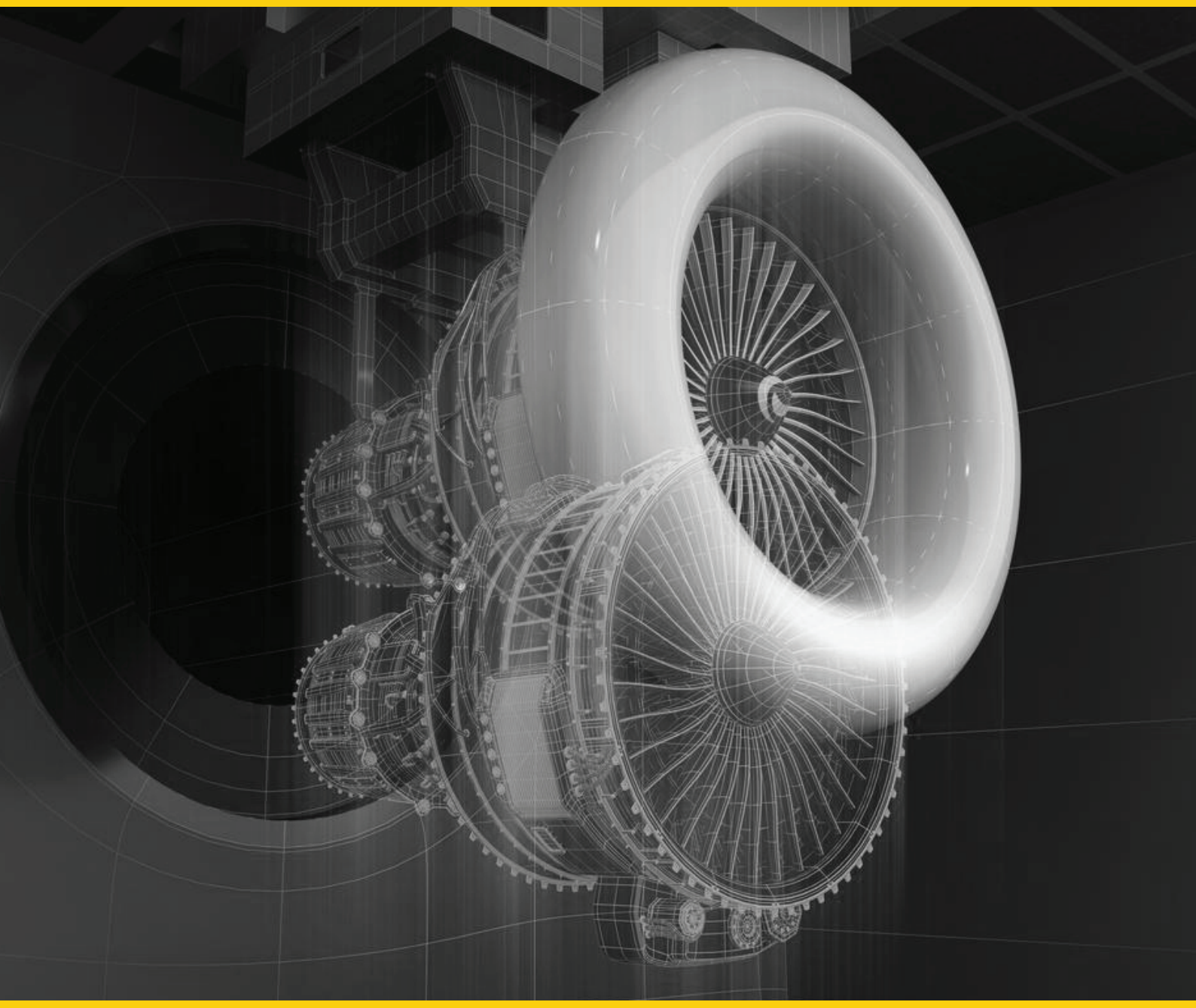
Digitalisation & Digital Twins:
Making the Most of Predictive Maintenance



Author: B. K. Sathish, Vice President and Global Head of Digital Engineering

Industrial engineering has significantly evolved over the decades, largely driven by continuous digital advancements. The foundation of such advances was laid by digitalisation that was accelerated by the digitisation of information, integration, and utilisation of digital tools, automation, connectivity, and analytics to optimise efficiency, productivity, quality, and safety to improve industrial processes, systems, and decision-making.

Digitalisation has had a profound effect on Original Equipment Manufacturers (OEMs). It has led to significant changes in how these companies design, manufacture, and distribute their products, as well as how they interact with their customers and suppliers. Historically, the introduction of Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) systems enabled engineers to design and model parts digitally, eliminating the need for physical prototypes. The 2000s saw the rise of the Internet, which opened up new avenues for collaboration and communication among design teams, suppliers, and customers.

In recent years, the fourth industrial revolution, or Industry 4.0, has brought new opportunities and challenges for OEMs. It involves the integration of digital technologies such as the Internet of Things (IoT), artificial intelligence (AI), big data analytics, and advanced robotics into the manufacturing process, allowing for even greater automation and efficiency.

Today, the Internet of Things (IoT), big data analytics, blockchain and AI, and other emerging technologies play a critical role in this digital evolution, contributing to the rise of "Digital Twins" and predictive maintenance.

1 Evolution and Implementation of Digital Twins

Digital Twins - dynamic, virtual replicas of physical systems - originated in the late 1960s when NASA began using mirrored systems to simulate conditions in space[1]. Over the years, as computational capacities expanded and IoT technologies matured, Digital Twins have become instrumental in modelling, monitoring, and optimising business operations in real-time.

The global Digital Twin market size was valued at USD 3.1 billion in 2020 and is projected to reach USD 48.2 billion by 2026[2]. Various industry leaders have employed Digital Twins to optimise operations.

2 Drivers and Hurdles of Digitalisation

The shift towards digitalisation and the creation of Digital Twins has several catalysts, including the rise of IoT, the need for efficient product design and production, and the growing demand for predictive maintenance. Furthermore, sustainability trends and the adoption of Industry 4.0 principles significantly contribute to this movement.

However, few notable hurdles exist. These include the absence of standardised data formats and protocols, cybersecurity threats, and significant initial investment in IT infrastructure and software[3]. Additionally, managing the massive data generated by Digital Twins requires advanced data analytics capabilities.

3 The Power of Predictive Maintenance

Predictive maintenance - proactively predicting and preventing equipment failures - has significantly gained ground, thanks to Digital Twins and emerging technologies. This maintenance model reduces operational costs, optimises replace-vs-repair decisions, and improves maintenance cost management.

Digital twins use real-time data and AI to predict potential breakdowns or faults before they occur. This foresight allows for strategic planning of maintenance, reducing downtime, increasing the lifespan of equipment, and optimising operational performance. Predictive maintenance powered by digital twins can dramatically decrease operating and maintenance costs in multiple ways.

The emergence of many cloud vendors/hyper-scalers in the IoT space and platform-as-a-service business models have helped in reducing the time required to implement the digital twin approach, thereby accelerating the digitalisation process.

The direct, tangible benefits include lower repair costs due to early detection of issues, minimised unplanned downtime, improved resource allocation, and extended asset lifespan. The use of digital twins can reduce unnecessary routine maintenance, instead enabling a more targeted, need-based approach.

Furthermore, this predictive approach also contributes to improved safety standards by foreseeing and preventing potential catastrophic failures. It also reduces wastage due to over-maintenance and helps companies avoid costs associated with overstocking spare parts, as requirements can be accurately predicted.

Aero-engine manufacturers, for example, utilise Digital Twins of jet engines to predict potential malfunctions, reducing operation costs and downtime. Similarly, mining companies use Digital Twins for predictive maintenance of their heavy machinery, enhancing operational efficiency.

4 Servitisation and New Revenue Models

The rise of predictive maintenance has given way to servitisation, where OEMs shift from selling products to providing comprehensive solutions. Servitisation has been transforming product-centric business models into one that combines products with value-added services. Here's how OEMs are leveraging servitisation to achieve these objectives:

1. **Pay-per-Use Models:** Instead of customers purchasing equipment, they pay based on actual usage, which allows for greater flexibility and scalability.

2. **Product Lifecycle Management:** This includes installation, maintenance, repairs, upgrades, and disposal/recycling services. By providing end-to-end support, OEMs ensure the optimal performance and longevity of their products, which helps reduce costs and downtime for customers.

3. **Performance-based Contracts:** Manufacturers supplying industrial equipment can charge based on the level of productivity, uptime, or energy efficiency delivered by the equipment. This incentivises both the OEM and the customer to work collaboratively to achieve the desired results.

4. **Data-driven Services:** By collecting and analysing data from connected products, manufacturers can provide insights, predictive maintenance, and optimisation recommendations to customers. These data-driven services help improve efficiency, reduce downtime, and enhance overall performance, creating additional revenue streams for OEMs.

5. **Asset Financing and Leasing:** Rather than purchasing equipment outright, OEMs' customers are increasingly exploring leasing or financing industrial equipment, paying regular instalments over a defined period. This allows customers to conserve capital, access the latest technologies, and easily upgrade or expand their equipment as needed.

This transition paves the path for new revenue models. Rolls-Royce's "Power-by-the-Hour" is a noteworthy example of this trend, where customers pay for engine usage instead of owning the engines.

Digital Twins and predictive maintenance strategies allow companies to transition from capital expenditure (CAPEX) to operational expenditure (OPEX) models. Companies can avoid substantial upfront costs by paying for services or usage instead, leading to more predictable and manageable OPEX.

Quest Global: Transforming Maintenance with Digital Twins

As a global leader in engineering and digitalisation, Quest Global has played a crucial role in driving the adoption of Digital Twins and predictive maintenance. By integrating IoT, AI, and machine learning, we have transformed clients' business models across various sectors.

In conclusion, although the digitalisation journey and the creation of Digital Twins are fraught with challenges, they hold immense potential for businesses. With leaders like Quest Global at the helm, companies can successfully navigate this transformative landscape.

References

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