PLANT RELIABILITY/SUSTAINABILITY WITH DIGITAL TWIN

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 and other software). This will be supported by AI (Artificial Intelligence) algorithms and adoption of IIoT (Internet of Things), smart sensors, which helps in providing an integrated understanding of the production cycle. This Operational Twin corelates 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 multilayered 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.**

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, and other variables, reducing development time, and improving quality of the final product or process.



Some of the features that make 'Digital Twins' a major breakthrough-.

- Asset Information Management.

Digital Twin is designed to deploy evolving technologies such as Artificial Intelligence and Machine Learning to analyze tasks and learn and evolve from experience. The data generated in the process is continuously analyzed and saved in the cloud.

- 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)

- 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

This approach would eventually eliminate the need for regular physical inspections with ongoing, 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. 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 analyzes it to provide actionable insight for informed decision making

Smart, connected assets (IIOT) are driving operational efficiency, overall equipment efficiency (OEE) performance gains, productivity, 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.

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

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.

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, 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.

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.

Digital Twins for Smart manufacturing with Reliability

Latest trend in industries and manufacturing is the need to improve on Energy Efficiency, reduction in Energy Consumption.

The Smart Motor Concept helps to get the motors under control, anytime and anywhere, with a cloud connection and data analysis, the motors are part of the digital enterprise. Complete transparency in production processes and the ability to manage fleet efficiently is ascertained. The motor's operating state is monitored and can detect potential failures through asset data.

For example, with **Smart pumps** -

- Achieving Zero Downtime and optimize utilization
- Improve Energy Efficiency, by monitoring how much energy had been consumed
- Monitoring the current consumption of the Motor/Pump via a Smart Devices connected to Pump
- From the smart device, monitor the Power consumption of the equipment, and thus understand the equipment energy efficiency.
- A fault in the pump choke/jamming fault which cause the current consumption to increase gradually.
- As there is a fault in the Pump A, the standby pump B take over to prevent download time.

- When the current consumption is abnormal, an email is triggered. Configured to a hand phone/computer/ IPAD or Android PAD which can display message.

Boilers (viz. Effimax 3000/Forbes)

- Online Boiler Efficiency Analyzer,
- Calculates Boiler's indirect Efficiency & Steam to Fuel ratio,
- Break up of all boiler losses (Stack Loss, Blow down Loss, Enthalpy Loss, Radiation Loss), Automatic Blow Down control,
- Monitors Steam Flow, Fuel Flow, % O2 Feed Water Temp., Stack Temp Steam Pressure,
- Real time Summary Report,
- Trending of Key parameters w.r.t Load.

Intelligent Building management system (IBMS)

Designing intelligent building management and security systems that deliver solutions for HVAC, access control, video surveillance, lighting control and energy efficiency. An integrated approach that unites multiple systems on one network, from a single software platform. Once integrated, data from those systems is assimilated and converted into information that empowers decisions and actions that enhance efficiency, comfort for building occupants and owners. A case study has given 10 – 15 % energy saving (HVAC) with a payback period of 1 year (with Demand flow model /Seimens).

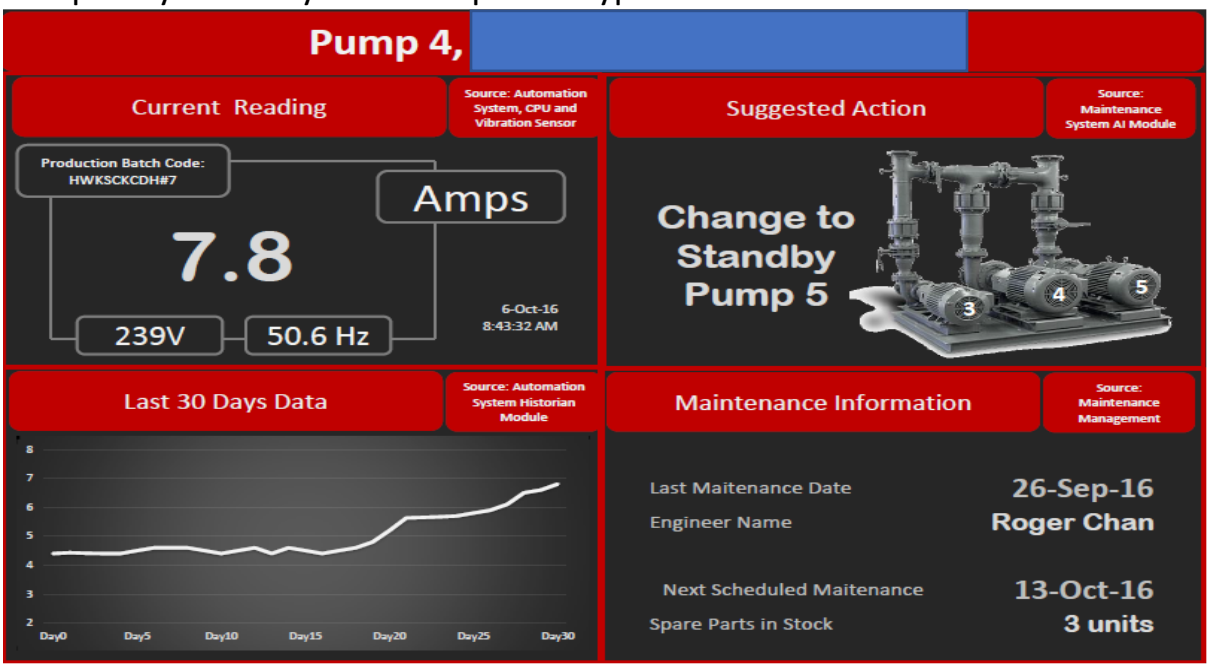
Energy monitoring with Intelligent MCC (iMCC)

Use of open networks, distributed I/O's, and electronic components is one way of defining an MCC as intelligent. Typically, intelligent systems -

- Control is achieved through a microprocessor-based system
- Network technology is used to replace hardwiring (inlc. Wireless)
- Some degree of enhanced diagnostic or protective functionality is Included as per process requirement.

Intelligent devices imbedded in the MCC not only provide network communications, but extensive functionality not available on standard devices, such as network configuration, diagnostics, extensive process information, and advanced protection for each unit. Significant technical expertise is required, but the systems have excellent life-cycle benefits in process applications where the additional information, diagnostics, and predictive features easily justify the incremental cost of the equipment.

Intelligent MCCs requires taking into consideration the cost variables, capability, and complexity. Therefore, it is important to realistically assess the capabilities and objectives, as any additional functionality comes with additional cost or complexity that may not be required. Typical – dash board.



SMART JUNCTION BOX

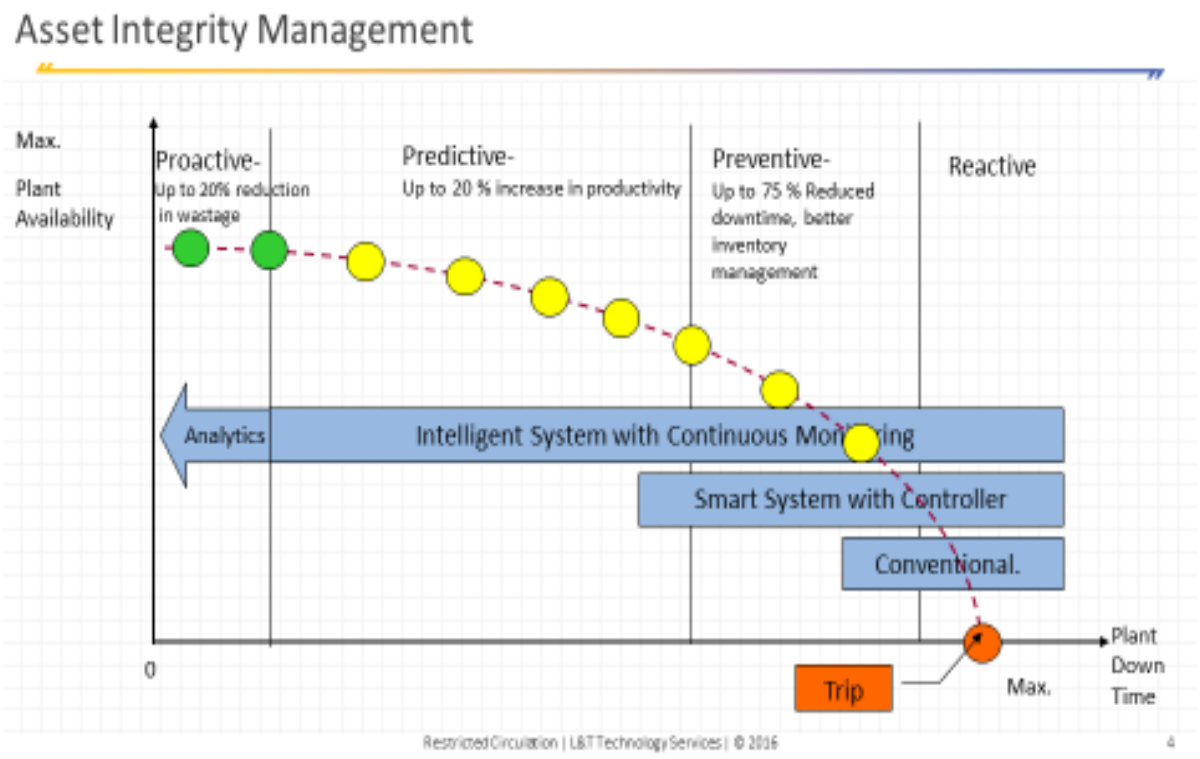
- Add Flexibility to the Schedule
- Achieve Good Design While Reducing Costs
- Connect in the Field and reduce cost
- I/O on Demand Increases Operational Flexibility
- Reduce Schedule and Risk
- Receive Proactive Alerts
- Reduce system footprint:

- Equipment room footprint is greatly reduced by replacing traditional marshalling cabinets with field mounted I/O
- Eliminate I/O home run cables:
- Field instrumentation wiring is reduced to the signal pair that connects the field device to the Field Enclosure.
- Save on home run multi-core cables, cable trays, associated engineering, and documentations.
- Significantly reduce cabinet design engineering

Compressor - *Air System Flow Control* (viz. *IntelliFlow)*

- High capacity, low pressure drop
- Electronic control (standard)
- Mounted dual pressure sensors
- Forward, backpressure and combination control
- Mounted c-UL NEMA 12 panel
- Multiple pressure set points
- Network communication ready

Asset Integrity Management for Process plants.



References-

- GE PREDIX – Process management with IIOT (refinery)
- Mindsphere – SIEMENS, process management
- EMERSON – Advanced process control management (APC -Smart refinery)
- Wonderware – Schneider electric –energy management
- ABB – Smart sensors for LV motors
- Ability – ABB – power sector
- SIEMENS – IBMS (intelligent building management system)
- Effimax – Boilers – Forbes Marshall
- Intelliflow – Air compressor (Ingersoll Rand)
- IMCC – Intelligent Motor control center
- Smart junction box – Emerson
- Smart pump – Rockwell Automation
- Meridium – Emerson asset integrity management (refinery)

- IBM Maximo – Plant maintenance
- APC – Asset management – AspenTech
- IOT/IIOT- EUROTECH (OT + IT integration); CISCO (IOT)
- SAP HANA – IT+OT integration
- IIOT- for motors with smart phone – ABB
- DCS / ESD – Honeywell (connected performance services), Yokogawa, ABB
- Digital Twin - UniSim (Honeywell), SIEMENS, SAP, GE Predix, Romeo (AVEVA), SPHERA (ORM)
- Cloud- DaaS, SaaS, PaaS, IaaS
- Data infrastructure- IBM BLUEMIX, GOOGLE CLOUD, MICROSOFT AZURE
- Software – PDS/PDMS/SMART PLANT/ AUTOPLANT/COMOS

Recognitions-

- Finalist at Hydrocarbon processing awards, - Best Automation and Modeling, Vienna, 2017.
- Finalist at Digital Technology Leader awards UK, 2017. (Process/Plant Engineering)
- Finalist at Cloud Technology awards, UK, 2017. (PDS/PDMS/Oracle projects on Cloud)
- Eminent Engineers Awards, Engineering Council of India - Finalist, 2017.
- **Winner,** Big Data World Awards, (EPCM projects), Hong Kong, 2017.
- **Winner**, Digital Transformation Awards -Plant Engineering, IDC India, 2017.
- Finalist, SaaS Awards, UK 2017.
- Finalist, Technology company of year, AEMT awards, UK, 2017.
- EGYPS, Egypt Petroleum show, 2018; Article Digital transformation/connected technologies.
- BTOES18, Orlando; Business Transformation and Operational Excellence.
- Eastern Mediterranean Gas Conference 2018, Cyprus.
- Finalist, DEVOPS Excellence awards, UK, 2018. Leader of the year, Digital Transformation.
- **Winner**- Digital Engineering Leader of the year, Award at Best Enterprising brands/leaders India 2018.
- **Big CIO** 100 Awards India 2018
- Finalist –Computing Big Data Excellence awards 2018, UK.
- Finalist- Digital Technology Leaders Awards, 2018, UK
- **I2OR** Award – Digital Engineering 2018.
- Finalist- Computing Cloud Excellence awards, UK 2018
- Finalist- Analytics professional of the year, UK 2018.
- Shortlist- Technology Hero of the year, Technology products award, 2018.
- British Engineering Excellence awards, Finalist ,BEEA UK 2018.
- Computing Security excellence awards, UK 2018, Shortlist.
- Finalist, DEVOPS Excellence awards, UK, 2019.
- D.Litt., Hon. Doctorate, University of Entrepreneurship and Technology, Delaware USA,2019.
- Shortlist - AIM awards, UK 2019.

- Approved Poster Presentation at BTOES 2019
- Finalist Digital leadership awards, India 2019

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