Adaptive Digital Manufacturing

Though automation and digitization have increased productivity and velocity of business operations to meet the global competitive pressures, manufacturers are still facing challenges in increasing OEE, managing quality involving complex supply chains, finding and resolving root-causes quickly, and meeting the ever-increasing customer expectations.

Oracle's **Adaptive Digital Manufacturing solution** provides a powerful set of tools for monitoring assets and processes in real-time, providing predictive insights and rule-based alerts on IoT data, converging and contextualizing enterprise data with operational data, utilizing adaptive intelligence to seek out hidden insights in the big data, and implementing closed loops to enable faster corrective actions based on the insights. The result is a digital productivity solution with an ability to assist and adapt to the dynamic manufacturing needs and circumstances.

Oracle Adaptive Digital Manufacturing solution consists of Oracle IoT Production Monitoring Apps for monitoring, AI Apps for Manufacturing for predictive insights, Java Cloud Service, Database Cloud Service, and Oracle Integration Cloud for integration and automation, and Manufacturing Cloud, Maintenance Cloud for execution.

 "The rationales for business to invest in new technologies include getting products to market more swiftly, improving efficiency and productivity, differentiating product offerings and, crucially, making better products. The demonstrable benefits brought by new technologies mean their deployment is inevitable."

World Economic Forum, 2017

Key Features

- Real-time monitoring of global production with drill-down capabilities up to sensor level

- IoT data analytics with anomaly detection and prediction of asset failures

- Converge and contextualize enterprise data with operational data

- Uncover hidden insights from big data utilizing adaptive intelligence

- Notifications on exceptions and ability to implement feedback loops into other modules

- Enterprise integration and automation

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INCREASE ASSET UTILIZATION AND PRODUCTIVITY

For the manufacturing operations to be managed effectively, data needs to be collected to know the current state of operations and measure improvements against set targets. With the ever-increasing speed of operations, it is important for everyone involved in the manufacturing enterprise to know the current state of production in real-time so they can immediately act on any issues that may arise. Furthermore, it would greatly help responsiveness if the digital solution can actively identify any anomalies, predict asset health, and provide notifications of any deviations and impending failures.

- Oracle's IoT Production Monitoring Cloud (Oracle IoT PM) helps to monitor globally distributed plants by connecting sensors and assets in production lines, tracking KPIs at various levels, detecting anomalies, and notifying any deviations.

- Oracle IoT PM reduces inefficiencies by providing rules engine to create alerts and notifications when certain exceptions occur in the process data. This way anyone concerned can be kept informed. These rules could also trigger actions in other SCM modules via APIs.

IDENTIFY AND RESOLVE ROOT-CAUSE ISSUES RAPIDLY

Manufacturing operations are getting complex with interconnected sequence of operations. Typically, it takes weeks and may be months to find the root cause of a complex problem and resolve it when the production involves multiple operations with lots of sensor data and process parameters. It is very time-consuming process to identify the root causes through traditional techniques such as design of experiments. Machine learning and artificial intelligence techniques extract patterns and correlations across the entire value chain in near real-time by connecting structured data from enterprise solutions, and semi-structured data from manufacturing operations.
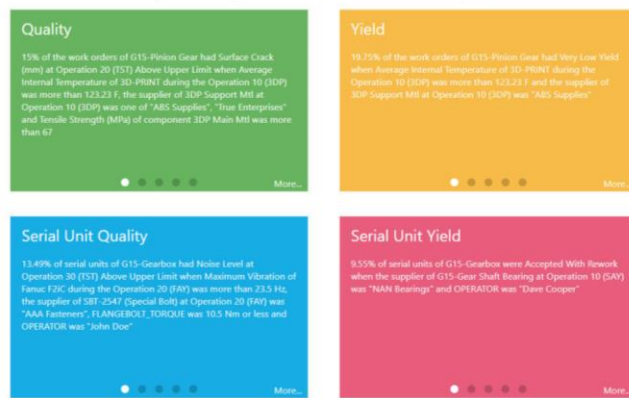
- Oracle's Adaptive Intelligence (AI) Apps for Manufacturing allows collection of enterprise data and operational data into a data lake that is used for drawing insights from converged big data.

- Utilizing artificial intelligence and machine learning techniques the AI Apps for Manufacturing provides detailed insights on all the influencing factors that led to a quality or yield exception so that all corresponding stakeholders can address the issue comprehensively.

- The Adaptive Intelligence Apps for Manufacturing has a very intuitive and an easy to use interface for extracting features, building models for drawing patterns and correlations on historical data, and visualizing insights and predictions on future events.

Key Business Benefits

- Full transparency with real-time visibility of production activity to collaborate and improve around

- Improve yield and quality with real-time analytics and oversight of production activity

- Perform rapid root-cause analysis to reduce costs and improve delivery

- Trace all affected orders to provide proactive field service to increase customer satisfaction

- Automatic asset anomaly detection and notification to reduce service response time

- Enterprise integration and automation helps accelerate decision making

Latest Insights!

Review latest insights about key patterns and correlations that affect operational efficiencies

Quality
15% of the work orders of G15-Pinion Gear had Surface Crack (mm) at Operation 20 (TST) Above Upper Limit when Average Internal Temperature of 3D-PRINT during the Operation 10 (3DP) was more than 123.23 F, the supplier of 3DP Support Mtl at Operation 10 (3DP) was one of "ABS Suppliers", "True Enterprises" and Tensile Strength (MPa) of component 3DP Main Mtl was more than 67

Yield
19.75% of the work orders of G15-Pinion Gear had Very Low Yield when Average Internal Temperature of 3D-PRINT during the Operation 10 (3DP) was more than 123.23 F and the supplier of 3DP Support Mtl at Operation 10 (3DP) was "ABS Supplies"

Serial Unit Quality
13.49% of serial units of G15-Gearbox had Noise Level at Operation 30 (TST) Above Upper Limit when Maximum Vibration of Fanuc F2IC during the Operation 20 (FAY) was more than 23.5 Hz, the supplier of SBT-2547 (Special Bolt) at Operation 20 (FAY) was "AAA Fasteners", FLANGEBOLT_TORQUE was 10.5 Nm or less and OPERATOR was "John Doe"

Serial Unit Yield
9.55% of serial units of G15-Gearbox were Accepted With Rework when the supplier of G15-Gear Shaft Bearing at Operation 10 (SAY) was "NAN Bearings" and OPERATOR was "Dave Cooper"

## ACCELERATED AND AUTOMATED EXECUTION

It is often too late to discover quality and yield issues later in the production process. It is better to disqualify or discontinue production of a part that is deemed to fail eventually at any stage of the build process to save time and costs. In this regard, it is advantageous to implement accelerated feedback loops that can be used to make quicker go or no-go decisions at any stage of the production process based on the insights from the upstream and downstream operational insights.

- Oracle IoT Production Monitoring provides rules and notifications to identify anomaly patterns and notify concerned stakeholders so they can take proactive actions thus minimizing downtime and response time.

- Integration of IoT PM with other Oracle SCM modules utilizing Oracle IoT Cloud APIs, Oracle Integration Cloud, and Oracle Java Services to exchange information between modules, update rules dynamically, and automatically trigger actions such as generating maintenance work orders.

- Predictions from AI Apps for Manufacturing are used to interrupt progression of a particular part when a certain combination of failure factors matches in order to avoid wasting time and cost otherwise spent on taking that part through completion where it would fail anyways.

PROACTIVELY ASSESS AND MITIGATE BUSINESS IMPACT

Once a production issue has been identified and resolved, it is also necessary to identify all orders and shipments affected by the influencing factors in order to service the customers proactively. This would greatly help mitigate future risks and improve customer experience.

- Oracle Adaptive Intelligence Apps for Manufacturing provides Genealogy and Trace functionality that allows tracking all affected orders and shipments for a particular work order or lot in order to service the affected customers proactively.

- Genealogy and Trace functionality can also show if there were any existing recall and field service issues for the concerned orders, further validating the insights drawn through AI.
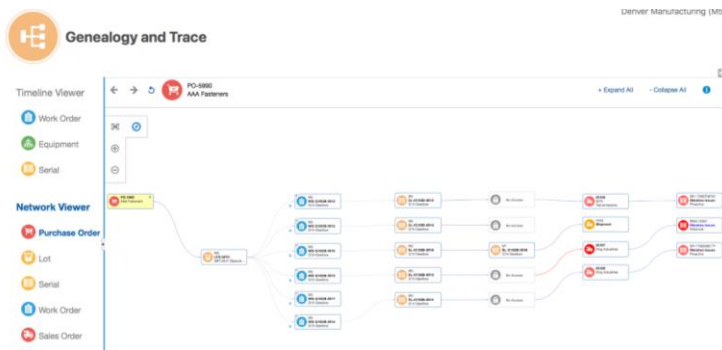
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