



TOTAL PRODUCTIVE MAINTENANCE SYSTEM TO IMPROVE EFFECTIVENESS IN THE PROCESS OF MAINTENANCE OF LIGHT AND HEAVY VEHICLES OF THE MUNICIPAL GAD OF SAN GABRIEL

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Abstract

This work plan exposes the main problems that the automotive maintenance area of the Municipal GAD of the City of San Gabriel goes through as it has to do with the fact that the vehicles and heavy machinery used in the different work of the Public Works Department are not Are ready to be used at the required time, frequent machinery shutdown and high maintenance costs. All this because there is no spare parts management, which does not have specialized professionals in the area and maintenance routes are not available. All of the above makes the implementation of a system of total productive maintenance in the car park of the Municipal GAD of the City of San Gabriel urgent, so that when implementing the SISMANCAR automotive maintenance system, it allows a clear and codified inventory of Vehicles and heavy machinery also has defined preventive maintenance plans, raise the technical rigor of automotive maintenance tasks and reduce maintenance costs in the car park.

Keywords: Maintenance scheduling, SISMANCAR system, cost reduction

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1. Introduction

The development of the present project assumes the main objective of the implementation of a total maintenance system for the automotive fleet, the activities have been improved, generating a maintenance plan for each vehicle for later analysis, through these factors access To the information, of all the tasks carried out, not done, with this will be able to determine the adequate state of the automotive fleet, finally reducing human resources, materials or time. Currently the public works management in the transport unit does not have a planned preventive maintenance system, for this reason, it is necessary to implement a system to comply with the necessary requirements to mitigate losses in time and money due to unjustified expenses For poor automotive maintenance.

This project is developed in the municipal GAD of Montúfar taking as a field of study the management of public works in the transport unit of the same, from which the information required by the automotive maintenance system is obtained.

Initially the project starts with a research problem, which make up important aspects such as: antecedents, problem approach, temporal and spatial delimitation, general objective, specific objectives, and finally the justification of each theme.

Continuing is the theoretical framework of the present research project, which deepens the issues of project development, taking into account new trends in maintenance management, maintenance definition, maintenance importance, maintenance objectives, maintenance types, basic principles Of the preventive maintenance system, theoretical explanation of the system of total productive maintenance.

Following this an important factor is the proposal where a study is carried out directly in the GAD of the city of San Gabriel where an analysis of the current mechanisms of maintenance will be realized, in addition, the

selection and codification of vehicles and heavy machinery by categories.

For the implementation of the system of total automotive production maintenance, among which it deals with the functionalities executed, preparation of catalog of equipment, elaboration of templates and maintenance plans, registration of vehicle location, initial maintenance record, planned and unplanned control Of routes and kilometrajes, process to generate work orders obtaining as a result the elaboration of planned maintenance that allows the constant warning of an alarm to the responsible one to execute the works.

Based on the above mechanisms, the reduction of costs in the automotive fleet in a period of six months, determined that the project study and implementation of the system, is of benefit to the institution, achieving the objectives proposed reducing the minimum value of 5% In economic factors of maintenance.

As a final factor, the conclusions and recommendations of the project are also made, the results obtained from each proposed objective are mentioned, and the respective bibliographic sources are also detailed and the annexes are a fundamental part of supporting the data entered.

2. Materials and methods

The methodology used is as follows:

Information search.- This method is used, which generates a search of information in secondary sources and quick reference on maintenance programs, history of each equipment in operation and after an analysis to carry out the implementation of a system that Meets the requirements in total productive maintenance.

Optimization.- This type of method consists of the analysis of bibliographic information.

Adaptation.- The use of this type of method is necessary to perform an analysis of the information, which allows to compare the information entry and codification of vehicles and machinery in the automotive maintenance system. The applied techniques and instruments:

Analysis.- It is used to know the current maintenance programs of the Municipal GAD of Montufar, based on the modern systems of maintenance.

Maintenance program.- Preparation of maintenance plans in vehicles and machinery with reference to the manufacturer's manual and the experience of the technician in charge.

Implementation.- Implementation of the system of total productive maintenance in the direction of public works in the transport unit.

Data entry.- Enter information such as; Schedules, plans, technical specifications, images, routes and kilometrajcs among others in SISMANCAR automotive maintenance system.

Operational tests.- The SISMANCAR automotive maintenance system is applied for a period of 6 months.

2.1 Program of previous maintenance within the Municipal GAD of San Gabriel.

Maintenance program for heavy equipment or machinery.

The preventive maintenance program for heavy machinery focuses on hours worked based on the most common demands and suggestions of equipment manufacturers, depending on their type, brand, spare parts specification, materials, lubricants and the conditions of use. Use of each of the equipment. The current maintenance plan is for visual use only, not programming to store tasks to be performed or to be performed.

Nomenclatura:																		
R: Realizar actividad descrita					I: Inspección, o ajustar o verificar					L: Lubricar								
ACTIVIDAD DE MANTENIMIENTO	KILOMETRAJE (CADA 5000KM)																	
	4000	8000	12000	16000	20000	24000	28000	32000	36000	40000	44000	48000	52000	56000	60000	64000	68000	100000
Aceite y filtro de motor	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Filtro de combustible	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
Filtro de aire	R	R								R	R	R	R	R	R	R	R	R
Aceite de caja de cambios	I									R								R
Aceite del Diferencial Dy P	I				R					R				R				R
Bujías																		R
Cables de bujías																		R
Batería (nivel de líquido y densidad)	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Marcha mínima del motor y aceleración	I	I			I		I		I		I		I		I		I	I
Limpieza inyectores carburador					R					R				R				R
Limpieza y calibración de frenos			R		R		R		R		R		R		R		R	R
Revisión de líquidos	I	I	I	I	I	I	I	I	I	R	I	I	I	I	I	I	I	I
Fugas de fluidos	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Bandas de accesorios			I											R				I
Banda de distribución																	R	
Sistema de escape	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Sistema de dirección revisión	I	I			I		I		I		I		I		I		I	I
Arbol de transmisión y crucetas y puntas de ejes	I				L				L				L				L	L
Sistema de suspensión revisión	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
Reajuste general				R		R		R		R		R		R		R		R
Medición de compresión										I								I

Figura 1. Maintenance program Heavy equipment

Maintenance program for light vehicles.

The planned maintenance activities, in force in the car park of the municipal GAD of San Gabriel, are elaborated in a text format, where you can visualize the activity, the frequency of maintenance and the responsible person, also it is worth mentioning that this is a Document where it is not possible to make modifications, nor to record data of the realized maintenance nor to realize.

 Plan de Mantenimiento Automotriz		
ACTIVIDAD	FRECUENCIA	PENDIENTE
Cambio de aceite y filtro del motor	4.000 KMS	Conductor
Cambio filtro de combustible	4.000 KMS	Conductor
Cambio de filtro de aire	8.000 KMS	Conductor
Cambio de aceite de caja de cambios	30.000 KMS	Conductor
Cambio de aceite del diferencial	30.000 KMS	Conductor
Limpieza de inyectores	5.000 KMS	Conductor
Cambio de banda de distribución	80.000 KMS	Conductor

Figura 2. Programa de mantenimiento Vehículos Livianos

2.2 Codification of the existing car park, in operation of the municipal GAD of the City of San Gabriel.

MARCA	TIPO	COLOR	AÑO	MODELO	CÓDIGO
VEHÍCULOS LIVIANOS					
CHEVROLET	DOBLE CABINA	PLATEADO	2015	D-MAX CRDI FULL AC 3.0 CD 4X4 TM DIESEL	CM-01
SUZUKI	JEEP	PLATEADO	2010	GRANDVITARA SZD,7LV6 4X4	JP-01
MAZDA	DOBLE CABINA	AZUL	2007	B2600CABINA DOBLE FULL	CM-02
MAZDA	DOBLE CABINA	AZUL	2011	BT-50CD4X4 STD CRD2.5FL	CM-03
MAZDA	DOBLE CABINA	AZUL	2005	B2600CABINA DOBLE FULL	CM-04
MAZDA	DOBLE CABINA	CREMA	2007	B2600CABINA DOBLE FULL STD AC	CM-05
TOYOTA	DOBLE CABINA	ROJO	2001	HILUX 4X4 CD	CM-06
CHEVROLET	DOBLE CABINA	NEGRO	2012	LUVV-MAX3.0L DIESEL CD TM 4X4 EXTREM	CM-07
FORD	DOBLE CABINA	BLANCO	2007	RANGERXL4X4 DOBLE CABINA	CM-08
CHEVROLET	DOBLE CABINA	ROJO	2006	LUV DOBLE CABINA	CM-09
PLATAFORMA					
CHEVROLET	CAJON-C	BLANCO	2004	NPR71L CHASIS CABINADO	PF-01
HYUNDAI	PLATAFORMA	BLANCO	2009	HD72 CHASIS CABINADO LWB	PF-02
HINO	PLATAFORMA	BLANCO	2006	FM1JRUJA	PF-03
VOLQUETAS					
CHEVROLET	CAJON-C	BLANCO	2001	KODIAK 157 CHASIS CABINADO	VQ-01
CHEVROLET	CAJON -C	BLANCO	2002	KODIAK 221 CHASIS CABINADO	VQ-02
NISSAN DIESEL	VOLQUETA	AMARILLO	2010	CWB459HDLB	VQ-03
NISSAN DIESEL	VOLQUETA	AMARILLO	2010	CWB459HDLB	VQ-04
NISSAN DIESEL	VOLQUETA	AMARILLO	2008	CWB459HDLB	VQ-05
RECOLECTORES					
FORD	RECOLECTOR	BLANCO			RC-01
INTERNACIONAL	RECOLECTOR	ROJO	2006	CHASIS CABINADO 4300 4X2 CAB STD	RC-02
AUSTRAL	RECOLECTOR	AMARILLO	2015		RC-03
MAQUINARIA PESADA					
CASE	RETROEXCAVADORA	AMARILLO	2001	RETROEXCAVADORA CASE 5805M	RX-01
KOMATSU	MOTONIVELADORA	AMARILLO		GD555-3A	MN-01
GALION	MOTONIVELADORA	AMARILLO			MN-02
JCB	RODILLO	AMARILLO	2010	RODILLO VM115D	RD-01
KOMATSU	TRACTOR DE ORUGA	AMARILLO		D65EX-15EO	TR-01
JCB	EXCAVADORA	AMARILLO	2010	JS200LC	EX-01
205	EXCAVADORA	AMARILLO			EX-02
VEHÍCULOS UTILITARIOS					
CHEVROLET	CAMION	BLANCO	2008	NPR71L CHASIS CABINADO	FR-01
HINO	UNIDAD MEDICA	BLANCO			UM-01
VOLKSWAGEN	OMNIBUS	BLANCO	2006	9150 OD BUS URB	BS-01
MOCICLETA					
YAMAHA	PASEO	AZUL	2007	T225X	

Tabla 1. Car park coding

2.3 Implementation of the automotive maintenance system SISMANCAR in the Gúif of Montúfar.

The system to be implemented allows for a total productive maintenance program, which promotes teamwork, resulting in continuous improvement, resulting in a better working environment and a longer life cycle of the equipment, on the other hand, The person in charge of the system must comply with a maintenance plan of any work equipment, which is controlled by a frequency of hours or kilometers in exact times, avoiding long stops of the equipment, in the same way, reduces costs and improves the service.

Phases for the implementation of the SISMANCAR maintenance system.

Module of the Technical Department.

We proceed to carry out the inventory with the removal of all the information of the automotive fleet, to form a catalog with all the active equipment, through this registry the maintenance schedules are made, to be able to plan and execute the activity, also allows us to document the Information of each of the equipment, it will be possible to associate images of the vehicle, supplier, on the other hand, it allows to generate preventive maintenance, to register corrective works, in the same way it will generate a work order of the activities to be executed in concessionaries, workshops Private and lubricating, and contains information on tasks with more priorities and details to guide the assigned technician.

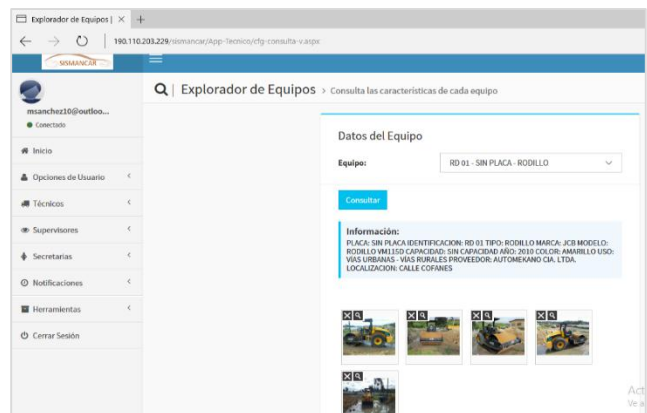


Figura 3. Parámetros del sistema

Module of the department of supervisors.

It is a fundamental part for the control of preventive maintenance, where it allows the responsible person to carry out maintenance plans or routines based on their experience or theoretical plans recommended by the manufacturer, in addition each maintenance plan is composed of three basic elements: parts, Activities and frequencies to be applied to vehicles.

The automotive maintenance system SISMANCAR generates work orders, in addition it will present a list of all the maintenance scheduled to be carried out in the established time or frequency, starting from the list of maintenance that must be done, the responsible generates the orders of work by specialties, The workshop can also be designated and a person responsible for routine non-routine preventive maintenance.

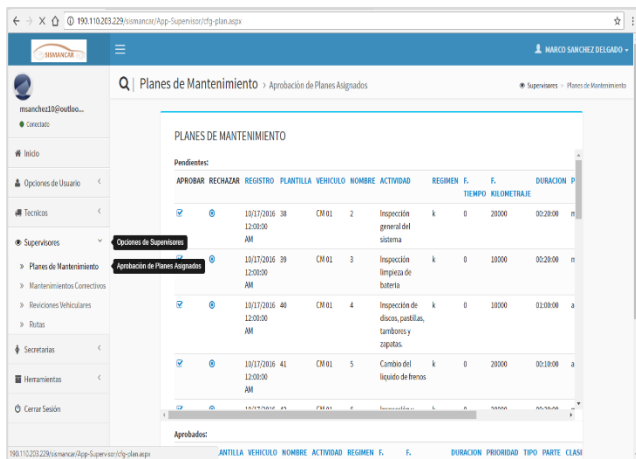


Figura 4. Maintenance Plans

Module of the Department of Secretaries.

In a maintenance plan controlled by the frequency regime and dates with which the routine activities are performed, it is necessary for the person responsible to register or update the daily data of the routes and readings so that the system can calculate the next maintenance to be performed in Function of the use of each vehicle, which is determined by reading the odometer or speed counts.

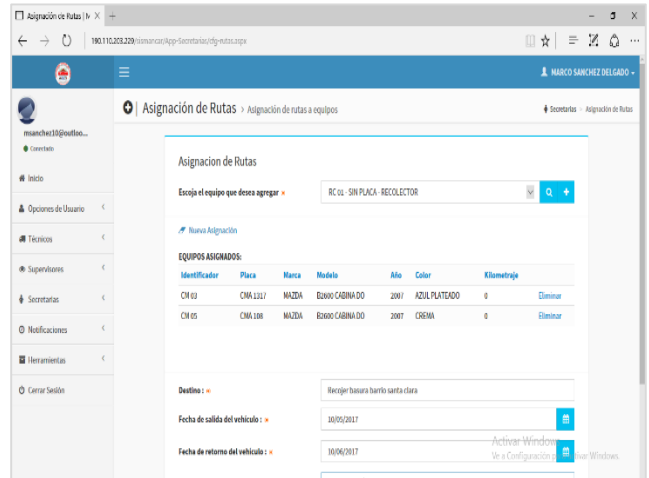


Figura 5. Route assignment

Module of the Tools Department.

A fundamental part in the system is the financial management who authorizes the delivery of lubricants, filters among others, to the driver or operator who removes from the warehouse to perform any work on the equipment, since the program has management modules Spare parts and of gallery where it will be possible to verify its existence before starting a work, this will avoid wasting time due to lack of parts, accessories or spare parts when performing maintenance.

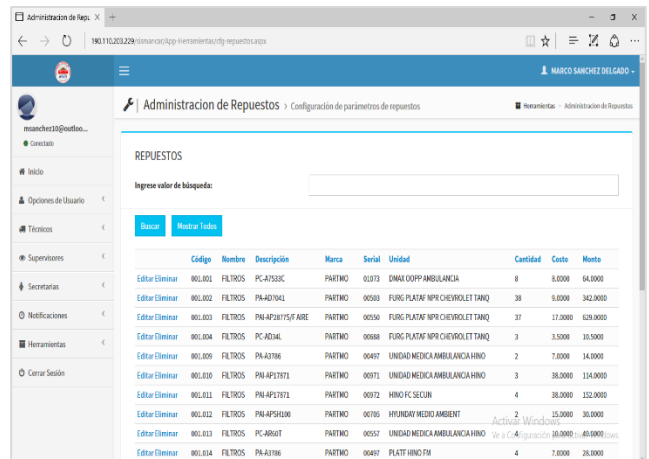


Figura 6. Spare parts

3. Results and Discussion

3.1 Analysis of reduction of costs in maintenance

According to the activities carried out during the development of the project, for the elaboration of the analysis of cost reduction through the use of real data in maintenance, compiled through resources such as: invoices of each one of the concessionaires and private workshops authorized by the municipal GAD Of the city of San Gabriel during a period of 6 months before the implementation of the system and a period of 6 months after the start of the SISMANCAR automotive maintenance system, achieving a cost reduction result by comparing the different maintenance periods Employees in the automotive fleet equipment.

Budget.

The Municipal GAD of San Gabriel has a total annual budget for the motor vehicle fleet, which consists of the following items.

ITEM	Presupuesto
Vehículos livianos	50.000
Recolectores, Volquetas, Maquinaria y Vehículos Utilitarios	53.800
Total	\$103.800

Tabla 2. Budget of the Municipal GAD of San Gabriel

3.1 General reduction of the real semester.

ANÁLISIS GENERAL SEMESTRE (REAL) PARA LA REDUCCIÓN		
DESCRIPCIÓN	CANTIDAD	PORCENTAJE
PRESUPUESTO REFERENCIAL GAD MUNICIPAL DE LA CIUDAD DE SAN GABRIEL	\$103800	100%
PAGOS SEMESTRAL SIN SISMANCAR (JULIO-DICIEMBRE)	\$54559.62	52.56%
PAGOS SEMESTRAL CON SISMANCAR (ENERO-JUNIO)	\$40952.18	39.45%
TOTAL	\$13607.44	13.11%

Tabla 3. Actual Cost Analysis

For the present general analysis of cost reduction of the project, reducing the 13.1% in

planned preventive maintenance costs, by comparing values and the difference of the same in the car park of the Municipal GAD of the City of San Gabriel, thanks to The implementation of the automotive maintenance system SISMANCAR.

4. Conclusions

- The analysis of cost reduction in the automotive fleet over a six-month period determined that the study and implementation of the SISMANCAR automotive maintenance system in the Municipal GAD of the City of San Gabriel is of benefit to the interests of the Institution. A reduction of 13.11% of the semiannual budget was obtained, which exceeded 5% of the silver target.
- In the implementation of the Total Productive Maintenance Plan in the municipal GAD of San Gabriel, it was determined that the main weakness in the administrative and operational processes of the automotive maintenance area is: The lack of planning, monitoring and control of activities to be carried out Successfully with the implementation of the automotive maintenance system SISMANCAR.
- It was determined that the Municipal GAD of San Gabriel has a total of thirty-four (34) motor vehicles between heavy machinery, heavy vehicles and light vehicles.
- Successfully managed, coded and stored in the database of the automotive maintenance system SISMANCAR all the information regarding the vehicles of the car park.

Thanks:

In the first instance I dedicate this work of degree to God for allowing me to reach this special moment in my life and to be able to culminate my professional career.

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