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Improvement of the maintenance administration system for the official vehicle fleet of the Yaqui River irrigation district

Mejora del sistema de administración de mantenimiento a flotilla de vehículos oficiales del Distrito de Riego del Río Yaqui.

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Abstract

This project was carried out in an organization in charge of operating, conserving and managing the canal network, drainage network, roads and hydro-agricultural infrastructure of the Yaqui Valley, in which various problems and delays in the service have been occurring because of failures in the personnel transport vehicles, due to a deficient maintenance process of the fleet, for which the objective was to make proposals for improvement through a procedure based on Reliability Centered Maintenance (RCM), by analyzing the current situation of the area under study, identifying occurred and potential failures, proposing a preventive maintenance program, designing a training protocol and delivering results to the client. Following the procedure described above, resulted in the design of a critical data collection format for the object under study, a list of recurring failures, a maintenance program proposal, and a user training protocol. Thus, the objective established by delivering to the interested parties improvement proposals to the preventive maintenance process of the personnel transport units of the Yaqui River Irrigation District was met.

Vehicle fleet, Maintenance, Reliability

Resumen

El presente proyecto se llevo a cabo en un organismo encargado de operar, conservar y administrar la red de canales y drenaje, caminos e infraestructura hidroagrícola del valle del Yaqui, en el cual se han estado presentando diversos problemas y retrasos en el servicio que presta, debido a fallas en los vehículos de transporte de personal, a causa de un deficiente proceso de mantenimimeto de la flotilla, por lo que el objetivo fue hacer propuestas de mejora por medio de un procedimiento basado en el mantenimineto centrado en la confiabilidad (RCM), a través de analizar la situación actual del área bajo estudio, identificar fallos ocurridos y potenciales, proponer un programa de mantenimiento preventivo, diseñar protocolo de capacitación y entregar resultados al cliente. El seguimiento al procedimiento anteriormente descrito, generó como resultado el diseño de un formato de recolección de datos críticos del objeto bajo estudio, lista de fallas recurrentes, propuesta de programa de mantenimiento y protocolo de capacitación a usuarios. Con lo que se cumplio el objetivo planteado al entregar a los interesados propuestas de mejora al proceso de mantenimineto preventivo de las unidades de transporte de personal del Distrito de Riego del Rio Yaqui.

Flotilla de vehículos, Mantenimiento, Confiabilidad

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1. Introduction

Although it can be said that maintenance has existed since the human being has consciousness (Montilla 2016), its appearance as a systematically organized activity is considered to have taken place in the United States in office and in the military sector during the First World War (Carcel, 2016).

The history of maintenance can be divided into four generations: the first from the beginning of the 20th century, until 1950, characterized by purely corrective maintenance actions, the second generation between the years of 1950 and 80 where preventive maintenance appears, the third from 1980 to 2000, marked by the application of predictive maintenance and condition monitoring; and from the 21st century, the fourth generation with comprehensive maintenance techniques such as total productive maintenance, focused on risks, focused on reliability, management focused on results and clients, knowledge management and energy efficiency (Pérez, 2021).

Maintenance is considered a series of management activities and techniques that aims to increase the availability, reliability and useful life of the equipment (Pérez, 2021; Contreras, 2016; Bermúdez-Puente, 2019; and Fernández, 2018); achieving in this way, maximizing the benefits obtained by the investment of both material and human resources, so that maintenance is a key part to make the processes more effective (Rendón, 2021).

For Gutiérrez and Valencia (2020) and Pérez (2021), the types of maintenance can be classified as: Corrective maintenance or breakage, which consists of repairing or replacing what has failed (must be repaired immediately) does not generate fixed expenses, because you only invest in it when it is clear that it is necessary, but in this system production becomes unpredictable and unreliable, the useful life of the equipment is shortened and it is difficult to diagnose the causes that cause the failure, which means assuming economic risks that can sometimes be significant.

Preventive or time-based maintenance, which consists of reconditioning or replacing the components of a piece of equipment or the equipment in its entirety, regardless of its state at that time, is scheduled based on the estimated life of the component or equipment, offers greater reliability, reduced downtime and longer useful life of equipment and facilities; On the other hand, this can suppose an unnecessary cost if it is applied to equipment in which the preventive maintenance has no effect.

Predictive or condition-based maintenance, which consists of using equipment or sensors to monitor and detect the condition by monitoring indicators at regular intervals of time and taking actions to prevent failures. This type of maintenance allows to increase the useful life and availability of the equipment, allows corrective actions in a preventive way, decreases the downtime of the asset and reduces labor costs; but on the other hand, it requires greater investment for the acquisition of sensors or diagnostic devices and greater investment in the training of personnel for its correct follow-up.

These classifications coincide with those suggested by Gallará and Pontelli (2020), only that they comment that the first major division of the classification has to do with the way in which the failure occurs, if the failure occurs unexpectedly it is classified as break maintenance, and if it occurs as expected as scheduled or planned maintenance.

Breakdown maintenance is equivalent to the corrective maintenance classification and scheduled maintenance includes preventive (based on time) and predictive (based on condition) of the Gutiérrez and Valencia (2020) and Pérez (2021) classification. In addition, Gallará and Pontelli (2020), add two more classifications to planned maintenance, maintenance due to breakdowns and corrective maintenance.

The breakdown is when an unexpected failure occurs, but due to its impact or severity its fix can be planned for later and the corrective consists of making improvements to its design to facilitate its preventive maintenance.

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Given so many options and advances in relation to maintenance, Reliability Centered Maintenance or RCM (Reliability Centered Maintenance), which is defined as a "Process to determine what must be done to ensure that any team continues to do what that its users want it to do, in its current operational context", offers decision makers a coherent model that allows them to apply those elements that provide the greatest value for them and their companies (Moubray, 2021).

In any organization, maintenance is a key element in making processes more effective, and the administration and efficient use of water for agriculture is no exception.

Climate change, inappropriate uses and practices, and inconsistencies in the allocation of this resource pose serious challenges to water management systems for agricultural use, considering that on average, 70% of the water extracted in the world is used for this activity and that irrigated agriculture currently represents 20% of the total cultivated area, contributing 40% of the total food production worldwide; In addition, by the year 2050 the projections ONU (2023) predict that the world population will increase from the current 8 billion to close to 10 billion inhabitants and, to satisfy basic food needs, the predictions regarding agricultural production is estimated at an increase of 70% for said year (Rendón, 2021).

The state of Sonora is one of the main agricultural producers in the country, with a production of 1.8 million tons of wheat grain, among other products (Government of Mexico, 2021), as well as in Mexico and throughout the world, for agriculture to be carried out, actions are necessary at the socio-organizational level in water management and consider improvements in water supply systems to provide services on demand, (Centro Internacional del Mejoramiento del Maíz y Trigo [CIMMYT], 2021). ; Therefore, the Federal Government since 1926, the year the National Irrigation Commission was created, has developed irrigation projects such as Irrigation Districts, which include various works, such as storage vessels, direct derivations, pumping plants, wells, channels and roads, among others (CONAGUA, 2023).

The state of Sonora covers a total area of 492,991 hectares, which is made up of the Yaquis, Altar, Mayo river, Yaqui river, Hermosillo coast, Papigochic, Guaymas colonies and dependents of district 038 (CONAGUA, 2023).

The body in charge of regulating water in the Yaqui River is the Yaqui River Irrigation District (for its acronym in Spanish, DRRY), whose purpose is to operate, conserve, and manage the network of canals, drainage network, roads, and hydro-agricultural infrastructure of the Yaqui Valley, this is located in the south of Sonora, partially covering the municipalities of Cajeme, Bacum, San Ignacio Rio Muerto, Navojoa, Etchojoa and Benito Juárez, becoming an essential part of the economy of the south of the state of Sonora (DRRY, 2023).

On June 27, 1951, the Yaqui River Irrigation District was established by presidential decree, but it was not until 1992 that the administration and operation of the irrigation districts were transferred to the users and the Yaqui River Irrigation District was created. , S. de R.L. from I.P. and C.V. with the objective of providing users with the service of operation of the canal network, measurement, irrigation plans, hydrometry and statistics; Canal network conservation works are carried out, such as clearing, formation of banks, formation of roads, application of herbicides, extraction of silt and aquatic plants, among others; as well as acquisition of machinery and specialized equipment, for the benefit of users and irrigation modules (DRRY, 2023).

For the above and to provide a good service, it has offices to the west of Cd. Obregón and the Carlos Conant Maldonado unit, where the warehouse, laboratory, electromechanical, vehicle control and machine shop departments are located.

In the vehicle control department the loan of trucks and vehicles is offered to the various areas that make up the Institution, however, the present study was limited to the personnel transfer units, which have 155 pick-ups used for the transport of personnel and use of managers, department heads, among others, due to the fact that through a personal communication on February 6, 2023.

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The head of the department commented that mechanical failures and accidents due to them frequently occur in this type of vehicle, causing delay in service, which can bring serious consequences to users such as flooding, lack of water for irrigation, among others; Therefore, the need to carry out actions to improve the maintenance program of the DRRY transport units was raised, so that their vehicles remain in optimal conditions of use and increase their availability and useful life.

2. Methodology to develop

The object under study is the preventive maintenance process of the fleet of vehicles for personnel transport, made up of 155 pick-ups, managed by the DRRY vehicle control department at the Carlos Conant Maldonado unit. The procedure was based on reliability centered maintenance (RCM), exposed by Moubray (2021).

3. Results

The results that are presented below include figures that, due to their size, will only be presented in part.

Analysis of the current situation of the area under study

In this first step, it was found that currently the official vehicle fleet administration system follows a manual documentary process (paper and pencil) and that it also omits a series of important data, such as: Vehicle model, type of engine, fuel use, maintenance history, description of activities carried out, criteria for scheduling maintenance, maintenance projections, among others; for which they were added in the improvement proposal to the maintenance management system; as well as it was possible to observe that the operators register the failures and send them to the vehicle control offices to issue the order. One of the reports is used to issue service orders for the units and the following is implemented for material requirements (see Figure 1).

Figure 1 Service order format and materials and service requisition format
Source: Yaqui River Irrigation District (DRRY, 2023)

Identification of occurred and potential failures

After collecting the pertinent data and supported by the interview with the inspector, as shown in figure 2, a list of recurring failures that the fleet has presented during its operation was created; This also includes a series of possible causes that would have originated these recurring failures, which helps to diagnose the breakdowns or breakdowns that each of the vehicles could present to be taken into account in periodic reviews and maintenance planning.

Figure 2 List of recurring failures
Source: Self-Made

Note. In the left column of figure 2 are the recurring failures of the fleet and in the right column the possible causes that cause them and/or recommendations are shown.

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Preventive maintenance program proposal

The maintenance program was prepared with Microsoft Excel software. As an example, in the format shown in figure 3 you can see the economic number of the vehicles, management to which it belongs, as well as the department, the most recent maintenance date, description of the service that was performed, key type (service performed), and odometer (see Figure 3).

Figure 3 Service program
Source: Self-Made

In figure 3, in addition to the service log, you can see the tabs of the other sheets that contain the maintenance program databases, which consists of four sheets, which include: Services, one report per unit, catalogs (keys, description and contacts), and the units that are active. The maintenance program is designed with a filter that allows you to easily identify the maintenance status of each of the vehicles.

Training protocol design

The scope of the training protocol shown in figure 4 reaches all members belonging to the offices in the vehicle control area and fleet users and includes: I. Activity of the company, II. Justification, III. Scope, IV. Purposes of the training program, V. Objectives of the training protocol, VI. Goals, VII. Strategies, VIII. Types, modalities and levels of training, IX. Actions to develop, X. Frequency and duration and XI. Resources (see Figure 4).

Figure 4 DRRY vehicle control training protocol
Source: Self-Made

Delivery-Reception of results to the client

For the delivery-reception of results to the client, a completion letter was prepared for the closure of the project, it was signed, validating the delivery and fulfillment of the proposed objectives as shown in figure 5. The Delivered products were: Critical data collection format of the object under study, list of recurring failures, maintenance program and user training protocol. See letter in Figure 5.

Figure 5 Project completion letter
Source: Self-Made

Note: The completion letter shows the general data of the project, the products to be delivered and the release signatures.

4. Conclusions

The development of this project through the methodology used, made it possible to achieve the proposed objective of making improvements to the maintenance program of the DRRY personnel transport units, since the analysis of the current situation, as well as the mode and effect of the failures that occur, allowed the identification of critical points where improvements could be made to the current maintenance process, according to the needs, to optimize it and, thus, provide a better service to the users of the fleet of official DRRY vehicles.

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As well as the design of the database in Excel will facilitate the follow-up and correct documentation of the services provided.

5. Recommendations

To achieve the desired success, it is recommended to implement the preventive maintenance plan proposed to the fleet and, when replacing components, ensure that they meet and/or exceed the specifications of the original parts, follow the training protocol, make use of and keep updated the data collection instrument (Excel); as well as create awareness among users about periodic reviews, preventive care, defensive driving and recurring failures.

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