

Master in Smart Industry

Asset Management on IBM Maximo

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MADRID

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Introduction

Nowadays, all companies invest time and money in trying to optimize the useful life of their assets. This is why a good maintenance plan for these assets has become an essential part of their business. As a consequence of the unprecedented technological progress of the last few years, new technologies capable of improving efficiency in the field of maintenance have emerged, as well as different software specialized in taking maintenance to other levels and, in this way, adding value to the company.

In this project, the IBM Maximo software, used worldwide, will be used to digitize and manage all the assets of a company in order to optimize their useful life.

This software will be used to create a system capable of managing different assets of an organization and their maintenance in a practical way. Different parts of Maximo, such as Escalations or Automation Scripts, will be used to manage the different work orders that the assets have, as well as processing the work orders generated due to preventive maintenance.

Objectives

As already mentioned, the project will consist of the creation of a complete system from scratch, containing assets and different elements with their own work orders, Escalations and Automation Scripts. All of this will be linked to the application of the software Preventive Maintenance. Therefore, the main objectives of the project will be the following:

- Create an organization with all the necessary elements to be able to automate work orders and preventive maintenance (Storerooms, Assets, Items, Job Plans, Work Orders...).
- Create Escalations using conditions (SQuirreL) to change the status of Assets and Items work orders.
- Create Automation Scripts (Python/Jython) to generate the work orders and update the information of these. Automation Scripts are similar to Escalations, but they are used to manage more complex issues that Escalations would not be able to manage efficiently.
- Create the Preventive Maintenance Plan (PMP) by means of frequencies and measurements of the assets. In case of having more time, it could be simulated readings of different parameters of the assets and have them reach Maximo by another program.
- Create graphs of the different asset parameters so that the user can view them in the Start Center.

Design

For the realization of this project the example of a car workshop will be taken, in which the assets of the customers and the workshop's own assets must be managed. In this case, it will be necessary to manage 2 cars and a motorbike belonging to 3 different users and 2 machines of the workshop.

Organization, site and its elements

Before starting with the maintenance plan and all the automations required for it, all the elements and users that will participate in the system must be created:

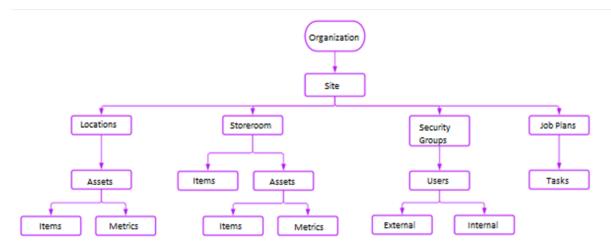
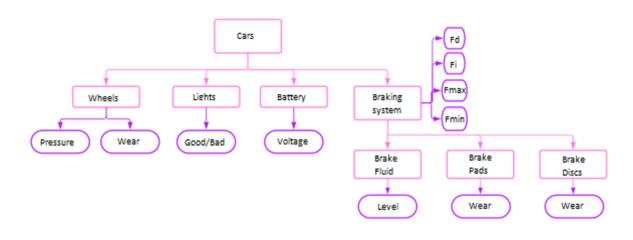


Figure 1: Organization, site and its elements

These elements are created from the different applications that IBM Maximo has.

There will be 3 locations, one for each place of operation of the customer's assets, and 1 warehouse, which will be the workshop itself. The cars and the motorbike will be made up of different items, such as wheel or the braking system. These items will also be in the workshop, to be used as spare parts in case of need.

The assets will have different metrics that will be used to activate both the maintenance plan according to the mileage and the different automations that will be carried out.



This is the example of a car's subassembly with all its metrics:



The motorbike will not have the battery item, instead, it will have oil and its chain system to maintain.

Apart from these metrics, 3 additional ones will be used to manage the braking system:

- Efficiency: $E = \frac{F}{M.M.A*g} * 100$, where F is the sum of all the forces, and M.M.A. is the weight of the vehicle.
- Imbalance: $D = \frac{100 \cdot (F_d F_i)}{F_d}$, where F_d is the force of the right Wheel and F_i of the left wheel.
- Ovality: $d = \frac{100*(F_{max}-F_{min})}{F_{max}}$

In addition, 2 security groups will be created for workshop customers and workshop operators, and they will be given different permissions. In the case of the workshop operator, he will have access to his inventory, system assets, work orders, customer service requests and the new application that will be created to manage maintenance. Customers will have access to Service Requests, as they will be able to create them if necessary. They will also be able to view the data of the new application to know the status of their assets.

Finally, the different Job Plans will be created with their tasks, which will be used to automatically create work orders based on them. This is the list of all the Job Plans that will be used in the system:

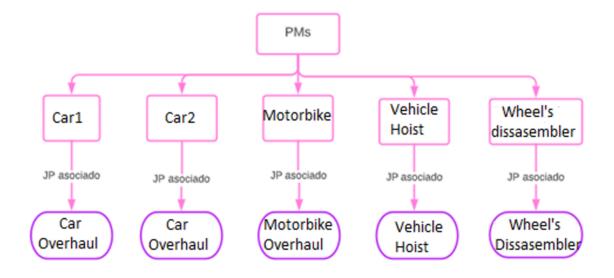
- 1. Car overhaul
- 2. Motorbike overhaul
- 3. Change wheels
- 4. Inflate wheels
- 5. Change lights
- 6. Change battery
- 7. Check battery conditions
- 8. Change oil
- 9. Change braking system
- 10. Change motorbike chain
- 11. Vehicle Hoist's Maintenance
- 12. Wheel Disassembler's Maintenance

Preventive Maintenance Plan

There will be 5 preventive maintenance plans, one for each asset to be created. The 3 customer assets will be managed by time-based frequencies and metric-based frequencies. The metric to be used is the mileage of the vehicles. For the 2 machines in the workshop, only time-based frequencies will be used.

These plans will generate different work orders, which can be viewed by the operator, based on the Job Plans already created and associated to them.

This is the scheme of all the PMs:





New application

A new application will be created for the operator to check the vehicles when the maintenance plan is triggered. This new application will take some data from the work orders created by the PMs and will have different fields to be filled in depending on the type of vehicles. The operator will have to fill them in, and, once this is done, different work orders will be created from the previous one, depending on whether the values entered are correct or not. In addition, if the operator enters excessive values, the application will warn him with an error message. To achieve this, some Automation Scripts are used.

To create the new application the following applications from Maximo will be used:

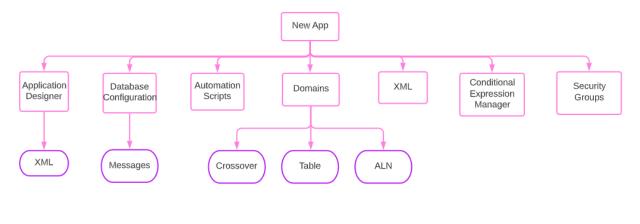


Figure 4: New application

This is the mockup of the application, created in Excel:

\triangle		Revisión Vehículo		Op	ierador 🤜	La 🔍	₽ 0	IBM
		\circ \checkmark \bigcirc \bigcirc \bigcirc \circ \land \leftrightarrow \Rightarrow \approx						
Find Navi	igation Item							
Go To App		← List View Revisión y Parámetros						
Available (
0	New	Usuario: >	Site: >	Fecha:		Status:		
	Save							
S	Clear Changes	Cliente:	Asset: >	Work Order: >	•			
8	Change Status							
More Actio	ms	Тагеа	Medidas					
		Revisión Neumáticos	Presión:	Desgaste: >				
		Revisión Luces	Luminosidad: >					
		Revisión Batería	Voltaje:					
		Revisión Aceite	Nivel Aceite:					
		Revisión Sistema de Frenado	Nivel Líquido Frenos: Desg	aste Discos: >	Desgaste	Pastillas:	>	
			Fi: Fd:	Fmax:	Fi	nin:		

Figure 5: Mockup of the new app

Automation scripts

Three different scripts will be created to automate the management of vehicle maintenance:

- 1. **New application:** It will automate that, when a work order is generated from the PMs, a new revision will be generated in the new application that has been created. In addition, it will automatically fill in some fields of the review based on the work order, such as the work order number or the asset to be reviewed.
- 2. **Error messages**: It will automate the creation of different error messages in some fields of the new application when the operator adds values that are not logical.
- 3. **New work orders**: This will automate the creation of new child work orders once the operator has added the values requested in the new application.

Escalations

Two different Escalations will be created for other simpler automations:

- 1. **Service Request**: An automation is going to be created so that when customers create a new SR and the operator resolves it and changes its status to 'RESOLVED', a notification is automatically sent to the customers so that they know they can go and pick up their vehicle.
- 2. Workshop machines: When a work order is generated via PMs for any machine in the workshop, it will have 3 tasks, the first one is to analyze the machine. If the operator performs a favorable analysis and changes the status of the first task to 'TERMINADA', the Escalation will cancel the remaining 2 tasks and change their status to 'CAN'. In case it simply changes the status to 'COMPLETED', the operator will have to continue with the remaining 2 tasks.

Results

Work orders are created from the Preventive Maintenance application based on the Job Plan:

Work Order: 3034	Revisión Coche		=	Program: ICA	I		Attachments @	
Location: CLIENTE1	 Lugar de operacion del coche 1 		=	Class: WO	RKORDER		Status: WAPPR	
Asset: 1017	O > Coche 1		=	Work Type:	Q,		Status Date: 7/14/22 0	0:00:00
Configuration Item:	>>			GL Account:	Q,		Inherit Status Changes? 🗌	
Feature:	>			Failure Class:	>		Accepts Charges? 🗾	
Feature Label:				Problem Code:	٩		Is Task? 📖	
Parent WO:	>			Storeroom Material Status:	>		Under Flow Control? 🗌	
Classification:		>		Direct Issue Material Status:	>		Suspend Flow Control?	
Class Description:		9		Work Package Material Status:	>		Flow Action:	>
aunch Entry Name:		>		Material Status Last Updated:		C	Flow Action Assist?	
Job Details			Asset Det	ails		Priority		

Figure 6: WO from the PM

At the same time, the revision is automatically created in the new application:

🛆 🗮 Revisión Vehículo	
Find Rev_vehiculosid	\circ \circ \Box \circ \leftrightarrow \rightarrow
Find Navigation Item	← List View Main
Go To Applications	
Available Queries	Work Order NUM: <u>3034</u> Description: <u>Revisión Coche</u> Fecha: <u>7/14/22 00:00</u> Status: <u>NUEVO 9</u>
All Records	Usuario: Q Cliente: Q Asset: 1017 Coche 1 = Site: ICAI
EN PROGRESO	Usuano Asset. 1227 State State
NUEVO	-
REV INPROG USUARIO	Tareas
REV TERMINADA USUARIO	
TERMINADO	Revisión Neumáticos
Common Actions	
New REVVEHIC	Presion_neum: Desgaste_neum: 9
Save REVVEHIC	
Clear Changes	Revisión Luces
Jore Actions	Luminosidad: 9
Delete REVVEHIC	Luminosidad: ~
Add to Bookmarks	Revisión Bateria
	Voltaje_bat:
	Revisión Sistema Frenado
	Nivel_liq_frenos: Q Desgaste_disco: Q Desgaste_past: Q
	Fmax: Fmin: Fd: Fl:

Figure 7: New application working

When it is filled in, the error messages appear if a field is not correctly completed:

🚹 🗮 Revisión Vehícu	lice
Find Rev_vehiculosid	
Find Navigation Item	🗲 List View 🧧 Main
Go To Applications	
Available Queries	Work Order NUM: 3034 Description: Revisión Coche Fecha: 7/14/22 00:00:00 Status: NUEVO Q
All Records	Usuario:Q Cliente:Q Asset: 1017 Coche 1 = Site: ICAI
EN PROGRESO	Usuario: Asset: 1017 Court Site: 1041
NUEVO	
REV INPROG USUARIO	© Tareas
REV TERMINADA USUARIO	
TERMINADO	Revisión Neumáticos
Common Actions	
New REVVEHIC	Presion_neum: 2.5 Desgaste_neum: BIEN Q
Save REVVEHIC	Revisión Luces
ore Actions	
Delete REVVEHIC	Luminosidad: <u>BIEN</u> 9
Add to Bookmarks	Revisión Bateria
	Voltaje_bat: You entered: 100 Valor del voltaje de la batería (VOLTAJE_BAT=100.0) muy superior a (VOLTAJE_BAT=100.0) muy superior a Image: Completa el campo con otro valor. (BMXZZ7149) Click "Edit My Value" to change the value you entered or "Go Back" to the value that was there before. Edit My Value Go Back Edit My Value Go Back

Figure 8: Error messages

Once filled in, 2 new work orders are automatically created, as the battery and braking system values are not correct:

> ○ □ ○ ← → ⅔							
Q, Advanced Search 🗸 💽 Save Query	Bookmarks						
Work Orders 🗵 Filter > 9, 🦉	C • • • 1 -	9 of 9 👘					
Work Order Reported Date+	Actual Finish	Location	Classification Description	Status Owner Job Plan	Asset PN	SN	Structural Code Is dynamic? Dynamic Job Pla
		_					
<u> </u>			-'		_' '		
3173 7/14/22 00:41:56		CLIENTE1	Recambio Sistema de Frenado	WAPPR	1017 3	5	NO
0	Advanced Search ✓ Save Query Nork Orders ♥ Filter > Q ♥ Work Order Reported Date+	Advanced Search ♥ ■Save Query ♥ ■ Bookmarks Nork Orders	Advanced Search v Save Query v Bookmarks Nork Orders 7 Filter > Q C 4 1 - 9 of 9 Work Order Reported Date v Actual Finish Location	Advanced Search v Searce Query v Bookmarks Nork Orders V Filter v Q C 4 1 - 9 of 9 Work Order Reported Date- Actual Finish Location Classification Description Image: Comparison of the search of the s	Advanced Search v Issue Query v Bookmarks Nork Orders Image: Eliter v C Image: Height and the second	Advanced Search v Save Query v Bookmarks Vork Orders Reported Datev Actual Finish Location Classification Description Status Owner Job Plan Asset PN Immediate Actual Finish Immediate Actua	Advanced Search v

Figure 9: 2 new WO Childs

On the other hand, the Escalation of the workshop machines automatically cancels the second and third tasks if the first one is set to 'TERMINADA':

Find Work Order	Q Y (• • • • •	> %	000									
Find Navigation Item	← List View	Work Order	Plans	Assignments	Related Records	Actuals	Safety Plan	Log	Failure	Reporting	Specific	ations	Serv
Go To Applications													
Available Queries	Work Orde	r: 3199	I	Mantenimiento El	levador de Vehículo	s		Ξ.	F	rogram: ICA	I		
All Records													
All Bookmarks):											
Video	Children	of Work Order 3	199	Filter		< o -	0 of 0 🤌	4					
Common Actions	Calaat	Wark Ordana	Marca De										
Common Actions Onew Work Order	Select	Work Orders	New R	w									
					5 ↑ ↓	6 1 - 3	of 3					±.	
	Tasks for	Work Order 319	99 🔻	Filter > 9	≅ ↑ ↓	6 1 - 3						<u></u>	8
New Work Order Save Work Order	Tasks for		99 🔻		₩ ÷ ¥	1 - 3		ated Dur	ration	Status		±.	8
New Work Order Save Work Order Clear Changes	Tasks for	Work Order 319	99 🔻 Task	Filter > 9		* 1 - 3				Status TERMINADA	8	±	
New Work Order Save Work Order Clear Changes Charge Status	Tasks for	Work Order 319	99 🔻 Task	Filter > Q Summary	ador			_	0:00		8	± 8	
New Work Order Save Work Order Clear Changes Charge Status Select Owner	Tasks for	Work Order 319	99 🔻 Task 10	Filter > Q Summary Analizar el Eleva	ador ador	=			0:00	TERMINADA		ی د د د	

Figure 10: Escalation of the machines

The Escalation of Service Requests cannot be tested, as there is no mail service in the environment in which this system has been developed.

The customers and the operator of the workshop will see the following screens when entering the system:

🗅 🔳 Welcome, (Operador del Taller 					Operador del Taller «C 🕼	© ₽ ⊘
ind Navigation Item							
To Applications	Favorite Applications	WO WAPPR 🗵 Filter					
My Recent Applications	Assets	Work Order	Description		Asset Description	Status Reported Date	
Assets	Service Requests	14194	Revisión Coche		Coche 1	WAPPR 7/16/22 13:40:18	
Inventory	Work Order Tracking	14189	Revisión Coche		Coche 2	WAPPR 7/16/22 13:39:4/	6
Purchasing	Revisión Vehículos	15029 14217	Revisión Coche Revisión Moto		Coche 2 Moto	WAPPR 7/16/22 18:11:25 WAPPR 7/16/22 13:43:06	5
Service Desk		14226	Hinchar ruedas		Moto	WAPPR 7/16/22 13:44:08	8
Work Orders		14227 15037	Recambio luces Revisión Moto		Moto	WAPPR 7/16/22 13:44:09 WAPPR 7/16/22 18:11:48	9
		14202	Mantenimiento Elevador de Vehículos		Elevador Vehículos	WAPPR 7/16/22 13:40:36	6
		14206	Mantenimiento Desmontadora de Ruedas		Desmontadora de ruedas	WAPPR 7/16/22 13:41:20	
		Set Chart Options					1-90
		WO INPROG 💟 Filte	() 9, 7 × 1				
		Work Order	Description	Asset Description	Status	Reported Date	
		14126	Revisión Coche	Coche 2	INPRG	7/16/22 13:21:46	
		Set Chart Options					1-10
		SR NEW 🗵 Filter >	o' 2 14 ⊞				
		Service Request	Reported Date	Reported By	Summary.	Asset Description	
		32803	7/16/22 11:55:20	USUARIO3	La luz delantera no funciona	Moto	
		Set Chart Options					1-10
		SR INPROG 🖲 Filter) 4 2 1 章				
		Service Request	Reported Date	Reported By	Summary	Asset Description	
		32804	7/16/22 11:56:27	USUARIO1	Rueda pinchada	Coche 1	
		32804 32802	7/16/22 11:56:27 7/16/22 11:54:11	USUARIO1 USUARIO2	Rueda pinchada EL coche no arranca	Coche 1 Coche 2	
		Set Chart Options					1-20
		Revisión Vehículos NU Work Order NUM	JEVO 🗵 <u>Filter</u> > 9, % 🤞 🛱 Description	lsset Client	te Fecha	Activate Windows	
		Work Order NUM	Description	usset Client	recha	Site Go to Settings to a Statue	

Figure 11: Operator Start Center

🛆 🗮 Welcome, Us	suario Coche 1) 🗇 IBM
Find Navigation Item							e
Co To Applications Hy Recent Applications Self Service	Favorite Applications Create Service Request Revisión Vehículos	Service Request En Progreso V Filter Service Request	> 9 8 2 甲 Reported Date 7/16/22 11:56:27	Reported By	Summary Rueda pinchada	Asset Description	
Service Desk Work Orders		Set Chart Options		030AIOI	Kasta pinchada	COULE 1	1-1 of 1
		Service Request Resuelta	Q 3 2 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Reported By	Summary	Asset Description	
		Set Chart Options	0 7 1 7				1-1 of 1
		Revisión Vehiculos En Progreso 🖲 <u>Filt</u> Work Order NUM	Description Asset	<u>Fecha</u>	<u>Site</u>	Status	
		No Data Fo	bund.				
		Revisión Vehículos Terminada 🦻 <u>Filter</u> Work Order NUM	: → ९, ७	Fecha	Site	Status	
		3034 R 14000 R	levisión Coche 1017 levisión Coche 1017 levisión Coche 1017 levisión Coche 1017	7/13/22 20:3 7/14/22 00:0 7/16/22 12:4 7/16/22 13:0	0:00 ICAI 8:11 ICAI	TERMINADO TERMINADO TERMINADO TERMINADO	
		Set Chart Options		.,,			1 - 4 of 4

Figure 12: Users Start Center

Conclusion

The project concludes having designed and created an asset management system with preventive maintenance. The final objectives that were proposed to create this system in Máximo have been met, and, in addition, more elements have been added to the system than had been proposed at the beginning. It was decided to create a system based on something real, such as a car workshop, and it has been a success, since, with this example, the functioning of the software itself and the entire system created is much better understood.

All objectives have been fulfilled, but, in addition, the objective of creating a new application to make the system more automatic and easier to use for the operator has been added. Thanks to the fact of creating this new car revision application, multiple Maximo applications have been used and interconnected with each other.

Bibliography

1. **Universidad de Alcalá.** LAS PRÁCTICAS DE DIGITALIZACIÓN IMPLEMENTADAS EN LAS EMPRESAS. *Revista Prisma Social.* [En línea] 21 de Diciembre de 2020. https://dialnet.unirioja.es/servlet/articulo?codigo=7742143.

2. Martínez, Adriana Martínez. Impacto de la COVID-19 en la producción, empleo y digitalización de empresas en Guanajuato: una primera aproximación. *SCIELO*. [En línea] 18 de Mayo de 2021. http://www.scielo.org.mx/scielo.php?pid=S2007-07052021000300201&script=sci_arttext.

 Delgado, Tatiana Fernández. Taxonomía de Transformación Digital. *Revista de Transformación Digital Cubana*. [En línea] 30 de Marzo de 2020. https://www.researchgate.net/profile/Tatiana-Delgado-3/publication/341051958_Taxonomia_de_transformacion_digital/links/5eab007c92851cb2 6768fa55/Taxonomia-de-transformacion-digital.pdf.

4. IBERDROLA. OPTIMIZACIÓN DEL MANTENIMIENTO. [En línea]

https://d1wqtxts1xzle7.cloudfront.net/36903895/_09__RCM_en_MAXIMO_IBERDROLA-with-cover-page-

v2.pdf?Expires=1652864667&Signature=adQFDRZRXZDMvcz8xa8UXVuqgS8rs9VBlN7RwLv9 2S4csEvRkiCMo2J1ljF8iva1EEa4ytX5ibXmeOAldtiu2rTRbembu24EHfvBd3f4h~WQGbOCqT6Z QI553N6Ouac.

5. **Grupo SANVALERO.** Gestión de Mantenimiento. *Estudios abiertos SEAS.* [En línea] https://d1wqtxts1xzle7.cloudfront.net/36903895/_09__RCM_en_MAXIMO_IBERDROLA-with-cover-page-

v2.pdf?Expires=1652864667&Signature=adQFDRZRXZDMvcz8xa8UXVuqgS8rs9VBlN7RwLv9 2S4csEvRkiCMo2J1ljF8iva1EEa4ytX5ibXmeOAIdtiu2rTRbembu24EHfvBd3f4h~WQGbOCqT6Z QI553N6Ouac.

6. **Iberdrola.** Mantenimiento predictivo: la técnica basada en datos clave para anticipar errores. *Iberdrola.* [En línea] https://www.iberdrola.com/innovacion/mantenimiento-predictivo.

7. **IBM.** IBM Maximo Application Suite. *IBM.* [En línea] https://www.ibm.com/es-es/products/maximo.