

Chart.js as a Graphic Solution to Data Behavior Chart.js as a

Graphic Solution to Data Behavior

¹Martínez Ramírez Violeta, ²Margarita Raquel García Sierra, ⁽³⁾José Edgar López Aburto,
⁴Héctor Cuanalo Bautista, ⁵José Abraham Martínez Villegas

<https://doi.org/10.61117/ipsumtec.v8i1.354>

¹Doctorate in Education. Tecnológico Nacional de México, Campus Instituto Tecnológico de Puebla. Department of Systems and Computing. ORCID ID: 0000-0003-1518-786X. Address: violeta.martinez@puebla.tecnm.mx, Av. Tecnológico 420 Col. Maravillas, C.P. 72220, Puebla, Puebla, Mexico.

²Master's Degree in Administrative Engineering. Tecnológico Nacional de México, Campus Instituto Tecnológico de Puebla. Department of Basic Sciences. Sciences Department. ORCID ID: 0000-0003-3965-0732. ORCID ID: 0009-0002-5046-7955. Address:

margaritaraquel.garcia@puebla.tecnm.mx, Av. Tecnológico 420 Col. Maravillas, C.P. 72220, Puebla, Puebla, Mexico.

³Bachelor's Degree in Computer Science. Tecnológico Nacional de México, Campus Instituto Tecnológico de Puebla. ORCID ID: 0009-0002-5046-7955, Address: edgar.lopez@puebla.tecnm.mx. Av. Tecnológico 420 Col. Maravillas, C.P. 72220, Puebla, Puebla, Mexico.

⁴Bachelor's Degree in Computer Science. Tecnológico Nacional de México, Campus Instituto Tecnológico de Puebla. ORCID ID: 0009-0005-4937-7831. Address: hector.cuanalo@puebla.tecnm.mx, Av. Tecnológico 420 Col. Maravillas, C.P. 72220, Puebla, Puebla, México. ⁵Student of the 9th semester of the Information and Communication Technologies Engineering course. Tecnológico Nacional México, Campus Instituto Tecnológico de Puebla. ORCID ID: 0009-0007-4270-7003. Address: i18221800.19@puebla.tecnm.mx, Av. Tecnológico 420 Col. Maravillas, C.P. 72220, Puebla, Puebla, Mexico.

Abstract - The present computational work developed under web technology, makes use of the JSChart tool to create real-time graphs of the collected values of financial data to be analyzed by means of images within a business unit. For ArcGis Pro [1] a chart allows the visualization of data that will facilitate the understanding of trends, critical points, relationships, among others. The exploration of information by means of customized graphs allows to point out, highlight outliers and better understand patterns. Thus, a more detailed analysis of a large amount of data improves its accuracy when making decisions.

According to PayFit [2], the reports and graphs are very useful for keeping business accounting up to date and helping finance areas in their tasks such as increasing business performance and staff performance. For senior executives, it provides an instant and comprehensive view of the business.

Keywords: *Chart, patterns, trends, web.*

Abstract -- The present computational work developed under web technology, makes use of the JSChart tool to create real-time graphs of the values collected from financial data to be analyzed through images within a business unit. For ArcGis Pro [1] a graph allows the visualization of data that will make it easier to know trends, critical points, relationships, among others. Exploring information through custom charts allows you to pinpoint, highlight outliers, and better understand patterns. Thus, a more detailed analysis of a large amount of data improves its accuracy when making decisions.

According to PayFit [2], reports and graphs are very useful for keeping company accounting up to date and helping finance areas in their tasks such as increasing business performance and staff performance. For senior

executives, it provides a comprehensive view of the business instantly.

Key words - *Chart, patterns, trends, web.*

INTRODUCTION

The sheer number of websites visited every second on the internet via PCs or smartphones is overwhelming. Having computational solutions within companies that collect data and represent it as actions to improve their operations and increase productivity can be better complemented with reports containing specific graphics. On the web there are a variety of tools for this purpose, among the most used by web code generators for data visualization are: D3.js, Processing.js, Google Charts, Chartjs.js, Vis.js, Sigma.js, Flot Charts, Chartist.js, Plot.ly and Seaborn. The choice of any of these will depend on ease of learning, ease of customization, variety of graphical elements, ease of customization, and the format of the data to be used. [3]

Problem

The company par excellence within the sector of transfers of new units from the plants that manufacture cars to the agencies of the country operates its processes in the area of tracking manually in multiple Excel files, which leads to a conflict in the management of data, since different formats are used and when sending them can cause inconsistency in these same.

Overall objective

Create an information system under web technology to increase efficiency in the management of logistics planning in the tracking area of the company through graphical reports that facilitate informed decision making by knowing the sharing of data collected in the area of logistics.

Specific objectives

-Analyze the requirements on resources such as operators and economic resources of the company's traceability area.

Design the database by means of the entity-relationship methodology.

-To distribute the graphic elements, typographies of the initial design for the pages of the web system to be published.

-Coding the site through Front End and Back End.

-Implement and test the web site.

Scopes

The creation of this web application has a great future projection because it only focuses on storing all the information handled by the tracking area with the implementation of route planning with the information.

Its improvements can become of great interest for the tracking area because it implements the different roles of each collaborator manages and migrate in its entirety to the system, it can also expand the catalog of graphical reports for an optimal analysis of the statistics.

Limits

They are intended for end users exclusively in the tracking area, extending the functionalities in the management of information on the tracking of the journey.

Development tools

The main development tool on which it is based in this work is C#; Microsoft considers C# as one of its best elements for modern and scalable web development, based on extremely dynamic and secure HTML, CSS and JavaScript. For data integration it allows stable connections to the most popular databases such as SQLite and SQL Server, among others.[4] C# is also used for data integration.

The star charting library called JS Chart from JavaScript, is an open source software oriented to offer remarkable features aimed at appearance thanks to the impressive palette of advanced colors, with gradient patterns to customize images, including advanced animations, without neglecting the proper rendering performance in all modern browsers for perfect visualization. In addition, you can combine its 8 different types of graphics. [5]

State of the art

Within the Universidad del Rey [6], the work entitled "Analysis of Web Content through Dynamic Reports" is published, which implements a web site where it successfully graphs parameters of access to the Internet, dynamically displaying reports whose purpose will be its analysis of web content. Here it can be corroborated that the updating of trends offers information on the behavior of cybernauts.

Based on PHP, the work "Sistema Generador de Mapas Temáticos y Gráficos Estadísticos" (Thematic Maps and Statistical Graphics Generator System) is published from Havana, in which statistical graphics obtained from the collection of the Geographic Information System databases are implemented, according to thematic maps. With this, the reports generated reflect in real time the areas of opportunity for decision making.[7].

In Bolivia, the work entitled "Sistema Web de Generación de Reportes Gerenciales de Indicadores Financieros de Responsabilidad Social", software was developed via web, through PHP and MySQL for the database, offering the institution to generate reports of financial social responsibility indicators including graphs of evaluation results, comparisons between indicators and comparisons between reports; as well as, the management of these reports for their publication and better decision making by senior executives.[8] The project was developed by the Ministry of Finance and the Ministry of Economy and Finance.

In Cuba 2017, the work entitled "Statistical processing module for decision support of the orion search engine", a web-based system that includes Symfony tools, Bootstrap for the design of the web interface, PostgreSQL and Solar database manager, HighChartsJS as a library to generate graphics in real time over the Internet.

The developed module has features and functionalities that allow the user administrator to make informed decisions based on the statistical analysis of the searches. The development of the statistical processing module for the search engine contributed efficiently in the process of sound decision making.[9] The development of the statistical processing module for the search engine contributed efficiently in the process of sound decision making.[9]

DEVELOPMENT

The following is a description of the steps that led to the creation of a website that generates graphical reports with the data collected from the administrative process of the tracking area.

1. Definition of the Problem or Need: Visual representation of data in a varied and graphical way.

2. Technology Selection:

Chart.js describes itself as a "simple and flexible JavaScript charting library for the modern web", it is also among the most popular libraries in the Github community because it provides a set of frequently used chart types, plugins and customization options, in addition to a set of built-in chart types.[5]

3. Implementation Planning:

The objective is to implement a library for the visualization of charts based on the manipulation of the software, with this, a better performance and accessibility for end users is achieved. Chart.js is an open source library which saves us the resource factor, the integration can be direct by "<script>" or by downloading the files to integrate them into the project. See image 1.

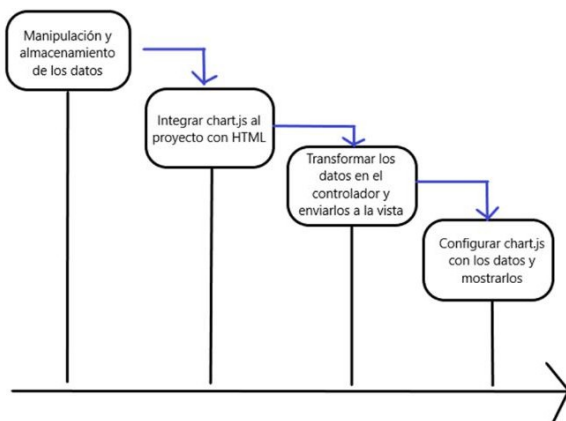


Figure 1. Chart insertion stages with Chart.js

System Design

The construction of the web system begins by applying the layout, views, color palette, typography, menus, forms, alerts, etc. See image 2.



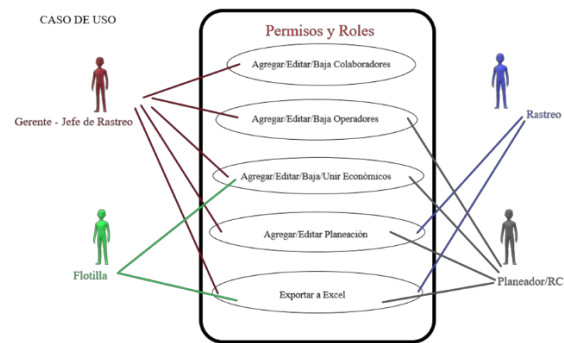
Image 2. Website layout

The layout in summary is the arrangement of the components of the view, that is to say, the distribution of the elements and their shapes, grouping typography, colors, etc.

In the planning, we addressed the point of permissions and roles that the web system will have, this has the purpose of providing a better organization and integrity of the data, so that only some can add, edit, delete some data, making it a friendlier environment for both the site and the database.

Database

A fundamental part of the project is of course the database, where all the system information is stored, it will manage the data according to the needs of the organization and in turn facilitates the exchange of data between the database and the system controllers. See image 3.



Use Case Diagram

As mentioned before, SQL Server was used in conjunction with the SQL Server user interface (SSMS) to design and perform all the development of the respective tables and stored procedures for their use. See Figure 4.

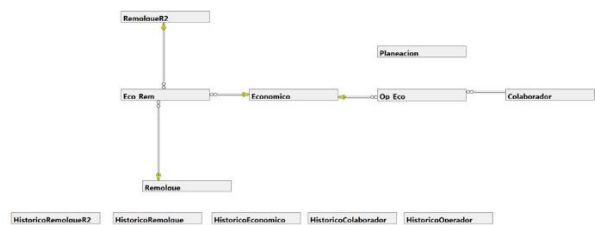


Image 4. Main procedures

Creation of the system with the architecture

We proceed to create the development environment in visual studio with the parameters established with the necessary frameworks, once the development environment is ready we proceed to create the database connection with the environment, we proceed to develop the classes, controllers and the layout with their respective views.

In the Front End development, with the layout already established, the next step was to create the alerts, the button actions and the corresponding tables for a user friendly and easy to use experience.

Back End Development

Back End consists of creating functions that facilitate the development of the system, within this we also find the connection with the database better known as model, the controller is the one that processes most of the information it receives, is the intermediary between the model and the view, is responsible for obtaining data from the view process them and send them to the model and vice versa.

```
[Authorize]
0 referencias
public class PlanificadorController : Controller
{
    0 referencias
    public ActionResult Planificacion()
    {
        return View();
    }
}
```

Figure 5. Model and View Controller

In the system functionalities section you will find:

Login, change password and reset password:

It is located in the Access controller, where libraries are involved to send emails to register the collaborator and reset their password, passwords are encrypted with 256-bit hash algorithm for greater cryptographic security, it queries the database to obtain the corresponding credentials, then the controller receives the information from the database, processes the information obtained and based on this redirects to the corresponding view.

List pertinent information:

It refers to list the information according to the view, the information will be stored in a table with the help of the jQuery DataTable, for a better management of the data, where two buttons will be included within each listed data that will have the function to edit and visualize, in some cases only one button will be reflected that will be the delete button, it also depends on the permissions that the collaborator has. The listing is made since the content of the page is loaded, it sends a jQuery request to the controller where it stores a URL with the dates and numbers (as the case may be) is by means of the stored procedure, it obtains a list and returns it to the view, in the view the information is arranged by means of HTML and jQuery.

Add/Edit/Delete collaborators, economic, operators, planning:

It is found in the Home, Interface and Planner controllers, this function can add, edit and delete the economic, collaborator, operator or planning depending on the case where it is used, what it does is to obtain the information from the form, send it to the corresponding controller by means of jQuery, the controller will process the information to know if it brings all the necessary information of the view, makes the corresponding query to the database by means of the stored procedure, this returns a response to the controller and the controller is in charge of sending it to the view.

Edit information:

It is possible thanks to the data listed in the corresponding tables, when you click on the edit button this will display information that is obtained through a jQuery request to the controller and the controller to the database that will list the unique data of that data, you will have the option to edit certain fields and when you click on the save button, this will obtain all the updated data at the moment of giving click sends them in a jQuery request to the controller, the controller verifies them and sends them to the stored procedure of the database this will obtain an answer, if it is favorable it will update the data of the field, if it is negative it will return an error that the controller will pass it to the request and this will show an error alert.

Display information:

The functionality of visualizing information is to be able to see all the information depending on the table without the option of editing the data, when clicking on the view button, this will send to the controller by means of jQuery a request to bring all the data, the controller consults to the database by means of the stored procedure generating a list with the corresponding data and the controller returns to jQuery that list and stores it in the different fields of the form for its visualization.

Graphics:

These are located in the Home controller, they have the purpose of summarizing the status of the economic and planning, they obtain the information in real time from the database, when loading the Dashboard page jQuery will make a request to the controller, it will make the corresponding query to the database through the stored procedure and obtain the data, the controller will return the data to the view and through jQuery and JavaScript will process the data to display the information in the graph.

4. Development and Implementation:

The first step to implement a graphic library to the project is to know what data will be processed to show them to the end user, in the database manager through SQL Server and with the help of stored procedures the data are manipulated to send them to the controller and thus consume it through JavaScript.

The integration of chart.js to the project was carried out by means of HTML tags, within a tag `<script>`.

Body of the graphics in HTML: See image 6.

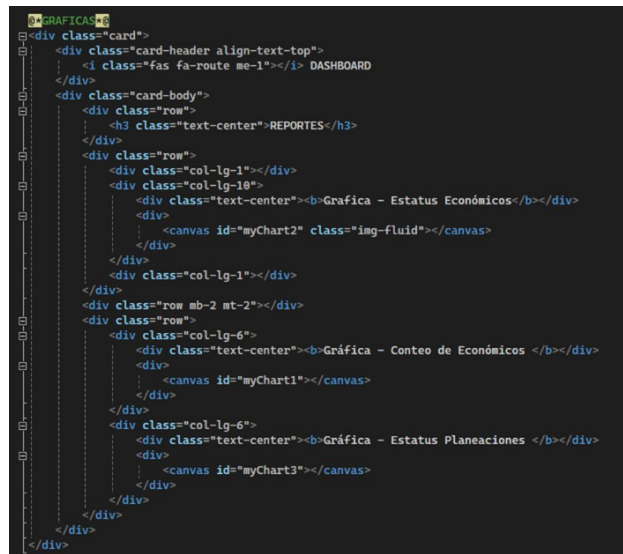


Image 5. Graphics in HTML

When the data arrives from the database to the controller via its connection, the controller stores it in a list and transports it to the view via a Json request.

With jQuery Ajax we receive the data directly from the controller in Json format, inside the jQuery Ajax request we manipulate the data of the list to be able to assign them in HTML and show them to the final user.

It is carried out by means of a function where we obtain the ID of the HTML tag of the chart, the received list is iterated, a new chart is created (new Chart) where it takes as main parameter the ID of the HTML where the chart representation will be created, the type of chart to use is given, in the data section the title of the chart is established, the labels and the data to show (the number of labels must be the same as the number of data to show), as an extra the colors, borders, etc. can be manipulated. See image 7.

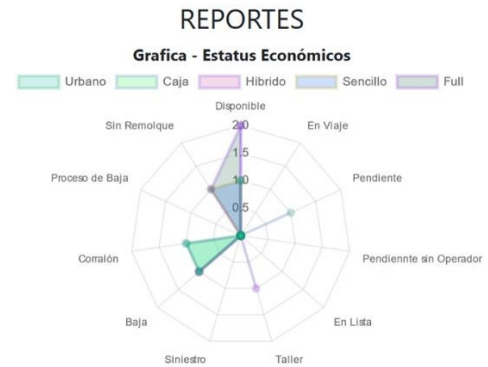


Figure 7. Economic status graphs

5. Testing and Validation:

Extensive tests were performed to obtain the best possible result, chart.js is a very powerful and manipulable tool for the creation of dynamic charts, this means that you must be very precise with the data to display and the number of labels in the chart, as well as the behavior of the data, because, without this the chart tends to destructure by itself which for the end user will be difficult to handle.

8. Evaluation of Results:

The indicators and evaluations show that chart.js meets all the needs required to show the end user a graphical representation of the data behavior. See image 8, 9 and 10.

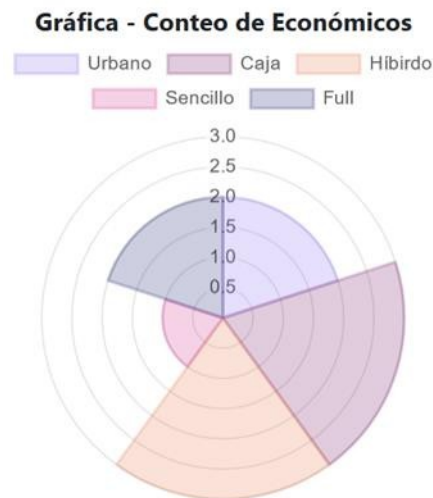


Figure 8. Economic Status Charts

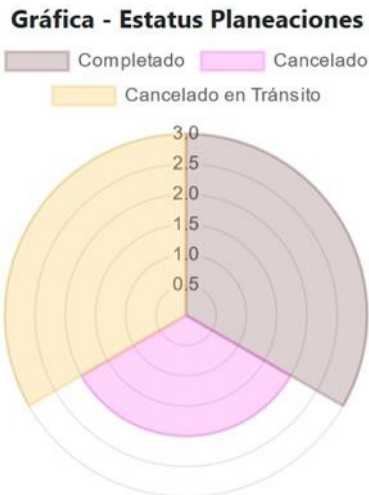


Figure 9. Planning Status Charts

Export to Excel:

The export to Excel button generates a URL of the controller concatenated with dates (as the case may be) and the number of collaborator, economic, planning (as the case may be) to send it to the controller through jQuery, the controller makes the query to the stored procedure and returns a list with all the information, the controller converts all that information and through a library stores the data in an Excel file in table format for downloading.

Overhaul and Testing Maintenance

Maintenance is a very important section when it comes to web systems development, it is recommended to periodically update each nuget package downloaded in visual studio, as well as the libraries and frameworks possible, since many of these updates contain security patches to possible vulnerabilities, it is also recommended to clean data from the tables, "Operator History" and "Economic History" to perform a faster query, it could be recommended a thorough cleaning of the planning performed, this based on the number of fields that the table has stored.

DISCUSSION AND ANALYSIS OF RESULTS

For the review we made use of an application that nowadays we can find in the inspection section of some browsers, this tool is lighthouse. "LighthousefromGoogle is a fully automated and open source tool that gives us the ability to measure the quality of a given web page, whether public or private. This is achieved by testing the usability and performance of the site we want.

Thus, thanks to their results, it is easier to establish where we need to improve" (cma, 2023). The lighthouse review yielded the following results: See image 10.

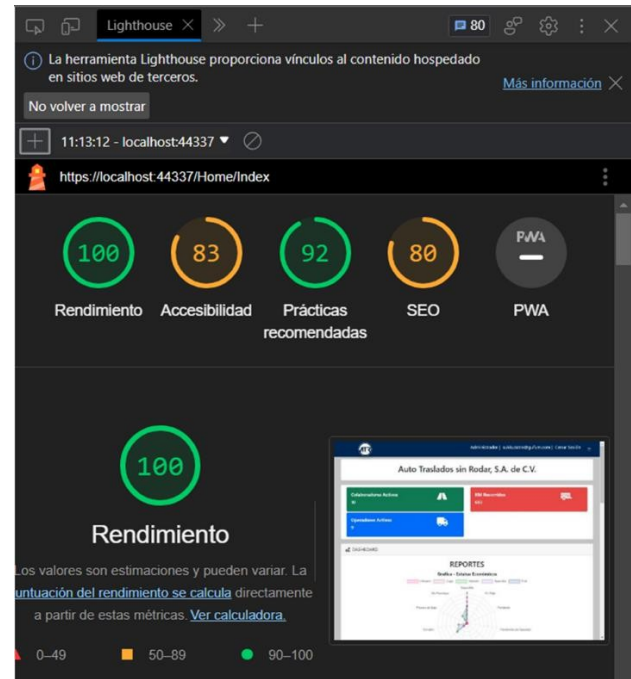


Image 10. Performance tests

In the testing section, constant tests were carried out in all possible cases, in order to avoid any spontaneous error in the execution of the system, in case of errors, they were corrected and error alerts were added to prevent the system from breaking down and not following its correct execution.

Discussion.

There are suggestions for the inclusion of perspectives in improvements where the representation of 3D models that enrich the visualization of 2D models is considered, as referred by Toptal Developers [11], adding textures and animation with CSS insertion, as proposed in its proposals envato tuts+ [12].

CONCLUSIONS

The creation of the information system under web technology to increase management in logistics planning is important because it promises to keep the information in a correct order for later use, in turn facilitates access and processing for users to maintain better productivity and data consistency.

It is concluded that the information system under web technology has a correct operation, fulfilling the expectations that were agreed from the beginning of this project, which are:

- Export the information from the tables to Excel workbooks.
- Concentrate the most necessary information to plot it on the dashboard to keep it under control of the data and its specific behavior in improving high-level decision making within the company, with optimal performance on the networking requirements of the logistics area.
- Provide access to the creation of users and their respective roles.
- Create a login section to keep information even more private.
- Develop a web-based system that is user-friendly for end users.

It is relevant within a profit analysis to make use of statistical graphs as they represent complex information in an accessible way (UNIR, 2025). According to Belcove (2025) images and diagrams facilitate the identification of strongly correlated parameters as it is easier to recognize data patterns and trends. Updated trends on a statistical graph allow necessary and correct actions to be taken immediately in the business organization under the visualization of behaviors such as: Nonexistence, danger, emergency or normal (scientologycourse, 2025).

Future work

Maintenance is a very important section when it comes to web systems development, to be periodically updated every nuget package downloaded in visual studio, as well as the libraries and frameworks possible, since many of these updates contain security patches to possible vulnerabilities.

Add the automation of the cleaning process on the data of the tables, "Operator History" and "Economic History" to perform a more precise and accurate query, as well as the automation of the thorough cleaning of the planning performed, based on the number of fields stored in the main table.

BIBLIOGRAPHY .

- [1] esri (2024) What is a chart? Available at <https://pro.arcgis.com/es/pro-app/latest/help/help/analysis/geoprocessing/charts/what-is-a-chart.htm>
- [2] PayFit (2023). What is the importance of reports and graphs on a company? Available at <https://payfit.com/es/contenido-practico/informes-y-graficos/>
- [3] Data School (2019). The good, the bad, the geek. 10 code libraries to solve your visualization projects. from projects. Available at <https://es.schoolofdata.org/2019/04/22/lo-bueno-lo-bad-lo-geek-10-code-libraries-to-solve-your-data-visualization-projects/index.html>
- [4] Microsoft .net (2024). ASP.NET web applications. Available at <https://dotnet.microsoft.com/es-en/apps/aspnet/web-apps>
- [5] JS Chart (2024). Simple but flexible JavaScript charting library for the modern web. Available at <https://www.chartjs.org/>
- [6] González Servant, E. (2010). Web Content Analysis through Dynamic Reports.
- [7] Sánchez, M. R. P. (2007). Title: SISTEMA GENERADOR DE MAPS TEMÁTICOS Y STATISTICAL GRAPHICS (Doctoral dissertation, University of Computer Science). Available at https://repositorio.uci.cu/bitstream/ident/TD_0468_07/1/TD_0468_07.pdf
- [8] Gonzales Apaza, P. (2017). Sistema Web de generación de reportes gerenciales de indicadores financieros de responsabilidad social para" Bolivia Tech Hub" (Doctoral dissertation). Available at <https://repositorio.umsa.bo/bitstream/handle/123456789/12911/T.3324.pdf?sequence=1&isAllowed=y>
- [9] Cabrera Martínez, A. (2017). Statistical processing module for decision support of the orion search engine (Bachelor's thesis, University of Computer Science. Faculty-1). Available at <https://repositorio.uci.cu/handle/123456789/7657>
- [10] Cma (2023). Google Lighthouse, everything you need to know. Cma. <https://cmacomunicacion.com/google-lighthouse-everything-you-should-know/>
- [11] TopTal Developers (2024). 3D Graphics: A Tutorial from WebGL. Available at <https://www.toptal.com/javascript/graficos-3d-un-webgl-tutorial>
- [12] envato tuts+ (2024). Creates an animated 3D bar chart animated bar chart. Available at <https://code.tutsplus.com/es/crea-una-tabla-grafica-de-bars-3d-animada--net-24831t>
- [13] UNIR (2025). Statistical graphics: types and importance in data communication. Available at <https://colombia.unir.net/actualidad-unir/graficos-estadisticos/#:~:text=Los%20gr%C3%A1ficos%20estad%C3%ADsticos%20son%20potentes,la%20evoluci%C3%B3n%20de%20distintas%20variables.>
- [14] becolve (2022). Transforming data into knowledge: the main advantages of data visualization. Available at <https://becolve.com/blog/transformando-los-datos-en-knowledge-the-major-advantages-of-data-visualization/>
- [15] scientologycourses.org (2025). Statistical Trends and Their Meaning. Available at <https://www.scientologycourses.org/es/tools-for-life/conditions/steps/statistic-trends-and-their-meaning.html>

Contribution role	Author(s)
Conceptualization	José Abraham Martínez Villegas
Data Curation	José Abraham Martínez Villegas
Methodology	José Edgar López Aburto
Project management	Margarita Raquel García Sierra
Resources	Proofreading and editing - Violeta Martínez Ramírez
Software	José Abraham Martínez Villegas
Supervision	Héctor Cuanalo Bautista
Validation	José Abraham Martínez Villegas
Visualization	Margarita Raquel García Sierra
Editorial staff	Original draft - Violeta Martínez Ramírez
Editorial staff	Proofreading and editing - Violeta Martínez Ramírez



This work is
 licensed under an
 international license
 Creative Commons Attribution 4.0.