**Technical Specification (TS)**

**Project Title:** BI Dashboard for Production Monitoring and Performance Analysis  
**Client:** Manufacturing Company  
**Developer:** MAAB Innovation  
**Objective:** Develop a BI dashboard to analyze production performance, optimize efficiency, and monitor key manufacturing metrics, including production output, resource utilization, machine downtime, and product quality.

**1. Project Goals**

1. **Monitor Production Efficiency**: Track production performance metrics like output, resource utilization, and downtime.
2. **Identify Bottlenecks**: Pinpoint areas causing delays, waste, or inefficiency.
3. **Quality Control**: Analyze defective products and identify root causes of quality issues.
4. **Resource Optimization**: Monitor usage of materials, labor, and machinery to minimize costs.
5. **Performance Benchmarking**: Compare performance across production lines, plants, and shifts.

**2. Functional Requirements**

**2.1. Dashboard Sections**

**2.1.1. Production Overview**

* **Purpose**: High-level summary of production efficiency and output.
* **KPIs**:
  + Total Production Output
  + Overall Equipment Effectiveness (OEE)
  + Downtime Percentage
  + Production Cost per Unit
  + Percentage of Defective Products
* **Visualizations**:
  + Line Chart: Production Output Over Time
  + Bar Chart: Downtime Across Machines or Lines
  + Pie Chart: Defect Distribution by Product Type
  + KPI Cards: Key Production Metrics

**2.1.2. Resource Utilization Analysis**

* **Purpose**: Evaluate usage of labor, materials, and machines to optimize efficiency.
* **KPIs**:
  + Material Usage Efficiency (Actual vs. Planned)
  + Labor Utilization Rate (Idle vs. Active Hours)
  + Machine Utilization Rate
  + Energy Consumption per Unit Produced
* **Drill-Through Options**:
  + Resource breakdown by production line or shift.
  + Analysis of overused or underutilized machines.
* **Visualizations**:
  + Heatmap: Machine Utilization Across Production Lines
  + Bar Chart: Resource Efficiency per Shift
  + Energy Usage Trend Chart

**2.1.3. Downtime and Bottleneck Analysis**

* **Purpose**: Identify machine downtime causes and process bottlenecks.
* **KPIs**:
  + Total Downtime Hours
  + Top Causes of Downtime (Maintenance, Failures, Setup Time)
  + Average Repair Time
  + Downtime Cost Impact
* **Visualizations**:
  + Pareto Chart: Top Downtime Causes
  + Gantt Chart: Downtime by Machine Over Time
  + Bar Chart: Downtime Hours by Production Line

**2.1.4. Quality Control Dashboard**

* **Purpose**: Track product quality and identify defect sources.
* **KPIs**:
  + Defect Rate (%)
  + Total Defective Units Produced
  + Defects by Product Type and Shift
  + Root Cause Analysis of Defects
* **Visualizations**:
  + Scatter Plot: Defect Rate vs. Production Volume
  + Bar Chart: Defects by Product and Line
  + Pareto Chart: Root Causes of Defects

**3. Data Structure**

| **Table Name** | **Description** | **Fields** |
| --- | --- | --- |
| **Production** | Daily production details. | ProductionID (PK), LineID (FK), ProductID (FK), Date, Shift, Output, DefectiveUnits, DowntimeHours |
| **Machines** | Machine performance and downtime. | MachineID (PK), LineID (FK), Name, Status, DowntimeCause, RepairTime, UtilizationRate |
| **Resources** | Usage of labor and materials. | ResourceID (PK), LineID (FK), Type (Labor/Material/Energy), PlannedUsage, ActualUsage, Cost |
| **Products** | Product specifications. | ProductID (PK), Name, Category, PlannedOutput, CostPerUnit |
| **Shifts** | Production shifts and labor hours. | ShiftID (PK), LineID (FK), Date, ShiftName, TotalLaborHours, IdleHours |

**4. Key KPIs**

| **KPI** | **Description** | **Formula** |
| --- | --- | --- |
| Total Production Output | Total units produced per time period. | SUM(Output) |
| Overall Equipment Effectiveness (OEE) | Machine efficiency measure. | Availability x Performance x Quality |
| Downtime Percentage | Share of time machines are idle. | (DowntimeHours / TotalHours) x 100 |
| Defect Rate | Percentage of defective units. | (DefectiveUnits / Output) x 100 |
| Material Usage Efficiency | Planned vs. actual material consumption. | (PlannedUsage - ActualUsage) / PlannedUsage |

**5. Technical Requirements**

* **Mock Data**: Students will create production, machine, and resource datasets.
* **Tools**: Microsoft Power BI or similar BI tools.
* **Performance**: Dashboard response time ≤ 30 seconds.
* **Accessibility**: The solution must support desktop and mobile usage.

**6. Implementation Roadmap**

1. **Data Generation**: Simulate production, machine performance, and resource usage data.
2. **Data Model Design**: Create relational tables for production lines, machines, resources, and shifts.
3. **Visualization Development**: Design dashboards for production monitoring, downtime analysis, and quality control.
4. **Testing**: Validate KPIs, drill-throughs, and data accuracy.
5. **Delivery**: Deploy dashboards for interactive analysis.

**7. Expected Outcome**

* A comprehensive BI dashboard providing insights into production efficiency, resource utilization, downtime analysis, and quality control.
* Identification of process bottlenecks and areas for cost and time optimization.
* Strategic tools for decision-making in production management.

***Note for Beginners****: Generate mock production data based on realistic assumptions. You are encouraged to add creative KPIs or modify the analysis structure to enhance the project scope. Think about how production managers would use this tool in real-life decision-making!*