

## Maintenance administration system for the infrastructure of a higher education institution

### Sistema de administración de mantenimiento a la infraestructura de una institución de educación superior

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#### Abstract

This research was carried out in a Higher Education Institution and addresses the need to develop a preventive maintenance program, since corrective maintenance is only carried out with an institutional log where complaints are addressed in the families of Refrigeration, Lighting, Hydraulic -Sanitary, Electrical System, Building Conservation, Painting, VIALTA, Miscellaneous, Locksmith and Waterproofing, which are sent by users on a day-to-day basis, correcting failures in the institution's infrastructure in a reactive manner and frequently without adequate training of the technicians. That is why this research aims to carry out improvement actions, through the 5QS methodology, to have a relevant maintenance and training program. The procedure consists of five phases that are: diagnosis, design, implementation, measurement and improvements, its development generated as a result a preventive maintenance program, in the Pool, Library, Comprehensive Center for Information Technologies of Extension and Culture, Center for Strategic and Business Studies, Management, Acquisitions, Aquaculture, CIIBAA, CEVE, A100, A200, A300, A400, A800, L500 and L600. With the application of this methodology, the stated objective was achieved since the preventive maintenance and training programs were obtained

#### Resumen

Esta investigación se llevó a cabo en una Institución de Educación Superior y aborda la necesidad de desarrollar un programa de mantenimiento preventivo, ya que únicamente se realiza el mantenimiento correctivo con una bitácora institucional donde se atienden las quejas en las familias de Refrigeración, Iluminación, Hidráulico-Sanitarias, Sistema Eléctrico, Conservación de Edificios, Pintura, VIALTA, Misceláneos, Cerrajería e Impermeabilización, que envían los usuarios en el día a día corrigiendo las fallas a la infraestructura de la institución de forma reactiva y con frecuencia sin la capacitación adecuada de los técnicos. Es por ello que esta investigación tiene como objetivo realizar acciones de mejora, a través de la metodología 5QS, para contar con un programa de mantenimiento pertinente y capacitación. El procedimiento consta de cinco fases que son: diagnóstico, diseño, implementación, medición y mejoras, su desarrollo generó como resultado un programa de mantenimiento preventivo, en los edificios Pool, Biblioteca, Centro Integral de Tecnologías de Información de Extensión y Cultura, Centro de Estudios Estratégicos y de Negocios, Rectoría, Adquisiciones, Acuicultura, CIIBAA, CEVE, A100, A200, A300, A400, A800, L500 y L600. Con la aplicación de esta metodología se logró el objetivo planteado ya que se obtuvieron los programas de mantenimiento preventivo y capacitación.

**Infraestructure, Maintenance, Administration**

**Infraestructura, Mantenimiento, Administración**

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## Introduction

The maintenance; it is to procure the longest useful life of the facilities and productive machinery; It is also a whole series of actions that must be carried out by the people in charge of this department, with the purpose that the equipment, machines, components and facilities involved in an industrial process are in the required operating conditions for what was designed, built, installed. and put into operation (Pérez, 2021 and Fernández, 2018). Although for Chanta (2017), it is the planning of tasks and resources to avoid failures or stops in production, in such a way that what is sought is to minimize maintenance and stoppages in the company, which cause losses substantial resources; Consequently, it is the set of operations and care necessary so that facilities, buildings, industries, among others, can continue to function properly (Royal Spanish Academy [RAE], 2021).

According to Bermúdez-Puente (2019), the types of maintenance are characterized by the way in which the intervention is carried out in the system (equipment, machine tools, facilities, etc., involved in the production of any good or service), and is classified as: Corrective: it is carried out only after the failure or decrease in the performance of a piece of equipment, machine or system; Preventive: repairs and/or replacements are carried out, without the occurrence of a specific failure, through the execution of a set of activities planned in advance; Predictive: it consists of carrying out inspections at regular intervals of time and the activities are programmed based on the expected time of future failures and other relevant aspects of the physical condition of the system; Detective: it is the regular inspection of the functions; and it is done with the help of a previous monitoring of the system without taking it out of operation based on human senses; Improvement: it is the modification or redesign of the original conditions of the equipment or the way of its installation.

Total Productive Maintenance: it is keeping the equipment ready to produce at its maximum capacity products of the expected quality, without unscheduled stops; in turn, Reliability-Centered Maintenance is for Tamba-Sanchez (2021) a methodology to develop maintenance plans that include all kinds of strategies (preventive, predictive, fault finding); but for Moubray (2021), it is a process to determine what must be done and guarantee that the teams continue performing their function for which they were designed.

On the other hand, the 5QS methodology depends exclusively on the validity of the answers given to the questions made in each of the phases (diagnosis; design; implementation; measurement; and improvements), objectivity being important in the conception of the diagnosis, since It is the starting point, although the flexibility of the methodology allows adjustments to be made according to the integral characteristics of the organization, to satisfy and guarantee the real expectations of maintenance in each of the equipment and facilities (Binotto and Britch, 2020). . The aforementioned will be achieved as long as there is adequate training, which is an educational activity that improves the development of human capacities. It is a simple process when it is used as a means to provide knowledge, however, it becomes complex when it is part of a training system to generate changes in people.

Currently, maintenance is widely related to education, unlike a few years ago when it was considered an expense or a requirement in labor laws (France, 2018). For Salgado et al. (2017) is a key activity for the survival of companies and their adaptability to the environment and to the changes that are taking place; in a complementary way Labrador et al. (2019), argues that the human factor is the resource that has the ability to transform the organization's resources into acceptable results. Currently the databases for Tasé-Velazquez et al. (2020) are necessary in the efficient use and administration of a preventive maintenance program; At the same time, they are currently useful for any discipline or application area where there is a need to manage data. They are becoming more voluminous every day, since the amount of information and its degree of precision is greater (Pulido et al., 2019).

Finally, databases are essential for information systems in their computer programs, servers or mobile applications (Arcidiacono, 2021 and TheOMS, 2021).

The institution wishes to minimize unforeseen events such as: Defects in air conditioning, lighting in general, leaks, failures in the supply of electricity and water, failures in doors and windows when opening-closing or infiltration of dust and water, which makes it difficult to provision of the service in classrooms, laboratories and administrative offices; as well as the damage of computer and office equipment, derived from the non-planning of preventive maintenance in the buildings. The distribution of buildings under study of the preventive maintenance program is presented below, see figure 1.



**Figure 1** Distribution of buildings  
Source: ITSON (2022)

The buildings have the service of different families such as: Refrigeration, Lighting, Hydraulic-Sanitary, Electrical System, Building Conservation, Painting, VIALTA, Miscellaneous, Locksmithing and Waterproofing, which are provided, in addition to the above there is poor training in general terms. Therefore, the need to carry out improvement actions was raised, through the 5QS methodology, to have a relevant maintenance and training program.

## Results

The result obtained in which there are figures is presented, which due to their size will only present a part.

### Phase 1. Diagnosis

Maintenance requests were analyzed, see Table 1

N° Application	Date	Applicant Name	Campus	Location
15544	30/09/22	Edgar Valdez	Obregón	Maintenance
15542	30/09/22	Daniel Nájera	Obregón	Lab. Microbiology
15538	30/09/22	Elsa Meleros	Obregón	Coordination Services for teachers
15537	30/09/22	Manuel Portillo	Obregón	Directorate of financial resources

**Table 1** Maintenance requests  
Source: Own elaboration (2022).

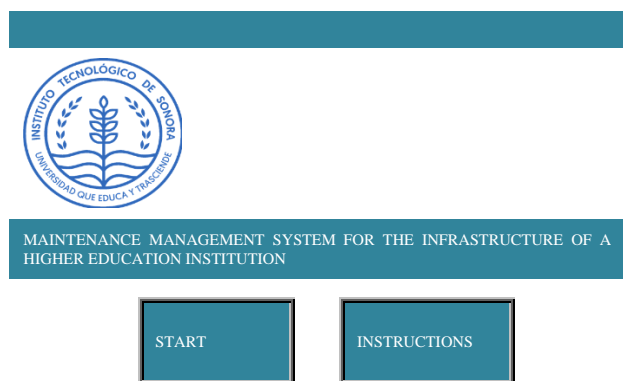
and an inspection format for the buildings and services was carried out, see table 3, which indicates the building, the date, the deterioration and its level.

Maintenance Inspection Record				
Date: 18/10/22		Inspector: María Duarte		
Campus: Centro		Building: 200		
Inspection Details				
Item: Electrical System	Reason for Inspection:	<ul style="list-style-type: none"> <li>• Periodic inspection (preventive) ( )</li> <li>• Maintenance request (corrective) (X)</li> </ul>		
Description: The 200 is equipped with the highest technology which is available for the use of the facilities when required, it has classrooms for teaching classes.				
Deterioration/ Failure	Conditions			Observations
	None	Mild	Serious	
Contact status			X	Ground floor: improvised double contact in poor condition in the utility room.

**Table 2** Inspection form  
Source: Own elaboration (2022)

### Phase 2. Design

The design and elaboration in Excel of the preventive maintenance administration system for the institutional infrastructure continued, see figure 2.

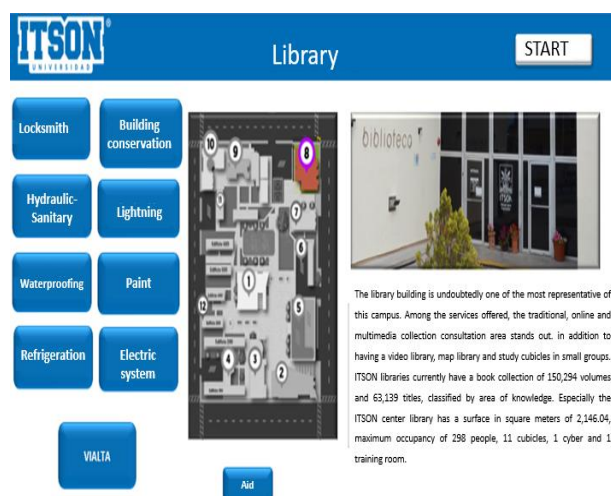


**Figure 2** Preventive maintenance program

Source: Own elaboration (2022)

At the same time, a training program is developed in the use and management of the database in the Excel program.

As an example, the service sheet of the rectory maintenance program is shown, see figure 3.



**Figure 3** Library service sheet

Source: Own Elaboration (2022)

### Phase 3. Implementation

The data recording was carried out in the preventive maintenance program of each one of the 10 families, taking as an example the lighting of the acquisitions building as shown in board 3; This information was collected by making tours of each of the buildings.

ILUMINACIÓN								
Date	Building	Type	Turn	Brand	Ability	Model	Specifications	Note
14-09 2022	Acquisitions	Fluorescent			32 W	2 x 3 2		3 8
21-09 2022	800 PB	Fluorescent			32 W	2 x 3 2		4 , A - 8 1 2
21-09 2022	800 ext	Led			30 W	2 x 3 0		8
21-09 2022	800 ext	Led reflectors			50 W			1
21-09 2022	800 PA	Fluorescent			60 W	2 x 6 0		2 , C 1

**Table 3** Acquisition building lighting data record

Source: Own Elaboration (2022)

### Phase 4. Measurement

A survey was applied, see figure 8, for satisfaction through the google forms tool <https://forms.gle/QqDEgCvirqBxW96c7>, towards the client, which allows knowing if the established objective of the preventive maintenance system was met, and shows a small description and rubrics that were used to measure said satisfaction.

### Phase 5. Improvement

The analysis concluded with the delivery of results, through a project completion letter to the corresponding area. This must be signed validating the delivery and fulfillment of the objectives committed in the project.

## Conclusions

This project was developed in the aforementioned buildings of the Instituto Tecnológico de Sonora Campus Centro, the purpose was to create a preventive maintenance program, as well as a training program in the use and management of the database for use in a timely manner. and efficient preventive maintenance program in decision-making, due to this it can be said that the proposed objective was achieved, since improvement actions were carried out, managing to improve the design (migrating from corrective maintenance to a preventive one, which does not had) and functionality, data was captured and also the information of each building was updated.

## Recommendations

Specific emphasis is placed on continuing to feed the database in real time for decision-making in a timely manner, and thereby reduce complaints and failures in the aforementioned infrastructure, managing to comply with the services offered in each building. , whether they are classrooms, practice laboratories or administrative offices, for which constant training is important.

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