

ANALYSIS AND EVALUATION OF AN INVOICING PROCESS TO REDUCE LOSSES IN A CUSTOMS AGENCY USING THE THEORY OF CONSTRAINTS AND SIMULATION IN BIZAGI®

ANALYSIS AND EVALUATION OF AN INVOICING PROCESS TO REDUCE LOSSES IN A CUSTOMS AGENCY USING THE THEORY OF CONSTRAINTS AND SIMULATION IN BIZAGI®

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Abstract -- This research determines the impact of analyzing a billing process at a customs agency to reduce cancellations resulting from an inefficient process and decrease fines imposed by the client using the theory of constraints and process simulation through Bizagi®. The methodology used consisted of several phases: first, the process was mapped to determine each of the activities and stations that comprise it; then, the constraint affecting the process was identified, which was the lack of review of charges, for which a new station dedicated to performing that activity was added. Finally, the new billing process was simulated with the aforementioned changes, for which 31 simulations were generated with error probabilities of 1%, 5%, 10%, 20%, and 30%. This article presents the simulations of the current and proposed processes with a 10% error rate.

The results indicated that adding a new station to review invoices before they are stamped, while maintaining the same error rate, reduces cancellations at the customs agency by 100%, which in turn reduces the amount of fines imposed by the customer by 94.52%. Therefore, it can be said that the use of a simulation tool such as Bizagi® and the theory of constraints has proven to be beneficial for modeling and analyzing the redesign of an invoicing process.

Keywords: Billing, Bizagi®, Simulation, Process Mapping, Customs Agency.

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INTRODUCTION

Foreign trade is one of the necessary and decisive activities today, which is why the role of customs is fundamental. In any customs agency, some of the most relevant indicators for owners or

general management are sales, costs, profits, and the level of customer complaints. Achieving these indicators is linked to various processes that, together, make it possible to achieve them.

[1] He mentions that it is extremely important for everyone involved to know each of the steps to be taken and who is responsible for them. Similarly, they should emphasize that these steps follow an order that must be followed without exception, as this will reduce the risk of any anomalies. One of these processes is invoicing. The billing process is a key strategic tool for knowing, at any given moment, how the company is doing financially and thus being able to understand, interpret, and evaluate it through monitoring and analysis of the information generated.

This research was carried out at a customs agency responsible for customs clearance of goods under different regimes. The high number of customs declarations to be invoiced led to invoicing errors, which resulted in fines being imposed by customers.

This research focuses on the billing area; other areas or processes are excluded from the information presented. The information was collected over a period of 36 months, and all the information for the analysis was obtained directly from the customs agency's database, so it can be considered reliable for analysis purposes. In 2024, there was an increase in the number of cancellations compared to 2023 (Table 1).

Table 1. *Number of Cancellations.*

Invoice Cancellations			
Month	Number of Cancelled Invoices		
	2022	2023	2024
January	103	250	356
February	82	115	457
March	69	90	503
April	34	81	234
May	35	77	201
June	39	53	218
July	41	40	214
August	39	39	225
September	16	42	282
October	67	68	388
November	23	136	516

December	48	303	600
Total	596	1,294	4194

Source: *Own elaboration.*

Since 2024, customer penalty costs have shown a steady upward trend, particularly throughout 2023, directly impacting the organization's profits (Table 2).

Table 2. *Customer fines for cancellations*

Customer fines for cancellations			
Year	2022	2023	2024
Total	\$3,081,422.62	\$3,558,665.53	\$5,695,908.37

Source: *Own elaboration.*

The overall objective is to determine the impact of analyzing a billing process on reducing cancellations resulting from an inefficient process.

Theoretical Framework

[2] It mentions how trade has evolved to become one of its variants, namely foreign trade, which has been, is, and will continue to be essential for international economic development, given that it constitutes a very broad basis for economic activity.

[3] It states that foreign trade comprises a set of relationships involving the exchange of commercial goods and services between a country (resident) and foreign partners (non-residents) through sales or purchases that give rise to credits and obligations. Foreign trade includes both import and export operations.

This exchange, which is generally of products in exchange for money, has as its main characteristic that in order to carry out the exchange, a border must be crossed. The border is traditionally known as customs.

[4] He points out that in any country, customs offices are generally located in border areas, ports, and import and export cities, and their main objective is to regulate and control the entry and exit of goods, the means by which they are transported, and the necessary procedures to carry them out. According to Article 167-D of the Customs Law in Mexico, customs agencies are legal entities authorized by the Tax Administration Service (SAT) to carry out customs clearance of goods under different regimes. In other words, they are intermediaries between companies and customs when services or advice related to foreign trade are needed.

To collect payment for customs clearance, the agency must issue a receipt where

mention the information of the transaction carried out, as well as the information of the issuer and the recipient, that is, it must generate an electronic invoice, better known as a Digital Tax Receipt via the Internet, which must be registered with the SAT.

[5] It mentions that the SAT is responsible for enforcing tax and customs legislation so that individuals and legal entities contribute proportionally and equitably to public spending, for auditing taxpayers to ensure they comply with tax and customs regulations, for facilitating and encouraging voluntary compliance with these regulations, and to generate and provide the information necessary for the design and evaluation of tax policy.

All citizens must register with the SAT. Once registered with the SAT, they can carry out a wide range of procedures, such as: generating an electronic signature, obtaining a tax status certificate, filing annual returns, claiming tax deductions, obtaining compliance opinions, and generating electronic invoices.

In Mexico, invoices issued by an entity for the purpose of generating a record of the acts or activities carried out, the income received, or the withholdings made by taxpayers, whether individuals or legal entities, are usually called Comprobante Fiscal Digital por Internet (CFDI) (Digital Tax Receipt via the Internet).

[6] Specifically, it states that taxpayers are required to issue CFDI to comply with tax laws as indicated in Article 29 of the Federal Tax Code (CFF). This decree includes the following scenarios: For the acts or activities they perform, for the income they receive, or for the tax withholdings they make. The process for generating invoices can be carried out in two ways. According to the Customs Processing Service, invoicing can be carried out through the SAT website or by contracting the services of an invoice certification provider.

Where [7] defines a process as a set of logically related tasks that exist to achieve a defined result within a company; therefore, they take an input and add value to it to produce an output. [8] From an administrative point of view, it takes into account that a process requires joint, consecutive, orderly, and planned activities that allow the established objectives to be met.

[9] He points out that in order to design an effective process, the structure of the process must be taken into account, which determines how the flexibility of the resources to be used will be designed, as well as their characteristics, the degree of customer involvement, and the mix of human skills and equipment that will be involved in the process.

A preliminary analysis must be carried out to take into account the documentation and detailed understanding of how the work is done and how it can be redesigned.

[10] It describes process redesign as a fundamental review of a company's key processes with the aim of improving, rethinking, redefining, and refining them, either by adding, modifying, or eliminating activities to reduce time or costs.

[11] It explains mapping as an analysis carried out on processes that allows the main elements of the process to be redefined or redesigned in order to reinvent it. This technique allows all the steps and activities to be identified in order to visualize which ones are essential and which ones are not, thus simplifying and rationalizing resources. [12] They mention that to represent these processes, the activities or actions describe two essential elements: symbols, which are geometric figures that describe the steps or decisions to be taken, and arrows or lines that connect the symbols for each decision or step, thus indicating the course of the process.

As a frame of reference, research on simulation and theory of constraints for the analysis of a service process was reviewed, including the following:

[13] They present an analysis of the billing process in a water sanitation company, using the **Bizagi®** computer tool to model the new process, achieving a 68% return on investment.

[14] They address the issue of optimizing the wool sack production process in a textile factory through the theory of constraints and process simulation, using Bizagi® software, achieving a 4% increase in total production. In addition, they visualize an improvement in times, reducing them by 13% and increasing final profits by 12%.

[15] They apply simulation to a customer service process in a food company by simulating processes, allowing for reduced waiting times and delivery times.

DEVELOPMENT

Methodology

The methodology applied to develop this research is proprietary, but it is largely based on process mapping and the theory of constraints.

The methodology consists of five main stages: analysis of the current situation, mapping of the billing process, identification of constraints, simulation of the current billing process, and finally, simulation of the new billing process.

Figure 1 shows the methodology used in the research, with each of these phases being interrelated.



Figure 1. Methodology applied in the research
Source: Own elaboration.

Analysis of the current situation

Figure 2 shows the current billing process, which begins with the receipt of customs declarations. Once the customer has paid for the customs declaration, the operations department takes the physical declarations to the billing department so that the information can be reviewed and then entered into the system to generate the invoice for the service requested by the customer. If the invoice is correct, it is processed and stamped to generate validity with the SAT for the service provided and then mailed to the customer. If, upon delivery, the customer detects an error in the data, the invoice is canceled and a new one is generated.

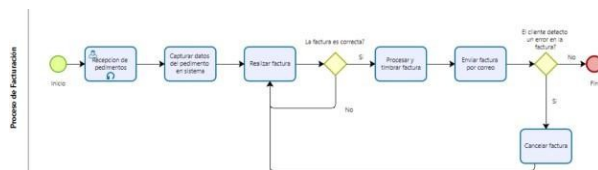


Figure 2. Current Billing Process.
Source: Own elaboration.

Mapping of the billing process

To analyze the current situation of the customs agency, the billing process was mapped in order to identify each of the stages that comprise it and the steps that are carried out.

Three sub-processes were identified within the current process, starting with the receipt of physical customs declarations, where the operations department is responsible for taking the folders with the declarations to the billing department for review and receipt.

The customs declaration is then checked to ensure that it has been registered in the agency's system so that the necessary data can be completed and the process can move on to the final sub-process, which is billing.

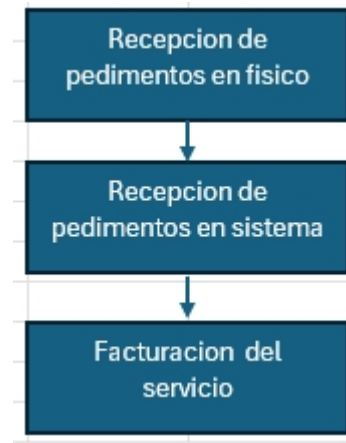


Figure 3. Billing Subprocesses.
Source: Own elaboration.

Finally, there is the sub-process corresponding to the generation of the invoice; for this, you must enter the invoicing system and consult the customs declaration number to be invoiced, check that the customs declaration data matches the data in the system, and if the information is correct, continue with the review of any additional observations requested by the customer. The next step is to record the payment for the service provided by the customs agency to the customer. Once the above points have been reviewed, the invoice is processed so that it can be stamped by the SAT and sent to the customer by mail and through the system.

Identification of restrictions

When applying process mapping, it was identified that the billing sub-process is presenting a restriction that affects the overall process and contributes to an increase in cancellations. The restriction corresponds to recording the charge for the service, which in turn consists of four additional steps: Review of fee charges, review of third-party expenses, fines, and customs declaration locks.



Figure 4. Billing Process Restrictions.
Source: Own elaboration.

Through observation and mapping, it was identified that the personnel responsible for billing omit the steps of reviewing the charges to be made to the customer. Firstly, the billing department does not check that the fees shown by the system

corresponds to the rate agreed upon with the customer. Omitting this review leads to charges that are higher or even lower than those established, so that when the customer receives the invoice, they identify it as incorrect and request its cancellation and re-invoicing.

In the next step, the customs declaration was not checked to see if it included any third-party expenses, i.e., any expenses for loading and unloading the material when it passed through customs inspection. Generally, if the system did not show this expense or it was not indicated in the customs declaration, it was omitted and it was assumed that no additional expense should be charged, which meant that when the customer reviewed their invoice, they did not identify the correct charge and requested the cancellation and correction of the invoice.

The third step is to check whether the customs declaration has any fines. However, the billing department does not check whether there is a charge for this item during the export or import process carried out for the customer. They only consider the charge if it appears in the system. In addition to this, fines can be charged to the customer or to the customs agency, which must also be taken into account when making the charge. This resulted in fines being charged to the customer that were not their responsibility, which is why they requested the correction of the invoice and its respective cancellation.

Finally, the billing department did not check whether the customs declaration had locks or seals. Locks or seals are security devices used to certify that the product or merchandise has been inspected and complies with established regulations, as well as to ensure that it has not been tampered with or improperly manipulated.

These locks can be requested by the customer or by the agency depending on the region to which the goods are destined. However, the billing department does not check whether the locks should be charged to the customer or not, so the billing clerk ends up charging for locks that the customer did not request or, on several occasions, omits to charge for them. This leads to the customer requesting cancellation of the invoice and re-billing.

Simulation of the current process

To simulate the various scenarios of the billing process, the Bizagi® software tool was used, which allowed activities to be added, modified, or deleted from the original process in order to visualize its behavior and determine the most viable option for optimizing the process.

The data set for the year 2024 was used to simulate the process, in which 42,000 invoices were issued, of which 4,194 cancellations were generated, representing an amount of \$5,695,908.37 pesos in fines imposed on

the customs agency for the high number of cancellations that have occurred year after year.

Table 3. Billing Data 2024.

2024			
Mes	Facturas Canceladas	Facturas Correctas	Multas por Cancelaciones
Enero	356	3144	\$455,921.58
Febrero	457	3043	\$569,348.33
Marzo	503	2997	\$496,328.44
Abril	234	3266	\$326,715.78
Mayo	201	3299	\$247,964.33
Junio	218	3282	\$312,642.79
Julio	214	3286	\$203,841.27
Agosto	225	3275	\$405,743.57
Septiembre	282	3218	\$449,398.55
Octubre	388	3112	\$568,716.74
Noviembre	516	2984	\$794,366.21
Diciembre	600	2900	\$864,920.78
Total	4194	37806	\$5,695,908.37

Source: Own elaboration.

To simulate the current process, a flowchart was created for the invoicing process using Bizagi® software. This process was divided into three sections: Operational area, Receipt of physical customs declaration, Receipt of customs declaration in the system, and Invoicing.

Figure 5 shows the first stage of the operational area process, which, as mentioned above, is responsible for delivering the customs declarations to the billing area. There is a customs declaration generation station, which is then followed by a decision as to whether the customs declarations are correct or not. For this decision, a probability of 99% correct and 1% incorrect was taken into account, since there are no significant errors in this area that affect the overall process.

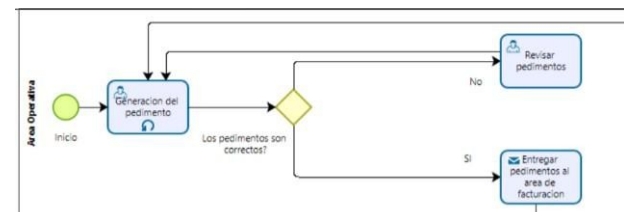


Figure 5. First Phase of the Billing Process.

Source: Own elaboration.

The next stage in the receipt of physical declarations is a station where the declarations delivered by the operational area are received. Here, a decision is made based on a 99% probability that the declaration data corresponds to that in the folder and a 1% probability that it does not.

If the data is correct, the customs declarations can pass through the following stations. However, if any are incorrect, they must be returned to the operational area for reprocessing so that they can be delivered correctly to the billing area.

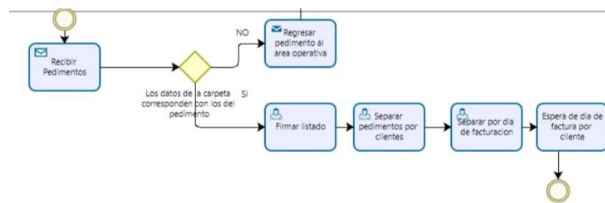


Figure 6. Second Phase of the Billing Process.

Source: Own elaboration.

Once the declarations are correct and pass through the stations corresponding to the second stage of the process, the declaration is received in the system (Figure 7), where a decision is made as to whether the customs declaration appears in the system as registered or not. For this decision, a 99% probability that it is in the system and a 1% probability that it is not in the system was used, as this phase does not directly affect the overall process.

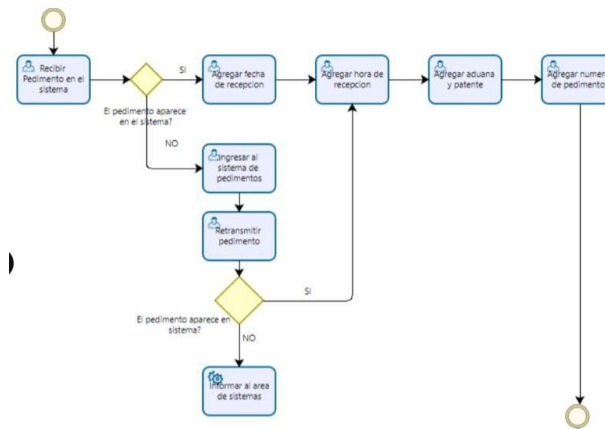


Figure 7. Third Phase of the Billing Process.

Source: Own elaboration.

Finally, there is the fourth and final stage (Figure 8), which consists of issuing the corresponding invoice. To do this, a decision is made at the end of the process, which consists of whether or not the customer accepted the charge. For this decision, a probability of 90% correct invoices and 10% incorrect invoices was used. This probability was taken in accordance with the cancellations submitted against the correct invoices issued in 2024, where 9.99% of the total correspond to the 4,194 cancellations and 90.01% correspond to the 37,806 invoices issued correctly.

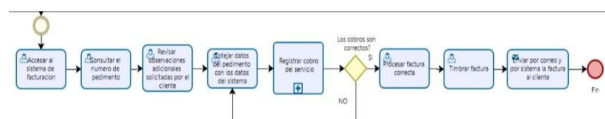


Figure 8. Fourth Phase of the Billing Process.

Source: Own elaboration.

Subsequently, the current process was simulated using the probabilities mentioned above and

Using a total number of 3,500 invoices, which corresponds to those issued each month by the customs agency. Thirty-one simulations were carried out, yielding the results shown in Table 4.

Table 4. Simulations of the Current Process

Source: Own elaboration.

Simulación	Facturas Canceladas	Facturas Correctas	Total de facturas
1	326	3174	3500
2	326	3174	3500
3	326	3174	3500
4	353	3147	3500
5	353	3147	3500
6	370	3130	3500
7	352	3146	3500
8	352	3146	3500
9	352	3146	3500
10	352	3146	3500
11	353	3147	3500
12	353	3147	3500
13	353	3147	3500
14	352	3146	3500
15	326	3174	3500
16	330	3170	3500
17	326	3174	3500
18	330	3170	3500
19	330	3170	3500
20	352	3146	3500
21	326	3174	3500
22	330	3170	3500
23	330	3170	3500
24	353	3147	3500
25	353	3147	3500
26	353	3147	3500
27	352	3146	3500
28	326	3174	3500
29	352	3146	3500
30	352	3146	3500
31	352	3146	3500

Simulation of the new process

For the new process simulation model, a new station was added to the billing phase (Figure 9). This station consists of reviewing the charges for services provided to the customer after they are recorded in the pre-invoice and before processing and stamping it, in order to avoid issuing invoices that reach the customer incorrectly. A decision was added prior to processing the invoice, which consists of ensuring that the charge is correct. If it is correct, processing and stamping the invoice is feasible, but if there is an error, the invoice must be returned to the charge registration station and reviewed again before processing.



Figure 9. Station Added to the Billing Process.

Source: Own elaboration.

Thirty-one simulations were performed to assess the feasibility of adding new stations to reduce the number of cancellations. The simulations, whose results are shown in Table 5, were performed with a 90% probability of correct invoices and a 10% probability of incorrect or reprocessed invoices. When the simulation was run, 3,500 customs declarations arrived at the billing area, of which only 3,094 invoices had all the correct data. On the other hand, 406 invoices were incorrect and had to be returned to the collection registration station to be reprocessed. Finally, 3,500 correct invoices were stamped.

Table 5. Simulations of the New Process.

Simulación	Total	Correctas	Incorrectas/Reprocesadas
		90%	10%
1	3500	3094	406
2	3500	3094	406
3	3500	3094	406
4	3500	3094	406
5	3500	3094	406
6	3500	3094	406
7	3500	3094	406
8	3500	3094	406
9	3500	3094	406
10	3500	3094	406
11	3500	3094	406
12	3500	3094	406
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25	3500	3094	406
26	3500	3094	406
27	3500	3094	406
28	3500	3094	406
29	3500	3094	406
30	3500	3094	406
31	3500	3094	406

Source: Own elaboration.

DISCUSSION AND ANALYSIS OF RESULTS

When mapping the processes, it was possible to identify the constraints that prevented the analyzed process from being carried out correctly. Four constraints were found in the billing area:

Review fee collection, third-party expenses, fines, and locks.

The simulation shows that by adding a station to the process and maintaining the same error rate, 3,500 correct invoices were delivered to the customer.

It was observed that as the probability of invoices being subject to the activities initially detected as constraints and resolved increases, there is a significant impact on process improvement (Table 6).

Table 6. Simulation Results.

Simulación	Resultados de la Simulación			
	Probabilidades		Resultados de la Simulación	
	Facturas Correctas	Facturas Incorrectas	Facturas Correctas	Facturas Incorrectas
1	0.70	0.30	2021	1479
2	0.80	0.20	2657	843
3	0.90	0.10	3094	406
4	0.95	0.05	3312	188
5	0.99	0.01	3644	36

Source: Own elaboration.

Adding the new station would involve assigning a person to be in charge of performing a complete review of the invoices, so hiring one more person for the invoicing area would cost the customs agency \$312,000.00 pesos annually. Comparing this information with the amount of fines for the year 2024, which was \$5,695,908.37, it would save the agency \$5,383,908.37, representing 94.52% of the total.

Below are studies related to the topic at hand, in which the authors present results and recommendations.

[15]In their research, they explain the topic of simulation using Simul8® software for analyzing the customer service process. The modeling carried out in the customer service process using Simul8® software allowed them to suggest various optimizations that would result in reduced waiting times. However, it is considered that the use of Simul8® software should be accompanied by other industrial engineering techniques, as it is geared towards production processes and not service processes, since the latter require more assumptions and data coding. However, [13]present an analysis of a billing process in the service centers of a water and sewerage sanitation company. In order to issue receipts correctly and reduce complaints about high consumption, Bizagi® simulation software was used to implement the new model, with the aim of applying changes to the process. To this end, activities were eliminated and modified. The process was implemented in September and October 2023, reducing commercial complaints about high consumption from 7.22% to 5.22% for the percentage of water.

The percentage of unbilled services decreased from 32.10% to 30.9%, and finally, the customer satisfaction index increased from 68.5% to 69.80%. On the other hand, [16] presents an analysis of the billing process for health services offered by an orthopedic and fracture clinic. The billing process was carried out in several stages: admission, registration, review, closing of the invoice, account preparation, and filing. When simulating the original process, it was detected that the problems were generating a 13.79% cost overrun in the billing process, where there were also downtimes that represented 50.54% of the process. Changes were made to the process that consisted of the reassigning activities and eliminating positions, which eliminated the 13.76% cost overrun of the process and, in turn, achieved a 6% savings in the total cost. In the literature consulted, no combination of the theory of constraints and **Bizagi®** was found.

CONCLUSIONS

It can be said that the use of a simulation tool such as Bizagi® has proven beneficial for modeling and analysis. Process mapping, together with the theory of constraints, made it possible to identify the limitations or constraints affecting the billing process.

Adding a new station to the process allows all invoices to be reviewed before they are stamped and sent, so that any errors identified can be corrected in time.

It should be noted that in a system where the main objective is to send correct invoices, a key factor in achieving this is the review of charges, since ignoring this point leads to incorrect invoices being sent to the customer, which results in cancellations and, consequently, complaints and fines. That is why adding changes or modifications to a process through simulation allows us to visualize its behavior prior to implementation and evaluate whether the decisions to be made are feasible.

As future research, we propose the use of the theory of constraints accompanied by simulation in companies in the tertiary sector.

Future lines of work could focus on:

- Artificial intelligence for decision-making: Exploring the use of neural networks to predict the behavior of process flows in various scenarios.
- Operations management: Modulation, analysis, and optimization of complex systems without altering reality.

BIBLIOGRAPHY

- [1] Antero, D. (2022). Proposal for Improvement in the Billing Process at ARQUIMELO SAS. Colombia.

- [2] Witker, J., and Hernández, L. (2008). Legal Regime of Foreign Trade in Mexico, Second Edition. National Autonomous University of Mexico. Legal Doctrine Series, No. 27 Mexico City.

- [3] Quintana, R., Rodríguez, M., Briones, W., and Bedor, J. (2021). Introduction to Foreign Trade. Live Working Publishing House. Ecuador.

- [4] (2021). "Mexican Customs Law." Retrieved from: <https://www.diputados.gob.mx/LeyesBiblio/pdf/LAdua.pdf>

- [5] (2018) Tax Administration Service Law. Mexico.

- Retrieved from:
https://www.diputados.gob.mx/LeyesBiblio/pdf/93_041218.pdf

- [6] Federal Tax Code, [C.F.F.], (2024), Official Gazette of the Federation, (Mexico).

- [7] Ugarte, R. A. (2012). Redesign of the Billing Process in an Automotive Company. University of Chile. Undergraduate Thesis. Santiago, Chile.

- [8] Mendoza V., and Moreira J. (2021). Administrative Management Processes, A Journey From Their Origins. FIPCAEC Scientific Journal (Promotion of scientific-technical research and publication multidisciplinary). Ecuador, Vol. 6, No. 3, pp. 608-620

- [9] Krajewski, L., Ritzman, L., and Malhotra, M. (2008). Operations Management: Processes and Value Chains. Pearson Education

- [10] Chuman, L. M. (2022). Redesign of the Logistics Management Process to Reduce Economic Losses at the Company Productos de Acero Cassado Norte.

- [11] García, D. (2020). Process mapping and its scope. Orizaba Institute of Technology/MIA. Research article. Veracruz, Orizaba.

- [12] Ferroni P., and Huarniz T. (2021). Process Diagram for the Preparation of Technical Files, with the Aim of Reducing Contractual Risks. Ricardo Palma University. Degree thesis. Lima, Peru.

- [13] Bedon S., and Vásquez J. (2023). Control of billing to reduce claims for high consumption using lean manufacturing tools in a water and sewerage sanitation company. Peruvian University of Applied Sciences (UPC). Professional Proficiency Project. Lima, Peru.

- [14] Barrera, C.I. (2020) Optimization of the Wool Sack Production Process at the KARMAM CIA LTDA Factory through the Application of the Theory of Constraints Methodology. University of the Americas. Degree Project. Quito, Ecuador.

- [15] Heredia D., Fernando Y., and Sánchez, G. (2020). Discrete Event Simulation Model for the Analysis and Improvement of the Customer Service Process.

- [16] Villota, C. A. (2022). Proposal for the Improvement of the Health Services Billing Process at the Orthopedics and Fracture Clinic. Medellin, Colombia. Journal of Engineering Research and Innovation. Vol. 8, No. 2, pp. 44-51.

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