

PROJECT MONITORING

PROJECT MONITORING

PMG333

Lecture 07

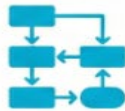
QUALITY MONITORING TOOLS

Prepared by
Dr. Bassel alhassan

Our Roadmap for Quality Monitoring



1. Check Sheets:
Data Collection



2. Flowcharts:
Process Mapping



3. Fishbone Diagram:
Root Cause Analysis



4. Control Charts:
Process Monitoring



5. Pareto Chart:
Prioritization (80/20 Rule)



6. Histogram: Data
Distribution



7. Scatter Diagram:
Correlation Analysis

PMBOK Quality Processes

Plan Quality Management



Identify quality requirements and standards for the project and its deliverables.

- **Key Output:** Quality Management Plan.

Manage Quality (QA)



Translate the quality management plan into executable quality activities.

- **Key Focus:** Process Improvement & Auditing.

Control Quality (QC)



Monitor and record results of executing the quality activities to assess performance.

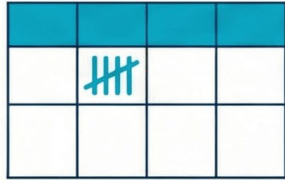
- **Key Output:** Verified Deliverables.

- **Definition:** A structured, prepared form for collecting and analyzing data in real-time.
- **Purpose:** To simplify data collection and ensure consistency.
- **Key Characteristic:** "The First Quality Tool" - often the starting point for problem-solving.
- **Usage:** Records frequency of events, defects, or issues at the source.



**"If you can't measure it,
you can't improve it."**

Tally Sheet



Used to count the frequency of events or defects.

Key Use: How often does it happen?

Location (Measles) Chart



Visualizes where defects occur on a product.

Key Use: Where does it happen?

Checklist



Ensures all steps or items are completed.

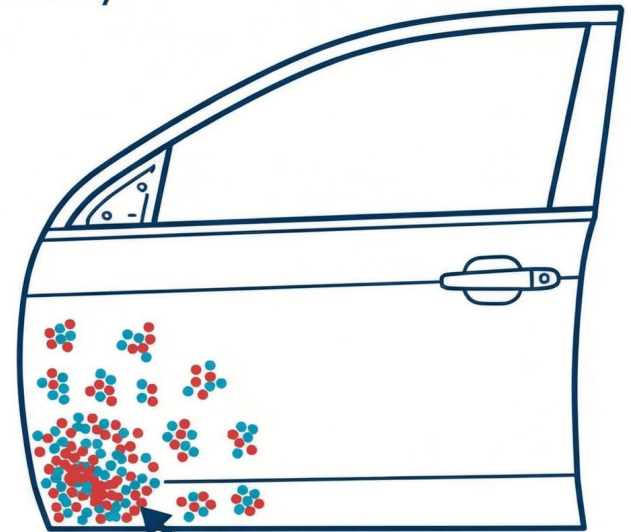
Key Use: Did we do everything?

Defect Concentration Diagram (Measles Chart)

Context:

- **Scenario:** Car Assembly Line - Paint Shop.
- **Problem:** High rework rate on vehicle doors.
- **Tool:** Measles Chart used to mark exact location of paint scratches.

Key Takeaway: Visualizing defect locations revealed a specific equipment calibration issue, reducing rework by 40%.



Concentrated Defects:
Robotic Arm Misalignment

Scenario

- **Problem:** Guest satisfaction scores dropped.
- **Method:** Front desk staff used a Tally Sheet to record complaints for 7 days.

The Check Sheet

Complaint Type	Tally	Total
Slow Room Service		12
Noise		7
Room Cleanliness		4
AC/Temperature		3

Key Insight

Slow Room Service accounts for 46% of all complaints.

Action: Investigate kitchen staffing during peak hours.

Scenario:

- **Context:** A software QA team tracking defects during a release sprint.
- **Tool Used:** Defect Classification Check Sheet.

Defect Classification Check Sheet

Bug Type	Count (Tally)
UI/UX Issues	(4)
Functional Errors	(2)
Performance Lags	(6)
Security Gaps	(1)

Key Insight:
Performance Lags account for 46% of total defects.

Action:
Prioritize code optimization before release.



Structured Data Collection

It's not just a list; it's a systematic way to gather facts in real-time.



Consistency is King

Ensures everyone collects data the same way, reducing human error.



The Starting Point

Often the first step before using other tools like Pareto Charts or Histograms.

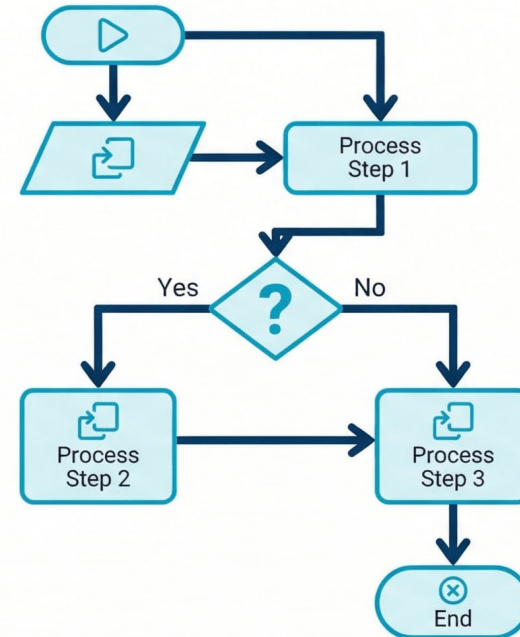


Versatility

Can be used for counting (Tally), locating defects (Measles Chart), or verifying steps (Checklist).

- **Definition:** A visual representation of the sequence of steps and decisions needed to perform a process.
- **Purpose:** To document, study, plan, improve, and communicate complex processes in clear, easy-to-understand diagrams.
- **Key Benefit:** "A picture is worth a thousand words." - Simplifies understanding and identifies bottlenecks.
- **Usage:** From manufacturing lines to software algorithms and administrative workflows.

"Visualizing the invisible process."



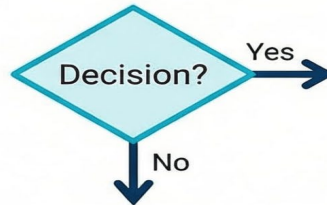
Common Flowchart Symbols

**Terminator (Oval)**

Marks the beginning or end of a process.

**Process (Rectangle)**

Represents a step or activity.

**Decision (Diamond)**

Indicates a point where a decision must be made.

**Input/Output (Parallelogram)**

Shows materials or information entering or leaving.

"Standardizing process communication."

Scenario

- **Context:** A production line for electronic components.
- **Goal:** Visualize the assembly and quality control steps to identify rework loops.

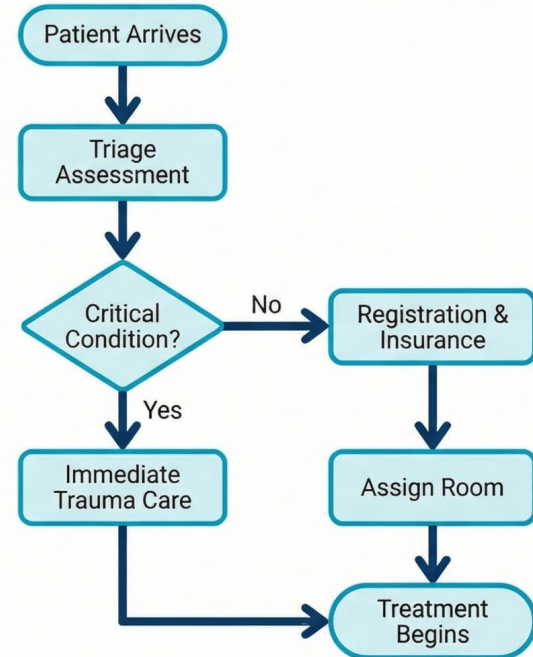
**Key Insight:**

The flowchart clearly identifies the 'Rework' loop, allowing the team to measure the cost of poor quality (COPQ) at this specific stage.

Scenario:

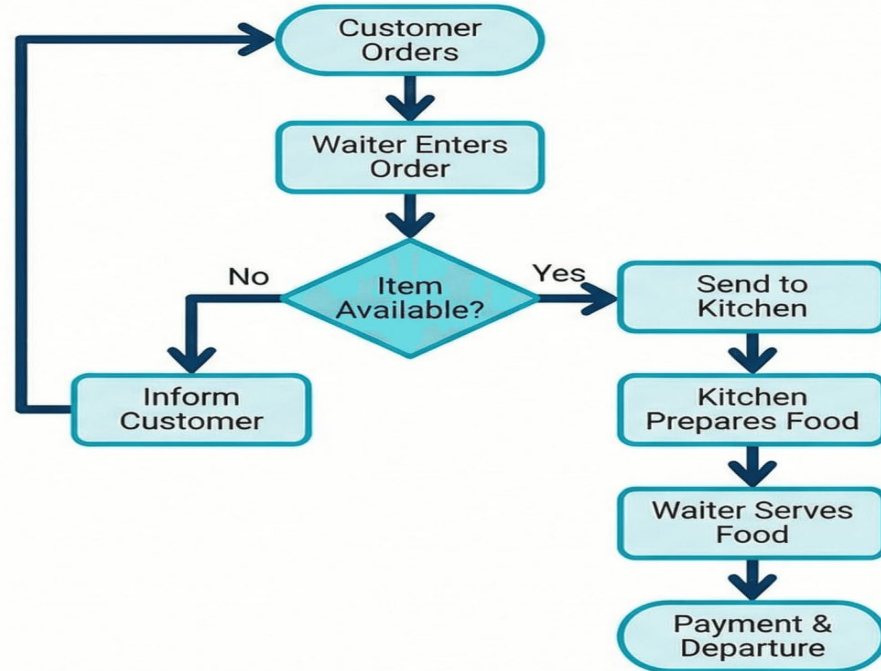
- **Context:** Hospital Emergency Department.
- **Goal:** Streamline patient intake and reduce waiting times.

Key Insight: “Visualizing the decision logic helps staff prioritize critical cases instantly.”
Impact: Reduced average wait time by 15 minutes.



Scenario:

- **Context:** Restaurant Service Workflow.
- **Goal:** Streamline order taking to reduce errors and wait times.





1. Visualizing the Invisible

Makes complex processes visible and easy to understand.



2. Identifying Bottlenecks

Highlights where delays, loops, and inefficiencies hide.



3. Standardization

Creates a 'best way' of doing things for everyone to follow.

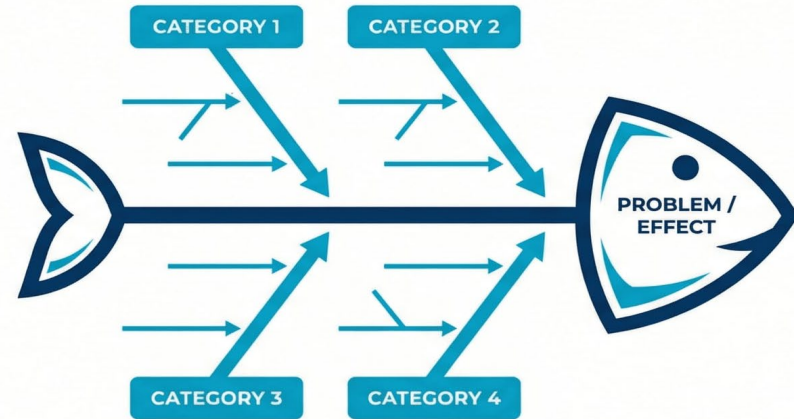


4. Communication Tool

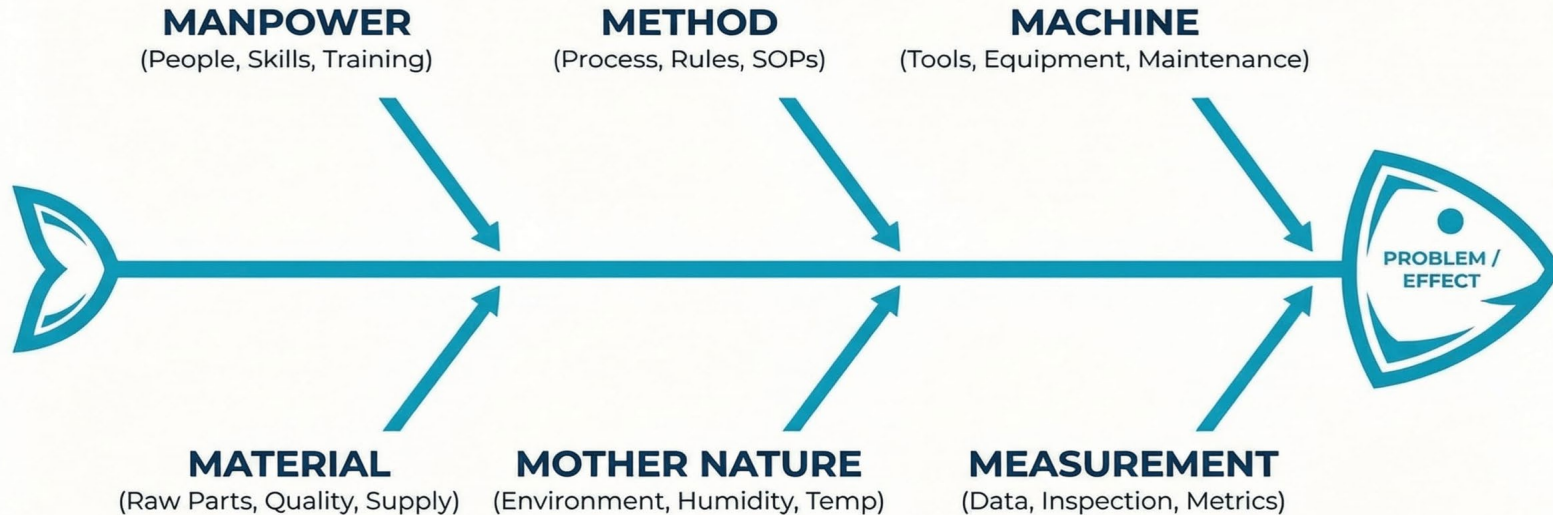
Bridges the gap between different departments and teams.

“A picture is worth a thousand words.”

- **Definition:** A visual tool for identifying, exploring, and graphically displaying all possible causes related to a specific problem or effect.
- **Origin:** Created by Kaoru Ishikawa in the 1960s (also known as Ishikawa Diagram).
- **Purpose:** To move beyond symptoms and uncover the **Root Cause**.
- **Structure:** Resembles a fish skeleton:
 - **Head:** The Problem (Effect).
 - **Spine:** The central line leading to the effect.
 - **Bones:** Categories of causes branching off the spine.



Focus on the cause, not just the symptom.

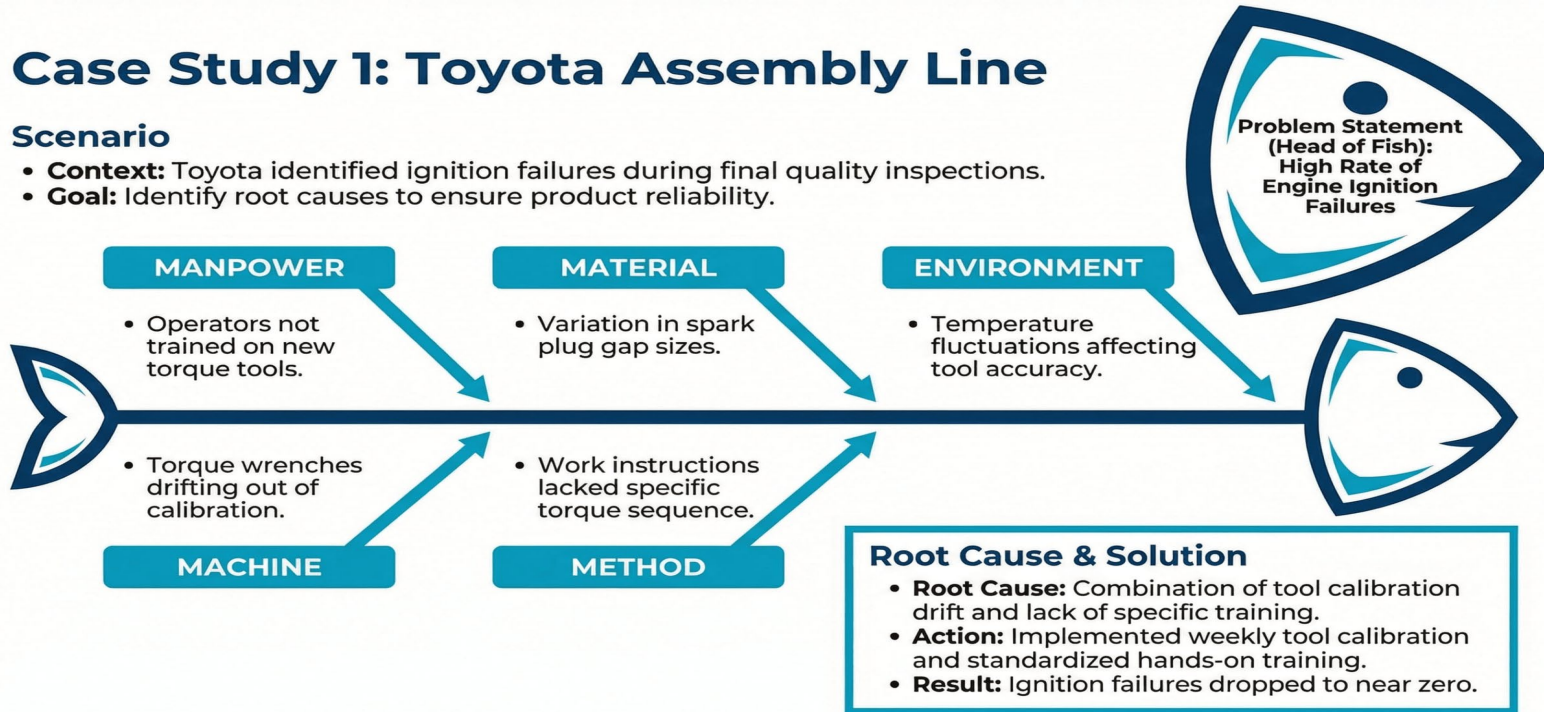


These categories ensure no potential cause is overlooked.

Case Study 1: Toyota Assembly Line

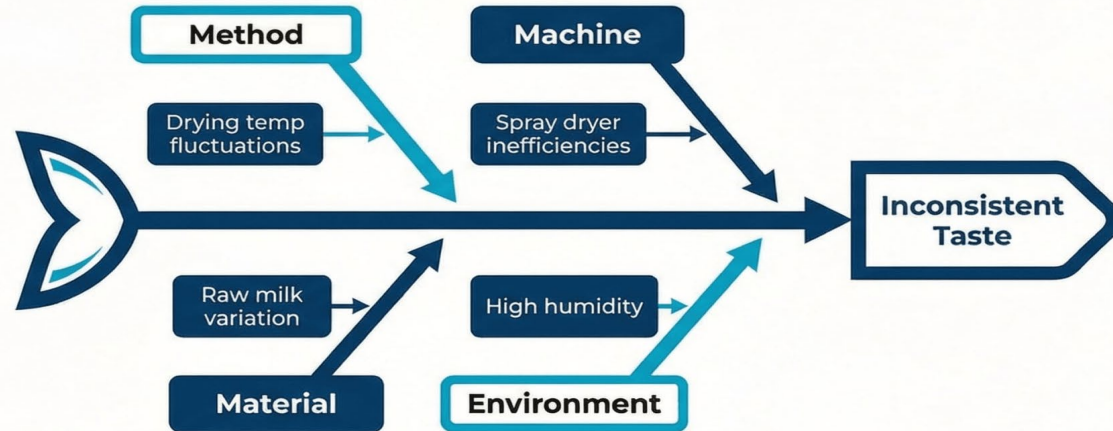
Scenario

- **Context:** Toyota identified ignition failures during final quality inspections.
- **Goal:** Identify root causes to ensure product reliability.



Scenario:

- **Problem:** Rising customer complaints regarding the taste of powdered milk.
- **Goal:** Identify root causes of taste inconsistency to safeguard brand reputation.



Key Insight: Root Cause Analysis revealed that humidity and drying temp were the main culprits, not the recipe itself.

Result: Standardized drying parameters restored consistent quality.

Digging for the Root Cause



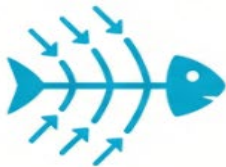
Root Cause Analysis:

Moves beyond symptoms to find the underlying “Why”.



Structured Brainstorming:

Organizes ideas using the 6Ms (Man, Machine, Material, Method, Measurement, Mother Nature).



Visual Clarity:

Shows the relationship between potential causes and the final effect.

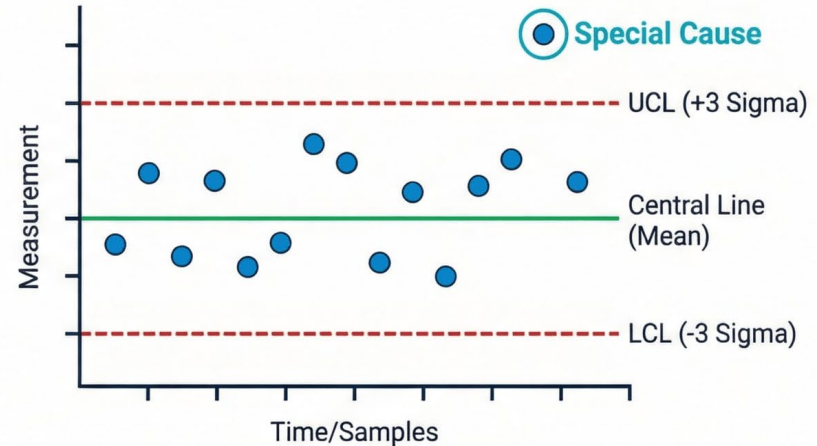


Team Collaboration:

Encourages diverse perspectives to uncover hidden causes.

“Ask ‘Why’ five times to find the truth.”

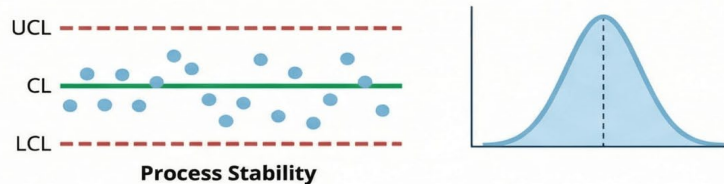
- **Definition:** A graph used to study how a process changes over time, distinguishing between normal variation and unusual events.
- **Core Components:**
 - **Central Line (CL):** The average or **Mean** of the process.
 - **Upper Control Limit (UCL):** Typically +3 Standard Deviations (Sigma).
 - **Lower Control Limit (LCL):** Typically -3 Standard Deviations (Sigma).
- **Purpose:** To determine if a process is 'In Control' (stable) or 'Out of Control' (unpredictable).



Differentiating between the two types of process variation using a clear visual comparison.

Common Cause (Noise)

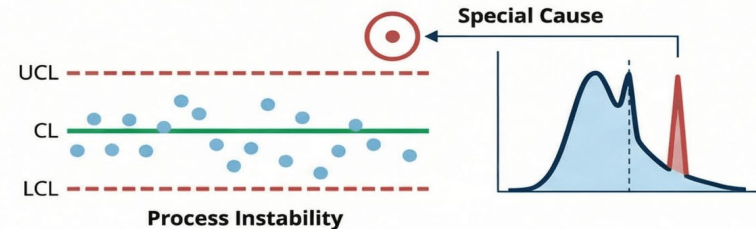
- **Definition:** Natural, inherent variation in the process.
- **Characteristics:** Predictable, stable, within control limits.
- **Action:** Requires fundamental system improvement to reduce.



Analogy: Normal traffic on your daily commute.

Special Cause (Signal)

- **Definition:** Unusual, assignable variation from external sources.
- **Characteristics:** Unpredictable, unstable, often outside control limits.
- **Action:** Requires immediate investigation and correction.



Analogy: A flat tire or an accident on your commute.

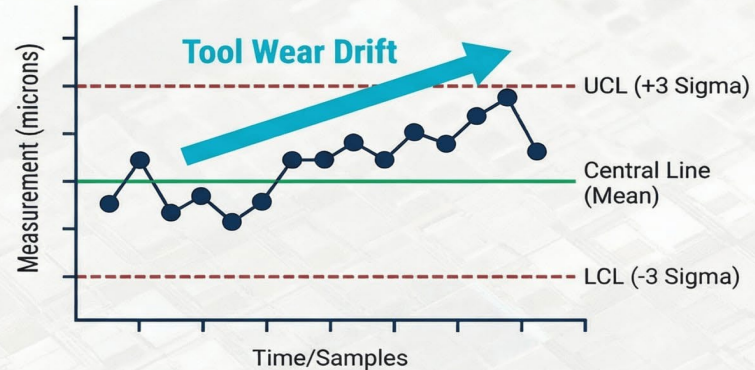
Key Takeaway: Treating common cause as special cause (tampering) increases variation.

- **Scenario:**

- **Context:** High-precision manufacturing of silicon wafers.
- **Metric:** Wafer Thickness (measured in microns).
- **Tool:** X-bar R Chart (Mean & Range).

- **The Story (Visualized):**

- **Problem:** Thickness variation causes chip failure.
- **Chart Pattern:** The Control Chart shows a distinct **upward trend** (7+ points rising) towards the Upper Control Limit (UCL).
- **Diagnosis:** This specific pattern indicates **gradual tool wear** on the polishing machine.
- **Action:** Maintenance triggered *before* defects occurred.

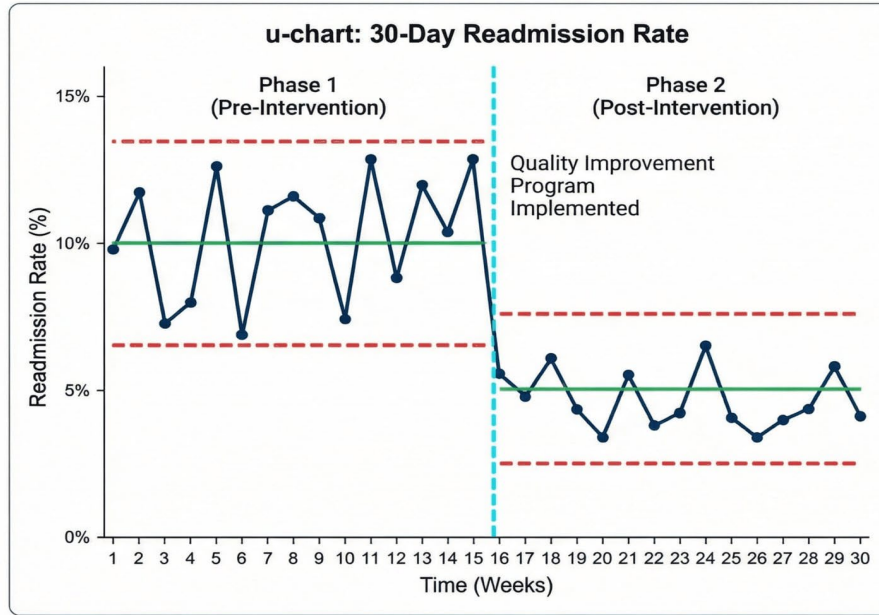
**Key Result:**

"Proactive maintenance replaced reactive fixes."

Outcome: Scrap rate reduced by 15%, Yield improved.

Lecture 07

Case Study 2: Hospital Readmission Rates



Scenario

- Context: A hospital monitoring the percentage of patients readmitted within 30 days.
- Goal: Reduce readmissions and improve patient care quality.

Key Insight

- The chart proves the improvement was real (Special Cause), not just random noise.

Result

Readmission rate dropped significantly and stabilized at a new, lower level.



Distinguish Signal from Noise

Stop reacting to random variation (common causes) and focus on real problems (special causes).



Process Stability & Avoiding Tampering

A stable process is predictable. Control charts are the only way to prove stability.

Adjusting a stable process actually increases variation. Control charts prevent this “over-adjustment.”



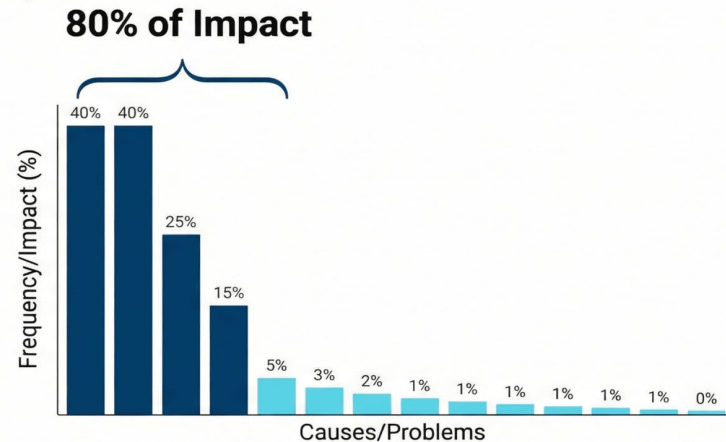
Basis for Improvement

You cannot improve a process until it is stable.

“Data without context is just noise. Control Charts provide the context.”

The 80/20 Rule (Pareto Principle)

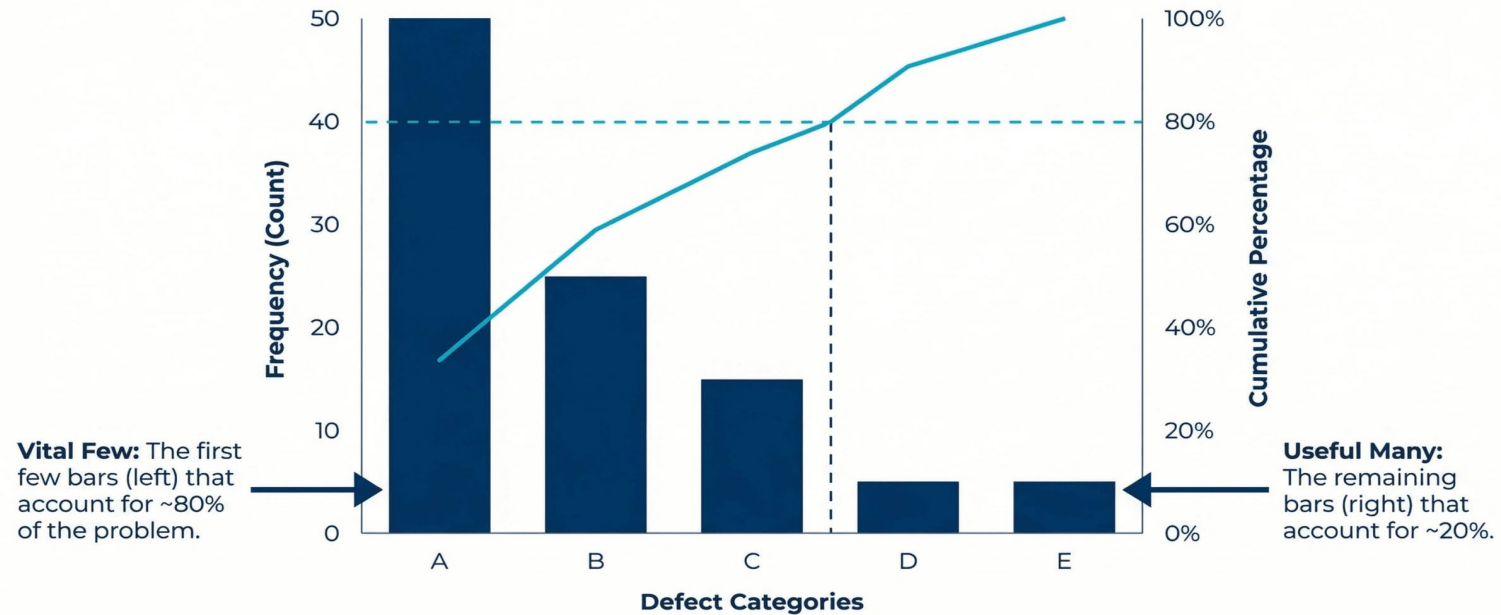
- **Definition:** A bar graph that ranks causes or problems by their frequency or impact.
- **Core Principle:** Roughly **80% of effects** come from **20% of causes**.
- **Goal:** To separate the “**Vital Few**” (critical problems) from the “**Useful Many**” (less critical ones).



Vilfredo Pareto

Lecture 07

Components of a Pareto Chart



Scenario

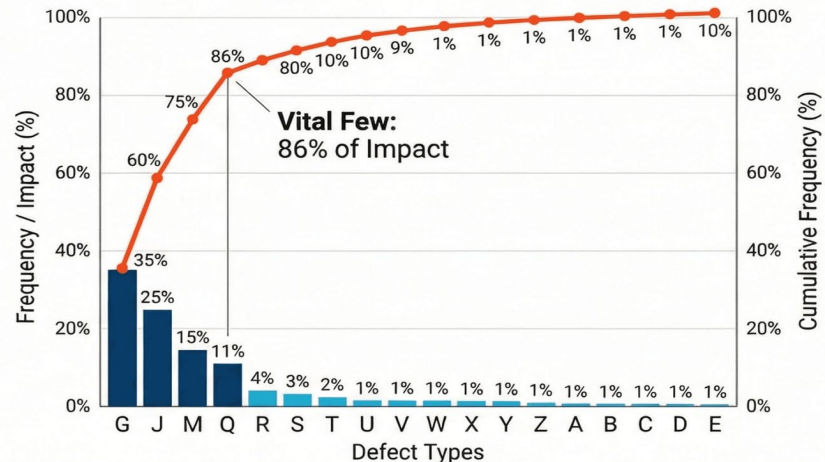
- **Context:** Drill manufacturing process analysis.
- **Problem:** High defect rate in finished products.
- **Analysis:** 18 different defect types identified.

Key Result

Focusing on just 4 defect types solves 86% of the quality issues.

Action: Targeted improvement on the “Vital Few” dramatically reduced scrap.

Pareto Chart: Defect Frequency & Impact



Scenario:

Context: A hospital audit of 430 medication errors to improve patient safety.

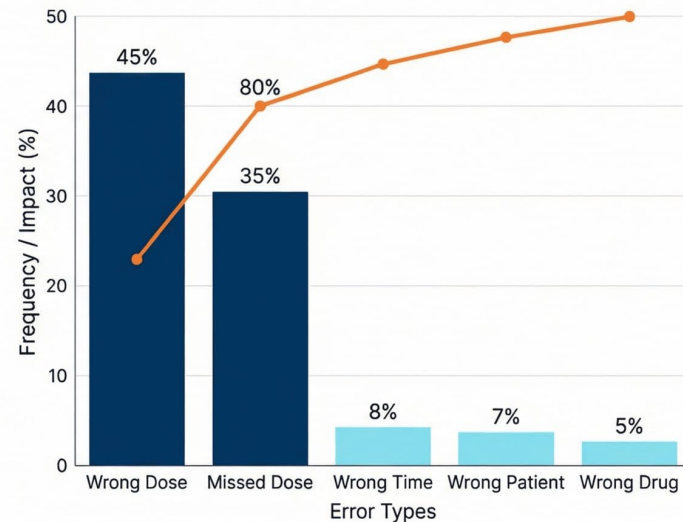
Goal: Identify the most frequent error types to prioritize interventions.

Key Insight:

- **"Vital Few":** Just two error types (Wrong Dose & Missed Dose) account for **80%** of all incidents.

Action: Implemented barcode scanning and double-check protocols for dosing.

Result: **60%** reduction in total errors within 6 months.

The Pareto Chart (Visualized):



Prioritize the Vital Few

Don't try to fix everything at once. Focus on the 20% of causes that create 80% of the problems.



Maximize Efficiency

Achieve the greatest impact with the least amount of effort by targeting the biggest bars first.



Data-Driven Decisions

Move from "I think" to "The data shows." Let the chart dictate your priorities.



Continuous Improvement

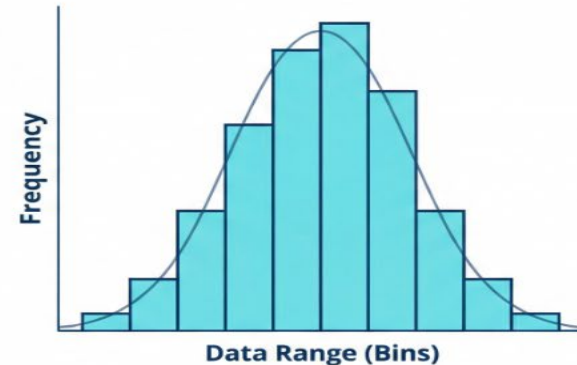
Once the top problem is solved, re-run the analysis to find the *new* vital few.

"Focus on the critical few, not the trivial many." - Juran

What is a Histogram?

Visualizing Frequency Distribution

- **Definition:** A bar graph that shows how often data values occur within specific ranges (bins).
- **Purpose:** To reveal the underlying frequency distribution (shape) of a set of continuous data.
- **Key Difference:** Unlike bar charts (which compare categories), histogram bars touch each other because they represent continuous data.



Interpreting Histogram Shapes



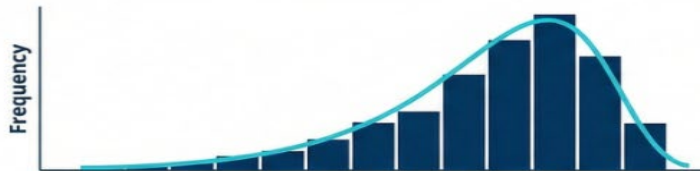
Normal (Bell-Shaped)

Stable, predictable process. Common in nature and controlled manufacturing.



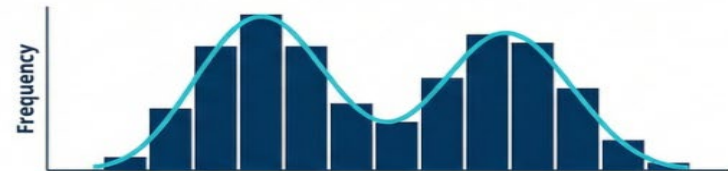
Skewed Right

Natural limit on the left (e.g., time cannot be negative).



Skewed Left

Natural limit on the right (e.g., test scores out of 100).



Bimodal

Two different processes mixed together (e.g., two shifts, two machines).

Optimizing Steel Rod Production through Data Analysis

Scenario

- **Context:** Steel rod production facility.
- **Problem:** High rejection rate due to diameter variance.
- **Data:** Measurements of 100 steel rods.

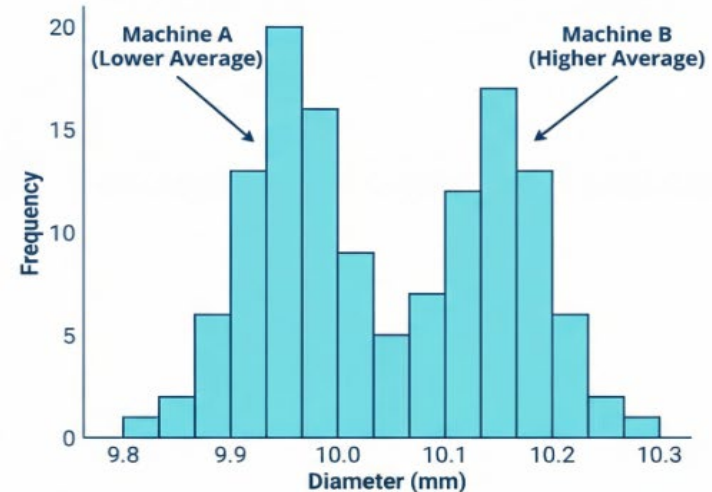
The Histogram Analysis

- **Visual:** A **Bimodal Histogram** (two distinct peaks/humps) is clearly visible.
- **Interpretation:** The two peaks indicate **two different populations** mixed together.
 - **Peak 1:** Represents output from Machine A (lower average).
 - **Peak 2:** Represents output from Machine B (higher average).
- **Root Cause:** The two machines were calibrated differently.

Key Result

- **Action:** Recalibrated both machines to the same target mean.
- **Outcome:** The distribution became a single, tight bell curve (Normal Distribution), significantly reducing defects.

Bimodal Histogram: Initial Diameter Variance



Visualizing Emergency Department Flow

Scenario

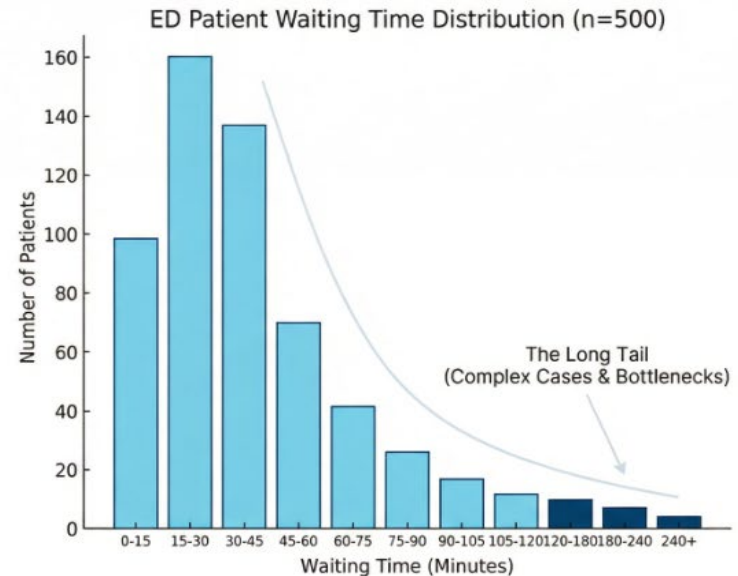
- **Context:** Emergency Department (ED) process improvement.
- **Data:** Measured waiting times for 500 patients.
- **Data:** Measured waiting times for 500 patients.
- **Goal:** Reduce patient dissatisfaction and overcrowding.

The Histogram (Visualized)

- **X-axis:** Waiting Time (Minutes) - e.g., 0-15, 15-30, 30-45...
- **Y-axis:** Number of Patients.
- **Shape:** Skewed Right (Positively Skewed). Peak is on the left (short wait times), with a long, tapering tail to the right (some patients waiting 4+ hours).

Key Insight

- **"The Long Tail":** While the average wait might be acceptable, the variation is the problem. The tail represents patients with complex cases or triage bottlenecks.
- **Action:** Implemented "Fast Track" for minor injuries to separate flows.
- **Result:** Reduced the tail and improved overall flow.



"Variation is the enemy of quality." - W. Edwards Deming



Visualize Variation: Don't rely on averages alone. See the full shape of your data to understand reality.



Assess Capability: Instantly determine if your process fits within customer specifications (limits).



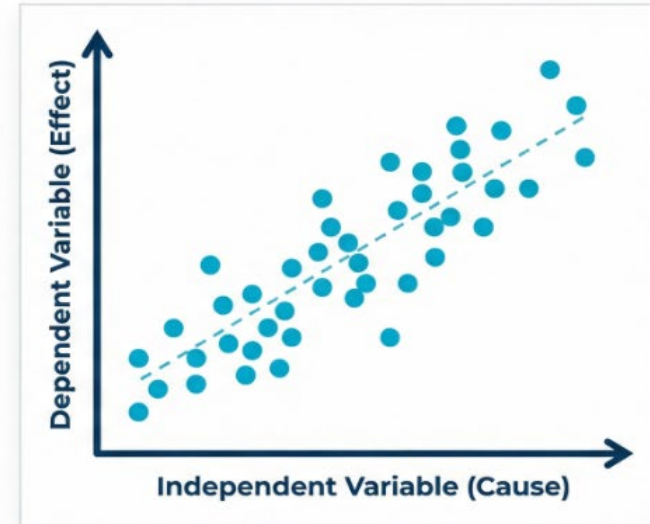
Detect Issues: Spot outliers, skewness, or bimodal patterns that indicate process problems.

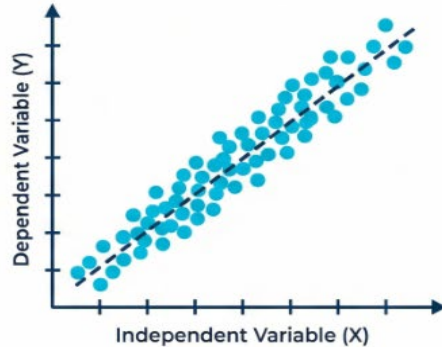


Data-Driven Decisions: Use the histogram to baseline performance and validate improvements.

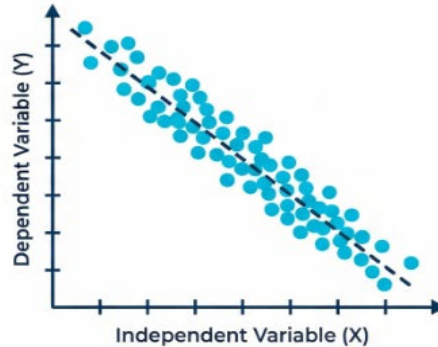
Visualizing Relationships

- **Definition:** A graph that plots pairs of numerical data (X, Y) to look for a relationship between them.
- **Purpose:** To test whether one variable (Independent, X) affects another (Dependent, Y).
- **Core Question:** "Does changing X really change Y?"

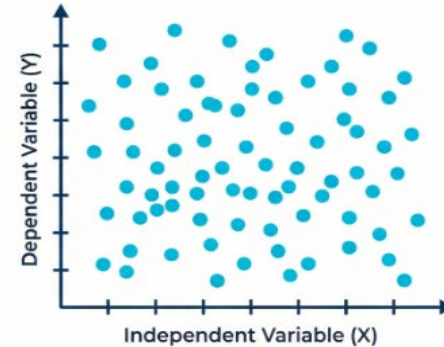


Positive Correlation

As X increases, Y increases
(e.g., Study Time vs. Grades).

Negative Correlation

As X increases, Y decreases
(e.g., Car Age vs. Price).

No Correlation

No relationship between variables
(e.g., Height vs. Shoe Color).

**Correlation $\neq$ Causation**

Just because two variables move together doesn't mean one causes the other.



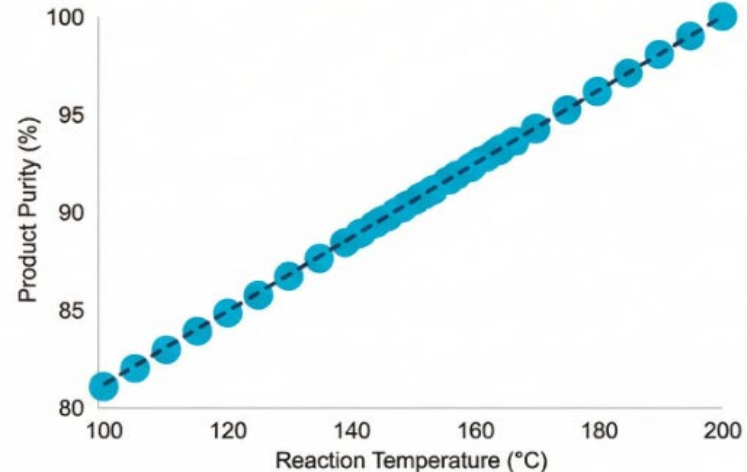
Scenario

- **Context:** Chemical Manufacturing Plant.
- **Problem:** Inconsistent product purity levels.
- **Hypothesis:** "Does reaction temperature affect purity?"

Key Insight & Action

- **Insight:** Temperature is a critical driver of quality.
- **Action:** Established strict temperature control limits (optimal range).
- **Result:** Purity stabilized at >99%, reducing waste by 15%.

The Scatter Diagram Analysis



Visual Pattern: Strong Positive Correlation. Points form a tight band rising from left to right. As temperature increases, increases, purity consistently increases.

Scenario

- **Context:** Customer Support Center.
- **Problem:** High variability in agent error rates.
- **Hypothesis:** "Does more training lead to fewer errors?"

The Scatter Diagram Analysis

- **X-axis:** Training Hours (Independent Variable).
- **Y-axis:** Errors per Week (Dependent Variable).
- **Visual Pattern:** Strong Negative Correlation.
Points slope downward from left to right.
Employees with low training hours have high error rates.
Employees with high training hours have low error rates.

Key Insight

- **Correlation:** Strong negative relationship ($r = -0.85$).
- **Conclusion:** Training is a key driver of quality.
- **Action:** Implemented a mandatory 40-hour training curriculum for all agents.





Identify Relationships

Instantly visualize if two variables are linked (Positive, Negative, or None).



Test Hypotheses

Move beyond “gut feeling” to data-driven proof of relationships.



The Golden Rule: "Correlation does not imply Causation."

Just because two things move together (e.g., ice cream sales and shark attacks) doesn't mean one causes the other. Always look for the underlying mechanism.

Data shows the *what*, you must find the *why*.

Thank You