
CONFERENCE
OMAINTEC
2024
EXHIBITION
THE 21ST INTERNATIONAL
OPERATIONS & MAINTENANCE
CONFERENCE IN THE ARAB COUNTRIES
Development of Reliability Centered Maintenance System Using Artificial Intelligence
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#OmaintecConf
An Initiative by
OMAINTEC
المجلس العربي للتشغيل والصيانة
Arab Operations & Maintenance Council
Organized by
EXICON.
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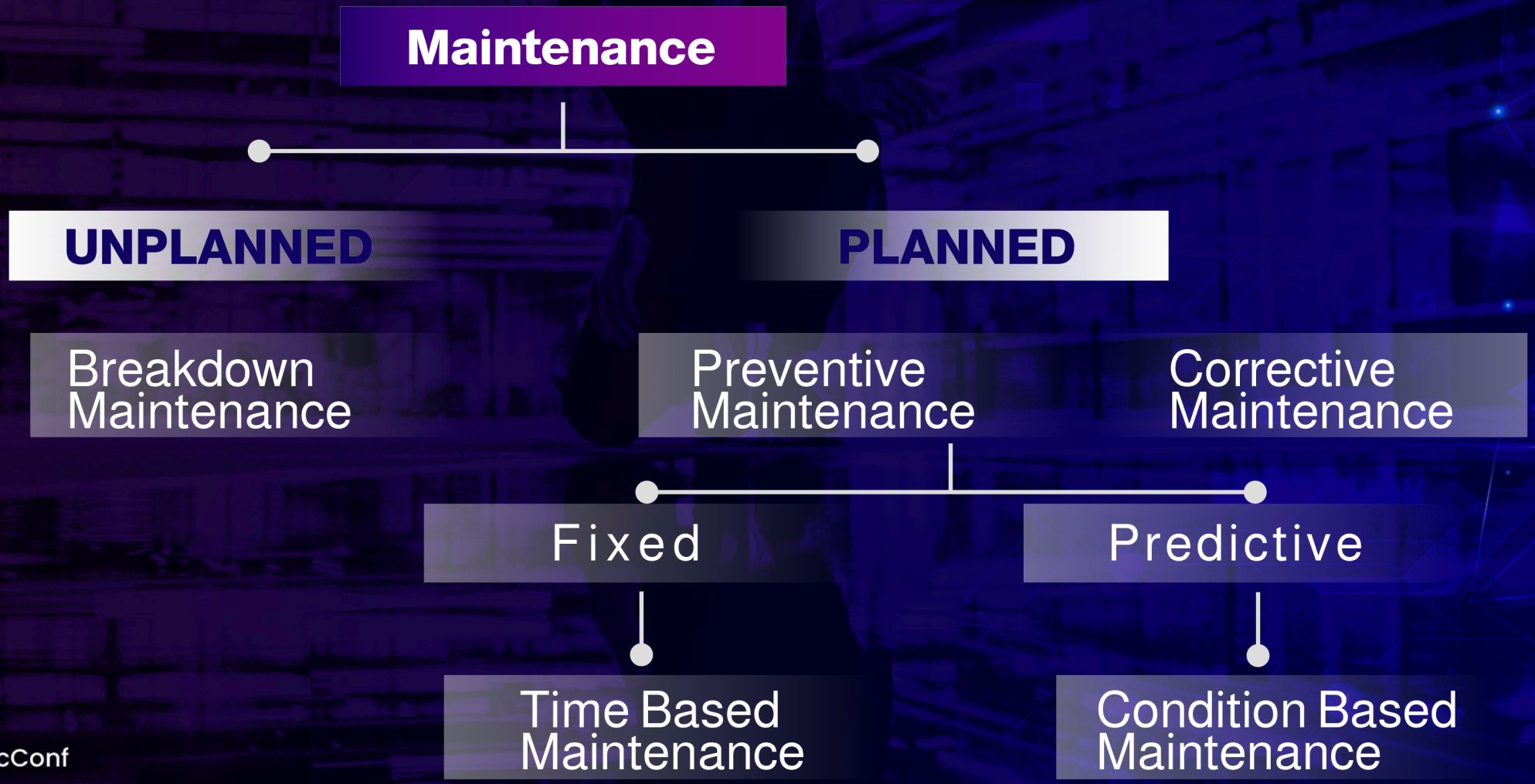
مجموعة أكزيكون الدولية

Agenda

- Maintenance Overview
- Motivation
- Data Collection
- Proposed Model
- Result & Discussion
- Conclusion

Maintenance Overview



Breakdown Maintenance

Unplanned Repairs

Breakdown maintenance is performed only when equipment has failed and is inoperative, requiring urgent and unplanned repair activities to restore the equipment.

High Costs

Relying on breakdown maintenance can lead to high downtime and repair costs, which can have a negative impact on operational efficiency.

Corrective Maintenance

Response to Failure

Corrective maintenance is performed in response to a detected failure or malfunction of equipment, with the goal of restoring the equipment to its proper working condition.

Reactive Behavior

Corrective maintenance is reactive in nature, proper planning can optimize the time and resources required for it.

Time Based Maintenance

Scheduled Intervals

This maintenance is scheduled based on the equipment's energization date. It is performed at fixed time intervals, regardless of the actual condition of the equipment.

Potential Oversights

It may ignore other causes of failure, unrelated to age or usage. For example, environmental factors or design problems.

Unnecessary Risks

Performing maintenance tasks too frequently or incorrectly might lead to unnecessary risks for some equipment.

Condition Based Maintenance

Proactive Approach

Predictive maintenance is a proactive approach that uses data and advanced analytics to forecast when maintenance is required.

Monitoring & Analysis

Requires monitoring and analysis of the equipment's condition or performance indicators.

Minimized Maintenance

This approach minimizes unnecessary maintenance and reduces the risk of unexpected failures.

Motivation

Error Avoidance

Avoiding human error for studying the data set.

Maximize Lifespan

Minimize the outages and maximize the lifespan for the equipment.

Reliability & KPIs

Improve the system's reliability and enhanced KPIs.

Proactive Maintenance

Move from Reactive to Proactive maintenance behavior.

Data Classification

Dataset Source

The data is provided from Saudi Electricity Company (National Grid) – Dammam Area.

Voltage Level

Contains 249 power transformers categorized by voltage level.

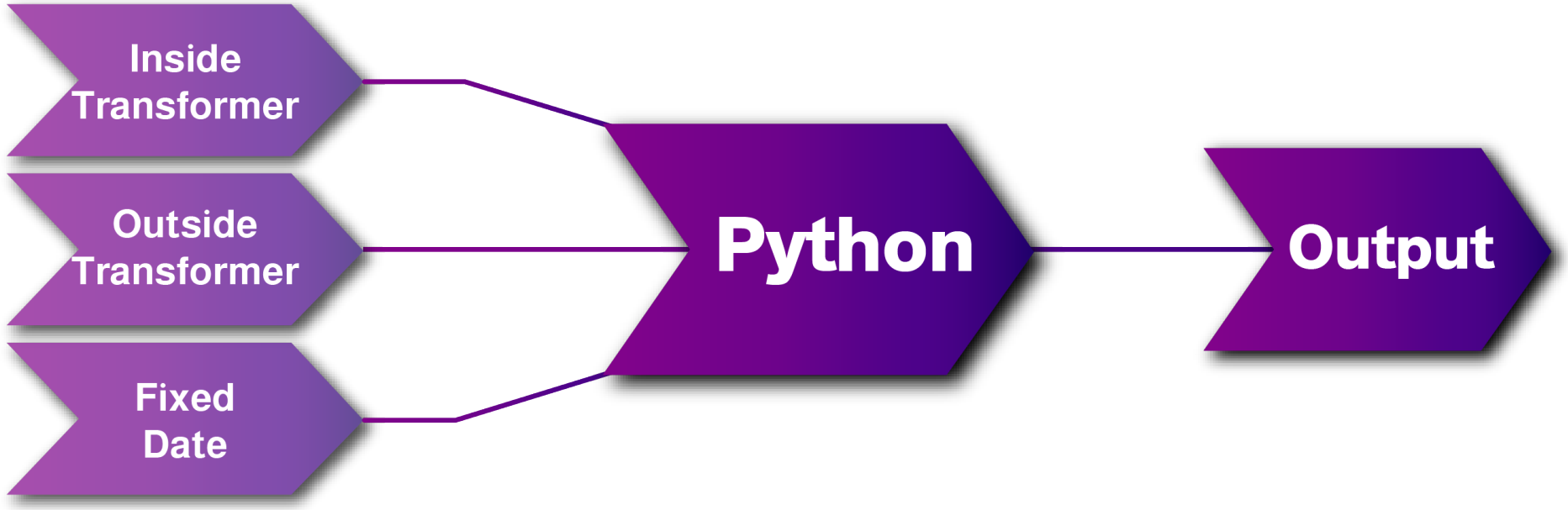
Modeling Variables

The dataset contains the transformer variables that has been included in the modeling.

69 KV	115 KV	230 KV	380 KV
23	150	38	38

Transformer Model

The model contains three different inputs to the python model, and each input has a score that represent the condition for the transformer.



Inside Transformer

Input Data	Score = 3	Score = 2	Score = 1
DGA	Green	Amber	Red
Oil Quality	Green	Amber	Red

Outside Transformer

Input Data	Score = 3	Score = 2	Score = 1
Oil Leakage	No Leakage	Minor	Major
Silica-gel	GOOD	-	BAD
Cooling System	Normal	-	Abnormal

Fixed Data

Input Data	Score = 3	Score = 2	Score = 1
Aging	0-10 years	11-20 years	21 & above years
Last PM	0-3 years	4-5 years	6 & above years
Voltage Level	69 KV & less	110 – 132 KV	230 KV & above
Feeding Sensitivity	Low	Medium	High

Python Model

Modeling Techniques

As part of modeling, different machine learning models have been tried out, including Logistic Regression, K Nearest Neighbors, Naïve Bayes, Support Vector Machine, Decision Trees, and Random Forest.

Data Ratio

The entire data is divided into an 80:20 ratio for training and testing purposes.

Sample Data

VOLTAGE LEVEL	Transformer number	DGA	OIL QUALITY	OIL LEAKAGE	SILICA-GEL	COOLING SYSTEM	VOLTAGE LEVEL	AGE	FEEDING SENSITIVITY	LAST MAINT
69KV	T501	2	2	3	3	3	3	1	3	1
115KV	T601	3	3	3	3	3	1	3	3	3
230KV	T702	3	3	3	3	3	2	3	1	3
380KV	T806	3	3	3	3	3	2	3	3	3

Result & Discussion

Model	Accuracy
Logistic Regression	94
K Nearest Neighbor	82
Naïve Bayes	84
Support Vector Machines	94
Decision Trees	94
Random Forest	92

Conclusion

Proactive Strategy

Overall, predictive maintenance enables organizations to move from a reactive approach to maintenance to a more proactive and efficient strategy.

AI Benefits

Developing an RCM system using AI can bring more benefits to organizations. These include improved maintenance decision-making, reduced downtime, and lower maintenance expenses.

Inventory Optimization

AI can assist in optimizing spare parts inventory management by analyzing historical data for the failures.

Reliability & Efficiency

Organizations can achieve higher reliability and efficiency in their maintenance activities. They can also improve their overall business performance.

نحن نعيش في زمن الابتكارات العلمية والتقنيات غير المسبوقة وآفاق نمو غير محدودة، ويمكن لهذه التقنيات الجديدة مثل: الذكاء الاصطناعي وإنترنت الأشياء في حال تم استخدامها على النحو الأمثل أن تجنب العالم الكثير من المضار وتجلب للعالم الكثير من الفوائد الضخمة.

صاحب السمو الملكي الأمير محمد بن سلمان بن عبدالعزيز آل سعود ولي العهد رئيس مجلس الوزراء رئيس مجلس إدارة سدايا

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THANK YOU!

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