Mini Review

iMedPub Journals
www.imedpub.com

American Journal of Computer Science and Information Technology

2021
Vol.9 No.3: 78

Plant Reliability, Safety, Sustainability with Digital Twin (AI)

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Citation: Pillai S (2021) Plant Reliability, Safety, Sustainability with Digital Twin (AI). J Comp Sci Info Technol Vol.9 No.3:78.

Abstract

The concept of digital transformation with 'Digital Twin's is about creating a digital representation of physical assets of a plant with 3D Intelligent model creation (governed by PDS, PDMS, SP, AUTOCAD, STAD, CAE and CAM software), as well as the enterprise and product lifecycle data management applications (SAP, WRENCH, project lifecycle/data management-CMMS and other software). This will be supported by AI (Artificial Intelligence) algorithms and adoption of IIoT (Internet of Things), smart sensors, which help in providing an integrated understanding of the production cycle. This Operational Twin correlates and threads real time streaming IOT data together with all other inputs, which eventually creates a dynamic virtual representation of the entire plant, which will give full visibility of the multi-layered interdependencies among asset, processes and operations. This will give insight into the complete manufacturing analytics and predictive analysis of the asset but also enables in quickly running through the historian data, with the objective of achieving plant safety, reliability and Sustainability.

Keywords: Digital twin; Data analytics; Smart sensors; Transmitters

Received: March 03, 2021; **Accepted date:** March 17, 2021; **Published date:** March 24, 2021

Introduction

Digital twins are used throughout the asset lifecycle to simulate, predict, and optimize the equipment performance and production system before investing in real physical assets.

By incorporating multi-level simulation, data analytics, and machine learning capabilities, digital twins can demonstrate the impact of design changes, real time scenarios, environmental conditions, energy management and other variables, reducing development time, and improving quality of the final product or process.

Asset Information Management-Digital Twin is designed to deploy evolving technologies such as Artificial Intelligence and Machine Learning to analyse tasks and learn and evolve from experience. The data generated in the process is continuously analyzed and saved in the cloud [1].

Predictive Analysis

Digital Twin enables the maintenance team or operations team, in predicting the asset performance, which supports asset lifecycle management; thus, preventing failures of industrial machines.

IT

OT Convergence Digital Twin's provides a complete solution to plant reliability. In other words, it enables convergence of technology such as Big Data, ML, Cloud Computing, AI, and IIoT.

Industrial Internet of Things (IIoT)

The network-controlled management could be even Wi-Fi enabled, of electronic devices with smart sensors, transmitters-for instance, the monitoring of a pump performance. Smart sensors make the automation of remote systems management possible. A combination of software (PLC/DCS/ESD/SCADA), smart sensors, and the network with smart gateways for meeting communication protocols, facilitates an exchange of data between objects and mechanisms from multiple global vendors. The result increases system efficiency and improves performance monitoring with better energy management. Transparency ensures that the details of data flows, such as who, what, when and where has accessed the data, are visible. This could create greater interest in design and quality control and potentially speed up the process of learning from defects/malfunctions and accidents [2].

Methodology

The process of engineering, procurement, and construction (EPCM) project execution uses vast amount of diversified technical information from multiple entities and software applications/platforms. A means to seamlessly integrate the various sources of data, including licensor data and display this information on a real time basis is envisaged. Intelligent systems enable the business through information and technology with necessary IT infrastructure/Operations Technology (OT) makes it easier to separate IT from the rest of the business applications. Enablement means creating an eco-friendly environment for

successful implementation to drive operational excellence accuracy/quality, efficiency, capture all data (Big Data) and hence productivity/business excellence.

This approach would eventually eliminate the need for regular physical inspections with on-going, real time monitoring and analysis. It combines a standard engineering methodology for analysis based on sensor data with an intelligent 3D plant model to provide visualized engineering insights [3,2]. This can increase operational efficiency by connecting real-time engineering data both to the key business processes and to other asset integrity management solutions, for predictive and proactive maintenance.

Smart equipment's and smart manufacturing plants generate massive amounts of data regarding their utilization and effectiveness. The performance digital twin captures this data from equipment's and plants in operation and analyses it to provide actionable insight for informed decision making

Smart, connected assets (IIOT) are driving operational efficiency, Overall Equipment Efficiency (OEE) performance gains, productivity, and energy management and business improvements. This has been made possible with the evolving of digital twin (digital thread -the digital twins getting interwoven) that ties together engineering design intelligent models, predictive and prescriptive analytics, and overall performance with greater plant reliability [4].

Process automation has enabled the team to focus on more strategic tasks; innovation and creativity, reducing/minimizing the repetitive process/efforts. It also created streams of data (using database with Oracle, FoxPro, Access) that can be useful later on similar projects and data analytics.

The tools developed for process improvements, that automate/virtualize individual work process, while implemented for cost reasons, have become powerful enablers for knowledge sharing. But it also requires a vision for what processes/parts of the business to be taken up for automation and transformation; the way business processes are executed within and across organizational sub verticals, serving customers [5,6].

The digital activities presented good opportunities for the business for transforming key areas of the business: customer centric focus/experience, operational processes/excellence and business models. (with IT, OT, IOT, IIOT, Analytics, SAP, ERP, EAM, Smart Engineering/manufacturing, cloud, next gen technologies). And better understanding of each of these digital fronts of technology helped to transform the business. This enabled business in integrating customer specific data to provide more customized solutions, service and product packages [6-8].

The process starts with taking advantage of the existing systems to gain an in- depth understanding and insight of specific business, geographies and market segments; augmenting and seamlessly integrating with new technologies and applications. With these aspects of transformation, there are very strong benefits from transforming internal processes through process improvements/digitization, employee capability/skill enhancement/enablement and quality/performance management.

Results

CMMS (Computerized Material Management System) solution designed to help organizations track and maintain equipment/spares, vehicles, buildings, inventory, and other assets on a real time basis. The company's existing maintenance data can be imported from the legacy system (Excel file) directly into the database/system. Users can even import equipment maintenance data (with GPS locations). The benefits of using such approach includes maintaining service ability, ability to manage the full lifecycle of each asset, improved productivity, reduced expenses, and the capability to make better business and maintenance decisions (with cloud system) [7,8].

Reducing downtime

Tracking maintenance backlog, increasing the reliability of assets, scheduling more preventive maintenance, making repairs and inspections easier.

Cost control

Control over inventory, avoid manufacturing scrap and rework, track and report on maintenance costs, save energy.

Increasing efficiency

Optimize maintenance schedule, automate work requests, standardize maintenance processes, improve access to maintenance resources.

Collecting data and information

Track maintenance metrics, report on relevant KPIs, collect real-time work order updates, access historical equipment.

Production-heavy facilities are steadily moving to this new reality and learning to integrate digital technology into their maintenance operation. As Industry 4.0 and digital transformation becomes the new standard for the industry, the focus for maintenance teams will be on optimizing these systems. Setting up maintenance software programs (CMMS) and implementing it successfully, organizations start discovering the advantages of integrating maintenance into their business transformation strategy, it will become important to change/transform the organization culture that embraces CMMS solution/strategy and continuously look for ways to optimize it [9].

Conclusion

The five main areas in which going digital can impact the long-term success of a company- revenue, efficiency, data management, reliability and safety. Digital solutions allow maintenance teams to track measure and optimize every element affecting the bottom line. Updated methods eliminate many of the costly, time-consuming inefficiencies associated with managing maintenance the old legacy way. Going digital provides a platform to collect, store and access maintenance information anywhere, at any time. When assets are reliable, they produce more value and use fewer

resources. Safety has a profound effect on a company's success.

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