluate the performance of the regionalizations and based on this choose the one that gives us the best result; the expected result here is a low coefficient of associated weights since this would express the balance between a low disparity of the HDI data and a high correlation of the municipalities of each region analyzed with respect to the same variable. The following table (3) shows the results of calculating the weights of each criterion for each of the alternatives.

Alternatives	Matrix of associated weights								
	Associated criteria (regions)								
	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6	Region 7	Region 8	Average W
Traditional Regionalization	0.0320	0.0396	0.1354	0.0640	0.0341	0.0313	0.0317	0.0361	0.0505
Max P Regionalization	0.0324	0.0333	0.0375	0.0292	0.0425	0.0843	0.0424	0.0436	0.0432
Cluster Regionalization	0.0666	0.0322	0.0343	0.0326	0.0307	0.1263	N/A	N/A	0.0538

**Table 3** Matrix of weights associated with the criteria  
 Source: Own elaboration using the GeoDa software for the calculation of the coefficients.

For traditional regionalization the associated weight of lower value is associated with region 7 and is 0.317, in this alternative it can be observed that regions 1, 2, 5, 6, 7 and 8 have very similar and favorable results, however, region 3 has an associated weight too high (0.1354) with respect to its other member regions.

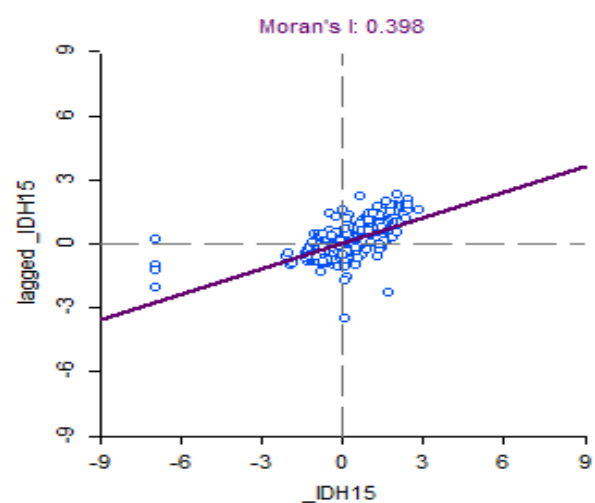
In the Max P alternative, all regions have low associated weights, with region 4 being the best performing with a weight of 0.0292, while region 6 was the one that obtained the highest value with a weighting of 0.0843. Finally, in the cluster-type regionalization all its regions obtained a good performance in terms of the values of their associated weights, however, region 6 contrasted with this performance trend and showed a high value of 0.1263.

Since the choice of the best alternative (regionalization) is determined by the one that on average shows the best result with respect to the weight associated with its criteria (regions) in the matrix, it is observed that the best performance is obtained by Max P regionalization with an associated weighting average of 0.0432; this indicates that there is for this alternative a better relationship between low standard deviation levels and high levels of spatial correlation of their municipalities with respect to the Human Development Index. As a second alternative with a coefficient of associated weights of 0.505 is traditional regionalization, and finally, with a value of 0.0538 is cluster-type regionalization.

*Spatial analysis of Max P regionalization*

the multi-criteria analysis developed in the previous section determined that the best alternative to reduce disparities in the economic development of the municipalities of the state is the Regionalization Max P, is also in turn guarantees the existence of certain positive levels of spatial correlation of their municipalities, which would cause them to contribute to each other when they increase their levels of development; however, the existence of these levels of spatial correlation does not guarantee that all the member municipalities of a region are correlated, to determine which of them are those that are developed in this analysis. To clarify a little, it is understood by spatial correlation coefficient to the positive or negative relationships that two or more places in a space have with respect to their neighbors, this indicator can be calculated globally or locally through the Moran coefficient which oscillates between values ranging from -1 to 1.

In Figure 1 you can see the global spatial correlation coefficient of the HDI in the state of Oaxaca, this presents a value of 0.398, this result indicates a correlation to consider within the municipalities of the state, since when the neighbors with whom a municipality maintains a geographical contiguity increase their HDI values by one unit, it will do so in the value presented here.



**Figure 1** Moran's overall statistic  
 Source: Own elaboration using the GeoDa software

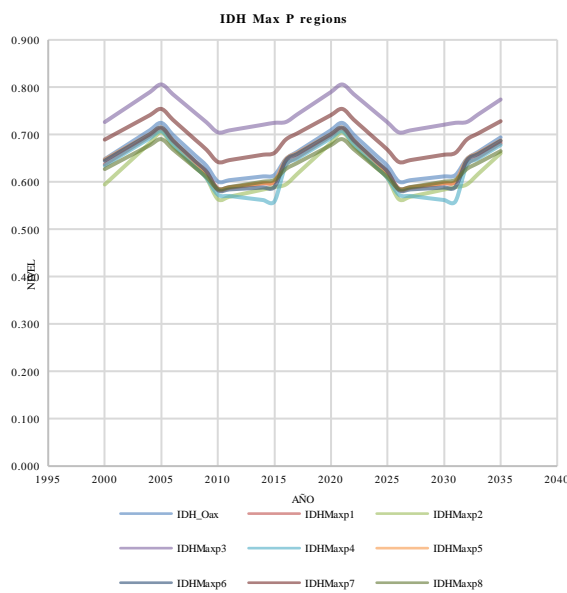


*HDI projection by region*

To analyze the HDI trend in each of the proposed "Max P" regionalization regions, an integrated autoregressive model of moving averages (ARIMA) from the econometric analysis of time series mentioned above was used, with the aim of predicting the values that it may acquire in the future.

HDI values were calculated based on the year 2000 to 2035, for each of the 8 proposed "Max P" regions. It should be mentioned that the last official calculation for the Human Development Index by the United Nations Development Program (UNDP), was made in 2015 so from 2016 the data obey the predictions made.

Figure 2 shows the trend that each of the regions acquires, in this one you can initially observe two very marked cyclical periods; both of them composed of a period of growth, one of degrowth and later accompanied by one of moderate recovery; this effect is observed at the state level and since it is the state that directly influences the development of each of the municipalities, it is replicated in turn in each of the regions analyzed. The first period, which runs from 2000 to 2015, is composed of official data calculated by UNDP, while the second period from 2015 to 2035 is composed of data projected using the ARIMA model.



**Figure 2** HDI Projection by Region

Source: Own elaboration based on data calculated with the R software.

Table 4 (annexes) shows the Human Development Index data for the state of Oaxaca and the proposed regions; For the year 2000 the state presented an HDI level of 0.648 so that 5 years later in 2005 it observed a growth of 0.077 units and thus be placed with an index of 0.725, later the HDI falls very markedly, in 2010 its performance was 0.601 and recovering slightly for the year 2015 with an index of 0.614; through this data you can analyze the cyclical period mentioned above and that was shown visually in the previous graph. The state observed a first period of satisfactory growth and then suffered a fall and then a slight recovery, an effect observed in all regions.

In the second cyclical period that includes from 2015 to 2035, the trend mentioned in the previous paragraph is repeated, from 2015 to 2020, the state observes a growth of 0.095 units going from an HDI level of 0.614 to 0.709; subsequently, the prediction made marks a fall in the levels of the HDI in the following 10 years, the state decreases by 0.097 units and would be placed at a level of 0.612 with respect to its HDI. In the last 5 years of the prediction made is accompanied by a period of growth, which would indicate the beginning of the cyclical process that we have mentioned and analyzed above; in this period of 5 years the state would obtain an HDI level of 0.694, a level that would not reach the best performance of the state that was observed in 2005 but that would still represent a high level of HDI.

With respect to the regions, the behavior observed by the HDI at the state level reproduces something that is to be expected because it is the state that determines through its public, fiscal, economic policies, etc. the direction that development will take; there are two regions that with respect to their HDI levels stand out above the others, these are the Max P3 region and the Max P7, this is due to the municipalities that make them up, since they become some of the municipalities with the best economic performance in the state.

With respect to the Max P3 region, some of the most important municipalities that make it up are Oaxaca de Juárez, Ocotlán de Morelos, San Antonio de la Cal, San Jacinto Amilpas, Santa Cruz Xoxocotlán, Santa Lucía del Camino, Etc. For its part, the Max P7 region has municipalities such as Ciudad Ixtepec, Salina Cruz, Santa María Huatulco, San Pedro Pochutla, Santo Domingo Tehuantepec, among others.

Taking as a reference point the year 2005 which is the year in which the Max P regions observed their best levels of economic development and contrasting with the last one for which the forecast was made, it is observed that although all regions suffer they observed a fall in their HDI levels, the recovery in 2035 is very close to the best observed HDI record; for this last year the Max P1 to 8 regions observed a level of development of 0.694, 0.682, 0.661, 0.774, 0.678, 0.688, 0.687, 0.728 and 0.665, respectively.

Something that is important to note is that despite the cyclical process presented by the HDI levels of the state of Oaxaca and the proposed regions, the way in which these regions are grouped together creates a reduction effect of regional disparities, both in the graph exposed and in the data shown, it is observed that, with the exception of the Max P3 region, all the others follow very similar or close levels of economic development, thus contributing to reduce the disparity gaps between regions with the type of municipal grouping proposed, this trend is reproduced throughout the entire period analyzed, from the year 2000 to 2035.

Annexes

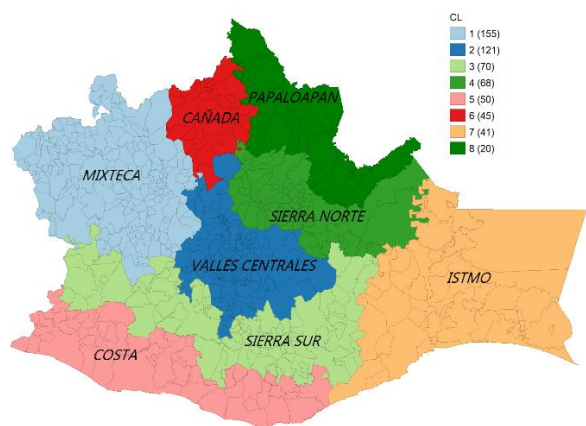


Figure 3 Regional and municipal division of the state of Oaxaca  
Source: Own elaboration using the GeoDa software

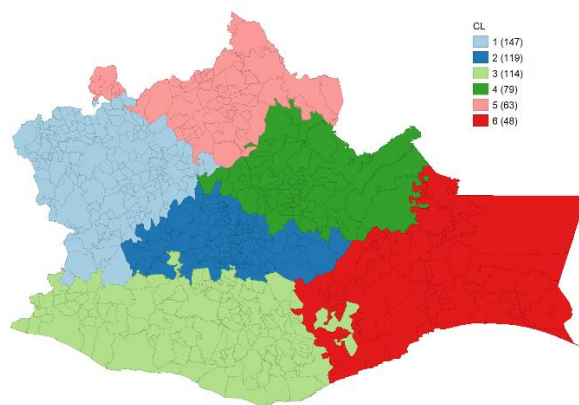


Figure 4 Regional and municipal division by the Max P Regions method  
Source: Own elaboration using the GeoDa software

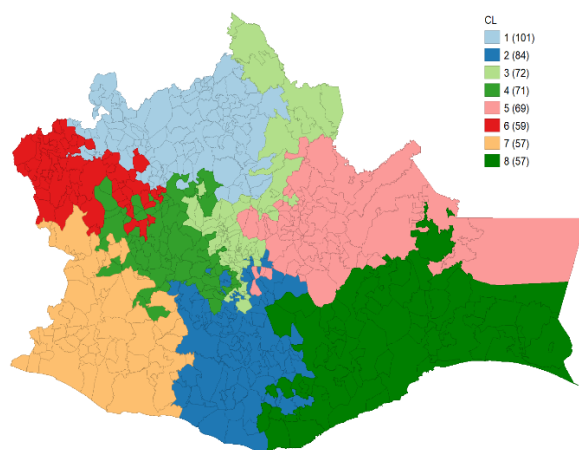


Figure 5 Regional and municipal division by cluster method  
Source: Own elaboration using the GeoDa software

Date	IDH Oax	IDH Maxp 1	IDH Maxp 2	IDH Maxp 3	IDH Maxp 4	IDH Maxp 5	IDH Maxp 6	IDH Maxp 7	IDH Maxp 8
2000	0.648	0.637	0.595	0.726	0.635	0.647	0.645	0.689	0.627
2001	0.663	0.652	0.617	0.742	0.649	0.661	0.659	0.702	0.640
2002	0.679	0.667	0.639	0.758	0.664	0.674	0.673	0.715	0.652
2003	0.694	0.682	0.661	0.774	0.678	0.688	0.687	0.728	0.665
2004	0.709	0.697	0.683	0.790	0.693	0.701	0.701	0.741	0.678
2005	0.725	0.712	0.705	0.806	0.707	0.715	0.715	0.754	0.690
2006	0.700	0.687	0.676	0.786	0.680	0.688	0.688	0.732	0.669
2007	0.678	0.665	0.653	0.766	0.656	0.665	0.666	0.710	0.650
2008	0.656	0.643	0.631	0.746	0.632	0.642	0.644	0.689	0.630
2009	0.634	0.620	0.608	0.726	0.608	0.618	0.622	0.668	0.610
2010	0.601	0.586	0.564	0.705	0.573	0.584	0.583	0.642	0.585
2011	0.604	0.589	0.569	0.709	0.570	0.587	0.584	0.646	0.589
2012	0.606	0.592	0.574	0.713	0.567	0.591	0.586	0.650	0.593
2013	0.609	0.594	0.579	0.717	0.565	0.594	0.587	0.654	0.597
2014	0.612	0.597	0.584	0.721	0.562	0.598	0.588	0.658	0.601
2015	0.614	0.600	0.589	0.725	0.559	0.601	0.590	0.661	0.604
2016	0.648	0.637	0.595	0.726	0.635	0.647	0.645	0.689	0.627
2017	0.663	0.652	0.617	0.742	0.649	0.661	0.659	0.702	0.640
2018	0.679	0.667	0.639	0.758	0.664	0.674	0.673	0.715	0.652
2019	0.694	0.682	0.661	0.774	0.678	0.688	0.687	0.728	0.665
2020	0.709	0.697	0.683	0.790	0.693	0.701	0.701	0.741	0.678
2021	0.725	0.712	0.705	0.806	0.707	0.715	0.715	0.754	0.690
2022	0.700	0.687	0.676	0.786	0.680	0.688	0.688	0.732	0.669
2023	0.678	0.665	0.653	0.766	0.656	0.665	0.666	0.710	0.650
2024	0.656	0.643	0.631	0.746	0.632	0.642	0.644	0.689	0.630
2025	0.634	0.620	0.608	0.726	0.608	0.618	0.622	0.668	0.610
2026	0.601	0.586	0.564	0.705	0.573	0.584	0.583	0.642	0.585
2027	0.604	0.589	0.569	0.709	0.570	0.587	0.584	0.646	0.589
2028	0.606	0.592	0.574	0.713	0.567	0.591	0.586	0.650	0.593
2029	0.609	0.594	0.579	0.717	0.565	0.594	0.587	0.654	0.597
2030	0.612	0.597	0.584	0.721	0.562	0.598	0.588	0.658	0.601
2031	0.614	0.600	0.589	0.725	0.559	0.601	0.590	0.661	0.604
2032	0.648	0.637	0.595	0.726	0.635	0.647	0.645	0.689	0.627
2033	0.663	0.652	0.617	0.742	0.649	0.661	0.659	0.702	0.640
2034	0.679	0.667	0.639	0.758	0.664	0.674	0.673	0.715	0.652
2035	0.694	0.682	0.661	0.774	0.678	0.688	0.687	0.728	0.665

Table 4 HDI regressions by region  
Source: Own elaboration based on data calculated with the R software

## Conclusions

In the multi-criteria analysis developed, a contrast is made between three regionalization proposals called scenarios, scenario 1 represents the traditional regionalization of the state, while scenarios 2 and 3 obeyed the Regionalization Max P and the Cluster type, in that order; these analytical scenarios were previously constructed following a methodological development and establishing the variables or criteria that were sought to optimize in these models of grouping of geographical or spatial units.

By means of an adaptation of the traditional CRITIC method, the standard deviations and spatial correlation coefficients of the Human Development Index were analyzed in each region of the proposed scenarios; in this adaptation of the aforementioned method, a low standard deviation is sought since it would indicate a lower dispersion in the HDI samples in each region and high spatial correlation coefficients, which would show the spatial dependence of the municipalities in each region; by means of this calculate a weighting that allows to evaluate the best option.

With respect to the results of the standard deviation, the Regionalization Max P is the one that showed a better result with a coefficient of 0.0715, in second place, the traditional regionalization was located with 0.0780 and the last the cluster tip with 0.0851; this result shows that the disparities with respect to the HDI coefficients for each of its proposed regions are smaller, so this type of grouping contributes to reduce the disparity in economic development both between the proposed regions and between their municipalities, this by the fact that it was taken as an optimization criterion to reduce the disparities observed in the HDI.

In the spatial correlation matrix carried out, the average spatial correlation coefficient of traditional regionalization and Max P regionalization are quite similar, the second obtaining a very slight advantage with a coefficient of 0.355 by one of 0.354, in both the HDI would increase on average by .35 in the hypothetical case that the development of neighboring municipalities increased by one unit; the best result seen here is that of cluster-type regionalization with a coefficient of 0.379, which may be due to its smaller number of regions and in turn the greater compactness of them, which is a key element in this type of regions.

To decide which region shows the best conditions in terms of lower levels of HDI disparity and better spatial correlation effects, the coefficient of weights associated with the regions was calculated. The associated weight coefficient sought the best relationship between low levels of disparity in economic development and a high spatial correlation in each region of the scenarios analyzed; a low coefficient indicates low dispersion and high correlation novices; the opposite happens for high levels of the coefficient.

To select the best regionalization alternative among the three analyzed, the average associated weighting coefficient was estimated, with Max P regionalization showing the best performance with a value of 0.432, followed by traditional regionalization with a higher value of 0.505 and finally cluster-type regionalization which obtained the worst performance with a result of 0.538.

The result obtained by the associated weighting coefficient of the Max P regionalization guarantees that it is in it that by grouping the municipalities through their 8 proposed regions, the levels of disparity in economic development are reduced and in turn maintains an acceptable level of spatial correlation between their municipalities; in this way it can be observed that through this adaptation of the CRITIC method it is possible to corroborate the proposed hypothesis in which it is affirmed that through the creation of new regions it contributes to reduce disparities and stimulate a more balanced development, this is achieved through the use of an analytical model where the optimization of the selected criteria (selected variables of the model) is prioritized. for the creation of the proposed regionalization.

In the spatial analysis of Max P regionalization, the levels of spatial dependence existing at the regional level are investigated in greater depth through the spatial correlation matrix already analyzed. At the global level, the spatial correlation coefficient was very close to 0.40, a value of great relevance since it reveals an important dependence among the municipalities of the state with respect to economic development. At the local level, the regions that observed the highest correlation levels are Max P4 with the best performance and a coefficient of 0.768, followed by the Max P region 3, 1 and 7 with values of 0.440, 0.432 and 0.404; exceeding all of them the overall coefficient of dependence.

The lowest levels of spatial correlation were presented in three regions, Max P5, 6 and 8 with respective coefficients of 0.170, 0.171 and 0.194; it is important to note the fact that 50% of Max P regions were above .40 as this indicates that this type of regionalization not only contributes to reducing disparities in economic development internally; but in turn, in most of its regions, the coefficients show that the municipalities present good levels of spatial correlation, that is, through the proposed groupings, the HDI level of a municipality will be raised when the HDI level is raised in the municipalities with which they have a geographical contiguity.

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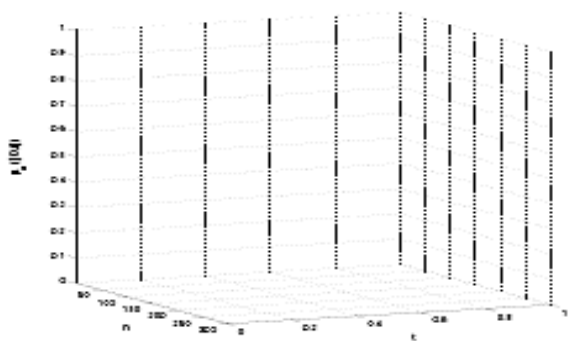
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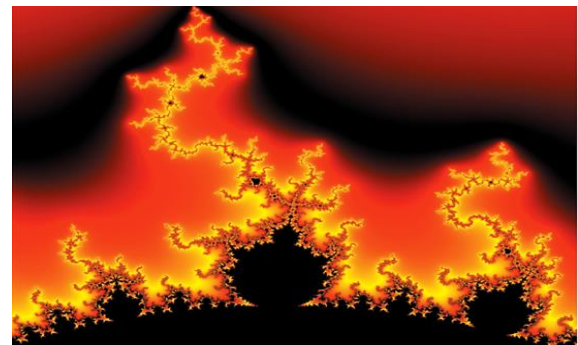
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