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Technical and economic feasibility of a vehicle inspection center in the canton of Quevedo

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RESUMEN

El presente proyecto de investigación se basa en un estudio de factibilidad técnico económico de un Centro de Revisión Técnico Vehicular para la futura implementación para controlar el estado mecánico, sistemas de seguridad, ruido excesivo, emisión de gases, que origina los vehículos generando excesiva contaminación al medio ambiente, además de reducir los accidentes de tránsito provocados por desperfectos en los sistemas que conforman un automotor ya que la Revisión Vehicular actual se la realiza de forma visual, sin estar regido a normas técnicas para la correcta funcionalidad vehicular. Con la utilización del software FlexSim permite simular procesos de una forma ideal, para optimizar los tiempos de trabajo y ocupación de los operarios y equipos que conforman cada uno de los procesos que se llevan a cabo. Se calcula el tamaño de la muestra con el fin de conocer la cantidad de talleres mecánicos a ser encuestados (68 talleres). Mediante el estudio de la factibilidad económica se determina los costos, ingresos que generara el CRTV con una proyección de 5 años de funcionamiento. La inversión estimada para la construcción en la primera fase y adecuación será de 350.000 dólares con una recaudación en el primer año de funcionamiento de 583.769,92 dólares.

Palabras clave: *factibilidad; técnico; económico; centro de revisión vehicular*

[1] Autor Principal

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ABSTRACT

This research project is based on a technical-economic feasibility study of a Vehicle Technical Inspection Center for the future implementation to control the mechanical condition, safety systems, excessive noise, gas emissions, which originate vehicles generating excessive pollution to the environment, in addition to reducing traffic accidents caused by malfunctions in the systems that make up a vehicle since the current Vehicle Inspection is done visually, without being governed by technical standards for proper vehicle functionality. With the use of FlexSim software, it is possible to simulate processes in an ideal way, to optimize work times and occupation of operators and equipment that make up each of the processes that are carried out. The sample size is calculated in order to know the number of mechanical workshops to be surveyed (68 workshops). The economic feasibility study determines the costs and income that the CRTV will generate with a projection of 5 years of operation. The estimated investment for construction in the first phase and adequacy will be US$350,000 with a revenue in the first year of operation of US$583,769.92.

Keywords**:** *feasibility; technical; economical; vehicle inspection center.*

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INTRODUCTION

Vehicle production and marketing in Latin America between 1990 and 2010 grew by an average of 200%, especially in developing countries, with serious consequences for public health and welfare. This growth has been counteracting the efforts of automotive engineering to reduce emissions from modern vehicles (ASTUDILLO, 2012).

The present study is aimed at the implementation of a vehicle technical review center in the canton Quevedo, in order to avoid the circulation of vehicles in poor mechanical conditions (engine, suspension, transmission, brakes, steering, bodywork and chassis), electrical, among others; since it is one of the factors that cause traffic accidents and excessive environmental pollution (HORA, 2018). Up to the present date, December 2018 that the Vehicle Registration Agency of Quevedo canton has been operating, it does not comply with some articles of the Organic Law of Land Transportation, Transit and Road Safety (LOTTTSV) among them Article 30.5 (literal j) which stipulates the following competence: Authorize, concession, implement Vehicle Technical Review Centers, in order to control the mechanical condition, safety systems, gas emissions, excessive noise that originate the means of land transport (VILLEGAS, 2010).

In 2003, the first vehicle technical inspection center was installed in the city of Quito; subsequently, similar centers have been installed in the cities of Guayaquil, Cuenca, Milagro, Daule, Colimes, Palestina, Pedro Carbo, Santa Lucia, Nobol, Isidro Ayora, Lomas de Sargentillo and Santo Domingo (GIACOMETTI, 2016).

Through field research in the CRTV of Santo Domingo canton and in the ANT Quevedo, relevant information was obtained for the development and completion of this project, which served to perform the simulation of each RTV process to each type of vehicle using FlexSim software, where the behavior and percentage of processing of each of the operations in said revision center and the percentage of occupation of each operator were visualized.

An economic feasibility study of the costs and revenues generated in 5 years of operation of the RTV was carried out, where the cost-benefit ratio was calculated to determine whether the project is feasible for its implementation.

METHODOLOGY

Type of research

The present project is considered to be carried out through exploratory research, since it lacks background studies on the subject in terms of its theoretical model or its practical application in the geography of the canton of Quevedo. This research will serve as a basis for the realization of new future research projects related to vehicle technical inspection centers.

Research Methods

Observation Method

This technique will allow us to know the visual inspection procedure for each type of vehicle, an indispensable annual requirement for registration at the agency in the canton of Quevedo. Like the observation in the CRTVs in Santo Domingo and the city of Quito where their vehicle fleet is subjected to rigorous tests with state-of-the-art technical equipment to diagnose mechanical failures (Salud, 2005).

Experimental Method

Conduct a field study by visiting the vehicle inspection center in the canton of Quevedo, to learn how the current vehicle inspection process is carried out. Visit the CRTVs in Santo Domingo and the city of Quito; to learn about their operation with the use of technical equipment to detect automotive faults, technical visits to a number of automotive workshops in the canton of Quevedo.

Analytical Method

Conduct a study of the current situation of the operation of the vehicle inspection center in the canton of Quevedo. Analysis of the measurement systems and variables applicable to each of the instruments that will be used in the vehicle technical inspection (OBANDO, 2014).

Sources of information gathering

The information obtained for the elaboration of the research project is based on:

- Primary sources: surveys of mechanic workshops, direct technical observation visits to vehicle inspection centers in Quevedo and Santo Domingo, interviews with authorities of ANT Quevedo and Quevial EP.
- Secondary sources such as: books, newspapers, magazines, documents, theses, data records.

Research design

Through field research and the observation and data collection method, the operation of the RTV and its different technical operations applied to each type of automobile will be known, with the use of FlexSim software, we proceed to ideally simulate each RTV process.

Research instruments

This research project uses direct observation of each of the processes in the CRTV of the canton of Santo Domingo in order to collect data. Interviews with workers and administrative personnel to learn about the operation of each process (RODRIGUEZ R. A.). A survey was conducted to a certain number of mechanical workshops by calculating the sample in order to record data and calculate a percentage.

Data processing

- Using the EXCEL2016 office package, the data obtained in the research was tabulated to generate graphs, cost calculations, income, annuity, net present value, internal rate of return that will be part of the results of the document (RODRIGUEZ M. M., 2009).
- With the FlexSim software, we will simulate the processes to which each vehicle undergoes a technical vehicle inspection.

RESULTS AND DISCUSSION

Vehicle types

ANT Quevedo classifies public and private service vehicles under the following general denomination for the vehicle inspection service (Costituyente, 2014):

- Motorcycles.
- Light vehicles.
- Heavy vehicles 1.5 to 14.9 tons.
- Double axle vehicles 15 to 20 tons.
- Tractor mules 20 tons and over.

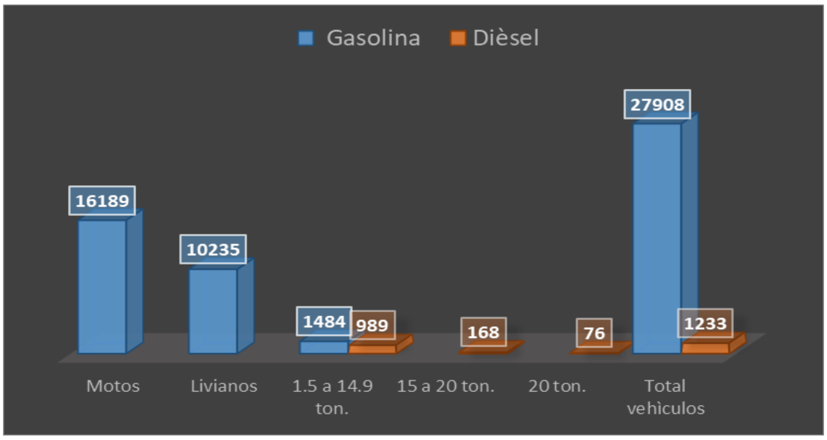
Classification of motor vehicles according to the fuel they use for operation

Table 1. Operating fuel

Type of vehicle	Number of vehicles	Gasoline	Diesel
Motorcycles	16.189	16.189	
Light car	10.235	10.235	
1,5 a 14,9 ton.	2.473	1.484	989
15 a 20 ton.	168		168
20 ton.	76		76
Total	29.141	27.908	1.233

Based on the data in the table above and field research, the canton of Quevedo has 27,908 vehicles using gasoline and 1,233 using diesel. Circulating 176 urban buses, 912 regular cab units and 240 executives.

Figure 1. Operating fuel



Technical operations applied in CRTV

The RTV is divided into three sections which will be explained in more detail in the following point. Applying the INEN 2349 Standard where it stipulates the necessary equipment to perform the vehicle technical review are the following (ESPARTACO, 2013):

a) Vehicle Technical Inspection applied to light vehicles:

- Luxmeter
- Pitch Aligner
- Brake tester
- Inspection pit
- Suspension bench

- Sound level meter
- Opacimeter and gas analyzer, depending on engine type
- Taximeter (used only for cab units).

b) ***Vehicle Technical Inspection applied to heavy vehicles:***

- Luxmeter
- Sound level meter
- Opacimeter and gas analyzer, depending on the type of engine
- Suspension bench
- Play detector
- Pitch aligner
- Brake tester

c) ***Vehicle Technical Inspection applied to motorcycles:***

- Luxmeter
- Gas Analyzer
- Brake tester
- Sound level meter

With the use of FlexSim software, a friendly tool to simulate processes in an ideal way to optimize the working time and occupation of operators and equipment that make up each of the processes that are carried out in the RTV, with the use of data obtained through field research in the CRTV of Santo Domingo and statistical data from the vehicle inspection center of Quevedo.

Table 2. *Time of RTV processes for each type of vehicle*

Process	Time to to execute the process	Gasoline vehicle	Diesel Vehicle	Motorcycles	Light	Gasoline Semi-Heavy	Diesel Semi-Heavy	Heavy
Gas Analyzer	90seg.	*		*	*	*		
Opacimeter	90seg.		*				*	*
Sound level meter	20seg.	*	*	*	*	*	*	*
Luxmeter	30seg	*	*	*	*	*	*	*
Suspension bench	90seg.	*	*		*	*	*	*
Brake tester	75seg	*	*	*	*	*	*	*
Pitch aligner	45seg.	*	*		*	*	*	*
Inspection pit	120seg.	*	*		*	*	*	*
Total		*470seg. (7.8min)*	*470seg. (7.8min)*	*215seg.(3.5min)*	*470seg. (7.8min)*	*470seg. (7.8min)*	*470seg. (7.8min)*	*470seg. (7.8min)*

RTV process to 2 and 4-stroke motorcycles

Average time of 120 seconds (2 min.), for the visual inspection of the motorcycle's condition, through field research at the CRTV in the city of Santo Domingo, the statistical average time of 62 motorcycles registered daily was determined, with an average time of 335 seconds (5.58 min).

Table 3. Motorcycle RTV

Process	Time
Gas Analyzer	90 seg.
Sound level meter	20 seg.
Luxmeter	30 seg.
Brake tester	75 seg.
Total	3,58 min

Figure 2. Motorcycle RTV design

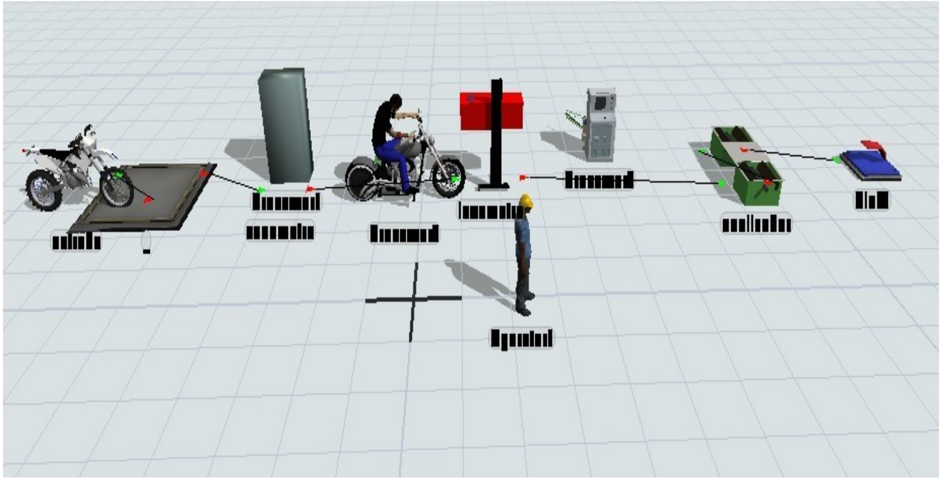


Figure 2 shows the process design created in FlexSim software, with each of the equipment used in motorcycle RTV.

Figure 3. Motorcycle RTV Simulation

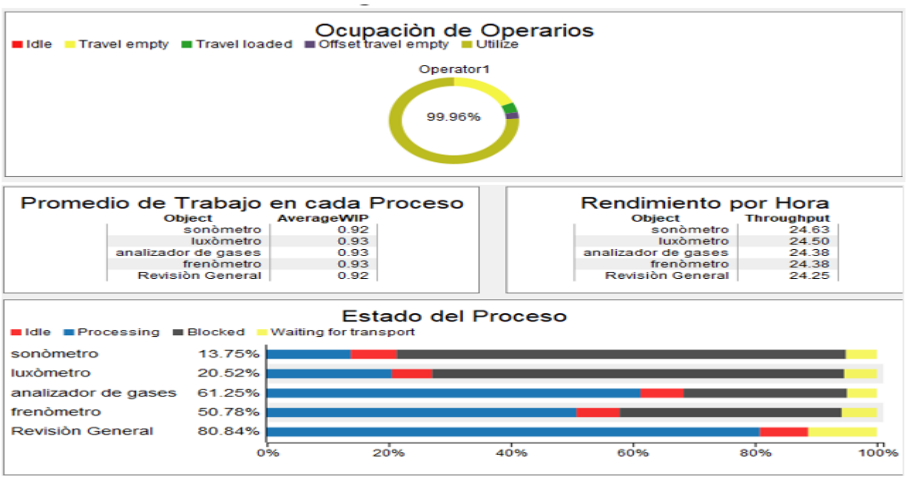


Figure 3, shows the simulation of the RTV process of motorcycles with the use of a single operator and a process time of 8 working hours (28800 sec.) resulting in 64 completed registration processes and recording the following:

- The operator will remain in activity for 75.70%, a travel empty rate of 18.10% and an offset travel empty rate of 2.48%.
- The percentage of the status of each of the processes as: Processing, Idle, Blocked, Waiting for transport.

Using the table of time supplements for rest, the standard time was calculated with the following formula:

Standard Time = $TPS\ x\ CA + \sum(t)$

Symbology:

TPS = Time Selected Average

CA = Performance Quality

$\sum$ (t) = Sum of tolerances

The average time selected is the one calculated in each RTV process to the different vehicles, being in the motorcycles a time of 335 sec. (5.58 min.), the quality of the performance is assumed that the operator has an extreme ability so the constant (1+0.15) is taken and the sum of the tolerances calculated from the sum of the constant and variable supplements.

Standard Time = 335 $seg.\ x$ (1 + 0,15) + 32seg

Standard Time = 417,25 $seg.$ (6,95 min)

RTV process for gasoline-powered light and medium-heavy-duty vehicles

Through field research at the CRTV in the city of Santo Domingo, an average time of 120 seconds (2 min) was determined. Through field research at the Vehicle Technical Inspection Center in the canton of Santo Domingo, applying the direct observation and data collection method, an average time of 590 seconds (9.83 min) was determined for the vehicle inspection of each vehicle.

Table 4. RTV of light semi-heavy gasoline-powered vehicles

Process	Time
Gas analyzer	90 seg.
Sound level meter	20 seg.
Luxmeter	30 seg.
Suspension bench	90 seg.
Brake tester	75 seg.
Pitch aligner	45 seg.
Inspection pit	120 seg.
Total	7,83 min.

Figure 4. RTV design light and semi-heavy vehicles

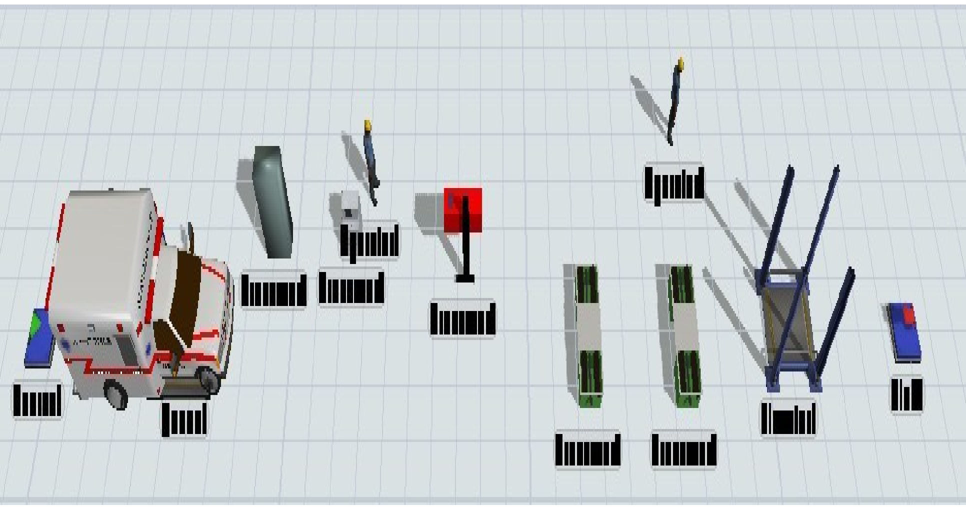


Figure 4 shows the design of the process created in the FlexSim software, with each of the equipment used in the RTV of light and semi-heavy gasoline and diesel vehicles and with the use of two operators who will be in charge of driving the vehicle and processing the RTV line.

Figure 5. RTV simulation for light and medium-heavy vehicles

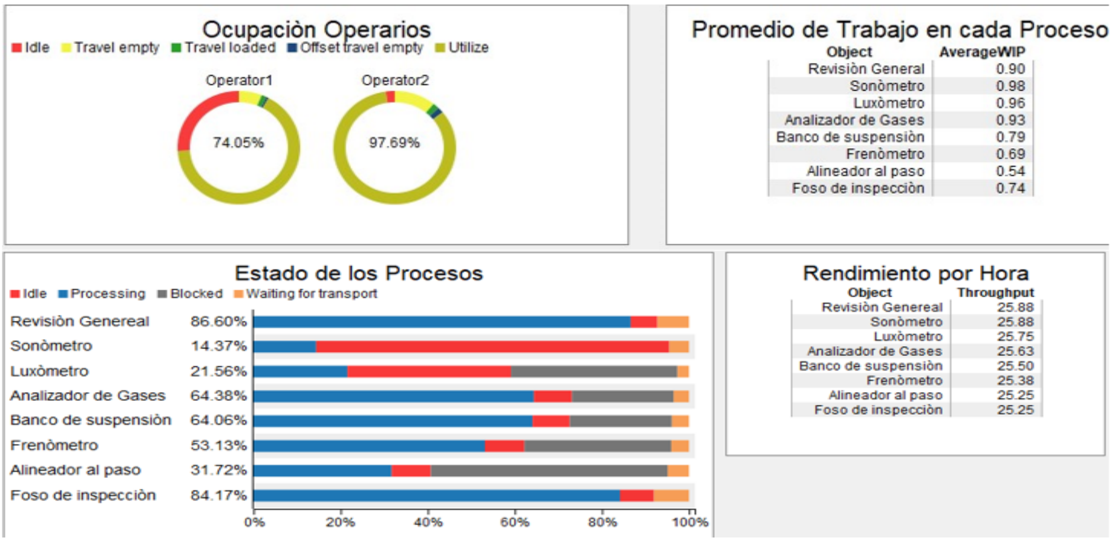


Figure 5 shows the simulation of the RTV process of light and semi-heavy gasoline and diesel vehicles with the use of two operators and a process time of 8 working hours (28800 sec.) resulting in 56 completed registration processes and recording the following data:

- Operator 1 remained active 67.28%, a travel empty percentage of 6.12%.
- Operator 2 remained in activity 83.40%, a travel empty percentage of 11.26%.
- The percentage of the status of each of the processes as: Processing, Idle, Blocked, Waiting for transport.

Using the table of time supplements for rest, the standard time was calculated with the following formula:

Standard Time = $TPS\ x\ CA + \sum(t)$

The average time selected in the RTV process in light and semi-heavy automotive is 590 sec. (9.83 min.), the quality of the performance is assumed that the operator has an extreme skill so the constant (1+0.15) is taken and the sum of the tolerances calculated from the sum of the constant and variable supplements.

Standard Time = 590 $seg.\ x$ (1 + 0,15) + $32seg$

Standard Time = $710.5seg.$ (11,84 min)

RTV process for semi-heavy-duty diesel-powered railcars

Through field research at the CRTV in the city of Santo Domingo, an average time of 120 seconds (2 min) was determined. And the average time of 590 seconds (9.83 min.), to perform the vehicle technical inspection of each vehicle.

Table 5. RTV of light semi-heavy-duty diesel vehicles

Process	Time
Gas analyzer	90 seg.
Sound level meter	20 seg.
Luxmeter	30 seg.
Suspension bench	90 seg.
Brake tester	75 seg.
Pitch aligner	45 seg.
Inspection pit	120 seg.
Total	7,83 min.

Heavy automotive RTV process

Through field research at the CRTV in the city of Santo Domingo, an average time of 150 seconds (2.5 min.) was determined for the visual inspection of each vehicle. Applying the direct observation and data collection method, the average time was 620 seconds (10.33 min).

Table 6. RTV of diesel heavy-duty vehicles

Process	Time
Gas analyzer	90 seg.
Sound level meter	20 seg.
Luxmeter	30 seg.
Suspension bench	90 seg.
Brake tester	75 seg.
Pitch aligner	45 seg.
Inspection pit	120 seg.
Total	7,83 min.

Figure 6. RTV process design

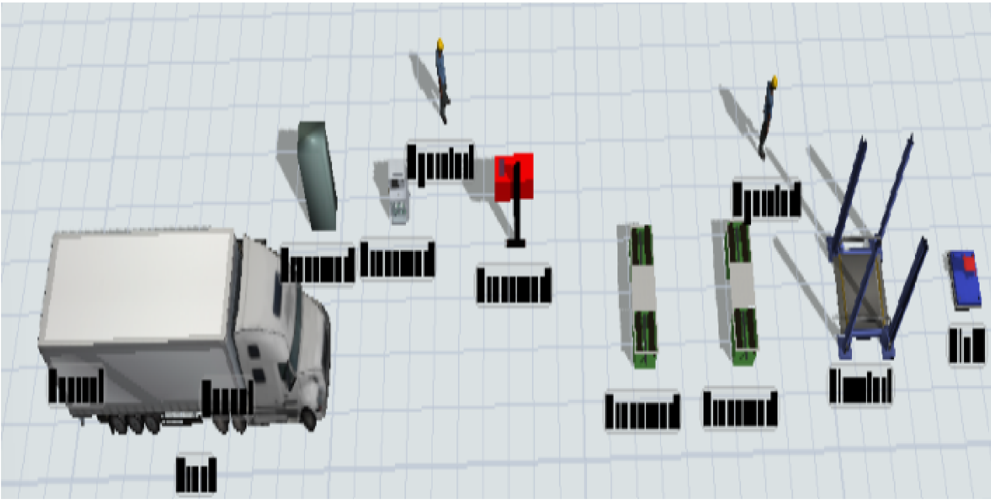


Figure 6 shows the design of the process created in FlexSim software, with each of the equipment used in the RTV of light and semi-heavy gasoline and diesel vehicles.

Figure 7. RTV simulation for heavy railcars

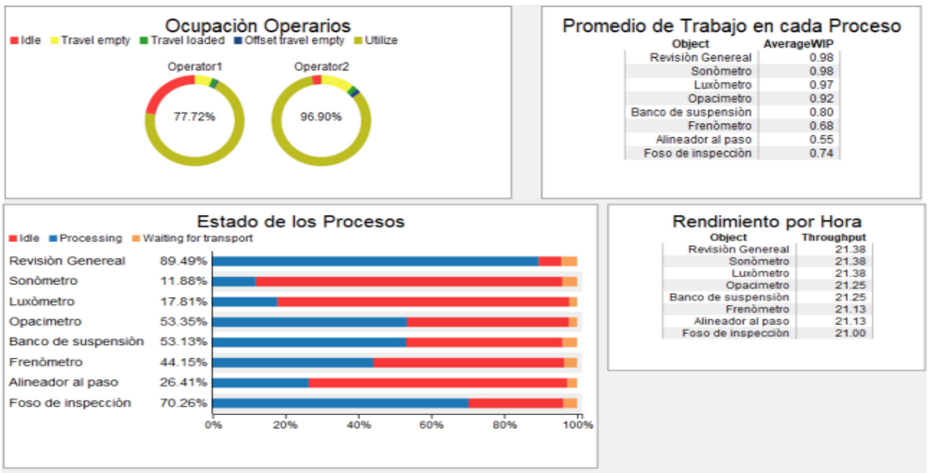


Figure 7 shows the simulation of the RTV process for heavy vehicles with the use of two operators and a process time of 8 working hours (28800 sec.) resulting in 55 completed registration processes and the following registration:

- Operator 1 remained in activity 71.32%, a travel empty percentage of 5.79%.
- Operator 2 remained in activity 82.60%, a travel empty percentage of 10.98%.
- The percentage of the status of each of the processes as: Processing, Idle, Blocked, Waiting for transport.

Using the table of time supplements for rest, the standard time was calculated with the following formula:

Standard Time = $TPS\ x\ CA + \sum(t)$

The average time selected in the RTV process in the heavy railcars is 620 sec. (10.33 min.), the quality of the performance is assumed that the operator has an extreme skill so the constant (1+0.15) is taken and the sum of the tolerances calculated from the sum of the constant and variable supplements.

Standard Time = 620 $seg.\ x$ (1 + 0,15) + 32seg

Standard Time = 745 $seg.$ (12,41 min)

Most frequent mechanical failures of automobiles in the canton of Quevedo

In order to proceed with this objective, the sample calculation equation was taken into account to determine the number of repair shops to be surveyed. In order to know the percentages of the most frequent failures and the state of operation of the vehicle fleet of the canton (DOMINGO, 2017).

Sample size calculation

With the total population or quantity of the vehicle fleet of the canton of Quevedo and considering constant confidence level, probability of occurrence or non-occurrence, maximum estimation error; we proceed to the calculation of the sample size, applying the equation to know the number of mechanical workshops to be surveyed (METE, 2014).

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

Datos:

N = 29.141 vehicles

Z = 90% is equivalent to 1,645

p = 50% = 0,5

q = (1 – 0,5) = 0,5

e = 10% = 0,1

Desarrollo:

$$n = \frac{29.141*(1,645)^2*0,5*0,5}{0,1^2*(29.141-1)+(1,645)^2*0,5*0,5} = \mathbf{67,49}$$

The calculated sample size is 68 mechanic shops for motorcycles, light, medium and heavy vehicles to be surveyed.

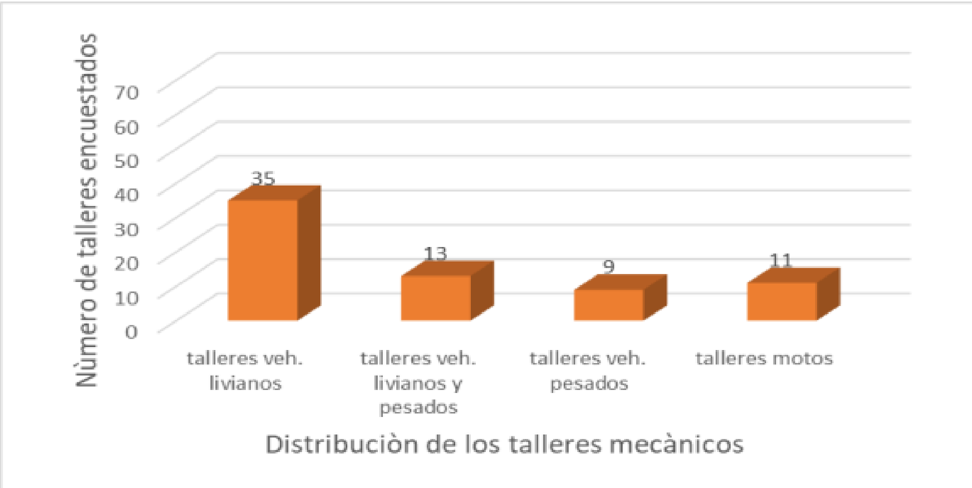
Survey results

The following results were obtained from the survey of 68 automotive mechanic shops engaged in the maintenance and repair of motorcycles, tricycles, light, semi-heavy and heavy vehicles in the canton of Quevedo:

Types of vehicles serviced

Taking into account motorcycle, light vehicle and heavy vehicle repair shops to determine the percentages of the total number of shops surveyed.

Figure 8. Survey results

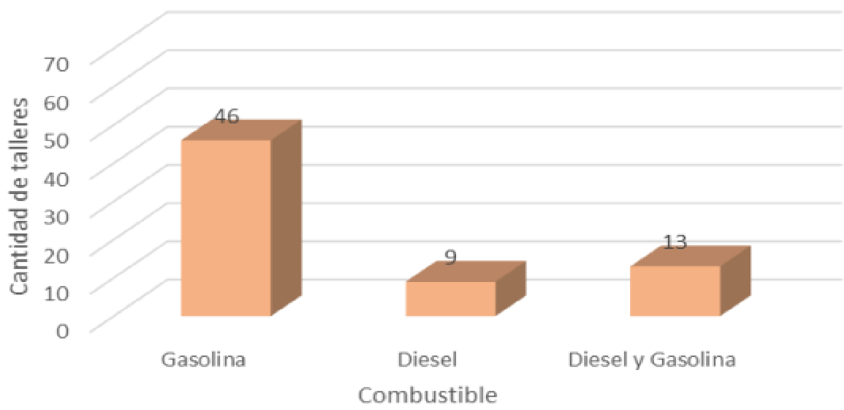


Of which 35 mechanical workshops are dedicated to the maintenance and repair of light vehicles, 13 workshops provide services to light and heavy vehicles, 9 workshops only work with heavy vehicles and 11 workshops only provide maintenance and repair services to motorcycles, tricycles and quad bikes.

Fuel used for operation

Each repair shop specializes in servicing gasoline-only, diesel-only, or gasoline and diesel vehicles, so the survey will show the percentage of each.

Figure 9. Classification of workshops



Of the workshops surveyed, 46 workshops service gasoline vehicles only, 9 workshops service diesel vehicles only, and 13 workshops service both gasoline and diesel vehicles.

Number of monthly customers

The survey showed that 26.47% of the workshops surveyed provide automotive service to a maximum of 15 customers per month, 67.64% receive between 15 and 30 customers and the remaining 5.82% of the workshops surveyed receive between 30 and 40 customers.

Age of vehicles attending the workshop

Vehicles with 5 years of use reach 14.70% of the workshops surveyed, 36.76% of the workshops service vehicles with 5 to 10 years of use and 48.52% of the workshops service vehicles with more than 10 years of use.

Upon receiving the vehicle in what state of operation are the following systems and rate them based on the percentages given.

Suspension system

According to the survey and averaging the results, it was found that in 26 workshops the vehicles arrive with the suspension system for corrective maintenance, in 24 workshops for preventive maintenance and in 18 workshops in good condition.

Steering system

In 19 workshops corrective maintenance is performed, in 33 workshops preventive maintenance is performed and in 16 workshops the system arrives in good mechanical condition.

Number of monthly engine repairs

In 32 workshops there are up to 5 engine repairs per month, in 30 workshops between 5 to 10 repairs per month and in 6 workshops between 10 to 15 engine repairs per month.

The workshop has a gas analyzer

According to the results of the survey, none of the garages have this equipment because it is expensive and the owners of the garages said that it is not essential to use it in the canton because there is no emission control system.

Compression gauge

37 workshops have this indispensable tool for a mechanical workshop; the remaining 31 workshops do not have this tool.

Vacuum gauge

12 workshops have this tool and the remaining 56 workshops do not.

Costs to be generated by CRTV

Costs of CRTV equipment and infrastructure through proformas

The following results were obtained for two vehicle technical inspection lines by consulting with three companies dedicated to importing this type of equipment.

Table 7. Equipment Proforma

Proforma MC Diagnóstico Automotriz	Proforma GLOBALTECH EQUIPOS AUTOMOTRICES	Proforma DANTON S.A.
$ 245.033,60	$ 138.508,80	$ 208.152,15

The equipment that was quoted by each company is as follows:

Brake tester, Suspension bench, Aligner to the step, Minor motorcycle brake tester, Play Detector, Gas Analyzer, Opacimeter, Tachometer, Luxometer and Regloscope, Sonometer, Tire Tilling Meter, PDA, PTI-Explorer.

Based on the proformas, it was determined that the best option for acquiring the equipment for the CRTV is the one issued by Globaltech Equipos Automotrices for a total amount of $138,5508.80, since it offers the best price in the market with equipment backed by a one calendar year warranty.

Estimated budget for the construction and adequacy of the CRTV

The acquisition of the equipment and tools that will make up the CRTV of the canton of Quevedo, which will have two lines of review for light, medium and heavy vehicles and another line only for motorcycles.

Table 8. Budget

Description	Total value $
Equipment	138.508,80
Pit	2.159,36
Industrial Shed	37.575,95
Infrastructure	167.500,00
Total	345.744,11

Cost projection for the next 5 years of the CRTV

For each year different types of costs were taken as the years of operation of CRTV pass, the vehicle fleet will increase considerably according to the projection, so a third revision line will have to be implemented in 2021, personnel growth, equipment maintenance; these factors will generate an increase in costs.

Table 9. Costs

Year	Investment $	Salaries $	Training	Basic services and maintenance	Total cost $
2019	345.744,11	183.960	2.000	8.000	539.704,11
2020		183.960		8.000	191.960,00
2021	69.254,40	186.060	1.500	25.000	281.814,40
2022		186.060		10.000	196.060,00
2023		186.060		30.000	216.060,00
Total					1’425.598,51

Calculation of amortization annuity

The budget for the construction and equipment of the CRTV will be obtained through a bank loan with an interest rate of 16.06% per annum for a 5-year term, so we will calculate with the equation of the amortization annuity to settle the debt through periodic payments (MOLINARES, 2009).

$$a = D * \frac{\frac{i}{100} * \left(1 + \frac{i}{100}\right)^n}{\left(1 + \frac{i}{100}\right)^n - 1}$$

Data:

D = 350.000 dollars

i = 16,06%

n = 5 years

Development:

$$a = 350.000 * \frac{\frac{16,06}{100} * \left(1 + \frac{16,06}{100}\right)^5}{\left(1 + \frac{16,06}{100}\right)^5 - 1}$$

a = 107.043 dollars

By paying installments of $107,043 per year for the 5 years we will cover the debt in full.

Loan amortization annuity table

Table 10. Amortization

Year	Interest %	Installment $	Amortization	Principal Outstanding $	Interest Rate%
0				350.000	16,06
1	56.210,00	107.043	50.833	299.167	
2	48.046,23	107.043	58.997	240.170	
3	38.571,37	107.043	68.472	171.699	
4	27.574,84	107.043	79.468	92.231	
5	14.812,27	107.043	92.231	0	0

CONCLUSIONS

Using the experimental method, information was obtained in the ANT Quevedo of the total number of vehicles registered in 2017 (29,141 automobiles), with the use of the SRI-ANT platform, the characteristics of each automobile were investigated: such as years of usefulness, with 82.67% of the total number of automobiles having more than 10 years of useful life and subject to frequent failures and the generation of greater pollution.

ANT Quevedo classifies the vehicle fleet as follows: motorcycles, light, 1.5 to 14.9 tons, 15 to 20 tons, 20 tons. Data from the SRI-ANT platform showed that 95.76% of the vehicles in the canton use gasoline as fuel for their operation and the remaining 4.24% use diesel as fuel.

With the statistical data of the CRV of the canton of Quevedo, it was calculated that 62 vehicle inspections of motorcycles are performed in 1 day of 8 working hours with an average time per inspection of 5.58 minutes and a calculated standard time of 6.95 minutes. The simulation of the process in the FlexSim software resulted in 64 vehicle inspections per day and a percentage of 75.70% of the operator's activity.

39 inspections are performed in 8 working hours to light and semi-heavy gasoline and diesel vehicles, statistically calculated with an average time per inspection of 9.83 minutes and a calculated standard time of 11.84 minutes. Simulating the inspection process in the FlexSim software resulted in 56 vehicle inspections per day, with an activity percentage of 67.28% for operator 1 and 83.40% for operator 2.

5 revisions are performed in 8 working hours to heavy vehicles statistically calculated and an average time for each revision of 10.33 minutes and a calculated standard time of 12.41 minutes. Simulating the inspection process in the FlexSim software resulted in 55 vehicle inspections per day, which varied significantly due to the number of heavy vehicles registered in this center with a total of 1233 units. The percentage of activity for operator 1 was 71.32% and 82.60% for operator 2.

Vehicles with more than 10 years of use arrive more frequently for maintenance at the garages, since the owners of the vehicles do not perform the proper preventive maintenance because the road conditions accelerate mechanical failures. In addition, the garages do not have the tools for gas analysis due to lack of knowledge and lack of municipal ordinance to prevent vehicles that pollute the environment excessively from circulating.

A feasibility study of the costs and income generated in 5 years of operation was carried out, where we proceeded to calculate the Benefit-Cost Ratio with a total of 2.78; which shows that for every dollar invested a profit of \$1.78 is obtained. By calculating the Net Present Value, a positive result of 2413484.25\$ was obtained, which is a favorable figure since it generates profits and the realization of this project is viable for its execution.

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