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GLOBAL MAINTENANCE DAY

AN INITIATIVE OF GFMAM

TECHNOLOGY IN MR&AM: A CATALYST FOR PROGRESS

GSMR
الجمعيـة الخليجية للـصيانة والأعتمـادية
Gulf Society For Maintenance & Reliability

www.gsmrgulf.org

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JUNE 2024 ISSUE

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GSMRsociety

VISION

To be the leading reference for maintenance, reliability and asset management

MISSION

To foster a community dedicated towards excellence in maintenance, reliability and asset management practices, through education, certification, and collaboration

Dear GSMR Members,

With an excellent start to 2024, GSMR walks the path towards a sustainable future. The GSMR family aims to establish concepts with endless possibilities for knowledge-sharing and career-driven opportunities for professionals. GSMR seeks to connect various professionals from the maintenance, reliability, and asset management industry, and further fetch insights that support growth and development.

On behalf of GSMR's Board of Directors, I'd like to congratulate the WIAM committee for successfully organizing the Women Empowerment & Cultural Transformation event. Dynamic women professionals from major organizations enriched the experience with their presence and shared their views regarding the MR&AM industry.

Our industry provides immense opportunities for innovation and growth, with the potential to revolutionize the way we extract and utilize our resources. With its renewable energy solutions, to cutting-edge techniques, the MR&AM industry is already on its way toward transformation. Our talented, youthful, and energetic WIAM committee recently initiated a Cup of Wisdom: Coffee meet in Bahrain for its fellow female professionals who focused on shared experiences and skill development.

GSMR's participation during the GSE Maintenance and Sustainability Forum opened doors in the Aviation Industry. We further widened our reach towards the medical field, by participating in the 1st International Operation and Maintenance Conference. It was remarkable to witness people connect on various issues and share expertise on its unique characteristics.

As the world transitions towards renewable energy, many new opportunities lie ahead of us. We intend to maintain best practices and incorporate them within the set standards, to further support professionals with the necessary tools for success. It's a great time for our youth to seek the right knowledge and skills that help pave the path for career enhancement.

I believe the youth has the confidence and the ability to be innovators, that lead the change. They will shape the future through their creativity, determination, and hard work. We should provide constant stimulation to professionals, to help them stay optimistic regarding their future while grounding ourselves within the core values by being responsible citizens.

I feel a sense of responsibility to introduce young, bright minds to the MR&AM industry, and direct them to a sustainable and prosperous future. We envision a sustainable, knowledge-based platform driven by the ambitions of a younger generation.

Saad Ibrahim Al Shamrani
Chairman
Gulf Society for Maintenance & Reliability

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Join GSMR's growing society of maintenance, reliability, and asset management professionals. Enjoy a wide range of benefits and programs, including free webinars with certification, discounted workshops, an opportunity to feature across GSMR's social media channels and publications, extensive networking with exposure to regional and international professionals, and MUCH MORE! For more information, email us marketing_pr@gsmrgulf.org

INTRODUCTION

On June 9th, professionals from the Maintenance, Reliability & Asset Management (MR&AM) industry gather to recognize the vital role of maintenance in the lives of individuals. Global Maintenance Day, initiated by the Global Forum on Maintenance & Asset Management (GFMAM), sheds light on the often-overlooked heroes who ensure smooth operations of the world. Let's delve into the importance of maintenance, reliability, and asset management across various aspects of life.

UNDERSTANDING THE BASICS OF MAINTENANCE AND ITS IMPACT

Maintenance is an activity that happens around every individual, positively affecting the world they live in, as families, organizations, or communities. The primary function of any maintenance is to ensure smooth operation of its various systems and equipment, although the impact of good maintenance is far beyond that. Good maintenance provides a positive influence and has far more influence that is not considered at first glance.

Maintenance isn't just about fixing things when they break; it's a proactive effort to prevent breakdowns and ensure optimal performance. Here's why maintenance matters:

1. **Economic Benefit:** Proper maintenance reduces downtime, extends equipment lifespan, and minimizes expensive repairs. Thus, it contributes significantly to economic stability.
2. **Sustainable Development:** Well-maintained assets consume less resources and have a smaller environmental footprint. Therefore, sustainable practices are essential for the planet's future.
3. **Safety First:** Maintenance ensures safe operations across industries. From elevators to power plants, diligent experts provide safety to the community.

COMMON MAINTENANCE CHALLENGES

Maintenance professionals often face several common challenges that impact their operations. Let's explore some of these challenges and their consequences:

1. **Shrinking Resources and Growing Workloads:** Maintenance experts struggle with limited resources while dealing with increasing workloads. This can lead to predictable maintenance failures, where the pressure to do more within controlled resources is observed.
2. **Smaller Budgets:** Tight budgets make it challenging to allocate funds for necessary maintenance tasks, affecting overall equipment reliability and performance.
3. **Fading Talent:** The maintenance workforce is shrinking, making it difficult to discover skilled professionals. This talent shortage can lead to delays in addressing maintenance issues.
4. **Out-of-Control Maintenance Costs:** Without effective cost management, maintenance expenses can spiral out of control, impacting the organization's bottom line.
5. **Declining Revenue:** Inadequate maintenance management can result in declining revenue due to equipment downtime, inefficiencies, and lost productivity.

MASTERING THE ART OF MAINTENANCE & BEST PRACTICES

Best Practices are crucial for ensuring high reliability and extended equipment life, along with providing professionals with the pathway towards excellence. Here are some best practices followed within the industry:

1. **Compliance with Safety Standards:** Ensure compliance with stringent regulations and safety standards imposed by regulatory bodies. Regular inspections and preventive maintenance are essential.
2. **Preventive Maintenance (PM):** Regular inspection of equipment's, addressing its wear and tear, and perform the necessary maintenance tasks promptly. By scheduling maintenance tasks, the lifespan of the equipment is extended, while preventing future failures.
3. **Predictive Maintenance (PdM):** Use data and analytics to predict when maintenance is needed. By utilizing the latest technologies such as sensors, detection of abnormalities in equipment performance is easier. This optimizes the resource allocation and minimizes its downtime.
4. **Reliability-Centered Maintenance (RCM):** Prioritize maintenance efforts based on criticality and risk. Failures that impact the environment, safety and production can be prevented with the use of RCM.
5. **Sustainability Practices:** Organizations and professional support energy efficiency initiatives and sustainable development to optimize resource management.

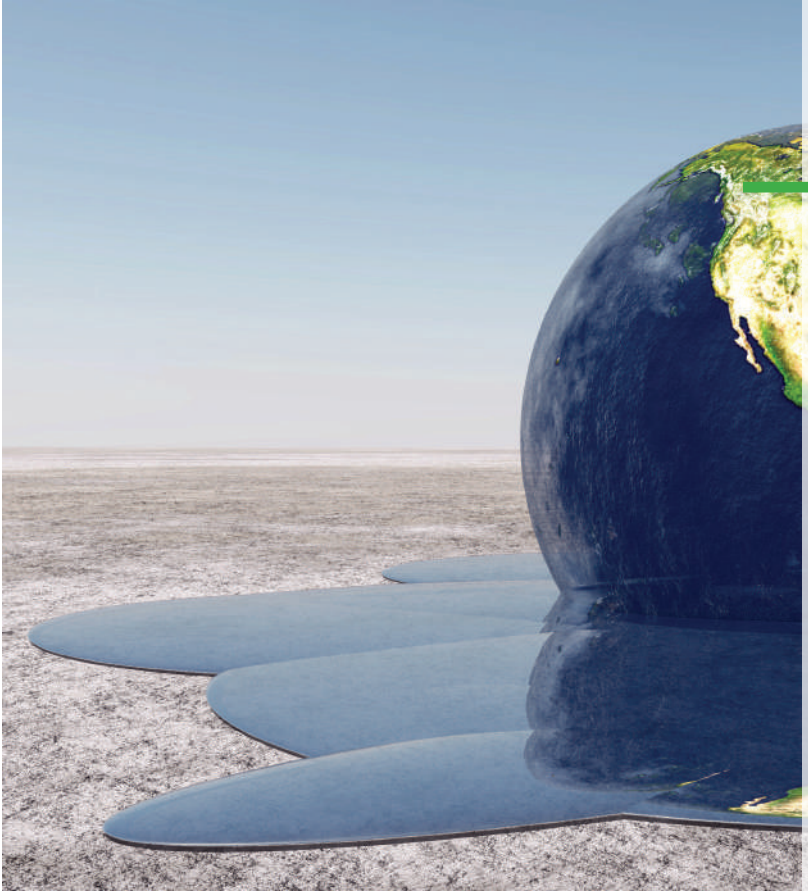
Remember, effective maintenance not only extends equipment life but also enhances overall operational efficiency within organizations.

ACKNOWLEDGING THE HEROES

The Gulf Society for Maintenance & Reliability acknowledges the significance of celebrating maintenance professionals across various industries in the Arabian Gulf for their exceptional contributions. GSMR believes in knowledge-sharing and providing recognition to professionals that keep our infrastructure, machinery, and technology function seamlessly. GSMR fosters the adoption of safe and best practices, continuous improvement, and competency development within the maintenance industry. On Global Maintenance Day, GSMR and GFMAM together recognize and appreciate the critical roles played by maintenance professionals, and for their unwavering support towards seamless operations and protecting the well-being of individuals within the community. Global Maintenance Day provides an opportunity to pause and recognize the remarkable achievements of maintenance professionals.

For more information or to get involved, visit the Global Maintenance Day

website: www.globalmaintenanceday.org



The role of infrastructure ASSET DIGITALIZATION to confront CLIMATE CHANGE

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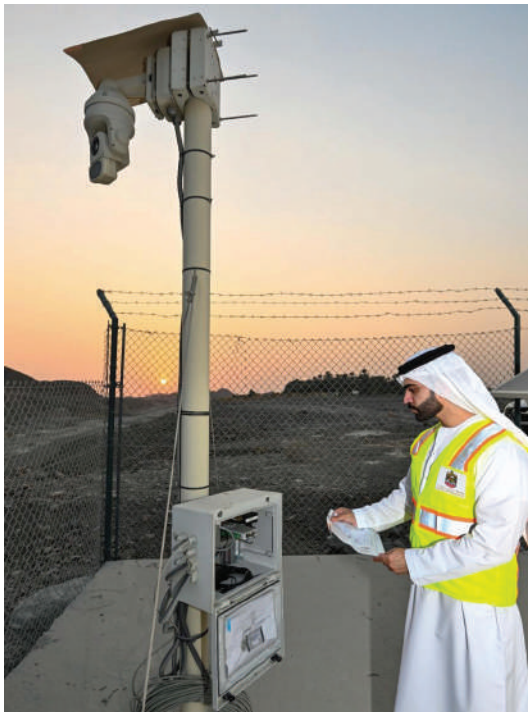
Climate change is currently considered one of the paramount issues troubling the international, regional, and local community. Especially with the increasing global population growth and urbanization of societies and the subsequent increase in economic and human activities that have affected the increase in temperature rates in the atmosphere and unexpected climate changes.

Also, the effects of climate change have resulted in a rise in sea levels, and it is a continuing phenomenon that the world has witnessed in the previous period. Specialists in the field still warn of its consequences on residential communities living near coastal areas and on their infrastructure and its repercussions in securing access to food, water, and health care necessary for these communities.

In the same context and the events that the world has witnessed recently, which confirmed that climate change has caused the recurrence of flood disasters witnessed by some different countries of the world and in various regions which has never before flooded vast areas of these affected countries and caused serious damage to lives and property, and its recurrence is very likely in the coming years, according to the opinion of specialists.

The expectations contained in the United Nations report indicate that 2.5 billion of the Earth's population will reside in urban areas by the year 2050, 90% of them in cities in Asia and Africa, and the GCC countries have one of the highest rates of residential concentration in these areas compared to countries in the world and at a rate ranging from 80% to 100%.



According to data issued by the World Meteorological Organization (WMO), global sea levels have been rising more rapidly since 1900 than in any previous century during the past three thousand years, which poses a threat to the lives of about 900 million who live in coastal region.

Furthermore, we cannot ignore the devastating impact of floods on lives and property, as floods between the years 1998 and 2017 affected more than two billion people around the world, especially people living in floodplain areas or unqualified buildings that are not resistant to climate conditions. Different areas lack flood risk warning systems, according to reports issued by the World Health Organization.

As leaders and experts in infrastructure asset management domain, we must take decisive action without hesitation. It is necessary to begin preparing plans and launching supporting initiatives to rehabilitate and raise the efficiency of existing and new infrastructure to be flexible and resistant to climate change. These initiatives must be supported with the use of advanced technology and raising the awareness of these asset users.

Additionally, we must start preparing plans to protect the coastline of coastal countries against the effects of sea level rise by using smart technologies and developing predictive models to study the impact of coastal floods, tidal factors, and wind directions on vital facilities, and infrastructure elements.

Infrastructure specialists must also begin to use digital and predictive systems capable of detecting events before they occur in facilities and roads.

Moreover, we must develop digital models for this infrastructure capable of developing scenarios for potential risks, natural disasters, and emergency situations through analyzing big data, which has an impact on raising the efficiency of the infrastructure and enhancing the readiness of all vital facilities to ensure business continuity and services provided and to protect humanity from these disasters.

In addition, the specialists must build an integrated cluster with the relevant security authorities and linking them to these digital systems to ensure that the event related to natural disasters affecting the infrastructure is managed in an institutional manner and to raise the readiness of national communication and cooperation between the community and the emergency, crisis and disaster management system.

In a practical application of practice in the UAE and led by the Ministry of Energy and Infrastructure in this field, the Ministry adopted modern technologies to monitor the flows of rainwater, torrents, and floods in the valleys of dams, which employs artificial intelligence to monitor and measure the flow of rainwater in the valleys using stations to monitor the flow of water instantaneously and automatically as well. Beside using modern technology in the process of analyzing and calculating the speed rates, quantities, and depth of water flows with high accuracy and sending them to the Ministry's control and monitoring unit, processing and analyzing their data for use in making appropriate decisions, making the UAE the first country in the Middle East to use such technologies.

SUCCESS STORY:

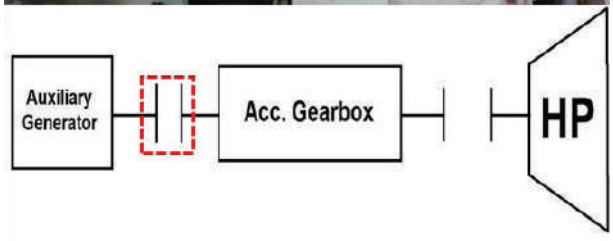
Turning Ideas Into PATENTS

STARTING MY JOURNEY IN MAINTENANCE & RELIABILITY

In 2017, the Sea Water Injection Department (SWID) maintenance management selected me to join the SWID Reliability Unit to work in the predictive maintenance program and contribute towards the sustainability of maintenance and reliability. I have been assigned to deploy the laser alignment feature of the vibration analyzer device in our equipment shaft alignment activities, as part of the SWID initiative for adapting new technologies.

THE PROBLEM

While attempting to conduct my first trial, due to one of the equipment, the gas turbine auxiliary generator that was connected to an 8-ton turbine rotor, made it impossible to execute the alignment performance with laser technology.



ESTABLISHING AN INNOVATIVE SOLUTION

I successfully developed an innovative solution by combining laser alignment technology with a new method for aligning the gas turbine auxiliary generator. This resulted in a significant improvement in equipment reliability by addressing vibration issues caused by misalignment. The invention utilizes a hydraulic ratcheting system and resulted in a 75% reduction in alignment measurement time, equivalent to an annual cost avoidance of $200,000 as manhour for Saudi Aramco's Sea Water Injection Department.

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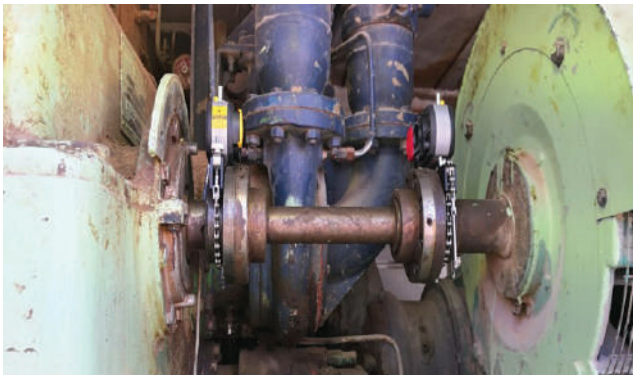
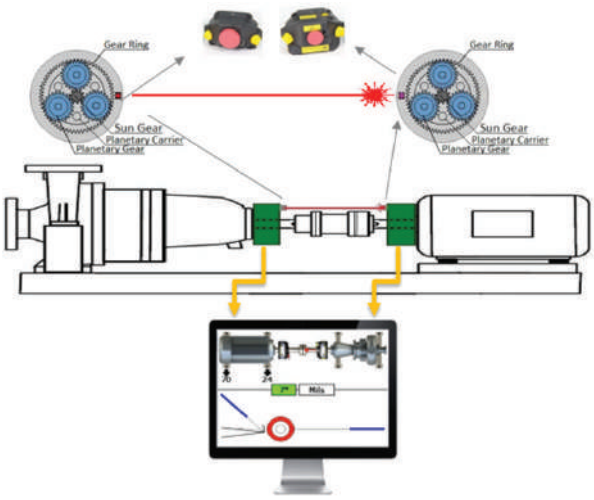


THE WAY TO A GRANTED PATENT

The above innovative idea was selected as one out of eight best innovations to be presented to SAOO management in 2018. I was encouraged at that time to file my innovative idea at the U.S. Patent Office. I started filing the invention disclosure form technically and legally. I then sent my application to Saudi Aramco Intellectual Property Management for review. After an initial rejection, I studied the patent program intensely, arranged another meeting, and the idea was later approved. After a significant effort, my invention was filed at the U.S. Patent Office in February 2019, and I was granted the patent in August 2021.

A NEW PATENT INSPIRED BY THE PREVIOUS ONE

The above invention "New Shaft Alignment Method" has inspired and led to develop another invention called the "Shaft Alignment Online Condition Monitoring System Using Planetary Gear Apparatus" which was successfully filed at U.S. Patent Office in February 2021. This invention allows for measuring and monitoring shaft alignment condition online while equipment is running, without the need for equipment shutdown. Compared with the traditional method, it requires equipment shutdown, resulting in time wastage, production loss, and human energy consumption. The inventors are currently working with Aramco EXPEC ARC for prototyping this apparatus.



APPOINTED AS DEPARTMENT PATENT OFFICER

Introduction

At the beginning of 2020, SWID management re-structured the SWID Innovation, Technology & Patent Program to set up a creative environment workplace for Innovation, Technology Development and Inventing Patents within SWID.

SWID renamed the Innovation Management Committee (IMC) to be Innovation, Technology & Patent Management Committee (ITPMC). This committee was modified to establish guidelines and practices aligning with the corporate guidelines and best practices to transform the culture from seasonal to a sustainable and systematic innovation to admire for excellence.

Furthermore, I would like to highlight that the SWID manager has created a patent office as SWID is the first operational department established patent office companywide. Currently, it is being led by myself as the Department Patent Officer. I was appointed after proving my worth and commitment to reviving the culture of innovation at SWID across Aramco, proving that creativity has no limits, and transforming the struggle into success. In other words, the youth generation is able to make changes and offer a new style of work that is in the interest of the organization.

Challenges

The department patent officer acts as the consultant and sponsor for SWID all innovators. The patent officer assists SWID inventors by conducting patentability search, assisting inventors with patent documentation and packaging as per patent and intellectual property (IP) requirements and assisting inventors with patent submission and tracking with Aramco lawyers and the outside counsel at patent agency offices till the invention becomes filed at the USPTO.

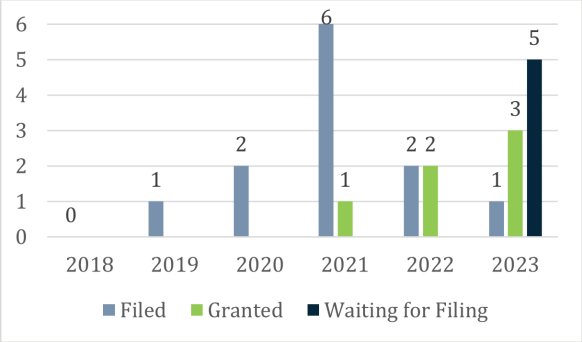
Results

SWID has a strong record since the establishment of the patent office in 2020 up to today.

SWID had zero patents up to 2018, and then until we achieved one in 2019 (my own), I worked hard to improve the office performance, which resulted

SWID to have 12 patents approved at USPTO, and 6 of which were granted up to now.

This is not all, SWID still has more patentable innovative ideas in the pipeline, with 6 were waiting for review and approval. In addition to these ideas, we still have 4 more ideas under our internal process, under SWID Office review.



SWID Patents Performance 2019-2023

GSMR EXCELLENCE AWARD – ACHIEVER AWARD: 1ST PLACE WINNER

This success story mentioned "Turning Ideas into Patents" was one of my projects that played a major role in achieving a prestigious award that was administrated by a non-profit organization, named "Gulf Society for Maintenance & Reliability (GSMR)".

Projects

- Success Story "Turning Ideas into Patents"
- Appointing as Department Patent Officer
- Success Story "SWID Lubrication Enhancement Journey"
- Appointing as Department Knowledge Officer

Based on that, I have been awarded as the 1st place winner at the GSMR excellence award ceremony in the achiever's award category. This ceremony was part of the 6th Middle East Maintenance & Reliability Conference (Maintcon) which was conducted in the Kingdom of Bahrain from November 27-30, 2022 under the patronage of Ministry of Oil and Environment and Bahrain Society of Engineers in Bahrain. The GSMR Excellence Award was competitive among professionals from the Arabian Gulf organizations in the oil & gas, academies, and industries. My nomination was based on my diverse skillset in Saudi Aramco business and the field of maintenance and reliability.

THE KEY ROLE OF TECHNICIAN BACKGROUND In the Development of MAINTENANCE PLANNERS

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In the realm of maintenance and reliability, meticulous planning is the cornerstone of operational efficiency. At the heart of this planning lies a fundamental requirement: a strong technician background. While the role of a maintenance planner may seem administrative on the surface, its effectiveness is deeply rooted in the technical expertise and hands-on experience of those who fill it.

Maintenance planners are responsible for scheduling, coordinating, and optimizing maintenance activities to ensure equipment reliability, minimize downtime, and enhance productivity. To excel in this role, individuals must possess a comprehensive understanding of the equipment they are managing its components and its maintenance requirements. This is where a robust technician background becomes invaluable.

First and foremost, technicians bring practical experience to the table. Having worked directly with machinery and systems, they possess an intimate knowledge of how equipment operates, common failure modes and the intricacies of maintenance procedures. This firsthand experience enables them to anticipate maintenance needs, identify potential issues proactively and develop more accurate and effective maintenance plans. Furthermore, technicians adept at troubleshooting and problem-solving. Their ability to diagnose issues quickly and accurately is instrumental in devising efficient maintenance strategies. By leveraging their technical acumen, maintenance planners can prioritize tasks based on criticality, allocate resources effectively, and streamline maintenance processes, ultimately maximizing uptime and minimizing costs. Moreover, a strong technician background fosters credibility and trust among maintenance teams. Technicians understand the challenges and demands of the job firsthand, allowing them to relate to their colleagues on the front lines. This mutual understanding facilitates communication, collaboration and buy-in for maintenance plans, leading to smoother implementation and greater overall success. In addition, technicians possess a practical understanding of safety protocols and compliance requirements. They are well-versed in best practices for maintaining a safe working environment and ensuring that maintenance activities adhere to industry standards and regulations. By integrating safety considerations into maintenance planning from the beginning, technicians help mitigate risks and safeguard both personnel and equipment. Furthermore, the holistic perspective gained from a technician background enables maintenance planners to make more informed decisions. They grasp the interdependencies between different pieces of equipment, production processes, and maintenance activities, allowing them to optimize maintenance schedules, minimize disruptions and maximize operational efficiency.

In recognizing the vital role of maintenance planners in driving reliability, efficiency and safety within industrial operations, it becomes evident that a solid foundation of technical expertise and hands-on experience is paramount. With a strong technician background, individuals are equipped with the requisite knowledge, skills, and insights to develop and execute maintenance plans effectively. By prioritizing the cultivation of maintenance planners with robust technical skills, organizations can position themselves for long-term success in an increasingly competitive industry, ensuring operational excellence and sustainability for years to come.

RESOURCE-BASED APPROACH TO THE ANALYSIS OF MAINTENANCE STRATEGIES FOR PROCESS ANALYZERS

(Presented at Open Innovation Digital Transformation and be available at IEEE website)

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Abstract

Process analytical instruments are key equipment used to monitor process units such as distillation columns for oil & gas processes and chemical reactors for various petrochemical productions. Aside from measuring components, these instruments are critical to ensuring the efficient and safe operation of chemical plants and various industrial processes. The technology involved in the design, development, installation, and upkeep of this equipment requires thorough evaluation for the design engineer to properly come up with a functional system to address process measurement requirements. Adequate maintenance practices ensure that these instruments are operating properly and provide sufficient information for process operators to formulate critical decisions about sustaining or maximizing plant production. The resource-based view provides a valuable framework for assessing and formulating proper maintenance strategies to ensure process analyzers are fully operational and reliable.

Keywords: Resource-based View, Analytical Instrumentation, Maintenance And Reliability

INTRODUCTION

In the field of industrial processes, the reliability and accuracy of instruments and process analyzers are critical to ensuring smooth operations, product quality and overall safety. To optimize their lifespan and performance, maintenance techniques need to be thoroughly studied due to the ever-increasing complexity of analytical devices and the continuous development of technology. Since these analyzers play a crucial role in various industries such as petrochemical, pharmaceutical and manufacturing, effective implementation of maintenance strategies is crucial to ensure their reliability and optimal performance.

Process analyzers play a central role in monitoring and controlling various aspects of industrial processes, from chemical production to environmental monitoring. The reliability and accuracy of these analyzers are of utmost importance for decision-making processes and compliance with strict regulatory requirements. Therefore, maintenance strategies tailored to the unique characteristics and requirements of process analyzers are essential.

The complexity of these analytical instruments coupled with the stringent requirements of petrochemical operations requires careful

evaluation of maintenance protocols to extend equipment life, minimize downtime, and ultimately contribute to the industry's overall goal of achieving optimal operational excellence.

Traditionally, the development of maintenance strategies has taken reactive or preventative approaches, with an emphasis on planned interventions or on-site troubleshooting. However, by taking into account the resources present in an organization, such as human knowledge, technological capabilities and accessible tools, the resource-based perspective introduces a paradigm shift. By focusing with the effective use of resources to increase the reliability and lifespan of process analyzers, resource based approached aims to align maintenance procedures with the company's strategic goals.

INSTRUMENTATION FOR MANUFACTURING PROCESSES

In the vast landscape of modern manufacturing, the complex network of instruments forms the backbone of operational control and efficiency. This research examines the diverse tools used in manufacturing processes with the aim of providing a comprehensive understanding of their roles, functions and importance.

Manufacturing processes rely on a variety of instruments, including sensors, transmitters and control systems, to monitor and regulate various parameters. For example, sensors act as sensory organs and collect real-time data on temperature, pressure, flow rates, volume, level, and analytical variables. Transmitters then convert this raw data into signals that can be interpreted and used for decision-making. Control systems, on the other hand, act as orchestrators, processing the information received and making the necessary adjustments to maintain optimal operating conditions.

Understanding the nuances of instrumentation is critical to optimizing manufacturing processes. The research concludes by highlighting the strategic role of instrumentation in achieving operational excellence and emphasizes the need for precision, reliability and adaptability in the ever-evolving manufacturing landscape.

PROCESS ANALYZER TECHNOLOGIES

Standing at the intersection of technological innovation and analytical precision, process analyzers serve as essential tools in unraveling the complexity of manufacturing processes and standard.

Process analyzers play an important role in providing real-time data to monitor and control manufacturing processes. They facilitate precise measurement of various parameters, ensure product quality, optimize operational efficiency and maintain strict regulatory standards. Within the extensive landscape of process analyzers, different types emerge, each tailored to specific analysis requirements and operational contexts.

At the forefront of process analysis technologies are spectroscopic analyzers, which use the principles of spectroscopy to identify and quantify chemical compounds. These analyzers play a crucial role in detecting molecular structures and understanding the composition of substances in manufacturing processes.

a. **Infrared (IR) spectroscopy:** IR spectroscopy is a versatile technique used in process analyzers because it can analyze the absorption of IR radiations by the molecular vibrations. This method is particularly suitable for identifying functional groups in organic compounds. In manufacturing processes, IR spectroscopy is used in the pharmaceutical, petrochemical and food industries and provides insights into chemical composition and structural information.

b. **Ultraviolet-Visible (UV-Visible) Spect roscopy:** UV-Visible spectroscopy is a valuable tool for quantifying the concentration of substances based on the measurement of interaction of Electromagnetic Radiations (EMR) on their absorption of ultraviolet or visible light. This method is often used in the analysis of compounds such as dyes, pigments and pharmaceuticals. In process analyzers, UV-Vis spectroscopy contributes to quality control and monitoring of reactions in real time.

c. **Mass Spectrometry:** Mass spectrometry is a powerful analytical technique used in process analyzers to precisely determine molecular weights and structures. It is essential in applications such as environmental analysis, forensics and pharmaceutical research. Mass spectrometry offers a high level of sensitivity and specificity, making it an invaluable advantage in understanding complex chemical compositions.

Chromatographic analysis devices play a central role in the area of process analysis and offer the possibility of separating and analyzing complex mixtures. Gas Chromatography (GC) and Liquid Chromatography (LC) represent two predominant techniques that are widely used in various industries.

a. **Gas Chromatography (GC):** GC is a powerful tool for separating and analyzing volatile compounds. In manufacturing processes, GC is used in applications such as environmental monitoring, petrochemical analysis, and flavor and fragrance analysis. Its ability to separate complex mixtures makes it an essential tool for industries that require precise identification and quantification.

b. **Liquid Chromatography (LC):** LC complements GC by focusing on the separation of non-volatile and polar compounds. With various modes such as High-Performance Liquid Chromatography (HPLC) and Ion Chromatography (IC), LC is versatile and applicable across industries. LC is instrumental in pharmaceutical analysis, food and beverage testing, and environmental monitoring, contributing to quality assurance and regulatory compliance.

Electrochemical analyzers examine the electrochemical properties of substances and provide valuable insights into various processes. Techniques such as potentiometry and amperometry are used to understand and quantify electrochemical reactions.

a. **Potentiometry:** Potentiometric Ion Sensors, which work on the principle of measuring electrical potentials, are used in various areas. pH meters, a type of potentiometric analyzer, are essential in manufacturing processes where maintaining proper pH is critical. Potentiometry is also used in ion-selective electrodes for specific ion concentration measurements.

b. **Amperometry:** Amperometric sensors measure current resulting from Electrochemical Reactions and offer high sensitivity. This technique is commonly used in sensors for detecting gases, ions and other electroactive species. Amperometric sensors contribute to environmental monitoring, occupational safety and process optimization.

Sensor-based analyzers include a variety of technologies, each designed to provide real-time data on specific parameters. These analyzers provide continuous monitoring and control functions, contributing to the overall efficiency and safety of manufacturing processes.

a. **pH Sensors:** pH sensors are crucial for maintaining optimal conditions in various chemical processes as these sensors measure the acidity or alkalinity of a solution, ensuring that the pH remains within the specified range for the desired chemical reactions. Industries such as pharmaceuticals, water treatment, and food and beverage industries rely on pH sensors for quality control.

b. **Conductivity sensors:** Conductivity sensors measure the ability of a solution to conduct electrical current, providing insight into the concentration of ions. These sensors are widely used to monitor water quality and help assess the purity and composition of liquids in various industrial applications.

c. **Gas Sensors:** Gas detection equipment play a critical role in industrial safety and environmental monitoring. These sensors detect the presence of gases and provide early warning of leaks or dangerous conditions. Industries such as petrochemicals, manufacturing and mining benefit from the real-time insights that gas sensors provide.

The landscape of process analyzer technologies is extensive and dynamic, reflecting the diverse needs of industries involved in manufacturing processes. Spectroscopic analyzers decipher the molecular signatures of compounds, chromatographic analyzers separate complex mixtures for

analysis, electrochemical analyzers explore the electrochemical domain, and sensor-based analyzers provide real-time insights.

MAINTENANCE PRACTICES

Most manufacturing firms develop various maintenance strategies including: corrective or breakdown maintenance; preventive maintenance which can be condition-based, time-based, or failure-finding; and predictive maintenance. Intervals between preventive maintenance activities are carefully selected so that occurrences of failures can be minimized by assessing the frequency of failures of each equipment. One common approach in predictive maintenance is the implementation of vibration analysis. In vibration analysis, patterns of vibration in rotating equipment are being analyzed and compared with the normal measurements.

Other factors to consider when developing maintenance plans are the common incident metrics:

a. **Mean Time To Failure (MTTF)**: Can be calculated as the total lifespan across devices divided by the number of devices.

b. **Mean Time Between Failures (MTBF):** The average time between failures which can be expressed as total lifespan across devices divided by the number of failures.

c. **Mean Time To Repair (MTTR):** Described as the average duration it takes to complete the repair of a system upon discovery of the failure, which can also be expressed as the total time consumed by repairing the unit divided by the total number of repairs.

d. **Mean Time To Recovery (MTTR):** Is the time required for a complete recovery after a product or system failure.

e. **Mean Time To Acknowledge (MTTA)**: The time it takes to initiate a maintenance work after an alert has been triggered of an issue.

Some economic considerations are factored in during the system's design to justify the case of implementing system or unit redundancy. If the turnaround time can be enough to cause significant economic losses through missed production opportunities, then redundant systems or hot standby units can help mitigate these potential losses.

In the case of process analyzers, the performance of sensors is commonly affected by the purity of process samples. Harsh environmental condition including extreme heat, humidity, and salty air atmosphere for installations and facilities near open bodies of water or salt lakes can all contribute to accelerated degradation of sensor performance and electronic failures due to corrosion of conductive surfaces. In many cases, these can be addressed through proper design of enclosures, and waterproofing or weatherproofing through the use of enclosures with Ingress Protection (IP) rating. International Electrotechnical Commission published the IP ratings, presented as two numeral designation, as standard for identification of protection against Ingress of solid or liquid particles of various sizes and modes, the first digit refers to the protection against solid objects while the second digit refers to protection against liquids.

Another important consideration is for electrical equipment installed and operated within hazardous environments. High-risk environments including distillation plants for petroleum products, reactor areas for chemical processing, or minerals refining and mining facilities are some of the applications where special types of enclosures are required to safely operate electrical equipment and devices.

For all safety reasons, both IP ratings and Ex ratings should be properly identified and understood by the maintenance personnel prior to working with the equipment. The maintenance technician should be aware of the concepts of proper alignment of sealants and sufficient tightening when closing the junction boxes so that all necessary protection is maintained after the maintenance work is completed.

ISSUES AND CHALLENGES

In assessing technologies to utilize for the improvement of maintenance processes, the Gartner's Business Model Components can serve as a framework for identifying value creation opportunities through enhanced plant and process efficiency through improved equipment reliability. The model looks into the following factors as key considerations: customer, finance, value proposition, and capabilities.

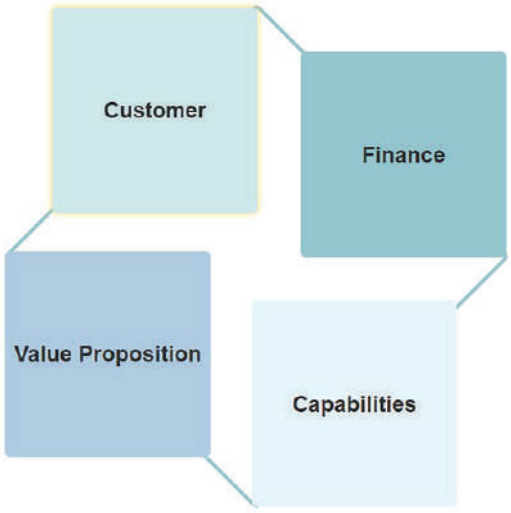

Fig. 1. Gartner's Business Model Components

1. **Customers:** Instrument signals and process information can be directly transmitted to the operations managers, production planning engineers and key executives to allow for faster decision-making during process upsets, thereby, minimizing system losses during such periods.
2. **Finance:** Economic value can be captured through the analysis of system ownership costs versus the financial value of benefits through efficient process and operation and minimized system downtimes.
3. **Value proposition:** This helps customers, including maintenance managers and operations engineers identify cost savings by allowing faster responses for operators during grade transitions. This allows lower transition grade outputs and maximizes on-spec productions through real-time process monitoring.
4. **Capabilities:** Seamless delivery of information from complex plant processes, equipment, and instruments to more intuitive plant knowledge database and user-friendly HMI and process monitoring software and applications.

RESOURCE-BASED STRATEGY ANALYSIS

A popular model for analyzing strategy is the framework developed by Robert Grant. Grant's Resource-Based View (RBV) considers the following as part of the firm's resources: assets, processes, attributes, and information.

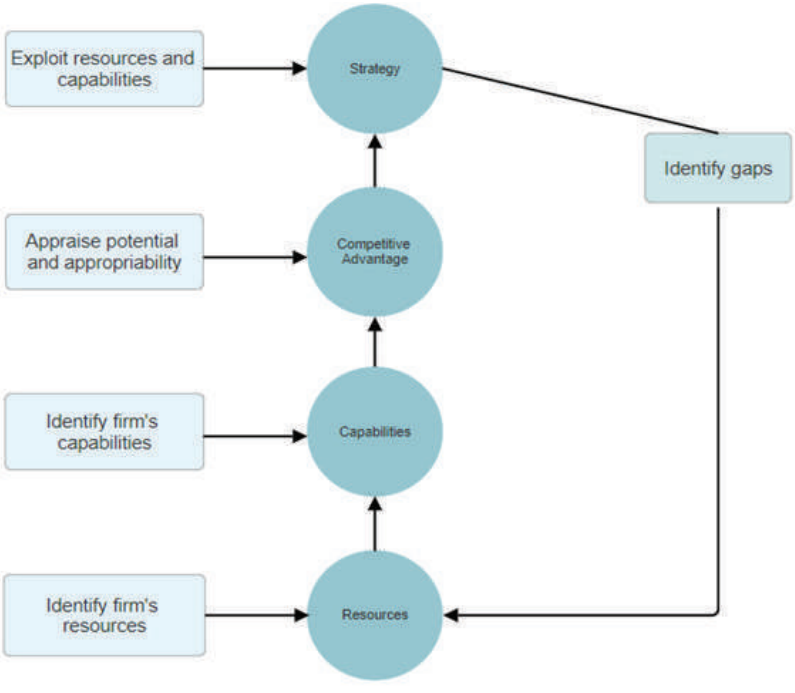

Fig. 2. Grant's Resource-Based Approach to Strategy Analysis

Grant's Resource-Based View can be utilized to assess maintenance strategies through evaluating the maintenance organization's capabilities and resources, and maximizing the utilization of each to enhance the firm's value-creation potential.

a. **Identify firm's resources:** The first step in the development of maintenance strategies is to identify the resources of the organization. The number of manpower, safety insurance spares, and locally available parts and services are key determining factors on deciding frequencies of maintenance activities, utilization of parts and consumables, and whether to pursue outsourcing for labor intensive tasks to lower maintenance costs.

b. **Identify firm's capabilities:** The management should be able to identify the system and manpower capabilities to maximize work productivity through focusing the talents of the workforce to those set of activities that create more value.

c. **Appraise potential and appropriability**: Maintenance planning should be properly organized so that the firm can sustain competitive advantage. Through proper maintenance planning and execution, unintended production downtimes can be reduced or even eliminated. This can result to improved production capabilities and allow firms to create more using less resources, resulting to lower production costs, improved product features, and enhanced overall competitiveness of the organization.

d. **Exploit resources and capabilities**: Strategies are developed to maximize utilization of manpower, tools, and equipment, while effectively executing the combined maintenance routine jobs and unscheduled activities addressing failure modes and pain points.

e. **Identify gaps**: The continuous improvement process of improving maintenance practices is based on the identification of gaps for each iteration of the procedures and standard practices. Through each revision cycle, man-hours figures and spares allocation can be optimized based on previous data.

CONCLUSIONS AND RECOMMENDATIONS

Grant's resource-based view provided a valuable framework for identifying improvement opportunities in the field of maintenance and reliability engineering, as applied in the practice of online process analyzer maintenance. This approach allows for incremental improvements in establishing sufficient resources and capabilities through each iteration of maintenance procedure revision. Each revision looks into critical metrics including failure rates, manpower requirements, and spares consumption, each factor contributing to cost-reduction initiatives while retaining equipment reliability and overall system functionality, resulting to efficient business operating conditions.

Digital transformation of maintenance processes can also be pursued to provide maintenance managers with real-time updates on status of critical equipment in order for key decision-makers to come up with rapid approaches to minimize system downtime and loss of production opportunities. Currently available mobile applications and web-based solutions will allow for maintenance supervisors to remotely monitor plant conditions for immediate communication and allocation of resources for critical activities and shutdown opportunities, anytime. Other industries with similar analytical equipment installations and automation requirements can benefit from the framework in developing strategies and implementing maintenance programs aimed at improving the reliability and overall cost of ownership of their instrument systems.

CHALLENGES OF AI TECHNOLOGIES ADOPTION

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Artificial Intelligence AI covers so many types of technology, where computers read inputs, analyze and take decision based on the algorithms set. It's capable of interacting with the surrounding environment through visual, audio or text information and can learn to improve the decision. In industry, AI has several applications which can contribute to cost savings by minimizing the downtime. For example, one area of AI is Machine Learning (ML) which is used in maintenance to monitor asset condition, predict failures and suggest solution for the decision maker to take the proper action beforehand to prevent failures and extend the asset life. On the other hand, many organizations are concerned about the accuracy, reliability and return of investment of the AI system, which might jeopardize their business. Therefore, there are factors that need to be evaluated before adopting AI technology, some of them are the ML model, Data availability and accuracy and the integration between program developer and asset owner.

ML MODEL

It's very crucial to select the right ML model that suits the nature of business, there are many existing automated model selection tools available that automate the process of selecting the right model for the right data. For instance, deep learning was adapted in predictive maintenance in an automotive grey casting manufacturing foundry to be used to identify the major breakdown parameter for a high-pressure hydraulic sand moulding machine, which was found to be the oil contamination. This achieved a reduction in downtime by 84%, and an increase of the MTBF (Mean Time Between Failures) by 880%.

DATA AVAILABILITY & ACCURACY

AI relies heavily on data from multiple sources such as IoT, sensors, etc. Therefore, to ensure data reliability it's recommended to use the ML-based algorithms (classifiers) that can classify the input data as reliable or unreliable, and filter unreliable data preventing it to be used in inference. For example, Unsupervised Learning which is another form of ML, is using its own methodologies to categorize pattern within data instead of relying on user feedback.

INTEGRATION BETWEEN PROGRAM DEVELOPER AND ASSET OWNER

AI technologies are expected to increase the efficiency and effectiveness of industrial processes. The primary goals are to reduce costs, save time, improve quality, and enhance the robustness of industrial processes. In the area of maintenance, when the AI recommends a maintenance decision, decision makers need to understand the underlying reason. Maintenance analytics developers need to understand what fault features in the input data are guiding the algorithm before accepting auto-generated diagnosis reports, and the maintenance engineer needs to understand which abnormal phenomena are captured by the inference algorithm before following the repair recommendations.

AI is a very promising and attracting field and needs a very high investment in infrastructure, tools and skilled manpower. Therefore, it requires an enormous effort to consider and study the abovementioned and other factors before adopting any AI technologies.

The Importance of Maintaining a Healthy History of Machinery Instrument Data in the Age of AI

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INTRODUCTION

With the widespread adoption of artificial intelligence, maintenance organizations have increasingly turned their attention to its application in their fields. Numerous models have been proposed with the goal of achieving zero-defect operation. In both theory and practice, deploying machine learning models in a plant can provide valuable insights into equipment health due to the huge volume of operational data industrial plants have. Consequently, it has the potential to address the limitations present in conventional condition monitoring strategies, rendering them error-proof and more autonomous.

PRACTICAL DISCUSSION OF DATA DRIVEN MODELS IN OIL AND GAS

To illustrate, let us discuss the example of one application. Abqaiq Plants, which is considered the largest oil processing facility in the world, and one of the oldest in Saudi Aramco, recently started using data-driven models to predict rotating machinery failures. Data-driven models use information from previously collected data (taken from the transmitters in the field) to identify the characteristics associated with whatever we want to model. If we were to model a vibration signal, for example, the independent variables we build our model on could be the speed of the machine, the lube oil pressure fed into the bearing, the bearing temperature, and so on. Using this model, we can determine whether the current real reading is acceptable and predict its future trends. Such a practice will allow the team to anticipate failures, plan a suitable shutdown window, and take corrective action before catastrophic failures occur.

Knowing that these models utilize previously collected data, which in turn is collected by transmitters and vibration probes, one could immediately see a potential problem: what if these data, which we build our model upon, are themselves faulty? Unfortunately, the entire model would not provide an accurate representation of what we desire to model.

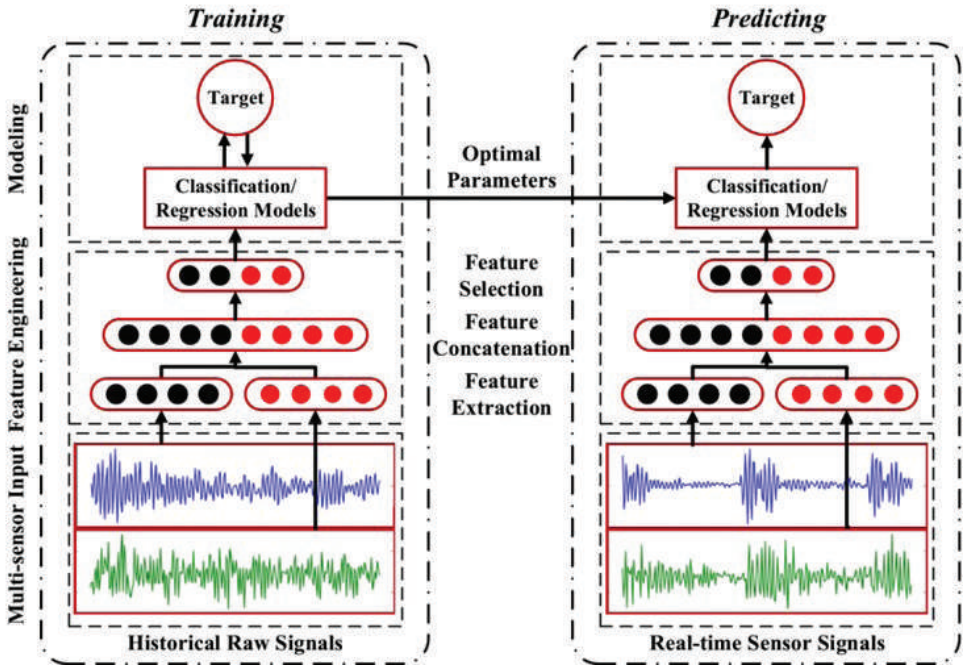

Figure 1: A flowchart of data-driven models (Zhang et el.)

Hence comes the importance of maintaining a healthy history of instrument data. Abqaiq Plants were able to easily deploy artificial intelligence solutions due to their early investment in data acquisition and storage. Facilities that did not give this subject enough care are struggling with the implementation — they either have a huge amount of faulty data or no data at all!

CASE STUDIES

In this section, two examples are shown to understand how faulty readings could jeopardize the models.

1. Faulty Accelerometer Readings of a Gearbox

Figure 2: Faulty Accelerometer Readings of a Gearbox

Figure 1 displays the trends of a turbine driving a shipper pump with a gearbox speed reducer in between. On 1/2/2023, represented by the line in the middle, the accelerometer started reading faulty vibrations of 1.35 G even though the equipment train was not running. On 1/5/2023, the new vibration readings were 4.35 G. However, this was not real vibration, as it was equal to the values before the faulty event + the offset (1.35 G).

One might think to keep this without fixing, since it is a small offset and the new values are still below the alarm limit. However, keeping it the same would affect the integrity of the data. Later down the line, if this facility decides to use prediction models for vibration values, without addressing this issue, they will find discrepancies between real values and predicted values.

2. Faulty Data of Inlet Steam Transmitters for Steam Turbines

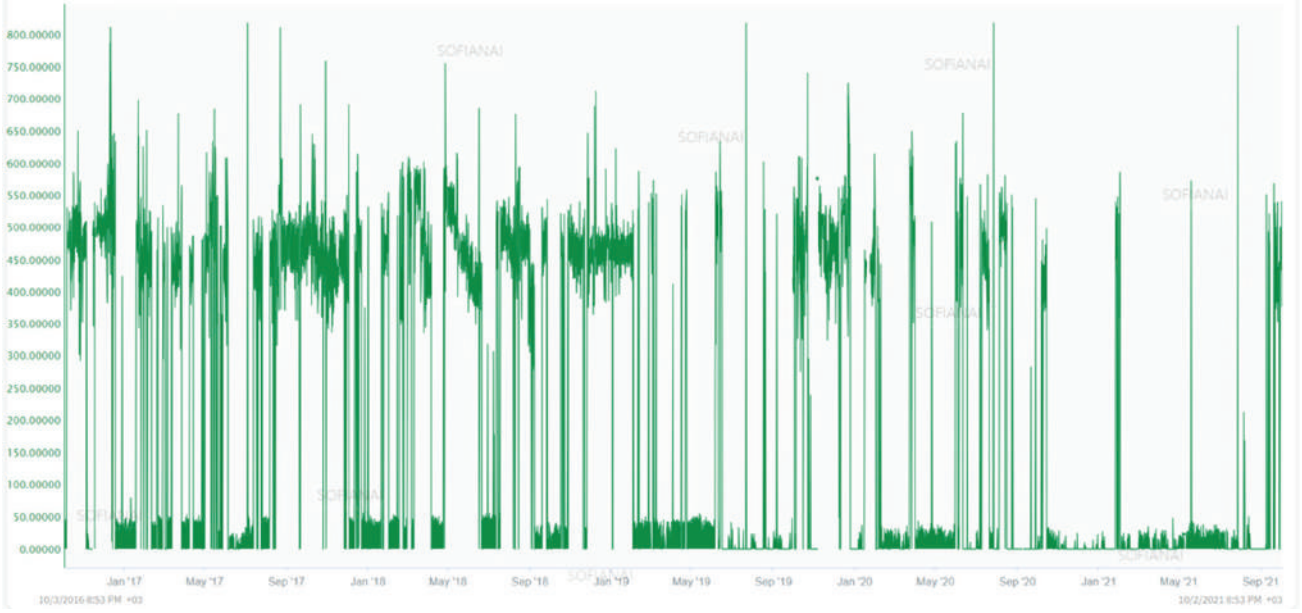

Figure 3: Faulty Data of Inlet Steam

When trying to model the performance of a single-stage steam turbine driving a transfer pump, it was found that the inlet steam flow transmitter had been reading abnormal values since 2016. Interviewing the field personnel revealed that these transmitters were bad actors and failed consequently, hence they were deemed unnecessary to repair. With these abnormal values, it was not possible to use the inlet steam flow as a parameter for modeling.

CONCLUSION

In conclusion, the integration of artificial intelligence in maintenance practices offers significant potential for enhancing equipment reliability and operational efficiency. However, the accuracy and effectiveness of AI-driven models heavily depend on the quality of historical data from machinery instruments. As demonstrated by the examples of faulty readings in accelerometers and steam transmitters, maintaining a robust and reliable data history is crucial. Investing in proper data acquisition, storage systems, and maintaining them ensures the integrity of predictive models, enabling organizations to anticipate failures and implement timely corrective actions, ultimately preventing catastrophic failures.

THE ROLE OF ROBOTIC PROCESS AUTOMATION IN STREAMLINING TURNAROUND AND INSPECTION (T&I) PLANNING ACTIVITIES

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Efficient Turnaround and Inspection (T&I) planning plays a critical role in today's oil and gas industry, ensuring safety, minimizing downtime, and optimizing operations. Recognizing the significance of this, Saudi Aramco has made substantial investments in digitizing these business processes.

One notable example is the corporate scale deployment of the Robotic Process Automation (RPA) technology to enhance Turnaround and Inspection (T&I) planning activities in SAP Plant Maintenance (SAP-PM). This deployment has resulted in improved productivity, accuracy, data integrity, streamlined operations and reliable outcomes.

Leveraging RPA technology to automate various T&I planning activities, enables organizations to automate repetitive and rule-based tasks by using software robots that mimic human actions, interacting with systems and applications similar to humans. Traditionally, T&I planning has been complex and time-consuming, requiring meticulous coordination and extensive manual data entry.

By digitizing and automating manual business processes, organizations can enjoy several advantages. RPA ensures high levels of compliance and data integrity by consistently executing processes according to predefined rules, establishing standardized business procedures. Automating tasks minimizes human errors and inconsistencies, resulting in enhanced data quality and reliability. This is particularly crucial for accuracy-demanding tasks like data entry, calculations, and report generation.

RPA bots excel at handling repetitive tasks at a significantly faster pace than humans, boosting productivity. They can operate continuously without breaks and complete tasks much quicker than human operators. Consequently, employees can focus on more strategic and value-added activities, leading to overall productivity gains.

This RPA is capable of assisting T&I planners in carrying out various repetitive planning activities within the SAP Plant Maintenance (SAP-PM) system. Instead of planners having to manually input data for planned T&I events into the system, this RPA can now effectively create numerous suborders and process high volume material reservations seamlessly. Additionally, it has the ability to effectively generate service line items from service contracts. This automation will result in a significant increase in planners' efficiency, allowing them to focus on more crucial and value-added activities. Additionally, the deployment is scalable, and is currently being trained to expand its capabilities to further support maintenance and reliability teams.

While RPA offers numerous benefits, it's not without challenges. Organizations must address concerns related to data security and privacy. Additionally, ongoing maintenance and optimization of RPA solutions are essential to ensure continued effectiveness.

In conclusion, RPA technology holds immense promise for enhancing efficiency and driving operational excellence in various industries. By leveraging automation to streamline processes, optimize workflows, and enhance workforce productivity, companies can gain a competitive edge in today's dynamic energy landscape.

IN-HOUSE MAINTENANCE OPTIMIZATION FOR **SURGE RELIEVE VALVE (SRVS)** SAVES ORGANIZATION OPEX

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THE PROBLEM

Brutal-force or doing more PM is not always the optimum case for any best-in-class asset management organization, which could result undesirable consequences or risks, such as infant type of failure. This pattern of failure generally arises due to multiple reasons, including workmanship or improper reliability design of the asset. As a result, this could result in rework, unplanned shutdown, and considerably consuming company expenditure (OPEX).

Nevertheless, the example that will be demonstrated is Surge Relive Valve (SRV) which functionally provides the interface with the process, with the valve's piston acting as a closing member that opens to allow flow to reduce the upstream pressure. During normal operations of the pipeline (pressure below setpoint), the pilot assures that the integral actuator keeps the valve closed. In case the upstream pressure reaches the setpoint, the pilot will change the position and release the pressure on one side, inside the integral actuator. This will result in the opening of the valve (piston moving out of the seat). The pilot will continue to open the valve as long as the upstream pressure is above the setpoint. Once the pressure is equal to the setpoint, the piston will stop moving. In case the pressure goes below the setpoint, the valve will close, in order to avoid too fast closure (e.g. creating an upstream surge again) the closing speed can be controlled.

SUCCESSFUL APPROACH

Saudi Aramco (WRDD) deployed new in-house maintenance optimization (PM) of the Surge Relive valves (SRVs) to maximize assets life cycle and improve WRDD OPEX. The team carried out holistic multi-disciplinary investigation to determine the root causes that were shaking the department's financial statements, without jeopardizing the safety and criticality of normal operations. The investigation included several elements such as historical maintenance data, including normal PM and overhauling, benchmarking and API- 510, and Original Equipment Manufacturer (OEM) strategies. It was revealed that the existing maintenance strategies are quite conservative.

THE POSITIVE OUTCOMES

Saudi Aramco's Western Region Distribution Department (WRDD) successfully created operational excellence value for the old PM strategy, interval from 3 to 5 years based on historical records, without jeopardizing the criticality of safety function and operational risk. It is noteworthy, this is in line with API- 510 and best practices in maintenance and reliability.

As a result, Saudi Aramco (WRDD) owns more than 44 SRV assets and by deploying this initiative, WRDD can claim an annual cost savings of $500 M, including materiel and repair by certified workshop. Notwithstanding, deploying this initiative will promote circular economy by maximizing the asset lifecycle.

NON-METALLIC SEAL-LESS PUMP FOR HYPOCHLORITE DISTRIBUTION AT QURAYYAH SEAWATER PLANT, SAUDI ARAMCO

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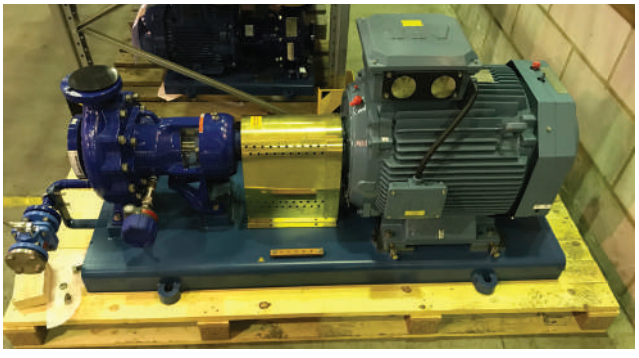
BACKGROUND

Qurayyah Sea Water Plant (QSWP) has six hypochlorite pumps supplying continuous hypochlorite for its operation of seawater treatment. These pumps were made of Titanium, which is an expensive material for producing parts. These pumps are continuously operated for operational requirements and face frequent damages for various reasons, due to its process characteristics.

NEW TECHNOLOGY DESCRIPTION

Non-Metallic Seal less Pump for Hypochlorite Distribution are being installed in Qurayyah treatment-1 and treatment-2 areas. Non-Metallic Seal less Pump for Hypochlorite Distribution will replace the existing High-cost Titanium pumps. The Non-Metallic seal-less Pump for Hypochlorite is being supplied by a local vendor while the high-cost Titanium pump is supplied by an international vendor. The spares of the Titanium pump are not only very costly but take a long lead time to procure.



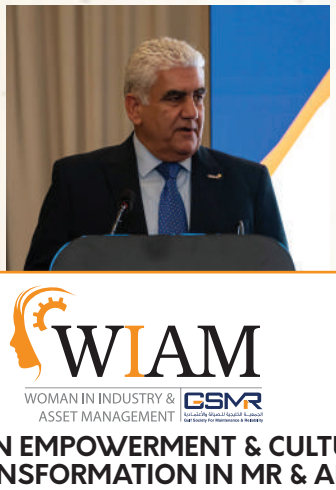
New Pump as Received

This type of pump is reviewed and approved by Central Engineering Division for rotating equipment as well as Material Engineering Group. The wet internal parts in contact with the hypochlorite solution are carbon fiber reinforced ETFE and the pressure containing factor is Aramid (Kevlar) fiber reinforced vinyl ester. In general, ETFE material is suitable to be used in the presence of hypochlorite solutions, with operating temperature up to 145 C.

New Non-Metallic Pump as installed at Treatment-1 Hypochlorite Distribution

One Non-Metallic Seal-less Pump for Hypochlorite Distribution is already procured and installed at treatment-1 and has been tested for its performance. It has following salient features:

- The idea is related to SWID Challenges for Corrosion control.
- The cost of acquisition and operation is quite low in comparison to the existing Titanium Pumps.
- A cost saving of around $100,000.00 is estimated for each pump.



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GSMR Board of Directors meeting held in the Kingdom of Bahrain

GSMR participated in MainTrain 2023 meeting held at Winnipeg Canada by PEMAC Asset Management Association of Canada

GSMR Asset Management & Digitalization Committee meeting held at GPIC, Bahrain

WORKSHOP & TRAINING

Modern Maintenance & Reliability Workshop organized for Aluminium Bahrain professionals

NEW VENTURES

GSMR and TLD Arabia Equipment Services signed a Maintenance Aviation Cooperation Protocol to facilitate collaboration for enhancing sustainability in the aviation industry

UPLIFTING MR&AM PROFESSIONALS

Virtual Academy conducted Technical Webinars and provided insights on stimulating matters within the MR&AM industry

PROMOTING WOMEN EMPOWERMENT

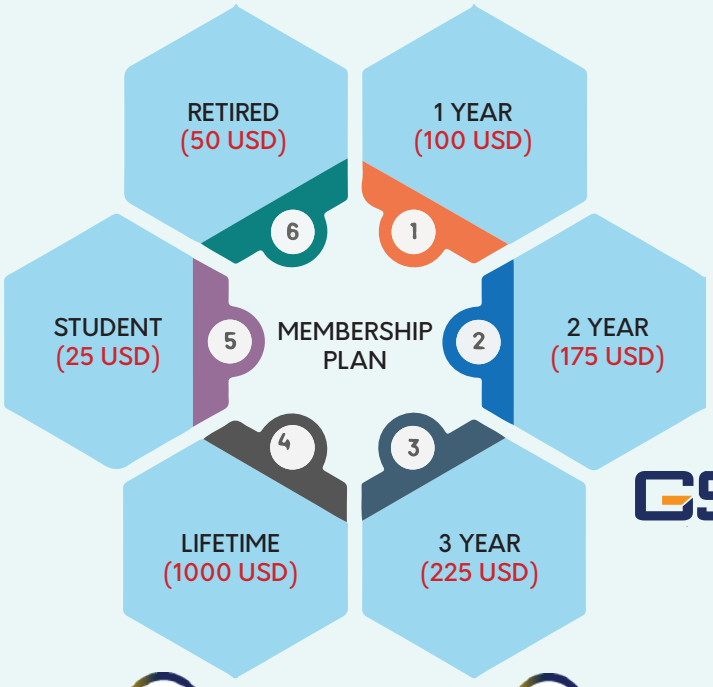
WIAM committee organized the cup of wisdom: coffee meet in Bahrain 2023

PARTICIPATION IN CONFERENCES AND FORUM

GSMR at the MEFMA CONFEX 2023 held in Riyadh, KSA

GSE Maintenance and Sustainability Forum held in Riyadh, KSA

GSMR at the 1st International Operation and Maintenance conference held in Hail, KSA



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- You will receive a confirmation of your membership within 48 hours.

"The most reliable way to predict the future is to create it."

- Abraham Lincoln

WIN! WIN! WIN!

Unscramble the names of eight capital cities from the phrases given below.

(Hint: Each phrase contains the name of two cities!)

LION JOB ENDING

TOOK MY ORE

CRIMSON ELBOW

RAPID DISARM

Send your answers to **riya.kanade@gsmrgulf.org** with your details (name, organization, GSMR ID, photo) and stand a chance to win exciting prizes!

Lucky winners will be announced.

Last date for entries: 10th July 2024

In the presence of

H.E. Dr. Mohamed bin Mubarak Bin Daina
Minister of Oil and Environment
Special Envoy for Climate Affairs
Kingdom of Bahrain

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