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Software development that determines IMSS quotas for SMEs

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Abstract: Currently, SMEs in Mexico do not have a high investment to include technology in their daily processes. Therefore, it leads to delays in their administrative obligations and therefore inadequate financial planning. In this sense, technological inclusion is required in SMEs to help them improve competitively with large companies. This study focuses on developing software that allows SMEs of the Juan C. Bonilla, Puebla in Mexico to calculate their administrative obligations in social security, which allows them to anticipate their financial situation and thereby determine correct decisions. The methodology used in this work has an application purpose because it adapts to the needs of SMEs, whit a qualitative approach because it is based on natural environments, in terms of its depth it is explanatory because it determines the causes and consequences, with respect to the obligations administrative, finally is experimental because the calculation variables can be manipulated in relation to the development of the software with which elements that were not useful for SMEs were detected. In the background, a flow diagram was prepared that determined the basic operations of calculating social security for that later the software was developed through the computer language C++. The results obtained from the software were through the preliminary implementation in the laboratory to small businesspersons from the Juan C. Bonilla, Puebla, making known through a usability list the functionality of the software with respect to the interface and the time to obtain the calculation of social security of which 90% seemed adequate to its daily operations.

Keywords: SMEs, software, innovation´, social security, administrative obligations.

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1 Introduction

Small and medium- sized companies have an important function in the Mexican economy, since there are 90% of these economic units, so that their function for economic development is vital, but, with the little technological development that these economic units have, they are become uncompetitive (Quispe, Patricio, Telot & Nogueira, 2017).

Regarding small and medium-sized companies, the use of technology is limited, since the high cost of Access to this technology means that their operations are affected with respect to competitiveness with large companies (Estrada, Cano & Aguirre, 2019). Regarding the productivity on SMEs, investment as well as innovation in technology is essential, given that the way of doing business is currently more dynamic (Ibujés & Benavides, 2018).

Therefore, it is necessary to invest in technology that makes small and medium-sized businesses competitive, especially in regions where they can be considered strategically essential to boost societies economy.

For the above, the evaluation of the software in this study was carried out in small medium-sized companies located in the municipality of Juan C. Bonilla, Puebla, México. This is given the proximity to the municipalities of Puebla and Cholula as well as the "*Hermanos Serdán*" International Airport of the state of Puebla. The above is because it is considered a municipality with high economic power due to its proximity to the aforementioned places and this result in competitiveness in SMEs having growth with respect to technological innovation.

Figure 1. Geographic location of Juan C. Bonilla. **Source:** Google maps (2024).

2. State of art review

Miraidy (2012) explains for SMEs, the lack of knowledge about technological innovation is minimal compared to large companies that have dedicated themselves to researching innovation, which means that SMEs are not as competitive in their operations.

However, there is evidence that innovation is due to the lack of developing it internally that is the lack of innovation on the part of the managers or directors of SMEs (Leyva, Espejel & Cavazos, 2020). On the other hand, according to Aranda, De la Fuente and Becerra, they reveal that the evaluation of technological management is based on business management processes (Heriberto, De La Fuente & Becerra, 2010).

Despite the growing research on technological innovation, it has been shown that there is a gap in the literature, however, to promote innovation within companies, specific knowledge is required that is part of the innovation process, which includes the Exchange information, problem solving and learning with other people or organizations. The study of Castillo y Torres in 2019 focused on analyzing the set of written relationships that influence innovation within SMEs, which are identified as academic cooperation, commercial cooperation and professional cooperation, whose objective within the study was to evaluate innovation through an instrument that was used by the Ministry on economy for the year 2017 (Castillo & Torres, 2019).

With regard to Europe, technological innovation is focused on SME son ecosystem models that allow them to develop intelligent products so that high levels of competition can be accelerated in organizations, in countries that showed a positive result in ecosystem innovation were the United Kingdom, Netherlands, Sweden, and Switzerland. Germany, Denmark, France and Norway (Khatami, De Bernardi, Vilamová, Cagno & Ricciardi, 2024).

For its part, there is evidence that innovation in SMEs has a significant relationship with their quality management; however, a fundamental role has also been found between the leadership style and the technological innovation of these economic units, since it follows that motivation in these companies is essential to create innovation (Abbas & Sagsan, 2019).

In Asia, specifically in China, it has been evident how SMEs have had an investment approach by foreign capital towards SMEs, having an impact in the quality of innovation of these economic units, because despite the distance they have SMEs compared to cities, these companies have proven to have a greater impact in their processes given the technological innovation they have (Cai, Cheen & Lin, 2020).

From the above, Ping and Hao, expressed in their study that the transfer of indigenous knowledge improves the innovation on SMEs with foreign capital financing, the transfer of knowledge has implied improving the relationship between the transnational transfer of knowledge and innovation in the state-owned companies (Ping & Hao, 2022).

It has also been shown that SMEs in China have taken advantage of block chain technology, with the innovation of new information Exchange mechanisms and systems, to have more agile and competent organizations compared to other organizations (Tachia et al., 2021).

Regarding the United States of North America, as a result of coronavirus-19 pandemic, electronic commerce flourished, however, work has been done with Artificial Intelligence (AI) in SMEs to have a better way of processing essential data in their processes, generating significant help to be more competitive in global markets (Barata, Ferreira, Carayannis & Ferreira, 2024).

Likewise, SMEs have experienced that innovation and competitiveness must respect human values, developing effective collaboration between humans and robots, relying on the shortage of capital for investment in this technology in government institutions, research centers and universities to implement it more effectively in industry 4.0. (Ietto, Ancillai, Sabatini, Carayannis & Gregori, 2024).

In Latin America, specifically in Brazil, it was evident that websites, mobile devices, digital marketing and new technologies have served as support to generate value in SMEs, taking into account that the more companies grew, the greater technological attention they received required, this in turn helps organizations and society have a closer link in their operations (Kieling, Tezza & Vargas, 2023).

In Peru it was evident that the clusters generate competitiveness for SMEs, however, the same companies demanded that in order to strengthen their productive chain, trained workers should be taken into account with respect to technology and that administrative processes, as well as operations have significant collaboration with technological innovation (Gutiérrez et al., 2023).

3. Methodology and Method

The methodology of the present work, in terms of its approach, is qualitative approach because it is based on natural environments, in terms of its depth it is explanatory because it determines the causes and consequences, with respect to the obligations administrative, It is applied research because development tries to find mechanisms that allow solving specific problems in small and medium-sized companies, In terms of this depth, it is descriptive because it is dedicated to the description of a fact without looking for its causes and consequences, finally, in terms of its design, it is an experimental investigation since the development variables are manipulated in order to study the approaches they produce.

The method that was used was to first analyze the Social Security Law regarding disability and life insurance, daycare and social benefits, illnesses and maternity, retirement, unemployment in advanced age and old age to know the different percentages established by the social security branch based on the salary benefits that each collaborator has, second, a flow chart was made with the alternatives that the user may have to obtain the result of the worker-employer quotas., subsequently, based on the analysis of the Social Security Law, the software will be coded in the C++ language.

Finally, the software was evaluated with micro entrepreneurs, in a laboratory environment, with the objective of determining the viability of the software, and being able to observe some opportunities to improve and thus adapt to the needs of small and medium-sized companies in the Juan C. Bonilla, Puebla, Mexico region, through a statistical sampling study.

$$n = \frac{(Z^2 * N * p * q)}{(e^2 * (N-1) + Z^2 * p * q)}$$

n = Selected sample.
N = Business population.
Z = Tabulated value of the confidence coefficient.
p, q = Variance of proportions.

For this case, a 90% confidence level was proposed, with a 10% error, so for p it was valued at 0.5 and q 0.5.

The 460 Small and Medium-Sized companies were divided into their study with respect to the application of the software.

Figure 2. Total SMEs in Juan C. Bonilla.
Source: Own elaboration with data from the DENUE INEGI.

A clustering algorithm was applied to select the sample in small and medium-sized companies with the 221 companies that resulted in the application of the previously described statistical formula.

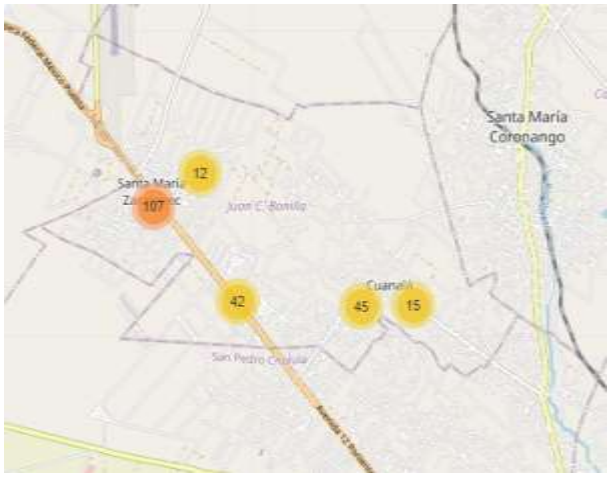

Figure 3. Sample selection.
Source: Own elaboration with data from the DENUE INEGI.

4. Results

The results obtained were the development of the software that determines the employer's worker quotas based on the salary and the minimum benefits granted to the workers. First, work was done on the program flow chart so that later it would be developed the code (algorithm) for determining employee-employer quotas through the C++ programming language.

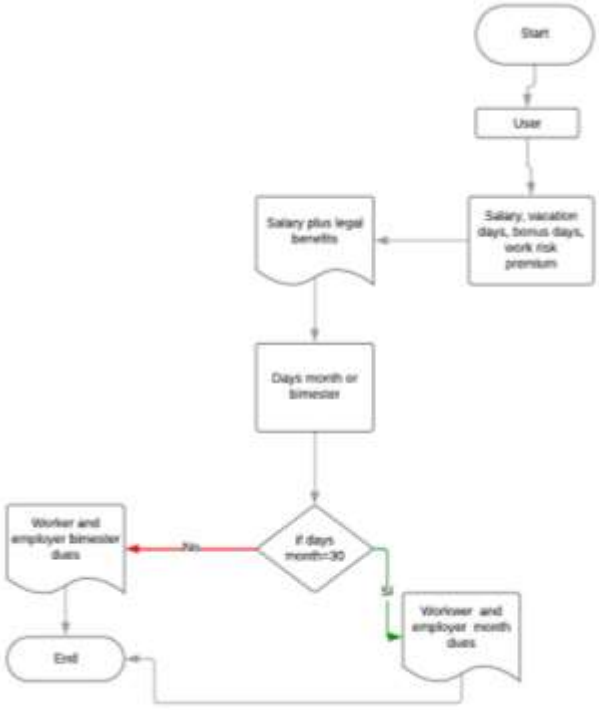

Figure 4. Program flow chart. **Source:** Own elaboration.

```
Algoritmo calculadora_imss

    LEER USUARIO;
    IMPRIMIR USUARIO;

    LEER SALARIO;
    LEER DIAS_VACACIONES;
    LEER DIAS_AGUINALDO;
    LEER PRIMA_VACACIONAL;
    LEER PRIMA_RIESGO;

    IMPRIMIR SALARIO_COTIZADO;

    LEER DIAS_MES;
    LEER DIAS_BIMESTRE;

    SI DIAS_MES = 30;
        IMPRIMIR CUOTAS_TRABAJADOR_MENSUAL;
        IMPRIMIR CUOTAS_PATRON_MENSUAL;
    FinSi

    SI DIAS_BIMESTRE = 60/61;
        IMPRIMIR CUOTAS_TRABAJADOR_MENSUAL;
        IMPRIMIR CUOTAS_TRABAJADOR_BIMESTRAL;
        IMPRIMIR CUOTAS_PATRON_MENSUAL;
        IMPRIMIR CUOTAS_PATRON_BIMESTRAL;
    FinSi
FinAlgoritmo
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Figure 5. Program pseudocode (Spanish).
Source: Own elaboration.

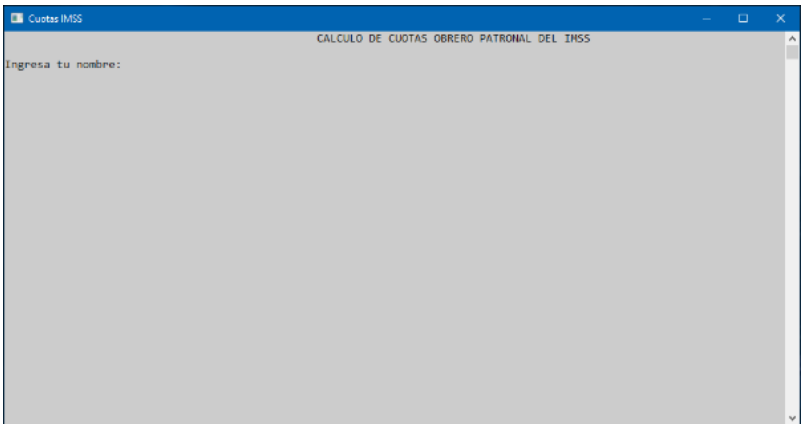

Figure 6. First view of the program (Spanish).

Source: Own elaboration. Figure one shows the software in a personalized interaction, since the program is user-friendly.

Once the program is customized, it requests the data corresponding to the calculation of the employer's worker quotas: the worker's salary, which is the daily salary granted for their services, the bonus days that will be granted, the vacation days and the vacation bonus that will be given to the worker; It should be noted that the program calculates the integrating factor, which is a concept requested by the tax authority for the payment of social security contributions based on the integrated daily salary.

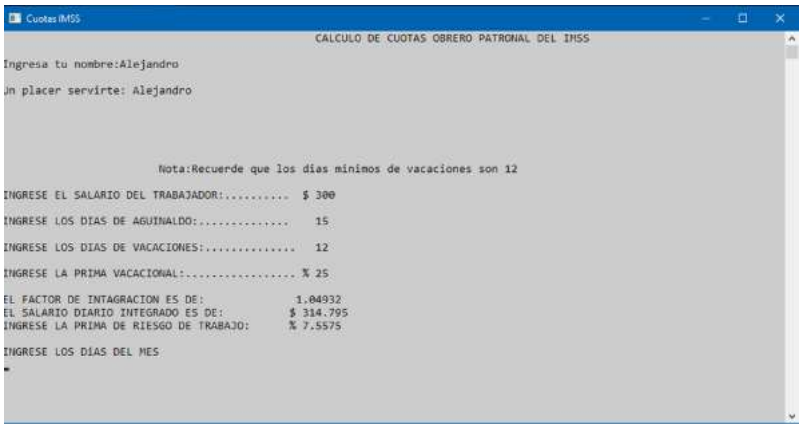

Figure 7. Second view of the program (Spanish).

Source: Own elaboration. Figure The figure shows how the program requests the primary data.

Once the primary data has been determined, the program returns the corresponding calculations divided into the fees that must be paid by the employer and the worker, for each of the insurances that correspond to them according to the percentages declared in the Social Security Law; It should be noted that the software requests the monthly or bimonthly days given the nature of the social security for the calculation of the corresponding worker-employer contributions.

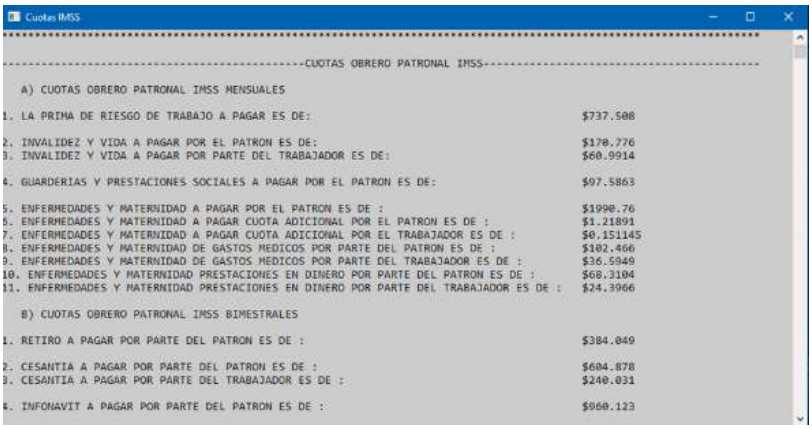

Figure 8. Third view of the program (Spanish).
Source: Own elaboration. The figure shows the calculation of the different insurances.

The program allows the corresponding calculations to be made in an approximate time of 19.194 seconds, allowing the user to obtain relative information about the cost of the social security of their collaborators.

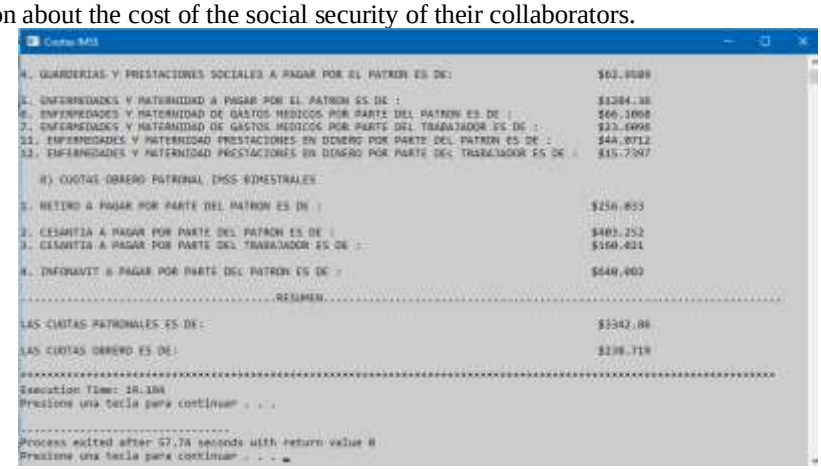

Figure 9. Fourth view of the program (Spanish).
Source: Own elaboration. The figure shows the calculation of the different insurances. The figure shows the output time of the result.

Finally, to evaluate the software, the variables were chosen with respect to the content and design of the program. Regarding the content, we sought to ensure that the result adhered to the fiscal regulations as well as the time of its deployment. Regarding the design, the interface of the program was evaluated in terms of the menu, color, and program interaction user.
The result evaluated with respect to the menu data was received with 75% in favor that the data requested is understandable, 10% that they are not understood and 15% stated that they are not understandable but that at the same time they are the data requested is understood.

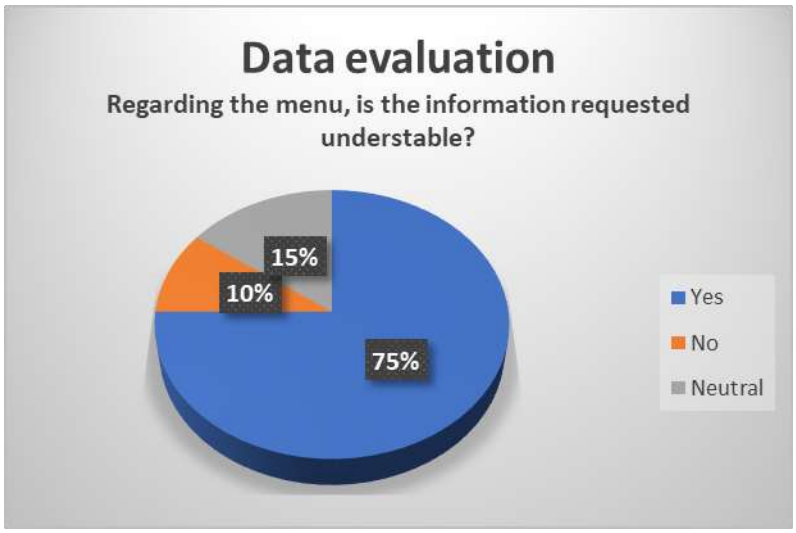

Figure 10. Data evaluation. **Source:** Own elaboration.

Recording the menu for selecting the periods to calculate, 80% stated that they did not understand what period the program was asking to calculate, while 10% stated that the period to be calculated should be more detailed and 10% stated that they were indifferent.

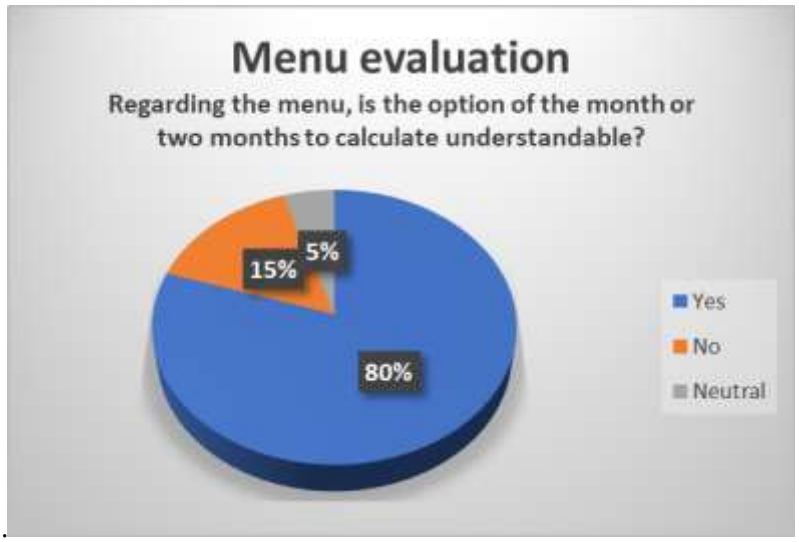

Figure 11. Menu evaluation. **Source:** Own elaboration.

In turn, for the color conditions in the program, 80% said they agreed with the colors shown, while 15% did not like the colors and 5% remained neutral.

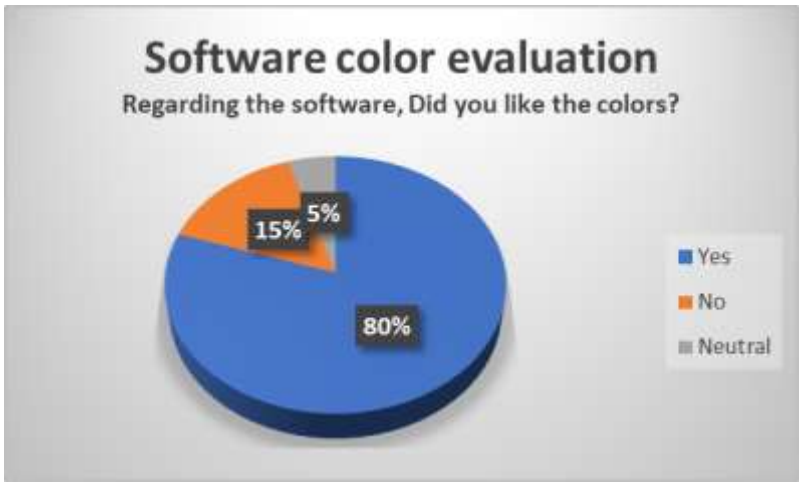

Figure 12. Software color evaluation.
Source: Own elaboration.

Finally, regarding the interaction with the program and the user, 90% stated that they were satisfied because it gives the expected result for making decisions regarding the expense of a worker´s social security, while 10% would be more comfortable with a friendlier interface.

Figure 13. Software interaction evaluation. **Source:** Own elaboration.

5 Conclusions

It can be seen that software development in the administrative economic area is essential to optimize times, according to the competition needs of Small and Medium - Sized companies. In addition, the importance of the application of tax regulations in a computer tool influences small businesses owners in making appropriate decisions to be more economically competitive.
For its part, the data requested in the program is essential to obtain an amount to pay to the IMSS, since all small and medium-sized companies are characterized by granting the minimum established in the law.

Regarding the interface as well as the use of colors by the program, more visual work is required so that the user can feel more comfortable with the work of the program. It was identified that the interaction of the software is of vital importance along with the visualization of the software, because for the user, apart from obtaining the required result, it is necessary that they feel comfortable at the same time, assuming that the software will be a tool in its own right workplace.

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