

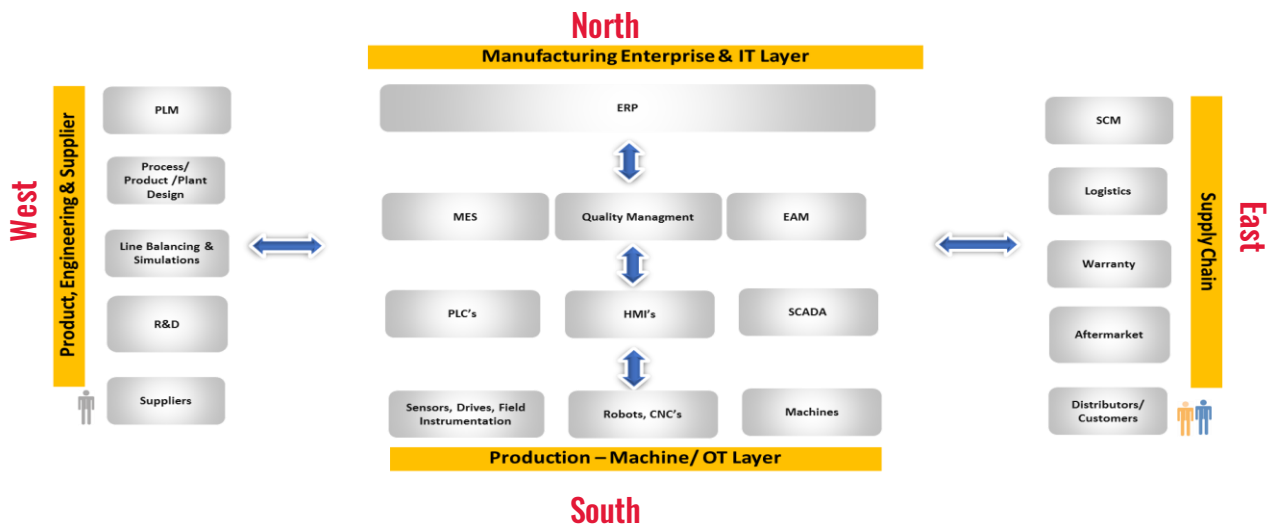
DATA DRIVEN MANUFACTURING

Digital Technology is helping factory shop floor to connect machines, connect product, connect factories, connect aftermarket, and connect R&D which is producing a wealth of data. Many of us have built multiple PoCs to connect such scenarios and have built real time monitoring, dashboards for visualization of various KPIs & other parameters.

Now the critical question is how do we derive the decisions? How do we improve factory performance and reduce the bottlenecks to have improvement on our critical KPIs such as throughput, quality, asset utilization, EHS, compliance, cost, fulfilment, etc. and develop an agile and adaptive manufacturing setup?

Tech Mahindra's Data Driven Manufacturing solution focuses on the four critical aspects to attain a closed loop decision making based on analysis of the data collected at

- South: Integration with machine / OT layer
- West: Integration with engineering, product management, R&D, supplier
- North: Integration with Enterprise layer (MES, ERP, QM, EAM)
- East: Integration with supply chain, aftermarket, warranty & logistics



Here are some use cases to explain in detail about our solutions:

South Integrations

Use case 1: Predictive Maintenance- Customer: Major Industrial Equipment Manufacturer

Predictive Analytics Use Case

- Repeated failure of equipment because of component failures & damages
- Unplanned Equipment shutdown leading to huge revenue loss
- Lack of preventive maintenance leading to reduced component life

The Solution

Data for Predictive Maintenance

- Maintenance & Engineering data
- Sensor data - Multiple Sensors
- Operational Data
- DFMEA data

Approach

- Data Collection & Clean-up
- Exploratory Data Analysis : Data Statistics, Variable Importance, Principle Component Analysis
- Supervised learning techniques to predict failure occurrence (3 months, 6 months & 1 year)
- Classification algorithms for both the predictor types
- Choose the best model using the model diagnostics

The Outcome & Benefits

- Plan maintenance based on the predicted Rest of Useful Life and probability of failure occurrence in the given time period
- Around 20% saving in cost & time
- Around 10% reduction in unscheduled maintenance

Use case 2: Weld Analytics- Customer: Global Auto OEM

Weld Analytics Use Case

- Unable to detect defects through inspection and sampling, due to limitations and dynamic play between various process parameters.
- Defects found later impacting the product quality and increased re-work cost.

The Solution

Data for Weld Analytics

- Machine & Tool Data: Applied Voltage, Weld Measurements, Current, weld category
- Inspection Log

Approach

- Organize, Transform & Aggregate the tool Data & the data from the maintenance & quality systems
- Variable Transformation & Significance Identification based on parametric analysis
- Further Develop Machine Learning Algorithm based on the conditions
- Predict the product quality proactively identifying the defects.

The Outcome & Benefits

- Reduces the costly ultrasonic and other Non-destructive Inspection.
- Prediction helped in proactively identifying more than 75% of the defects.
- Reduces the overall manufacturing process time by 25%.
- Significantly reduces rework & Scrap cost

North Integrations

Use case 3: Dynamic Scheduling- Customer: Major Auto Tier1 based out of Japan

Dynamic Scheduling Use Case

- Dynamic rescheduling reduces lead times and enables fast response to Changing orders, supply conditions and machine downtime leading to requirement of dynamic scheduling on real time
- Incorporating all the current manufacturing rules & constraints while creating a production schedule & sequence
- Need to ensure manufacturing remains lean: reduced inventories, work in process, staffing and material costs

The Solution

Data for Dynamic Scheduling

- Data from Robots, PLC's, HMIs & MES systems
- Data from Enterprise systems
- Manufacturing Production Rules & Constraints
- Data from Warehouse Management

Approach

- Collect the Order data from the Enterprise systems
- Utilize production rules & constraints, Inventory rules and other manufacturing condition to generate the schedule
- Make the schedule available for the MES system to execute the production
- Provide feedback from the Automation (Robots, PLCs...) about the production status & changing conditions
- If required, re-schedule on real time basis to provide better & efficient schedule on current order & production conditions

The Outcome & Benefits

- Dynamic rescheduling reduces lead times and enables fast response
- Ensures that plant throughput is as close to the maximum as possible, given the mix of orders and constraints
- Ensures that each order is fulfilled on time, with all the required features, while providing visibility / tracking information



Use case 4: Quality- Customer: Aircraft Manufacturer

Quality Use Case

- Inconsistent machine, product or production parameters impacting the quality of output.
- Poor product quality and associated wastage due to lack of proactive corrective approach.

The Solution

Data for Quality

- Machine PLC Data
- Multiple Sensor Data
- MES & EAM Data

Approach

- Identify Critical Quality Parameters
- Collect the data from sensor and process information
- Identify patterns of combination of multiple sensor trends & failures
- SPC/ SQC Analysis
- Unsupervised & Supervised anomaly detection techniques
- Anomaly Alerts & Data Visualization providing feedback to production on various functional issues and feedback to maintenance on better maintenance planning

The Outcome & Benefits

- Up to 20% improvement in Productivity
- Eliminate quality issues due to equipment functional issues
- Proactive planning of maintenance by observing anomaly percentage in the selected window
- Enable Deep Diving to the Anomaly Root Causes to address the core issue
- Visualization showcasing the Trend & Anomaly

West Integrations

Use case 5: Plant Simulation- Customer: India based Auto OEM

Digital Simulation Use Case

- Reduce time to market, by minimizing manufacturing launch issues
- Simulation of material flow, process & ergonomic studies
- Increasing demand for highly customized Vehicles
- Shorten time to setup new facility or add capacity

The Solution

Data for Plant Simulation

- Engineering Design
- R&D data
- Factory Layout
- Tools & Fixtures design

Approach

- Collection of all the product engineering, factory layout, tool design data, etc. data
- Analysis and modelling in digital tools to create digital replicas of the your machines, lines, factory assets and products to be setup/ produced
- Complete material flow, process & ergonomic simulation & feasibility studies to provide complete feedback for production to be setup & product to be made with required throughput, quality & efficiency.

The Outcome & Benefits

- Complete visibility of manufacturing bottlenecks to assist production teams in improving throughput
- Automatic Line Balancing & Layout planning, Analyzing the packaging requirements
- Minimize material travel from the source to the final destination
- Capex reduction for new facility/ addition of lines..

Use case 6: Process Management (eBom, mBom, BOP, WI)- Customer: India based Auto OEM

Process Management Use Case

- To establish a collaborative global manufacturing process management platform
- To Shorten time in manufacturing planning and tool selection
- To quicken the process b/w engineering & production so a change in design can be reflected quickly
- To enable workers with instruction to increase their efficiencies manifold

The Solution

Data for Process Management

- Product engineering data
- Tooling & fixtures data
- Process data
- Production Stage data

Approach

- Collect data from different engineering sources such as your product design & engineering data, tooling & fixtures design data
- Visualization and analysis to create process sheets, control plans, line balancing simulations, virtual simulations
- Creation of e-bom to m-bom & Bill of process and further work instructions which helps in execution of production
- Engineering to production for implementing any design changes from factory layout to process & product in a efficient and synchronized manner.

The Outcome & Benefits

- Quicker manufacturing planning and tool selections
- Automatic updates on Work Instructions based on design changes
- Synchronized process management for global manufacturing needs
- Increased operational efficiency and competitiveness

East Integrations

Use case 7: Warranty Analytics Customer: US based construction equipment Manufacturer

Warranty Analytics Use Case

- Warranty claims impacting the brand image and bottom-line
- High Warranty cost : lack of clarity in areas where efficiency can be improved & cost reduced
- Once size fits all service / warranty packages does not yield considerable revenue
- Less visibility of geo specific warranty forecast
- Increasing fraudulent claims
- Poor dealer performance and customer satisfaction

The Solution

Data for Warranty Analytics

- Customer Demography & Service data
- Dealer & Maintenance data
- Product performance usage & service data
- Warranty claim data
- Inventory & MES data

Approach

- Data Extraction, Injection & Integration
- Exploratory Data Analysis
- Supervised & Unsupervised ML to extract insights from the data
- Visualization plots, reports & Alerts
- Feedback to Production & Engineering on Quality & Performance for Continuous Improvement

The Outcome & Benefits

- 5-10% reduced warranty costs
- 10-20% increase in supplier recovery
- 5-10% improvement in first time fix rate & claim cycle time
- 10%-20% improved visibility of warranty reserves & Claim Rate and 5-10% decrease in fraudulent claims &
- Over 15% reduction in parts inventory
- 5-10% improved dealer performance tracking
- 10-30% increase in services revenue
- 5% improved product quality through the advanced availability of product performance & claim data
- Increases revenue through personalized sale of warranty products



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