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Harnessing the Power of Artificial Intelligence in the Oil and Gas Industry

By Ts. Ng Jiun Huei, Petroliam Nasional Berhad

The integration of artificial intelligence (AI) into various sectors has become a game-changer with no exception to the oil and gas industry. With its vast and complex operations, this industry stands to gain significantly from AI technologies. From exploration and drilling to production and maintenance, AI is revolutionising every aspect of the oil and gas lifecycle. *CONTINUED ON PAGE 02 >>*

/what's inside

/editorial committee

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/chief editor's note

As the year draws to an end, TECHIES 27th edition concludes with series of articles on artificial intelligence (AI) – the most sought-after topic of discussion in the last few months.

From exploration to downstream operations, there are many opportunities in the oil and gas industry where AI can be applied. For instance, information gathered from explored reserves could serve as training data for machine learning algorithms to search new and viable reserves. AI-aided designs can propose the combination of equipment and configurations that yield the highest productivity possible. With the use of AI, many critical tasks in the oil and gas industry can be completed in a relatively shorter timeframe.

Moving forward, AI has the promising potential of assisting smoother transitions to zero-carbon energy sources. A more accurate forecast of energy demand is possible with the analysis of a huge volume of data. Thus, any disruption of energy supply can be predicted and avoided. The reporting of Environmental, Social & Governance (ESG) and Carbon Credit Accounting can be expedited if AI is adopted appropriately.

Here's to welcoming another year of soaring knowledge and rising technology. Happy reading!

Zuraidah Mohd. Zain

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During Exploration and Drilling

The initial phase of oil and gas operations, which are exploration and drilling, involves identifying potential sites and extracting resources. Traditionally, this process is time-consuming, expensive, and fraught with uncertainties.

Seismic surveys produce vast amounts of data, which geologists use to create subsurface maps. AI algorithms, particularly machine learning, can analyse these datasets faster and more accurately than humans. Accurate production forecasting is essential for planning and investment decisions. AI algorithms can analyse historical production data and other variables, resulting in more accurate predictions compared to traditional methods. By identifying patterns and anomalies, AI helps pinpoint the most promising drilling sites, which reduces exploration risks and costs. This helps companies make informed decisions about resource allocation and investments.

Once a drilling site had been identified, AI can predict drilling conditions and optimise the required parameters in real time. Predictive analytics models use historical data and real-time inputs to forecast potential issues like equipment failures or hazardous formations. This allows for proactive adjustments, minimising downtime and ensuring smoother operations.

Optimisation of Yield from Reservoir

Once the oil and gas are extracted, managing the reservoir to maximise output and extend its life becomes crucial.

AI techniques can optimise Enhanced Oil Recovery (EOR) methods, such as water flooding, gas injection, and chemical EOR. Machine learning models analyse historical production data to determine the most effective EOR strategy for a specific reservoir, improving recovery rates and extending the productive life of the field.

Ensuring Safe and Smooth Operation

The maintenance of equipment and safety are critical aspects of oil and gas operations.

AI-driven predictive maintenance models analyse data from the equipment to predict the right time for maintenance. This approach reduces unplanned downtime and extends the lifespan of critical assets. For example,

“AI-driven predictive maintenance models analyse data from the equipment to predict the right time for maintenance. This approach reduces unplanned downtime and extends the lifespan of critical assets.

machine learning algorithms can detect early signs of wear and tear in pumps, compressors, and pipelines, allowing for timely interventions.

Ensuring the safety of personnel and operations is paramount in the oil and gas industry. AI can enhance safety through real-time monitoring and anomaly detection. For instance, computer vision systems can analyse video feeds to detect unsafe conditions or behaviours, triggering alerts to prevent accidents.

Matching the Demand

AI models can predict the demand for oil and gas products by analysing market trends, historical data, and external factors. Accurate demand forecasting helps optimise inventory levels, hence reducing storage costs and preventing shortages or oversupplies. To optimise logistics, AI analyses transportation routes, delivery schedules, and storage capacities. Machine learning algorithms can identify the most efficient routes and modes of transportation, reducing costs and ensuring timely deliveries.

Way Forward for AI Implementation

The foundation of any AI application is data. The oil and gas industry generates vast amounts of data from equipment and operations. AI can ensure that the processes of collecting, storing, and managing these data are executed in an efficient manner. This

involves deploying IoT devices, establishing data management systems, and ensuring data quality.

Selecting the appropriate AI technologies and tools is critical. Companies need to evaluate various AI solutions, including machine learning platforms, predictive analytics tools, and computer vision systems to determine which best fit their needs. Collaborating with AI experts and vendors can aid in this selection process.

Integrating AI solutions with existing IT and operational systems is a complex but necessary step. This involves ensuring compatibility, developing application programming interface, and setting up data pipelines. The goal is to create a seamless flow of information between AI systems and the existing infrastructure.

A skilled workforce is essential for the successful implementation of AI. Companies must invest in training their employees to work with AI technologies. This includes hiring data scientists and AI specialists, and providing upskilling and reskilling instructions for existing staff.

Once AI systems are deployed, continuous monitoring and improvement are necessary to ensure the delivery of desired outcomes. This involves tracking performance metrics, analysing results, and making adjustments as needed. AI systems should be scalable and adaptable to changing business needs.

To wrap up, the application and implementation of AI in the oil and gas industry will transform the sector, making operations more efficient, safer, and profitable. From exploration to drilling, production, maintenance, and logistics, AI is revolutionising every phase of the oil and gas lifecycle. As the industry continues to embrace AI technologies, the future promises even greater advancements, driving innovation and sustainability in this critical field.

By leveraging AI, the oil and gas industry can navigate the challenges of the modern energy landscape, ensuring a more resilient and prosperous future.

By Ts. Syed Mohd Azinuddin bin Syed Azmi,
Ace Binazin Ventures

Embracing AI in Petrochemical Plants: A Technologist's Perspective

The petrochemical plant commissioning and operation process is undergoing rapid evolution through the integration of advanced technologies such as artificial intelligence (AI). This article presents the transformative impact of AI in the petrochemical sector. Several real world applications and the benefits derived from leveraging AI in various facets of petrochemical facility management are duly discussed.

Knowledge Based System: Revolutionising the Switching of High Pressure Ammonia Pumps

In 2005, a project aimed at enhancing production capacity of a fertiliser plant in Malaysia was executed. In this project, a new set of impeller and casing for high pressure ammonia pump was designed and fabricated. Replacement of the new parts was done without interrupting the production operation of the plant.

A model of a high pressure pump for ammonia.
Source: High-pressure ammonia pumps for fertilizer plants (India) | EBARA CORPORATION.

With caution, switching from Pump A to Pump B, isolating hazardous ammonia, draining, dismantling old parts, and installing new parts were properly conducted. The commissioning and start-up of the new pump marked a significant milestone. Since then, the daily production of granular urea became 2100 MT - a whopping 1800MT increase in capacity. The information captured throughout the project served as the basis in the configuration of appropriate databases. With the help of AI, the databases are now used to design more efficient processes.

Predictive Operability & Maintainability with AI

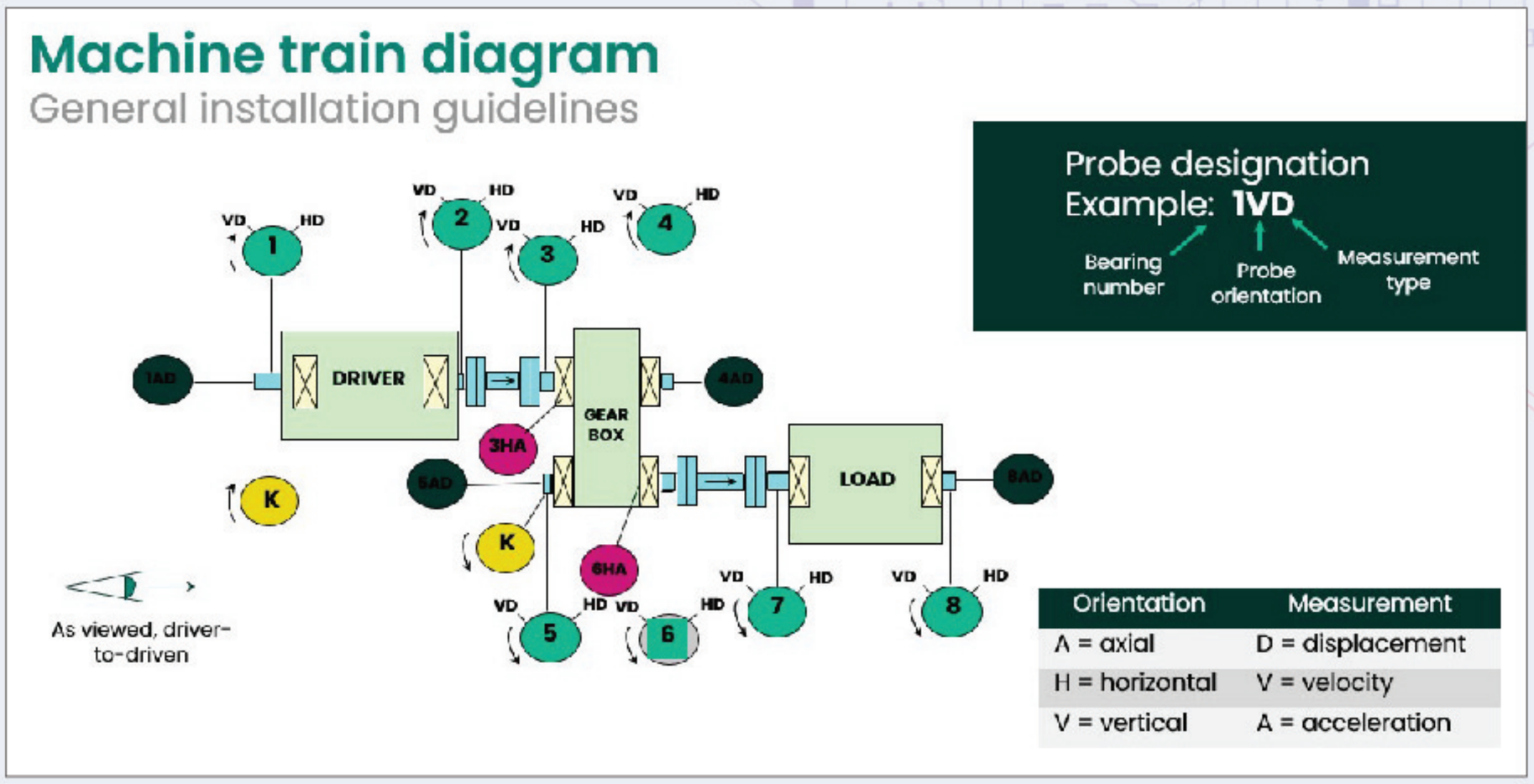
AI has revolutionised the way technologists participate in plant management and proactively anticipate and prevent equipment failures. By leveraging AI algorithms to analyse historical data and real-time sensor readings, maintenance teams can predict potential failures, extend equipment lifespan, and minimise disruptions to facility operations. This has significantly reduced cost and optimised facility performance.

Previously, plant management and technologists relied heavily on foreign expatriates, often referencing subject matter experts and consulting rotating machinery handbooks. A typical technologist's daily routine involved carrying a vibration probe, recording data, and uploading the data into a dedicated software. The critical equipment had real-time monitoring devices not only for vibration, but also for pressure, temperature, and flow measurement. Then, the vibration graphs would be analysed. Any anomaly would trigger further investigation. To identify potential problems, handbooks were consulted. Other proactive maintenance actions such as collecting lubricant oil samples from rotating equipment for laboratory analysis was also done to verify the existence of problems. Once the problem had been confirmed, a report would be prepared for submission to the rotating engineer, manager, and experts.

Today, with the advent of AI, the data that had been collected over many years can be used as training data for AI algorithms to predict the operability and maintainability of equipment. It is expected that the AI Condition-Based Monitoring Strategic Approach can significantly boost Overall Equipment Effectiveness (OEE) to almost 100%.

Bar Code Technology: Streamlining Commissioning Processes

In 2008, the adoption of a Computerised Completion Management System (CCMS) with bar code scanning capabilities streamlined the transition from construction, commissioning and operation phases of a methanol plant project. This digitised approach, introduced by German technologists, had revolutionised documentation processes, ensuring seamless data capture, storage, and analysis -



Typical Machine Train Diagram of Rotating Equipment Condition Based Monitoring by Bently Nevada. Source: Vibration Measurement Tool, Device | Bently Nevada.

resulting in efficient facility operation. Combining CCMS with AI will create a more robust process.

AI Driven Commissioning: Enhancing Efficiency and Accuracy

AI-powered commissioning processes have redefined traditional manual methods by automating repetitive tasks and using machine-learning algorithms to identify optimum operating conditions. This digital transformation has enabled commissioning teams to focus on higher-level decision-making, achieving design nameplate capacity and ensuring a safe and smooth start-up of petrochemical manufacturing.

The current approach involves complying to the project management system, and focusing on the commissioning management module and standard practices. A commissioning personnel must completely understand how the petrochemical manufacturing facility works. This includes identifying the need for commissioning documentations such as procedures and checklists, in addition to adhering to step-by-step procedures based on experience. This process depends on the competencies of the Plant Manager and Commissioning Manager. Approvals are acquired through bureaucratic channels. This conventional and rigid method takes a relatively long time. Manual operator interventions are necessary for opening and closing valves, draining and venting hazardous materials, and manually lining up sub-processes. Historical data on other similar plants needs to be captured and processed using machine learning. With AI, the process will be better streamlined and optimised, making the entire system more efficient.

Fault Detection and Diagnostics: Human AI Collaboration

The integration of AI-powered fault detection and diagnostics tools has empowered technologists to monitor equipment performance and potential malfunctions in real-time. While AI systems provide valuable insights, human intelligence remains crucial in cross-examining indicators and making decisions when it comes to addressing equipment failures during the commissioning and initial operations.

A key strategy to follow is to start with the end in mind. The approach involves data collection and analysis from previous projects to establish lessons learnt and then structure it into a proper live documentation. A disciplined execution, coupled with frequent health checks by stakeholders, can identify potential flaws, with a focus on critical success factors. Data is compiled, analysed, monitored, and discussed to find the best solutions in delivering technical and technology petrochemical services.

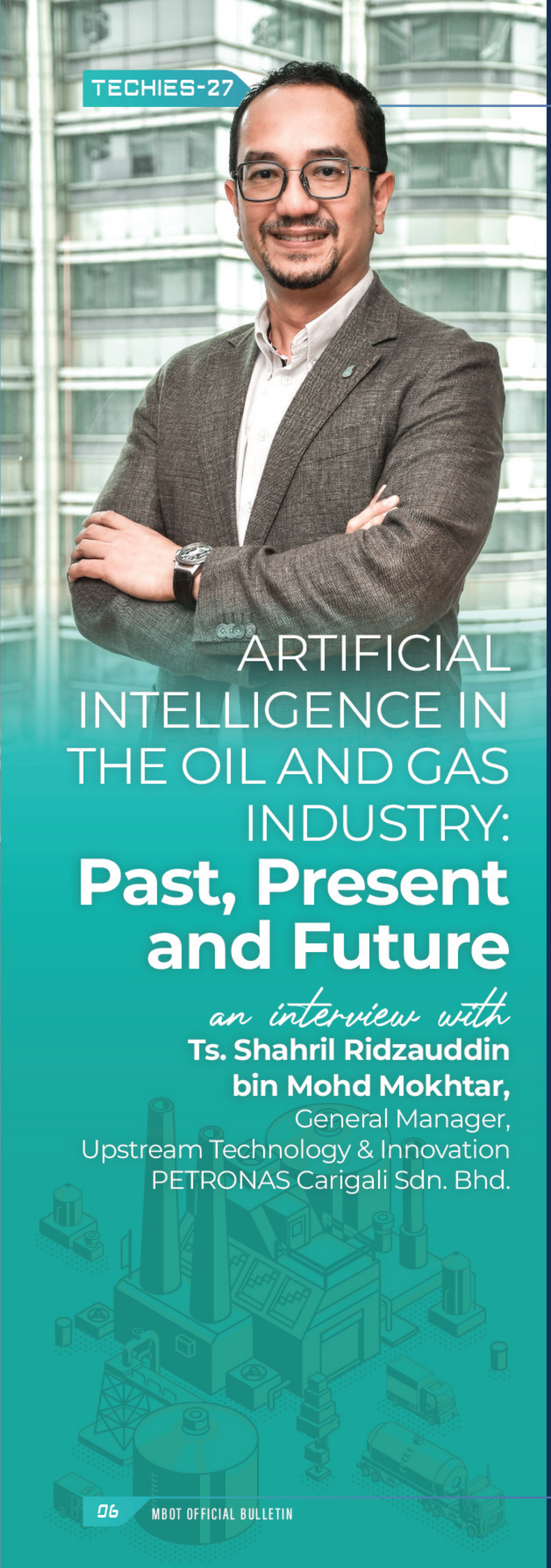
Sharing success stories and data from past experiences with others is vital. A constructive feedback is always welcomed to enhance Malaysia's oil and gas technology services data bank.

Challenges and Considerations: Navigating the AI Landscape

While the benefits of AI in petrochemical manufacturing and commissioning are immense, challenges related to data integrity and the continual improvement of AI systems must be properly addressed. With the abundance of data uploaded into company storage and made available through intranet, implementation of robust analytics and accurate information systems are necessary. This includes allowing AI to learn from previous databases and having regular updates of algorithms with machine learning in order to maximise the potential that AI can bring about.

Conclusion

Beyond 2020, the incorporation of AI into petrochemical manufacturing and its commissioning processes will result in a significant leap towards Industry Revolution 4.0. By harnessing AI capabilities to automate various tasks, petrochemical facilities will be operating at a greater efficiency with lower costs. AI will not only drive competitiveness but also set new benchmarks in the industry.



ARTIFICIAL INTELLIGENCE IN THE OIL AND GAS INDUSTRY: Past, Present and Future

an interview with

Ts. Shahril Ridzauddin bin Mohd Mokhtar,
General Manager,
Upstream Technology & Innovation
PETRONAS Carigali Sdn. Bhd.

Please provide a short introduction on your career achievement.

I have been in the energy industry for nearly 24 years. I transitioned from the nuclear industry in the UK to the oil and gas industry where I have worked in 15 countries. With a mixture of experience as technology provider, regulator, and operator, I have seen different aspects of technology R&D, commercialisation, deployment, and replication. While my career evolves mainly around wells and production activities for many years, the introduction of digitalisation, data analytics & automation (DDAA), and artificial intelligence (AI) to the oil and gas industry have sparked much interest in me. Among my career achievements, two that really stand out for me are 'Transforming into Digitally Enabled Business' (TIDEB) for the Wells fraternity and being awarded the 'Asia Pacific Regional Technical Awards in Data Science and Engineering Analytics' by the Society of Petroleum Engineers International in 2024. With a strategy I curated back in 2021, the Wells fraternity of the oil and gas industry has fully transformed into a digitally enabled business through the deployment of machine learning, risk management, business process automation, operation automation and performance insights.

Can you share a brief history of AI adoption in the oil and gas industry?

While the general perception that AI adoption in the oil and gas industry has just started in recent years, in actual fact, AI has been around in this industry since the 1970s. However, back then, AI was mainly about data quality, processing power, and modelling capabilities. The industry appetite to achieve faster and more accurate data contextualisation, coupled with higher processing power and more complex modelling capabilities, have expedited the oil and gas industry dependency on AI. In the 1970s, AI was predominantly focused on subsurface and drilling advancements due to the uncertainty of subsurface data and the huge costs involved. Fast forward 50 years, almost every discipline in the industry – including finance, business, and human resources, among others - benefits from extensive AI models.

What is the current practice of AI-assisted procedures in reducing production cost in the oil and gas industry?

Reducing production cost covers two main elements – achieving superior operational efficiency levels and managing risks. The industry had been looking at various conventional ways to continuously lower production costs. Conventional ways are usually based on contracting strategy, optimising human power and other resources, and deploying hardware technologies. However, improvements are now stagnant, whereby the conventional ways seem to no longer be sufficient to sustain superior operational efficiency and manage the associated risks.

AI, through data contextualisation and machine learning, are now proven to be able to provide solutions to untapped areas of time-to-failure and time-to-risk realisation predictions and dynamic operating envelope optimisation. For rotating equipment on production operations, AI models are used to

predict equipment time-to-failure. This helps operators perform necessary corrective maintenance before actual failure happens - hence avoiding highly expensive unplanned production deferment of hydrocarbon.

In drilling operations, AI models are used to predict potential stuck pipe incidents and optimise the rate of penetration (ROP) by utilising fast yet safe parameters. In addition, autonomous drilling uses even more complex AI models that have been proven to significantly reduce cost as well as carbon footprint.

“It was common to hear that many oil and gas jobs would be lost to AI, robots or computers. Ten years later, the same community is still around. Its members have not lost their jobs.”

Will AI reduce our reliance on human intelligence in the energy sector?

This has always been the general perception and concern when AI and even when digitalisation, data analytics and automation (DDAA) first swept through the oil and gas industry circa 2014. It was common to hear that many oil and gas jobs would be lost to AI, robots or computers. Ten years later, the same community is still around. Its members have not lost their jobs. Instead, they are now more digitally savvy and their workload, especially clerical works, have been decreased. In certain areas, process cycle efficiency indicators have improved up to 37% with the introduction of DDAA and AI.

Hence, in my opinion, AI will not reduce our reliance on human intelligence in the energy sector. Humans are the ones who created computers, robots and many other AI-enhanced machines and we have yet to see any of these technologies able to run on their own without human intervention. AI is about faster processing and faster contextualisation of available data to assist humans. It will not remove human intelligence when making sense of complex situations that require wise decision-making. It will not take away the responsibility and the EQ of the human worker.

What is the role of AI in ensuring a smoother energy transition?

While the oil and gas sector still plays an integral role in supplying energy to the world, we are continuously seeking ways to expand our energy sources to go beyond hydrocarbon. AI plays a similar role in this area, whereby it helps us improve the accuracy of energy forecasts, which in turn will provide a supply-and-demand balance, and eventually, will reduce our reliance on fossil fuels.

Coupling AI with automation and the right learning models, real-time efficiency optimisation can be executed on renewable energy enablers. For example, AI helps us make better decisions when doing auto-adjustments on the angle of solar panels and the pitch of wind turbine blades.

Do you think AI will significantly contribute to the planning, familiarisation, compliance and reporting of environment, social and governance (ESG) aspects in the oil and gas industry?

AI, especially machine learning (ML) and natural language processing (NLP), cuts across multiple layers in the energy sector, including ESG. AI is used to harness different stacks of information such as emission reports in a much faster way. This enables the identification of data trends, risks, and opportunities. Without AI, these aspects may be easily missed, and hence, not appropriately analysed. AI ensures that no data is missed out. As such, a more accurate understanding of the impact of our activities on ESG can be garnered.

What is your advice to technologists who may find coping with technology evolution in the oil and gas industry a challenge?

Continuous learning, be innovative and build sustainability awareness. The time is now to ensure every activity we do in the oil and gas sector carries the weight of impact on both ESG and SDG. Continue to seek knowledge, technologies and new ways of working to play our part in this sector. In learning, go beyond the boundaries of technical knowledge. Learn crucial skills such as how to be innovative in a more structured manner. Do remember that our time now is borrowed from the next generation including our children. Do not rob them of their clean and safe future.

/mbot news

WOMAN TECHNOLOGIST CHAPTER RED LIPS 2024: 'WOMEN IN TECH PARADOX'

26 NOVEMBER 2024 – The Malaysia Board of Technologists (MBOT) successfully hosted the MBOT Woman Technologist Chapter Red LIPS (Leadership Insights for Professional Sharing) 2024 at Hotel Cititel Midvalley, Kuala Lumpur. The event, themed "Women in Tech Paradox," brought together 136 MBOT members, including mentors, mentees, and industry leaders, to discuss the challenges women face in the tech industry. It also marked the end of a year-long mentorship program with 14 mentors, offering participants valuable insights on creating positive change in the world of tech.

The event kicked off with an opening address by Ts. Dr. Mahaletchumy Arujanan, MBOT Board Member, followed by a warm welcome from Ts. Sharifah Zaida Nurlisha binti Syed Ibrahim, Chairperson of the WTC.

The event forum featured prominent speakers, including Datuk (Dr) Yasmin Mahmood, Chairperson of Tourism Malaysia, and Emeritus Prof Dr Phang Siew Moi, FASc, Deputy Vice-Chancellor at UCSI University. The session was moderated by Assoc. Prof. EUR. ING. Ts. Ir. Dr. Syuhaida Ismail, Director of Research at the Maritime Institute of Malaysia (MIMA). The forum focused on how women can overcome challenges and advance their careers while driving change in a male-dominated industry.

A special session on image grooming and professional style was led by certified image consultant Ms. Wawa Idris, who shared practical tips on personal branding and enhancing professional appearance.

/mbot registration

56,504	12,208	24,743	3,424
Graduate Technologists	Qualified Technicians	Professional Technologists	Certified Technicians

96,879
Total MBOT Registrants
(As of December 2024)

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