

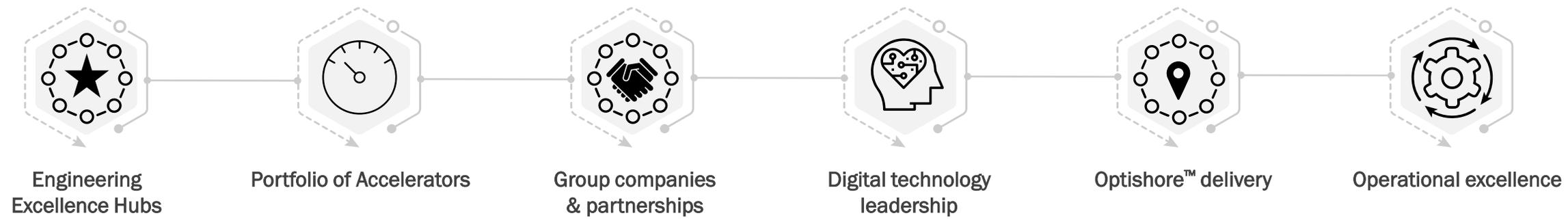
Tech Mahindra's Digital Offerings

Connected World. Connected Experiences.

Tech M Integrated Engineering Services



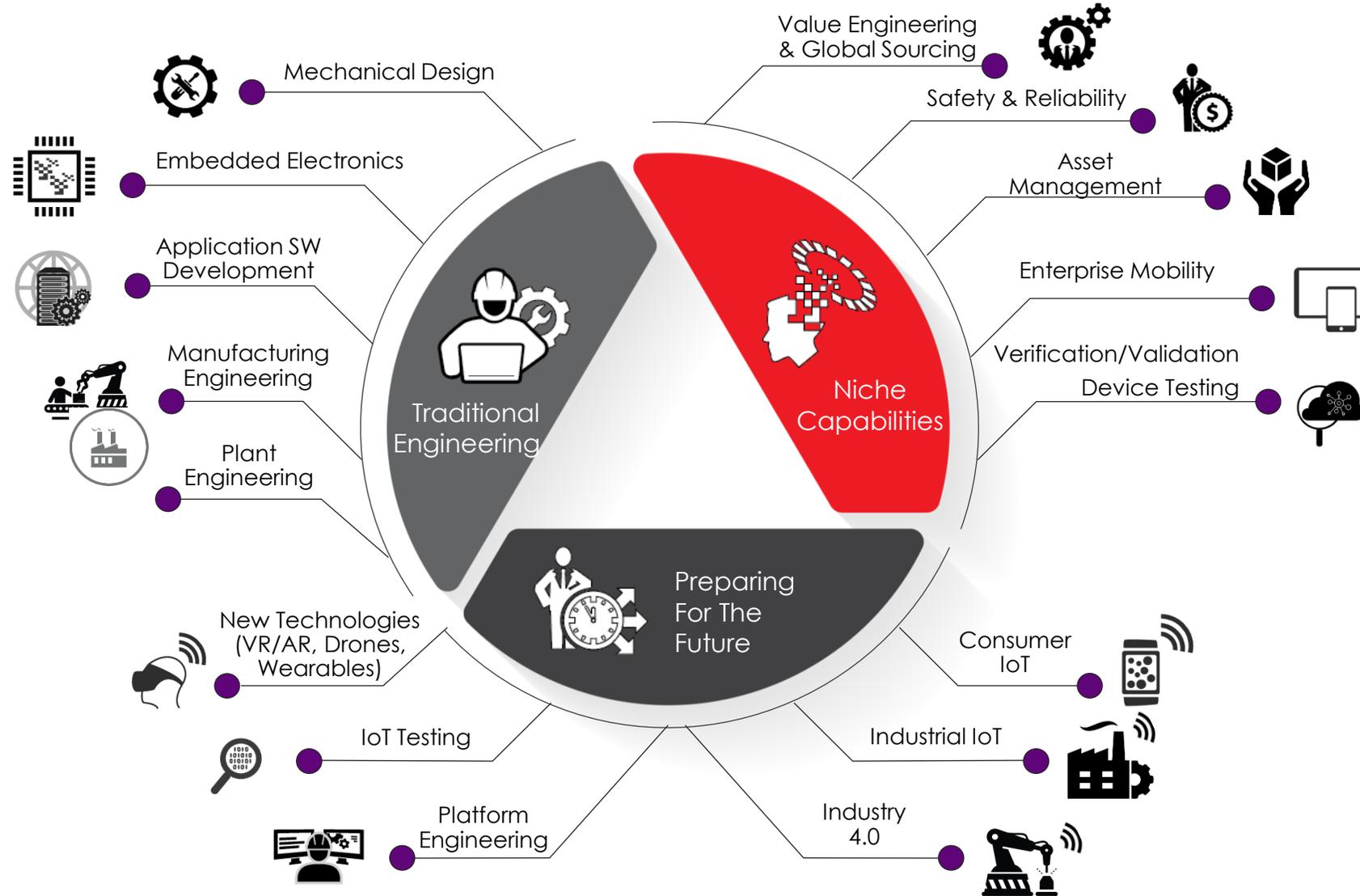
Our engineering prowess



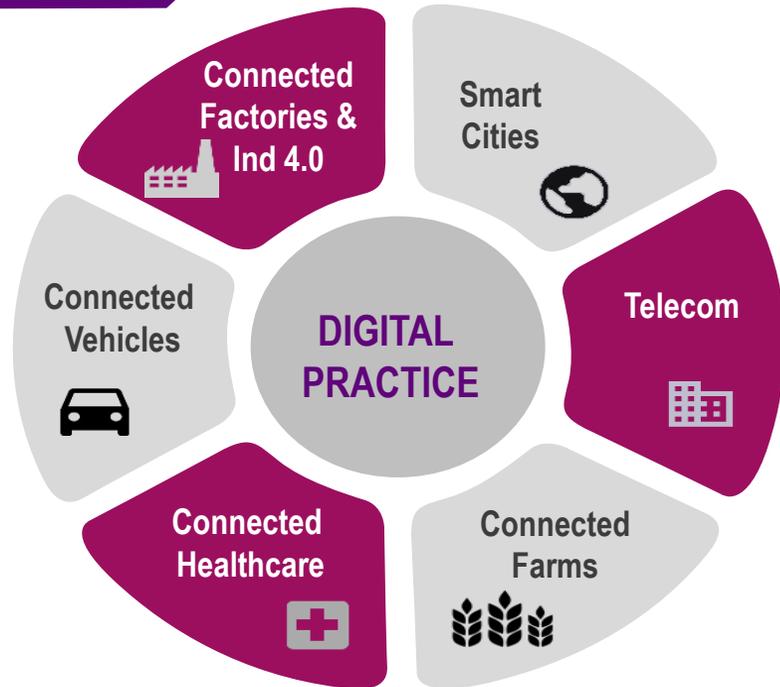
Expertise across 9 key engineering domains

Aerospace | Automotive | Discrete Industrial & Manufacturing | Energy & Utilities | Healthcare | ISV & Internet | Smart Cities | Telecom | Transportation

Our Capabilities Straddle The Entire Value Chain



IOT EXPERIENCE



OUR PHILOSOPHY

DESIGN | **E**NGINEERING | **D**IGITAL | **C**ONSULTING

OUR E2E IOT CAPABILITY



LAB & COEs



WE LEAD ON STRATEGY, CREATIVITY INNOVATION



'Leaders' in 17 of 20 Digital Quadrants

Leader in Engineering & Digital

IMPLEMENTATION



Winners Circle – IoT Services, High Performer in Analytics



Star Performer – Digital Services

COMPLEX INDUSTRIES



Niche - Magic Quadrant for Data & Analytics



Major Players - Key Service Providers in Business Analytics

ANALYST MENTIONS



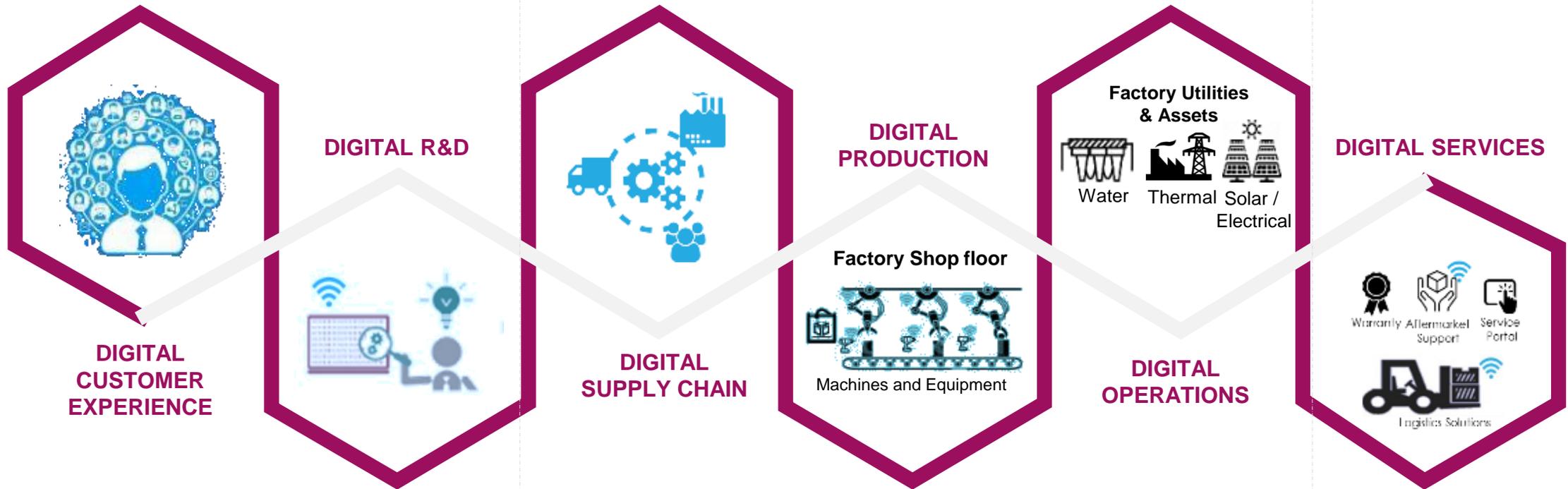
Leader in Analytics

Digital Engineering – Across Product Value Chain

Smart Products /
Connected Products

Smart Manufacturing /
Industry 4.0

Smart Services /
After Markets



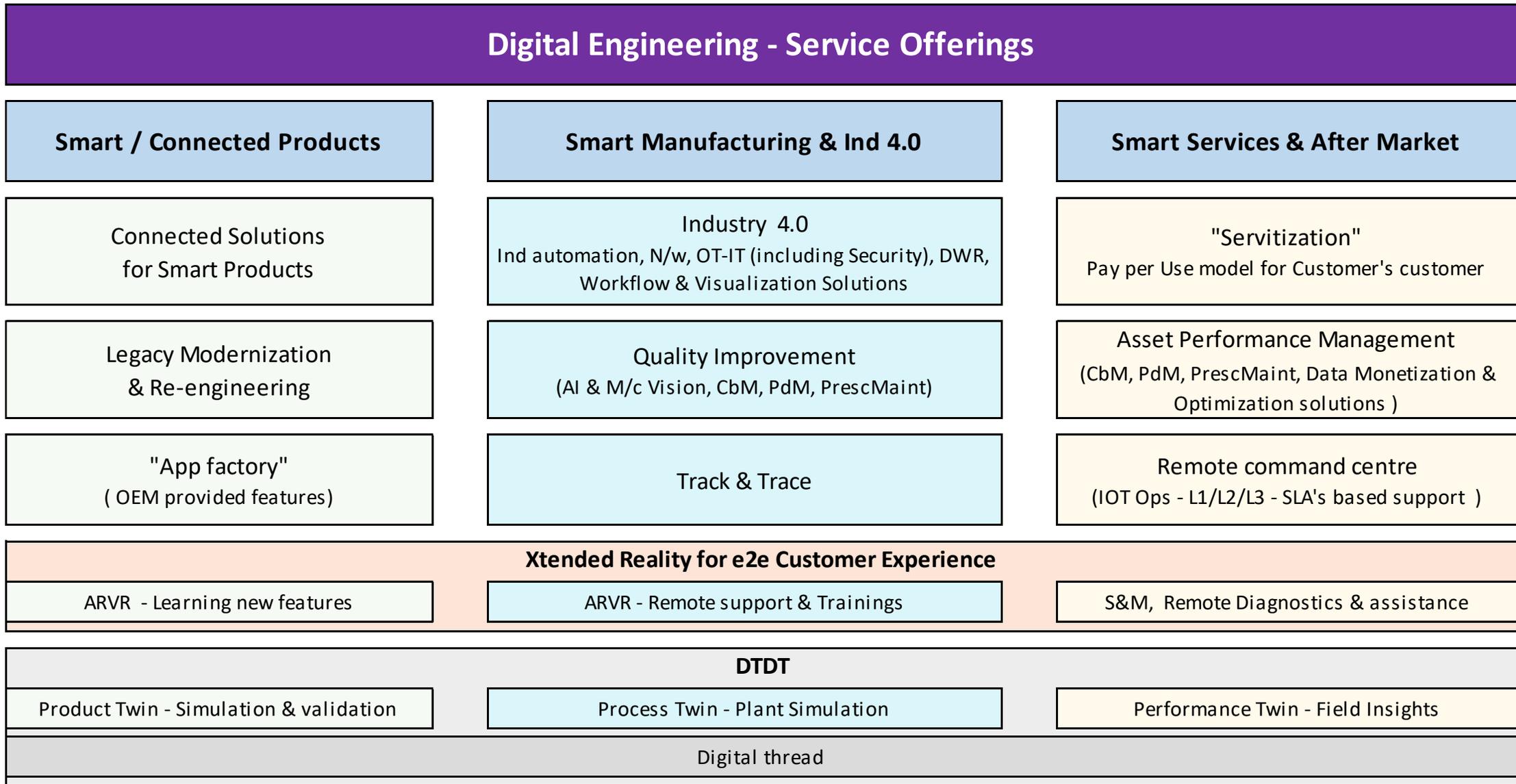
AI Toolkit

Heat map of Opportunity within Manufacturing Industry
Multiple Success stories across – Business Support function,
Procurement, Mfg., Logistics & Warehousing, After Sales support

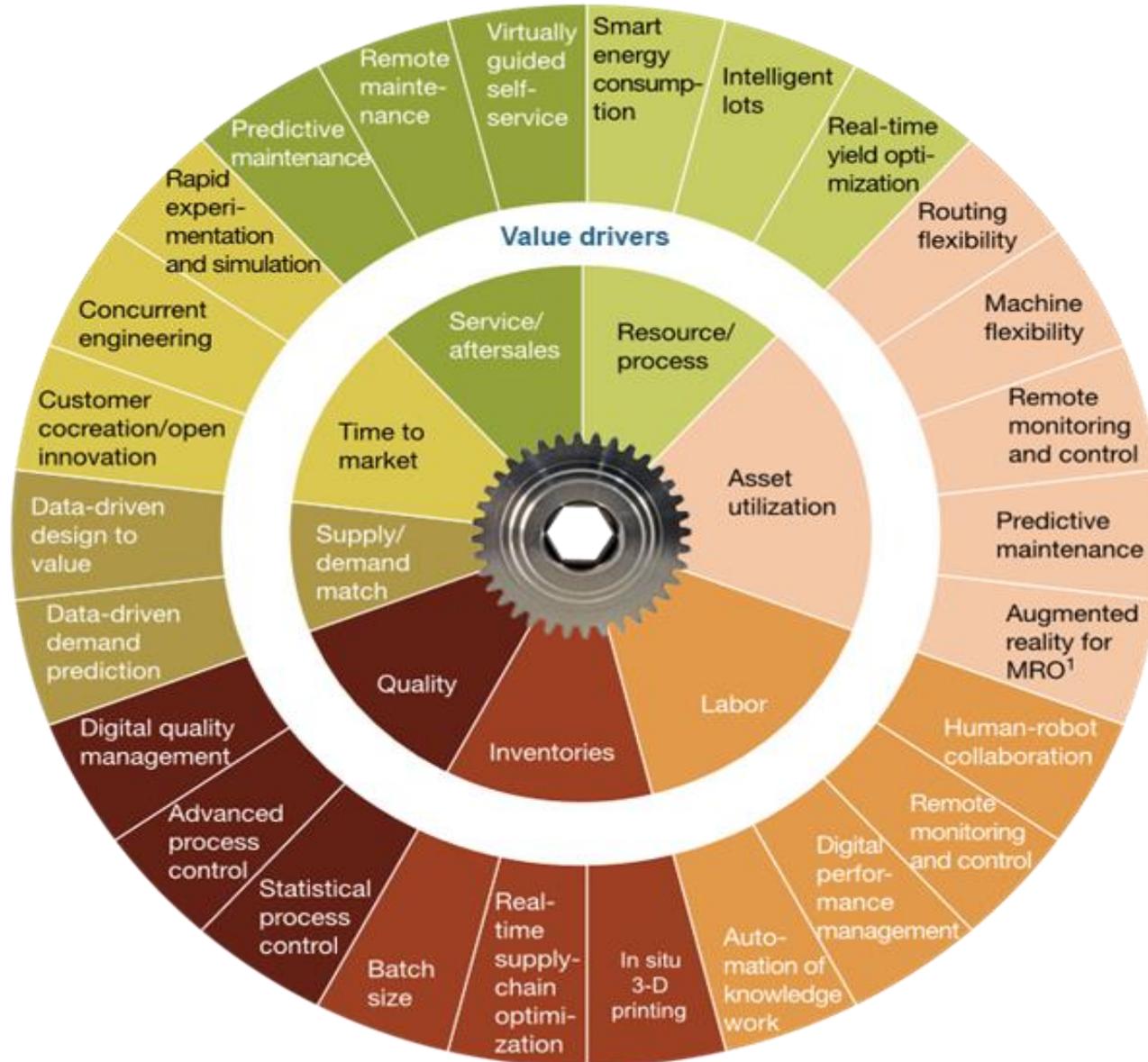
Tools & Platform

- Factory and Security Assessment Toolkit
- Reusable Middleware component
- Process fleet manager framework





TechM experience across various Industrial IOT use-cases





Digital Case Studies
across verticals &
use cases

Case study: Remote monitoring & Diagnostics for Steam Turbine

Overview

- Remote Service Platform (End- End SW Framework)
- Smart Electronics platform for sensors and controls interface
- Open standards based communication interfaces
- Enterprise Mobility Service Platform

Business Objectives /Benefits

- **Real-time Asset Health & Performance Monitoring**
- **Reduction in Breakdowns & Unplanned Maintenance**
- **Central Command & Control Center for Global Asset Monitoring**

Functions & Features

- Retrofit Sensors and controls network
- SCADA protocols (MODBUS, DNP, IEC, PROFIBUS, etc)
- SCADA to OPC conversion
- Ecosystem for Customized M2M requirement
- Engineering Analytics Framework



Solution Scope

- Co-development of End-to-End Framework on Predix Platform
- Clod based Dashboard Visualization
- Operationalization & running of the central Command & Control Center

Benefits to end user

- Real-time Insights into Asset Health & Performance
- Timely alert & Remote assistance from Central Command Center



PRODUCT DESIGN

- Virtual design review
- Ergonomics study



Design efficiency

- Reduced design cycle time
- Reduced prototype cost



MANUFACTURING

- Training
- AR works instructions
- Vision Picking



Efficient field team

- Improve training efficiency & safety
- Improved productivity
- Reduced errors



SALES & MARKETING

- Virtual showrooms
- Virtual product presentation



Customer experience

- Reduce sales cycle time
- Enhanced customer experience



SERVICE & MAINTENANCE

- See-What-I-See
- AR maintenance instructions



Remote maintenance

- Improve asset utilization
- Reduce maintenance cost
- Reduce machine downtime



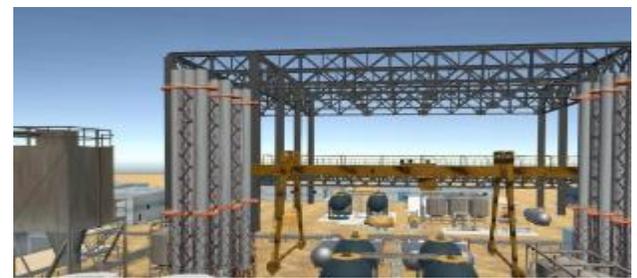
AR Solution for the reduction of Service Costs

- Objectives**
- Experts are traveling to site to help the onsite technicians to fix the issues
- Solution**
- Use of AR solution and Vuzix Smart Glasses to connect the technician to expert in real-time and get assistance/guidance
 - Step by step inspection, maintenance AR work flow including videos
- Achievement**
- Up to 50% of the issues solved remotely by expert engineers
 - Reduced mean time to repair up to 30%



AR Solution to improve the Turnaround time

- Objectives**
- High equipment maintenance and installation costs with high turnaround times
- Solution**
- Use of AR solution and Realwear Smart Glasses to connect the technician to his line manager in real-time and get assistance/guidance
 - Collate all the data (videos, pictures, comments) by onsite technicians for automated installation/maintenance report generation
- Achievement**
- Reduced Issue resolution time up to 30% leading to faster turnaround for customer
 - Faster on boarding of new technicians with training on job using AR



Improving Worker Safety using Virtual Trainings

- Objectives**
- To improve safety and efficiency of O&G field operators using effective means of virtual training
- Solution**
- Immersive and interactive training module on safety procedures at the refinery
 - Virtual walk through of the refinery in a life size 3D environment
- Achievement**
- Improve safety and performance of field operator
 - Reduce risk for field operator during training process

Case study: Product Twin for a Micro Factory & Sub-systems

Overview

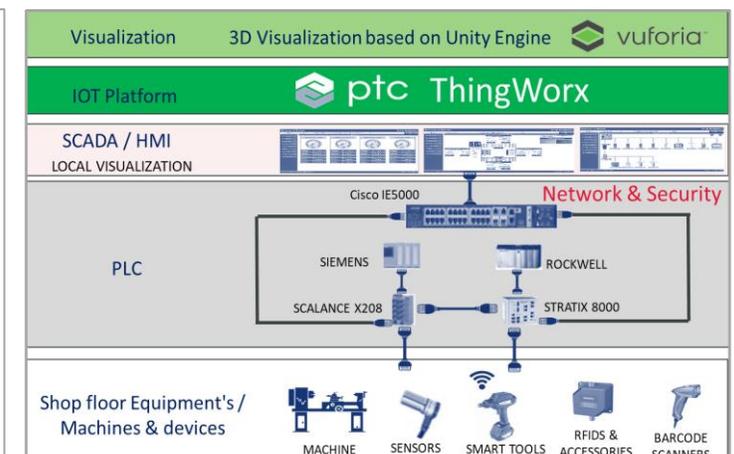
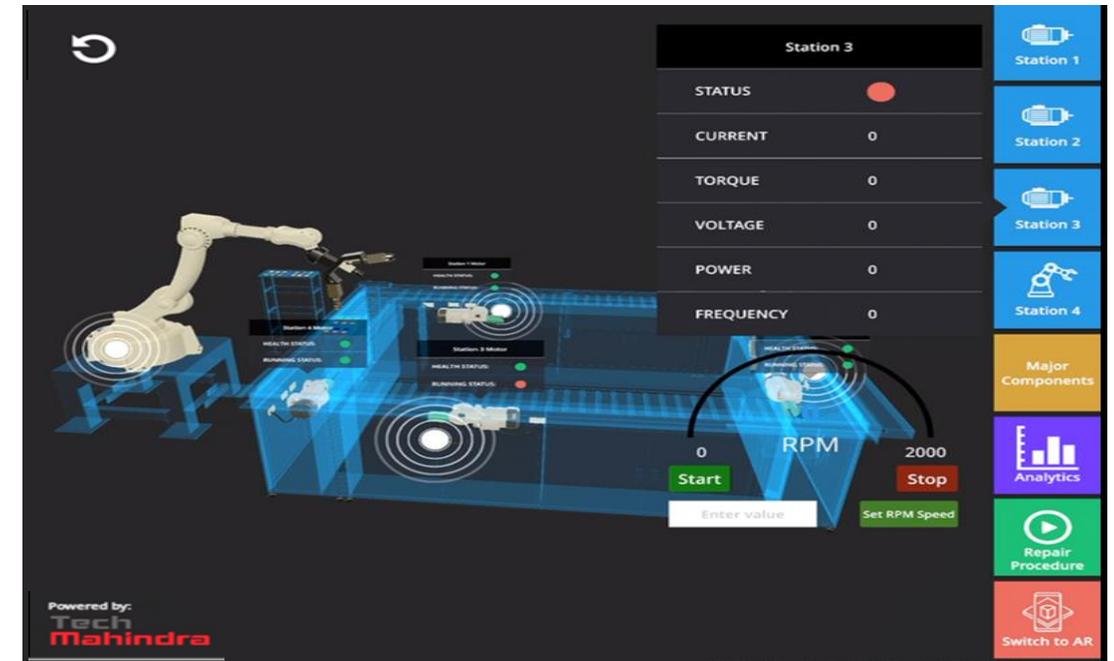
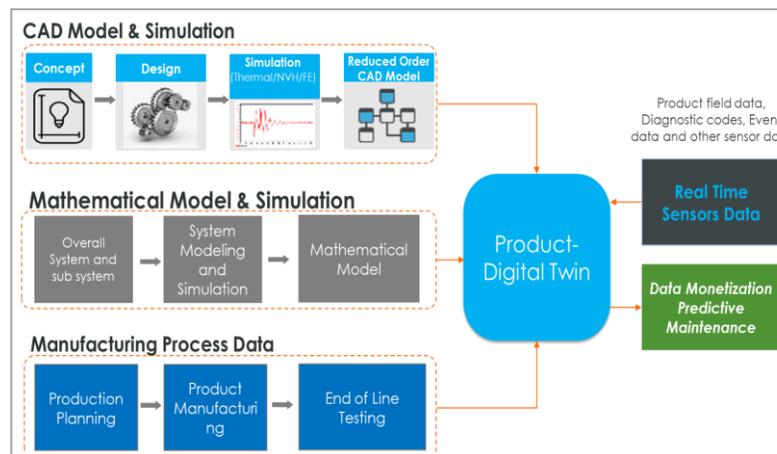
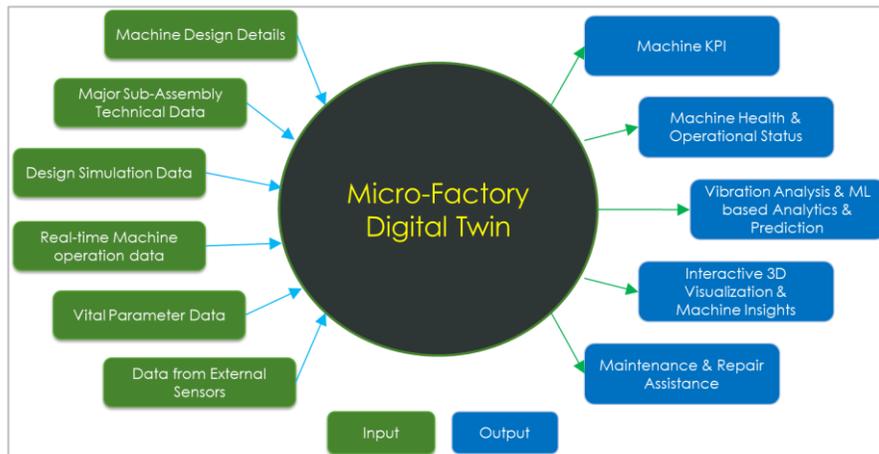
- End to End Digital Twin solution for a Micro Factory

Business Objectives /Benefits

Single Solution offering

- Remote Monitoring & Control of Machine
- Real-time Insights into
 - Machine Health, Performance & KPIs
 - Health & Operational Status of Major Subsystems
- Failure Prediction & CBM Analytics
- Interactive 3D & AR based Visualization
- Repair / Maintenance Assistance

Functions & Features



Case study: Predictive Analytics Modelling for Mining Equipment

Overview

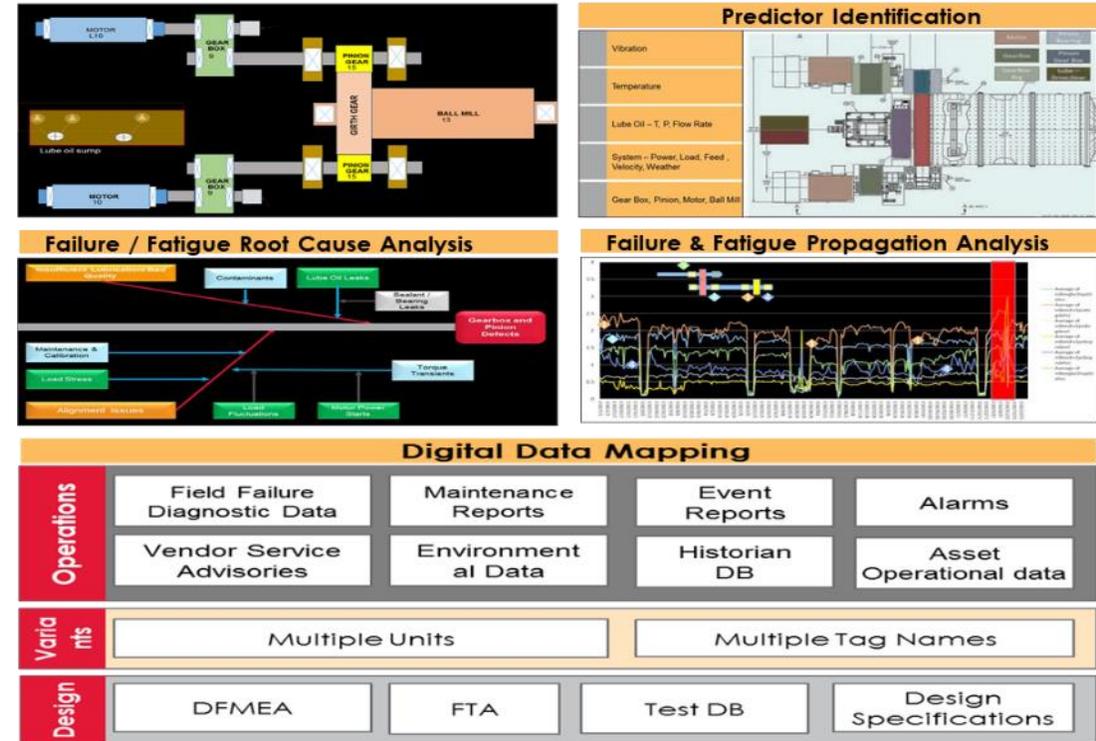
- Predictive Analytic models to forecast failures and root causes in gear-boxes, pinions & bearings, at least six months in advance
- Equipment Details & Problem Statement
 - 16 MW powered mining equipment
 - Only 2 global spares providers
 - \$1.5 M/day loss due to unplanned shutdown

Business Objectives /Benefits

- Increased Availability & OEE of Machines
- Reduction in Breakdown & un-planned Maintenance
- Reduction in Spares & Inventory

Functions & Features

- ▣ Predictive Analytics & Modelling for
 - ▣ 4 units + 8 failure events (4 unique failures)
 - ▣ 160 parameters/unit with 1 second resolution
 - ▣ 640 historian files
 - ▣ 220 GB of Data



Solution Scope

- ▣ Data Analysis & Data Ingestion
- ▣ Data Processing
- ▣ Modelling and Validation.

Benefits to end user

- ▣ Insights into Equipment, associated Failures (Technical & Statistical) & respective Root Causes
- ▣ Failure Prediction based on the Engineering Design & Machine FMEA

Aero



Digital thread for Aero Tier 1

Catalogue based model

Collaboration platform integrating – MES, ERP, Project & requirement mgmt. tools, Design, validation and quality mgmt. tools

Reduce development lead time, effort and scrap



Virtual Airplane Authoring Suite for American Aircraft OEM

Flight Simulator /3D Modelling/ MATLAB-Simulink interaction with Web and Data Analytics (Web Pilot Training)

Compliance with FAA regulations / Predictive Modelling for Aircraft Performance / Pilot Behaviour – Reduced TCO



CBM & PdM for Italian Aero supplier

Catalogue based model

Sensorisation
Machine Connectivity
CBM, PdM & Visualization

Reduce maintenance & Inventory cost, Improved uptime



Process Fleet Manager for Europe based Aero Manufacturer

IoT based automated work flow mgmt. & work activity monitoring

Enable aircraft production rate from 600/year to 800 /year along with Maximo integration



70+ Aircraft for NA based Aviation company

Joint investment & Revenue share

Real time health monitoring of aircraft component / engine.

Improved turnaround time and ground crew productivity



AR/VR based Maintenance training European Aero OEM

AR/VR based virtual interactive and immersive training technician using smart glass

Train multiple scenarios and effective evaluation

Process

Digital solution for S. African Mining customer

CoE - Model

Digitalize & Automate Operations in the mine and associated plant including Asset health monitoring and control

Increased production optimization

Process variation monitoring for US Roofing Manufacturer

Connect and collect the data from PLCs
Configure historian and store the data
Integration of Enterprise systems

Reduce the process variation and scrap



Connected supply chain for Australian construction material manufacturer

Fixed bid with complete ownership

Vehicle tracking, driver fatigue monitoring integration with planning & scheduling tools

360 deg visibility and Improved Productivity

Digital Factory : 130+ plant for Japanese Auto Tier1

Hybrid (Fixed for dev + T&M for support)



IOT Data Server for E2E Plant Process Monitoring through Machine Connectivity & Big Data Analytics

Improved productivity, efficiency and Flexibility

Digital transformation of plant for US based Truck manufacturer

Outcome based model



Business & technology consulting, usecase finalization, project charter creation & implementation

Improvement in cost of Quality, OEE and operational efficiency

Connected car for S.Korean premium Auto OEM (50K+ vehicles)

Joint IP



Remote control (HVAC, windows, Engine ON/OFF), Assistance, remote diagnosis and OTA

New revenue channel & better user experience

CBM & PdM for Indian Tractor Manufacturing plant



Condition Based monitoring & Predictive Maintenance of 20+ year old legacy Machines

Reduce downtime and improved productivity

Vision based paint quality check for 2-wheeler manufacturer

Hybrid (Fixed for dev + T&M for support)



ML to detect the defects in paint Quality inspection of 2-wheeler fuel tanks

Reduce rework & standardize inspection process.

Unified platform for Indian Auto OEM (20K+ vehicles)

Joint IP + revenue share



Solution catering to trucks, tractors, LCV, etc. – Geofence, route planning, driver behavior, health

20% increase in utilization, 15% reduction in fuel expense for fleet operators

Spot welding analysis for Sweden based Auto manufacturer



Machine connectivity to monitor process parameters trend and forecast welding fault

Reduce faults and quality inspection time

Frontline 4.0 for Japanese Auto Tier 1



AR remote assist solution for onsite technician using smart glass for real time collaboration

Reduce SME travel costs and On-job training for new technicians

Frontline 4.0 for US based Auto OEM



Remote maintenance for the dealership network across globe using AR/VR solution

Reduce SME travel costs and On-job training for new technicians

Digital twin for Industrial Motors for Japan Manufacturer



Hybrid (Dev. In Fixed + Support in T&M)

Sensor & gateway development
Condition Based monitoring &
Predictive Maintenance

Improved sales revenue & Reduce
downtime by 15%

Connected product for US motion and control technology leader

Gateway Application with OPC UA
Protocols. Product line custom application -
Filtration health, Press Analytics, HPU unit
health

Better support Aftermarket and Support
Increased Revenue

Connected Electric 2-wheeler for USA OEM



Fixed Bid

Remote location monitoring,
Route history, trip planning,
battery management & OTA

Enable new business model (e.g. PAYD)

Indoor Asset tracking solution for US appliance manufacturer

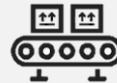


Subscription based model

10,000+ asset tracking across
three plants using BLE tags

Improved asset visibility and asset audit
compliance

Command and Control center for Global Appliance Manufacturer



Unified solution to monitor multiple
plant spread across geography

360 deg Operational Visibility, Increased
Productivity and Traceability

Connected vehicle platform re-engineering for global Telematics service provider



Architect new cloud based
platform, Camera based behavior
monitoring appl. Development and
CRM -IOT Platform-ERP integration

Asset tracking in Yard & during Movement for US Based Industrial leader

Subscription based model

Cloud based solution to track asset
in yard and outdoor tracking
using LTE-M based asset tracking devices

Improved asset visibility and operational
efficiency

Vision based quality check for European personal care OEM

Outcome based (model accuracy)

AI/ML based quality inspection of the
product at end of line

Improve quality check accuracy to 99.5% and
reduce false rejection

Remote patient monitoring & elderly-care



TechM IP in subscription model

Remote vital monitoring post discharge for critical care, chronic patient and elderly care.

Effective utilization of hospital resources & reduced cost for patients

Health kiosk for Hospitals



Joint IP + Revenue share

An IOT platform which enables remote diagnosis And improve care coverage through remote clinics.

Increase hospital reach to remote location

Digital twin for Vaccine Production for UK Pharma

Real time monitoring of process parameter and predictive deviation in process parameter

Reduce batch rejection and improve consistency in quality

Lab sample tracking for US Pharma



BLE based indoor lab sample tracking - preparation room > hatch > micro biology lab > IPC lab.

Reduce financial & time losses due to missing or delayed samples

Cold chain monitoring for UK pharma



Subscription based model

Multi-modal Pharma container tracking for Location & temperature excursion

Reduce wastage and improved compliance and quality

Surgical Kit Tracking for US based Pharma & life science company

Surgical Kit tracking solution for both Indoor & Outdoor locations with Sterilization Proof Track Device and intelligent sensors enables intelligent reporting for longer battery backup

AI based image analysis for Japanese medical equipment manufacturer



AI cognitive solution that validates and reports if a pre-surgical equipment assembly follows the standard quality guidelines

Faster turnaround time and greater operator satisfaction

VIEWOMICS - AI Driven Digital Pathology



CV based Platform to extract critical information from histopathological slices and provide prognosis report.

Soln points out the AOI, identify the % of Stromal TILs and suggest potential treatment options for Cancer*

Connected product for Netherland based radiology equipment OEM



Cloud based secure application for doctors and patients to access radiology image

Improve customer digital experience and enable image analytics

E & U

Diesel generator monitoring solution for Indian OEM

Joint IP



Application development to monitor health, power output, line power and fuel pilferage

*Better support Aftermarket Support
And new revenue channel*

Command & control center for 6000 + stream turbine for NA based OEM



Remote health monitoring & Diagnostics of turbines

Ensure 99% uptime of the turbine

Solar power plant monitoring for European energy specialist



Developed gateway, Cloud based Remote condition monitoring application and health alerts.

New business model to deliver power as a service rather than selling invertors

Retail & CPG

Cold chain monitoring for Indian food supplier



Reefer truck monitoring solution – location, route planning, temperature excursion and alert

Reduce wastage & improved audit trail for quality

Connected dispenser for US based CPG



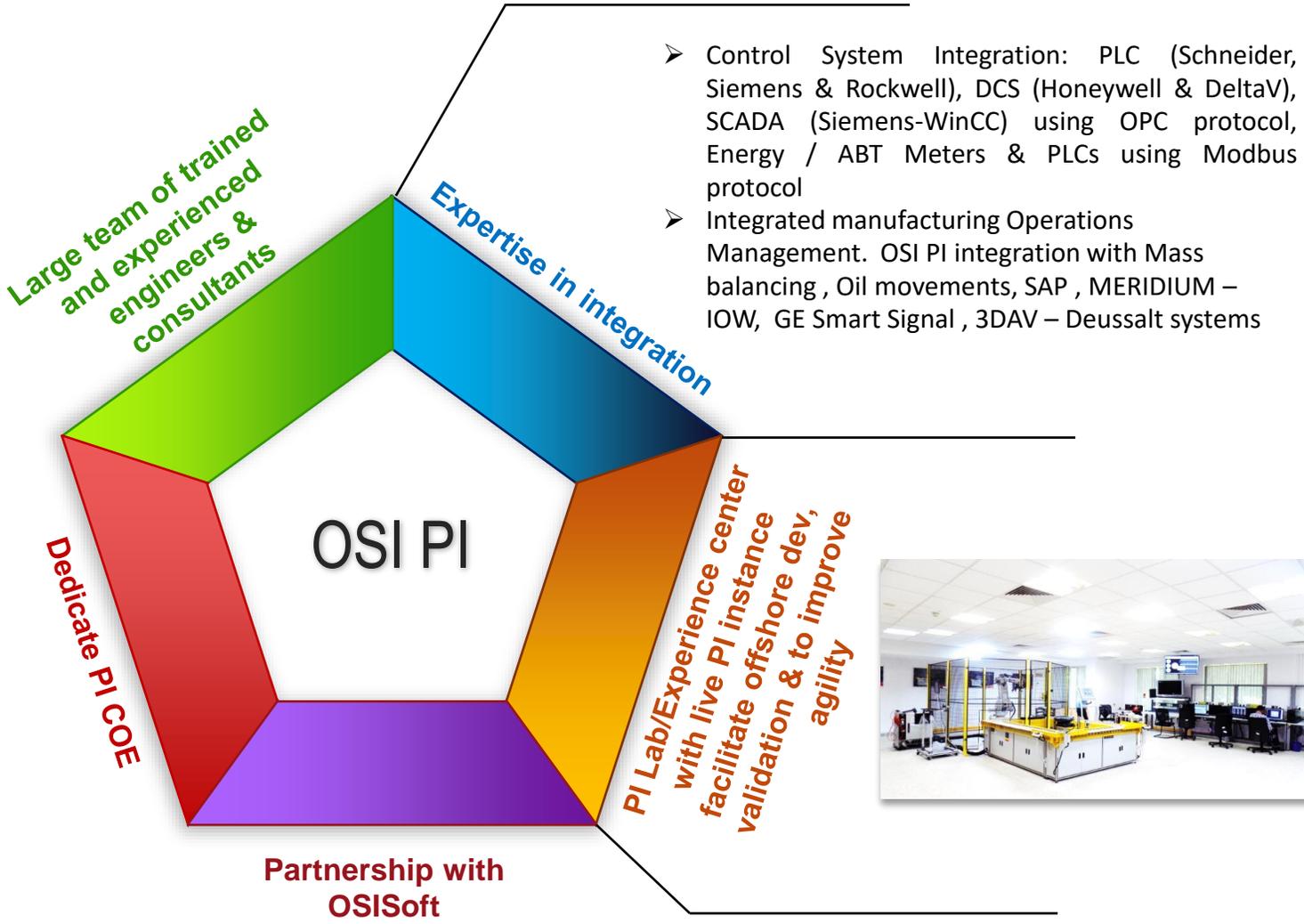
Fixed bid with complete ownership

Developed gateway, Cloud based condition monitoring & Predictive maintenance application.

Reduce service maintenance cost by 4 times

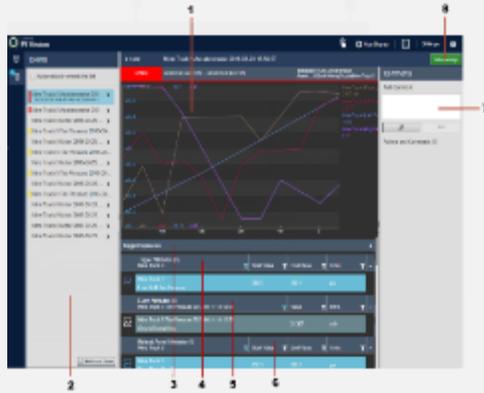


OSI PI Capabilities & Case studies

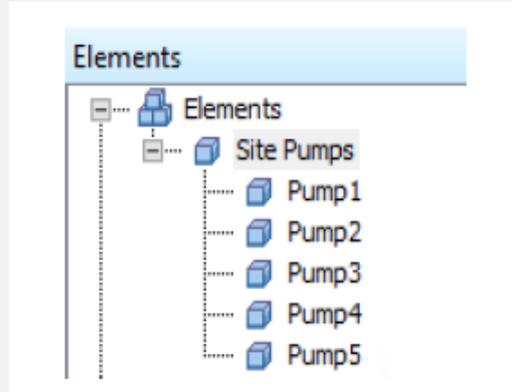


- Strategic partnership with OSI Soft for solution development and as SI Partner globally
- 45+ PI resources with various engineering back ground like ,Chemical, Mechanical, Instrumentation
- Consultants have experience in providing various value added services through PI AF, ACE and PI web parts for various Industries
- Strong process and methodology for on shore & offshore model for PI implementation
- We provide consulting, implementation, migration, support and managed services

PI Event frames



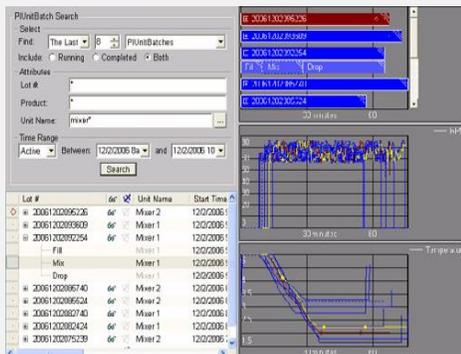
PI AF



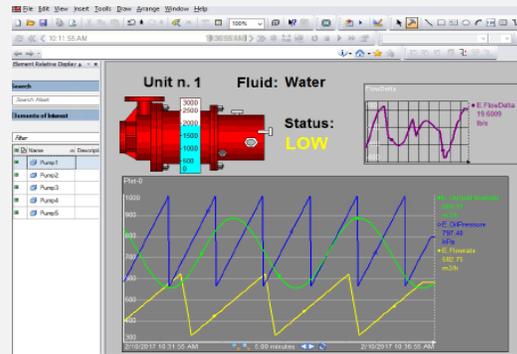
PI Cloud Connect



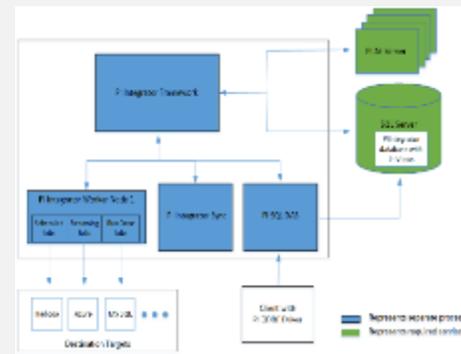
PI Batch View



PI Process Book



PI Integrator for Business Analytics



Plus more.....

Our Services



Site study & consulting



System Architecture



System Integration including OPC config



Upgrades and migration to PI from other historians



Project Management



Advanced analytics



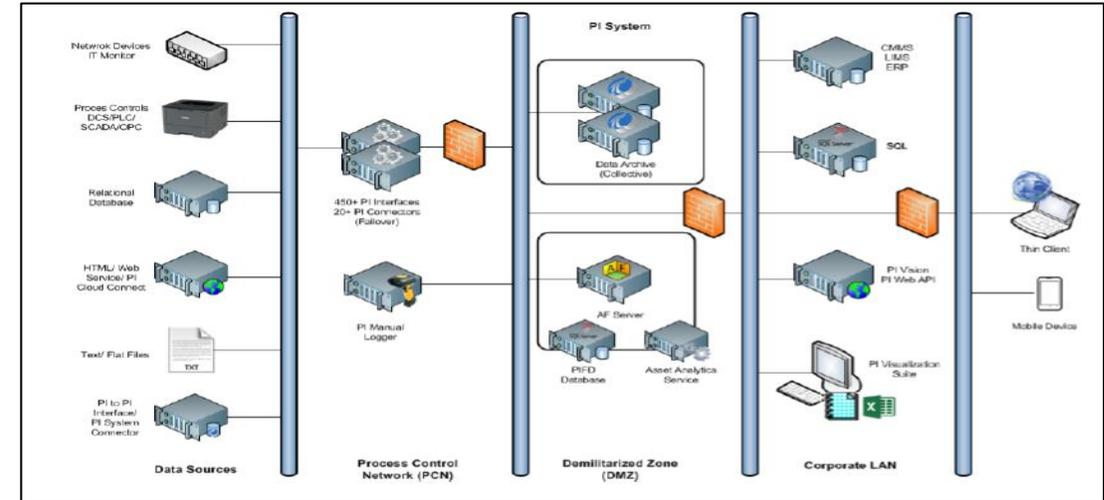
Cloud migration

Tech M can help in optimizing PI implementation cost with right shoring

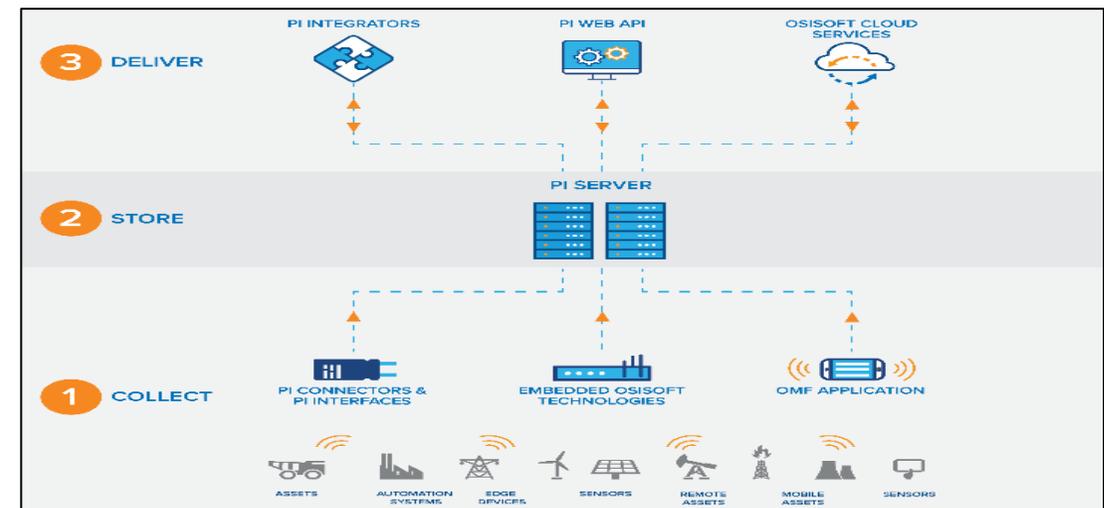
PI System sensor-based data infrastructure provide Real-time, historical and predictive insights for solving operational and business problems in below area

- ✓ **Energy Efficiency Improvement**
Energy utilization information within and across assets, systems and plants
- ✓ **Process optimization**
Improvement in process efficiencies
- ✓ **Asset health optimization & minimizing asset failure**
Asset remaining operating life prediction
- ✓ **Improve safety performance**
Data to the right people at the right time in the right format to optimize safety & minimize risk
- ✓ **Quality improvement**
Preventing quality deviations and improving quality
- ✓ **Risk and regulatory compliance**
Automate collection, aggregation & processing of data for regulatory compliance & reporting

OSI PI Architecture



OSIsoft Technologies Enables IIoT in Three Steps



Case study- Remote Implementation of PI System – Completely from Offshore Location

Business Problem

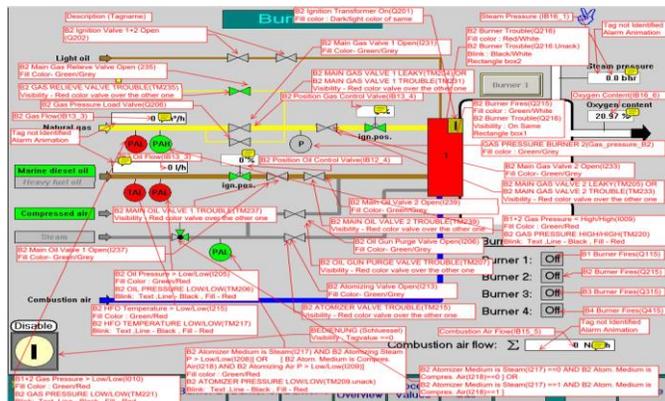
- Client is an FPSO Operator about to start production in one of their vessels in Nigeria
- Due to COVID & Security restriction – unable to send expert professionals for Start up of Plant
- Requires Technology Enablement of Expert professionals located in their Remote Monitoring Center

SOLUTION DESCRIPTION

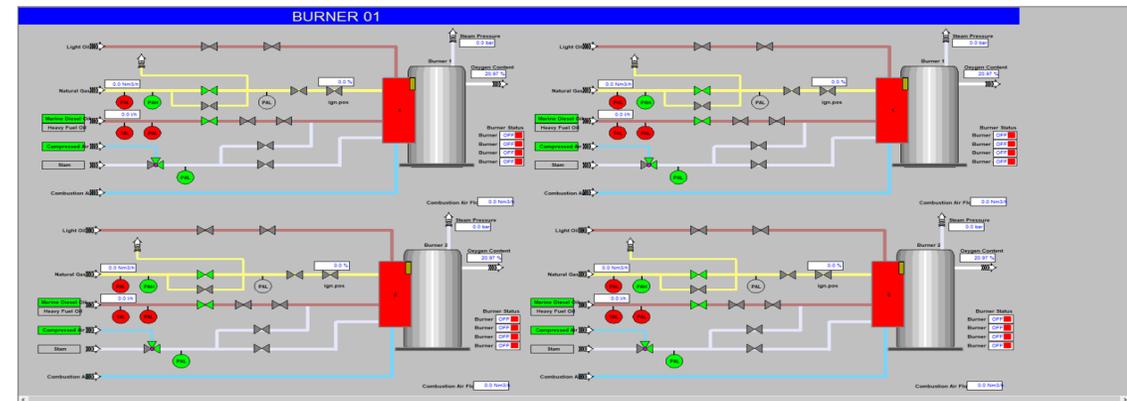
- Client is EA Customer OSIsoft PI leveraging which almost all DCS tags can be pushed to PI
- However due to lack of Technical Expertise at site – Tech M had to deploy resources with DCS Skillset (e.g. AC410 Advant Controller)
- For achieving quick turnaround time – deployed resources with variety of skills like **Rockwell, ABB, Siemens PLC, OSIsoft PI** in rapid pace
- All work in Site (including DCS modifications) done remotely under strict supervision of Client Team.**
- Tech M team helped client identify critical tags by looking at DCS backups
- Complete responsibility of tag identification, creation of tags, developing and deploying screens on Tech M
- Turnaround time of within 2 weeks** for deploying Critical Screens required for Startup of Boiler – enabling before time completion of Screen before startup

Business Value

- Complete remote startup of remote asset from Central Location
- Prevention of security risk/COVID of physical visit to site for Startup



High Level Solution Approach



Condition Based Maintenance of Rotating Equipment on OSI PI Platform leveraging First principle and data science –Illustrative

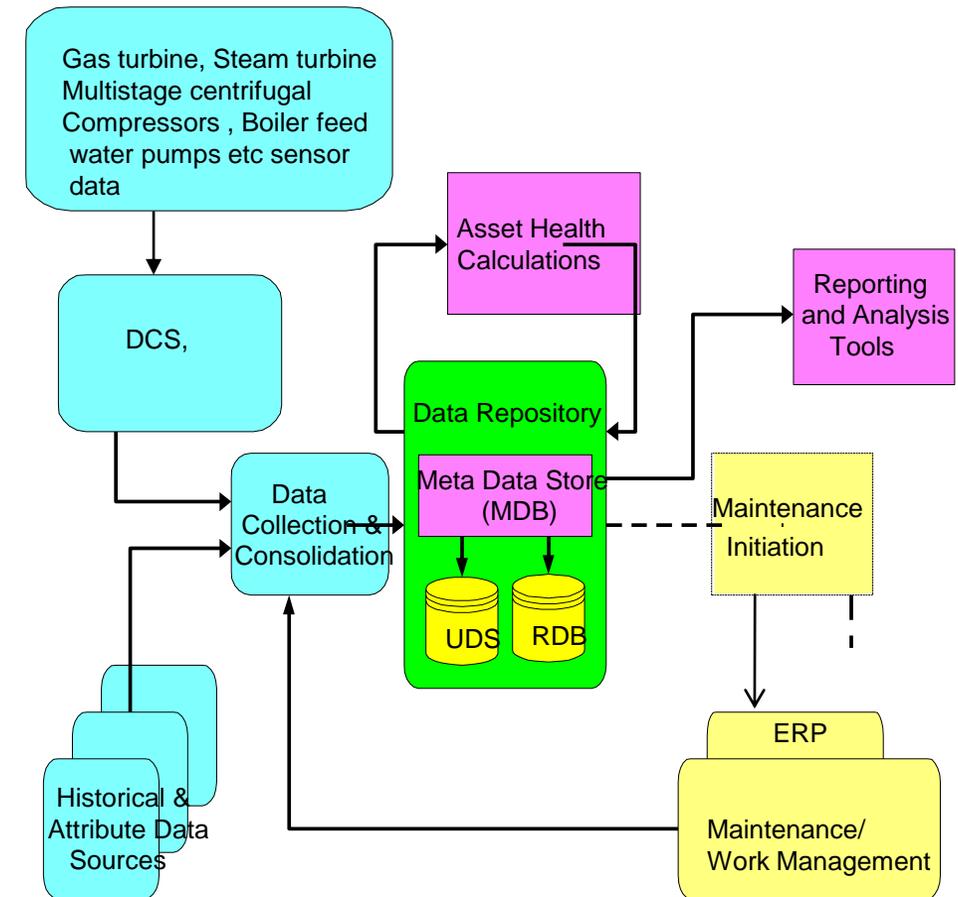
- Huge amount of process and equipment data from DCS and other control system is not used optimally
- Reciprocating compressors are poorly monitored and it is 3 times expensive to maintain than Centrifugal compressors
- Sun dyne pump process parameters never monitored but majority of break downs caused due to process reasons

Data Collection & Consolidation

Reciprocating Compressor	Centrifugal Compressor	Centrifugal Pumps
Vibration (Crank Case)	Suction pressure variation	Power
Vibration (Cross Head)	Discharge Pressure variation	Flow
Lube Oil Temp	Discharge Temperature variation	Pump Efficiency
Load factor	Surging and performance curves	characteristic curve to monitor performance
		Cavitation prediction
Packaging Temperature	Inlet Flow	
Valve Temperature	Lube Oil Pressure	
Bearing Temperature	Lube Oil Temperature	
Rod Drop	Lube Oil DP	
Rod Run Out	Polytropic Efficiency and Head	

Leverage plant historian data for CBM purpose to improve MEI (Maintenance Efficiency Index) and avoid costly breakdowns

CBM Conceptual Model



THANK YOU

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