**Project Overview**

**Objective:** Development of an IoT-based framework for energy optimization in industrial assembly lines.

**Case study:** An SMT PCB Assembly Line

**Components:**
- Data Aggregation Platform
- Data Analysis Engine and KPI displays
- Simulation Model for Prediction and Process Optimization

**Sensor Deployment**

**An SMT-PCB Assembly Line**

**Data-flow Architecture**

**IDEAM (IoT Data Exchange & Analytics Middleware)**

**Data Store**

**Offline Analytics**

**Online Analytics**

**IoT Gateway**

**SPI**

**MODBUS**

**BLE**

**MQTT**

**UDP**

**HTTP**

**Physical IoT End Device**

**Logical IoT End Device**

**Parameterized Simulation Model with GUI support**

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**Key Performance Indicators and Insights from Data**

**A Snapshot of Vibration Sensor Data**

**Machine-wise break-up of energy over a week**

**Performance Metrics Tracked:**
- Machine-wise idle-times, latencies and energy consumption
- System Throughput
- Machine Breakdowns, Shifts.

**Insights:** The Re-flow oven accounts for more than 85% of the total energy consumption on average, whereas the Pick and Place machines are often the throughput bottlenecks.

**Energy Optimization and Ongoing Study Items**

- Impact of buffering between the Pick and Place and Re-flow operations (preliminary results based on simulation indicate that up-to 2X reduction in energy is possible via buffer insertion.)
- Design space exploration of line configuration
- Optimal inspection and re-calibration policies
- Human-in-the-loop modelling
- Dashboard for real-time operational support