**Problem Definition & Design Thinking**

**Title:** Root Cause Analysis For Equipment

### Failures Problem Statement:

In industrial and manufacturing environments, equipment failures can lead to significant downtime, increased maintenance costs, safety hazards, and decreased productivity. Despite scheduled maintenance and monitoring systems, recurrent equipment malfunctions still occur, indicating underlying issues that are not being adequately addressed.

This project aims to perform a comprehensive root cause analysis (RCA) of equipment failures to identify the primary factors contributing to breakdowns. By systematically examining failure data, operational conditions, and maintenance practices, the objective is to uncover patterns and root causes—whether mechanical, electrical, human, or procedural—that lead to equipment downtime. The findings will support the development of proactive strategies to enhance equipment reliability, optimize maintenance schedules, and reduce operational disruptions.

**Target Audience:**

**Maintenance Engineers and Technicians**:To understand failure patterns and improve maintenance practices.

**Quality Assurance Teams**:To identify process-related causes of equipment failure impacting product quality.

**Health, Safety, and Environment (HSE) Officers**:To minimize safety risks arising from unexpected equipment breakdowns.

**Industrial Data Analysts**:To apply data-driven methods for identifying root causes and forecasting failures.

**Objectives:**

**Identify and Analyze Root Causes:**To systematically investigate and determine the underlying causes of frequent or critical equipment failures.

**Collect and Interpret Failure Data:**To gather historical maintenance logs, operational data, and failure reports for accurate analysis.

**Classify Failure Types:**To categorize failures based on mechanical, electrical, human error, environmental, or procedural issues.

**Evaluate Existing Maintenance Strategies:**To assess the effectiveness of current maintenance practices (e.g., preventive vs. reactive maintenance).

**Improve Workplace Safety:**To eliminate failure causes that pose safety risks to operators and technicians.

**Develop Proactive Maintenance Plans:**To shift from reactive to predictive maintenance using insights derived from root cause analysis.

**Design Thinking Approach:**

**1. Empathize**

**Goal:** Understand the people involved—maintenance staff, engineers, operators, and decision-makers.

* Conduct interviews and surveys with technicians and operators.
* Observe how equipment is used and maintained in real-time.
* Collect anecdotes, complaints, and pain points regarding equipment failures.

**2. Define**

**Goal:** Clearly articulate the problem based on insights gathered.

* Problem Statement Example:  
  *“Technicians face repeated equipment breakdowns due to unidentified root causes, leading to costly downtime and operational inefficiencies.”*
* Identify common failure points, user frustrations, and systemic gaps in maintenance processes.

**3. Ideate**

**Goal:** Brainstorm possible solutions and approaches to uncover root causes and improve equipment reliability.

* Use tools like Fishbone Diagrams, 5 Whys, and Failure Mode and Effects Analysis (FMEA).
* Collaborate in cross-functional teams to generate innovative solutions.
* Consider tech-based solutions like IoT sensors, predictive maintenance algorithms, or AR-assisted diagnostics.

**4. Prototype**

**Goal:** Create low-cost, quick versions of the solution or process changes.

* Develop a small-scale RCA dashboard using real failure data.
* Prototype a new workflow for logging and analyzing equipment failures.
* Build a basic decision tree model or root cause database.

**Key User Concerns:**

**Inaccurate or Incomplete Failure Data:** *We don’t have enough historical data to pinpoint the root cause.*

**Time-Consuming Diagnostics:** *It takes too long to identify what’s wrong and fix it.*

**Lack of Skilled Manpower:** *Not all technicians are trained to troubleshoot complex failures.*

**Recurring Issues:** *We keep fixing symptoms, not the actual problem.*

**High Maintenance Costs:** *Unplanned repairs are costing us more than scheduled servicing would.*

**Safety Risks:** *Breakdowns can create unsafe working conditions.*