Introduction to Methods Engineering and Operations Analysis

Sections:

1. Evolution and Scope of Methods Engineering – part 1
2. How to Apply Methods Engineering – part 1
3. Basic Data Collection and Analysis Techniques – part 2
4. Automation and Methods Engineering – part 2

Introduction to Methods Engineering and Operations Analysis

3. Basic Data Collection and Analysis Techniques

Basic Data Collection & Analysis Tools

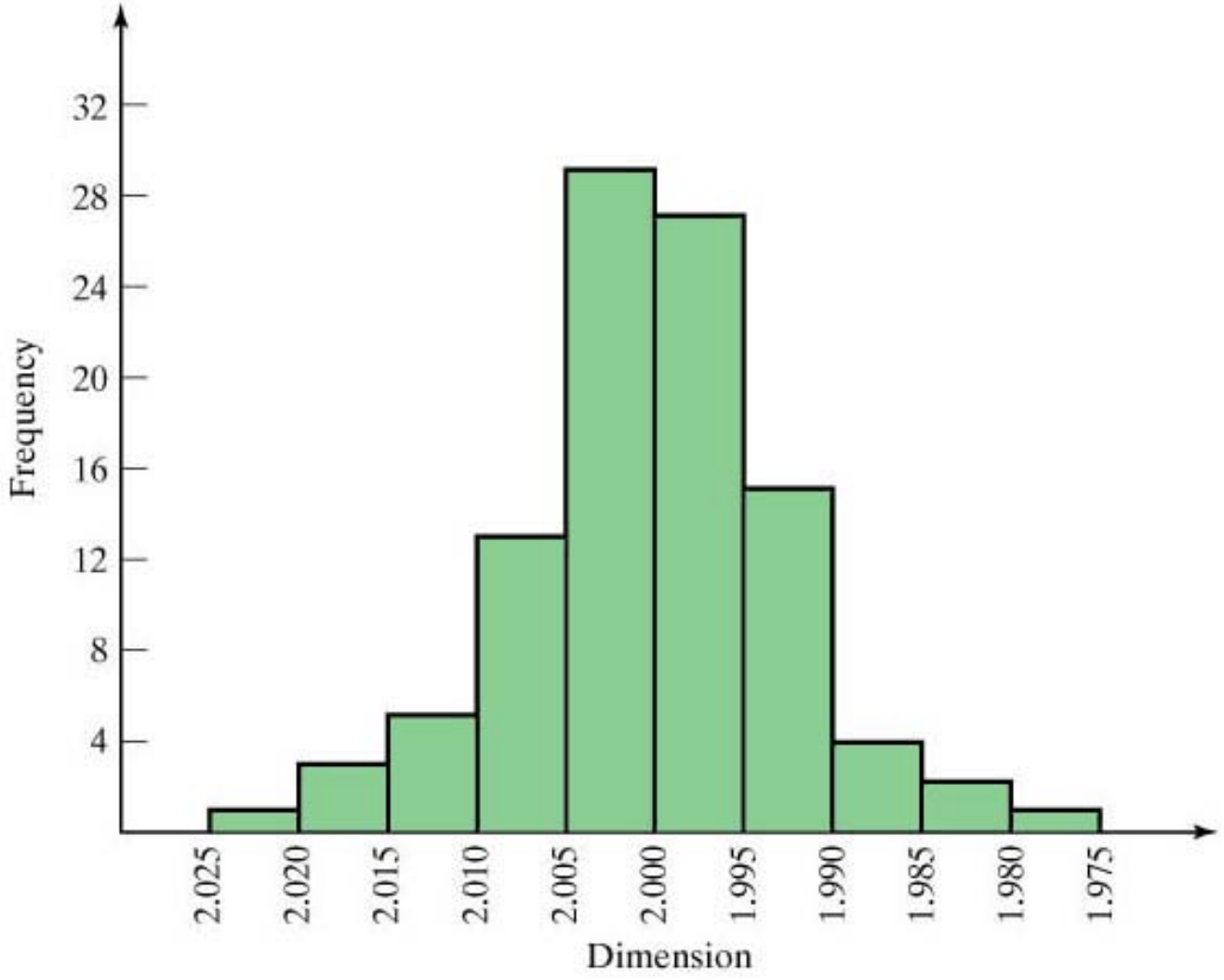
1. Histograms
2. Pareto charts
3. Pie charts
4. Check sheets
5. Defect concentration diagrams
6. Scatter diagrams
7. Cause and effect diagrams

1. Histogram

A **statistical graph** consisting of **bars** representing different members of a population, in which the length of each bar indicates the **frequency or relative frequency** of each member

- A useful tool because the analyst can quickly visualize the **features** of the **data**, such as:
  - **Shape** of the distribution
  - Any **central tendency** in the distribution
  - Approximations of the **mean** and **mode**
  - Amount of **scatter** in the data

Histogram for Data Display

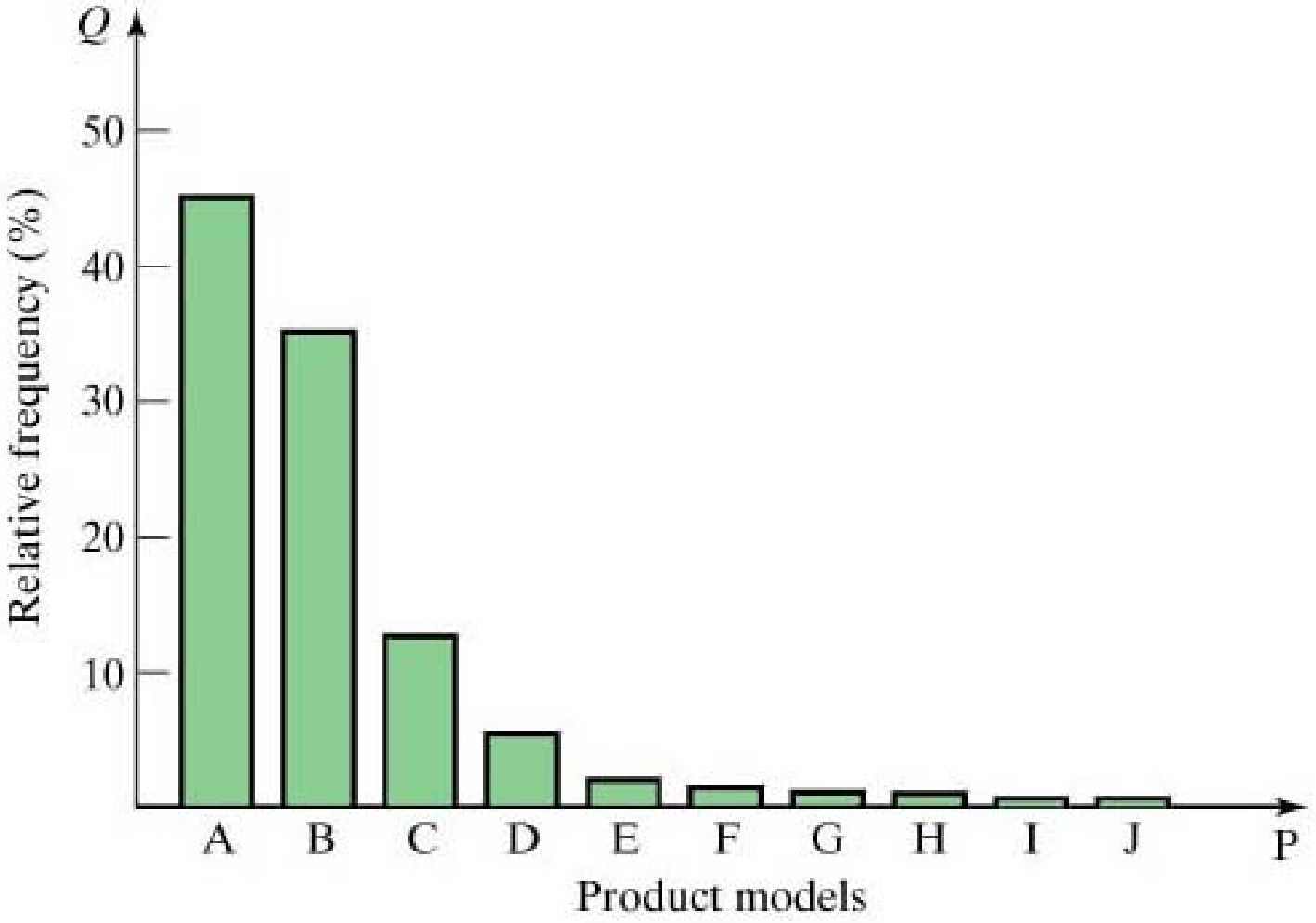


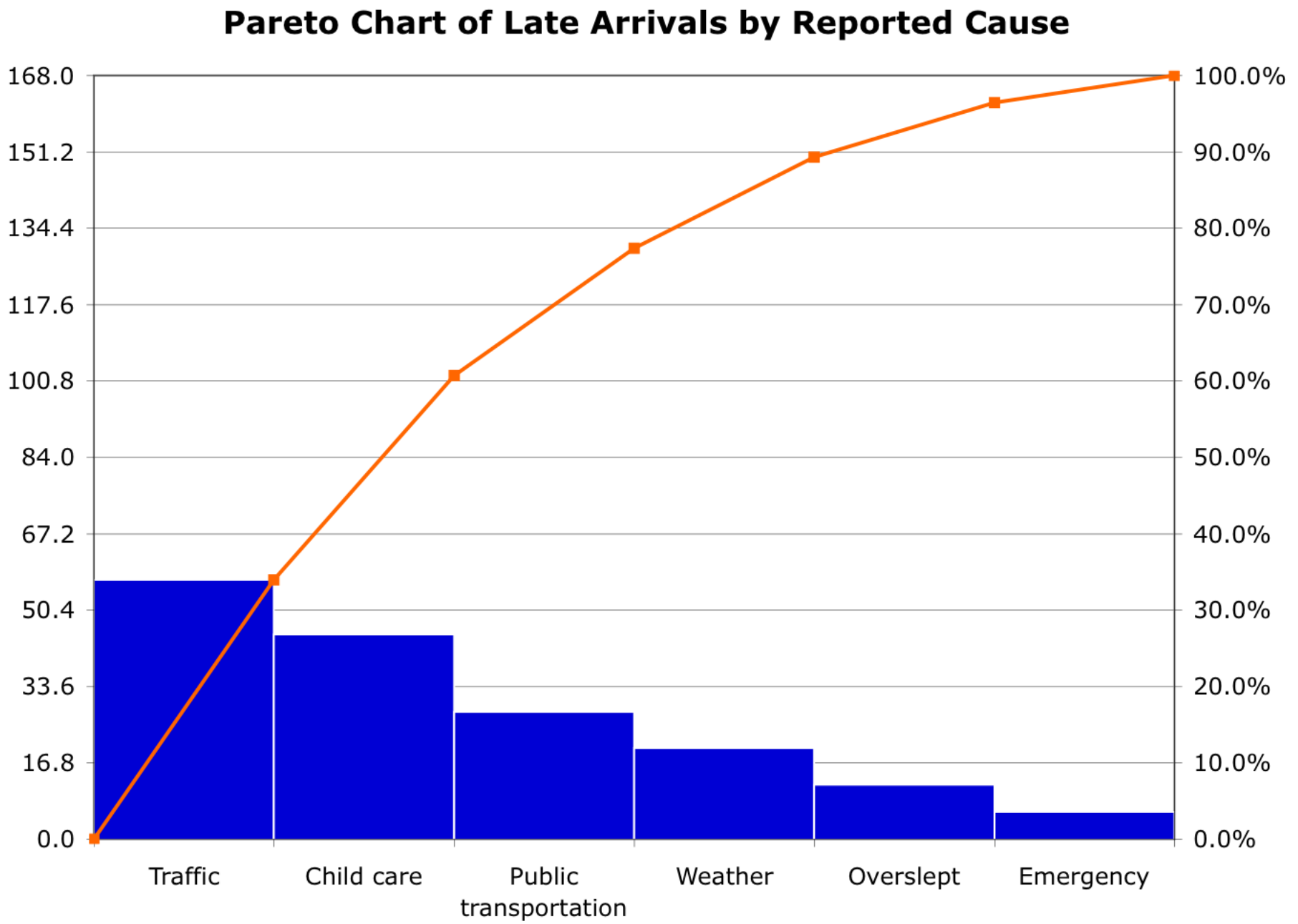
2. Pareto Chart

Special form of **histogram** in which **attribute data** are arranged according to some **criterion** such as cost or value

- Based on **Pareto's Law**: "the **vital few** and the **trivial many**" (watch video)*
- Often identified as the 80%-20% rule
  - 80% of a nation's **wealth** is owned by 20% of the **population**
  - 80% of **sales** are accounted for by 20% of the **SKUs** (stock-keeping units)

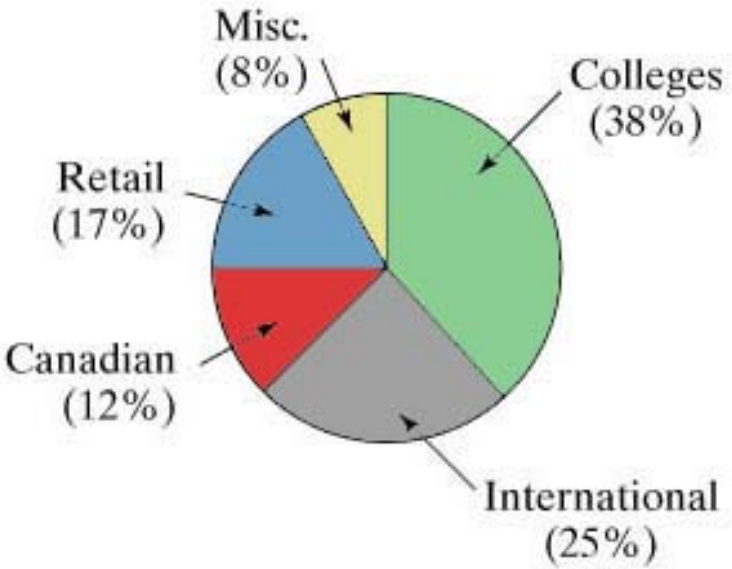
Pareto Distribution



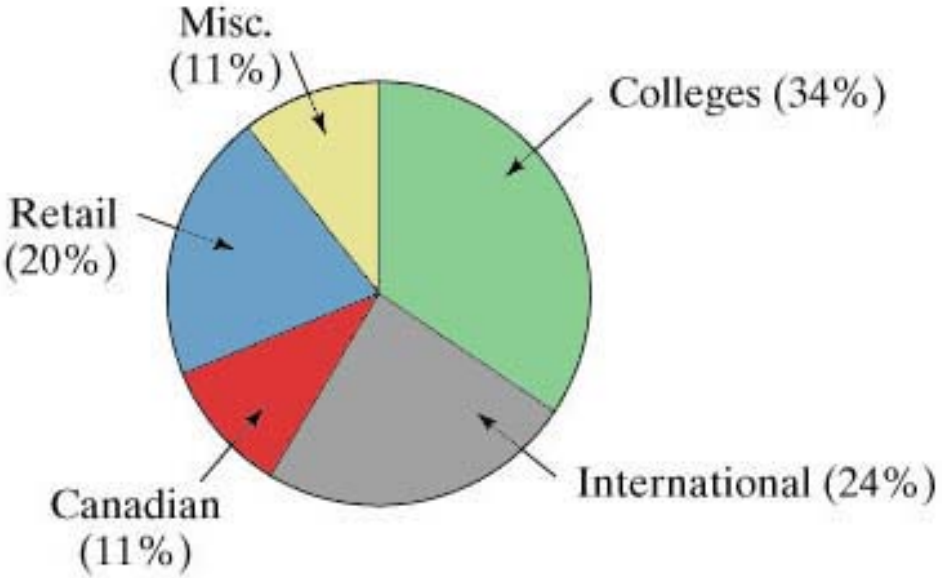

Pareto Chart of Late Arrivals by Reported Cause
168.0
151.2
134.4
117.6
100.8
84.0
67.2
50.4
33.6
16.8
0.0
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
Traffic
Child care
Public transportation
Weather
Overslept
Emergency

3. Pie Charts

Example: **Annual sales revenues** and **customer distributions** for two years



Year 1



Year 2

4. Check Sheet

Data collection tool generally used in **preliminary stages** of a study of a **quality problem** (video)

- Data often **entered by worker as check marks** in a given category
- Examples:
  - **Process distribution** check sheet - data on *process variability*
  - **Defective item** check sheet – *types and frequencies of defects* on the product
  - **Defect location** check sheet – *where defects occur* on the product

Check Sheet

Motor Assembly Check Sheet

Name of Data Recorder: Lester B. Rapp

Location: Rochester, New York

Data Collection Dates: 1/17 - 1/23

Defect Types/ Event Occurrence	Dates							TOTAL
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	
Supplied parts rusted		8	5	4	2			20
Misaligned weld			3			2		5
Improper test procedure								0
Wrong part issued		1		2				3
Film on parts								0
Voids in casting				4	2			6
Incorrect dimensions						2		2
Adhesive failure								0
Masking insufficient					1			1
Spray failure			5					5
TOTAL		10	13	10	5	4		

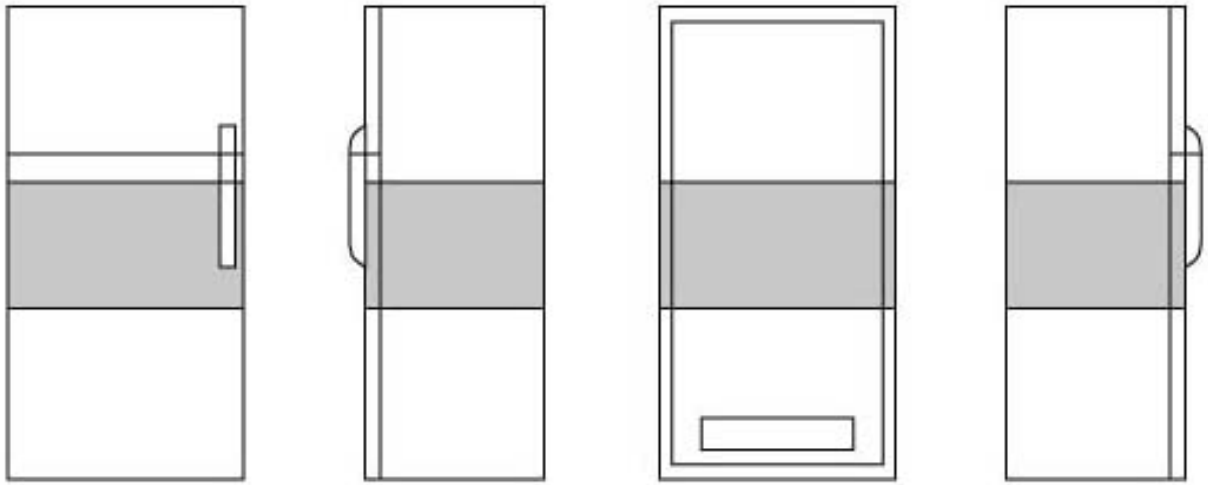
5. Defect Concentration Diagram

A drawing of the product (all relevant views), onto which the locations and frequencies of various defect types are added

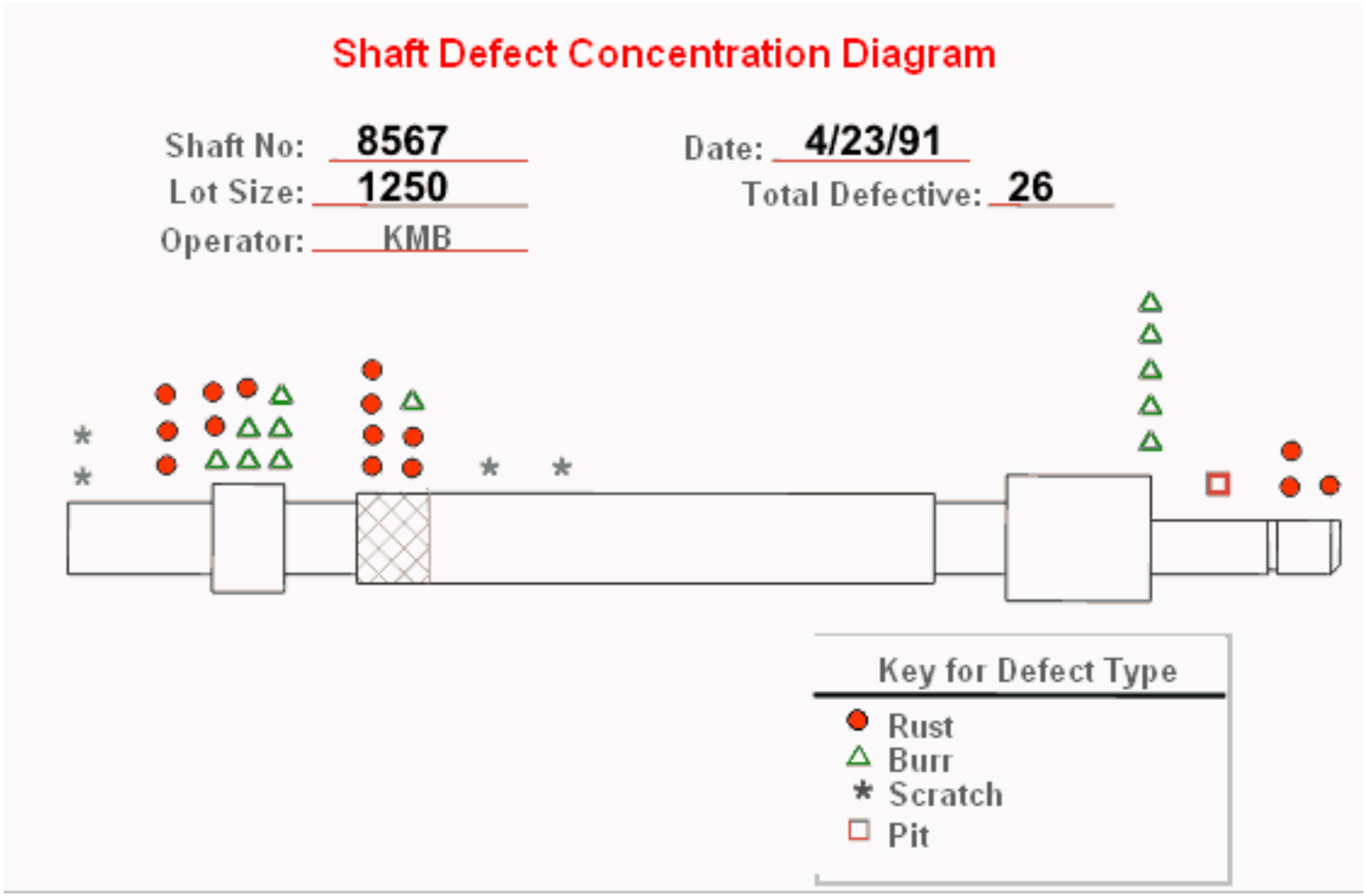
- Useful for analyzing the causes of product or part defects
- By analyzing the defect types and corresponding locations, the underlying causes of the defects can possibly be identified

Defect Concentration Diagram

Four views of refrigerator showing locations of surface defects



Defect Concentration Diagram



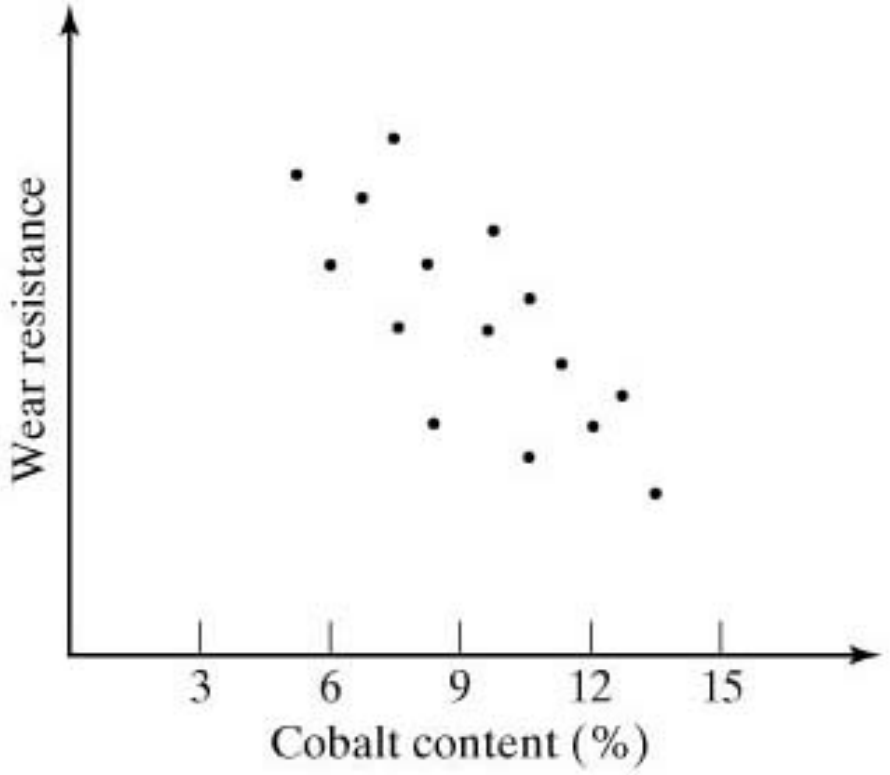
6. Scatter Diagrams

An **x-y plot** of **data collected** on two variables, where a **correlation** between the variables is **suspected**

- The data are **plotted as pairs**; for each x_i value, there is a corresponding y_i value
- The shape of the collection of data points often reveals a pattern or **relationship** between the **two variables**

Scatter Diagram

Effect of **cobalt content** on **wear resistance** for a cemented **carbide cutting tool**

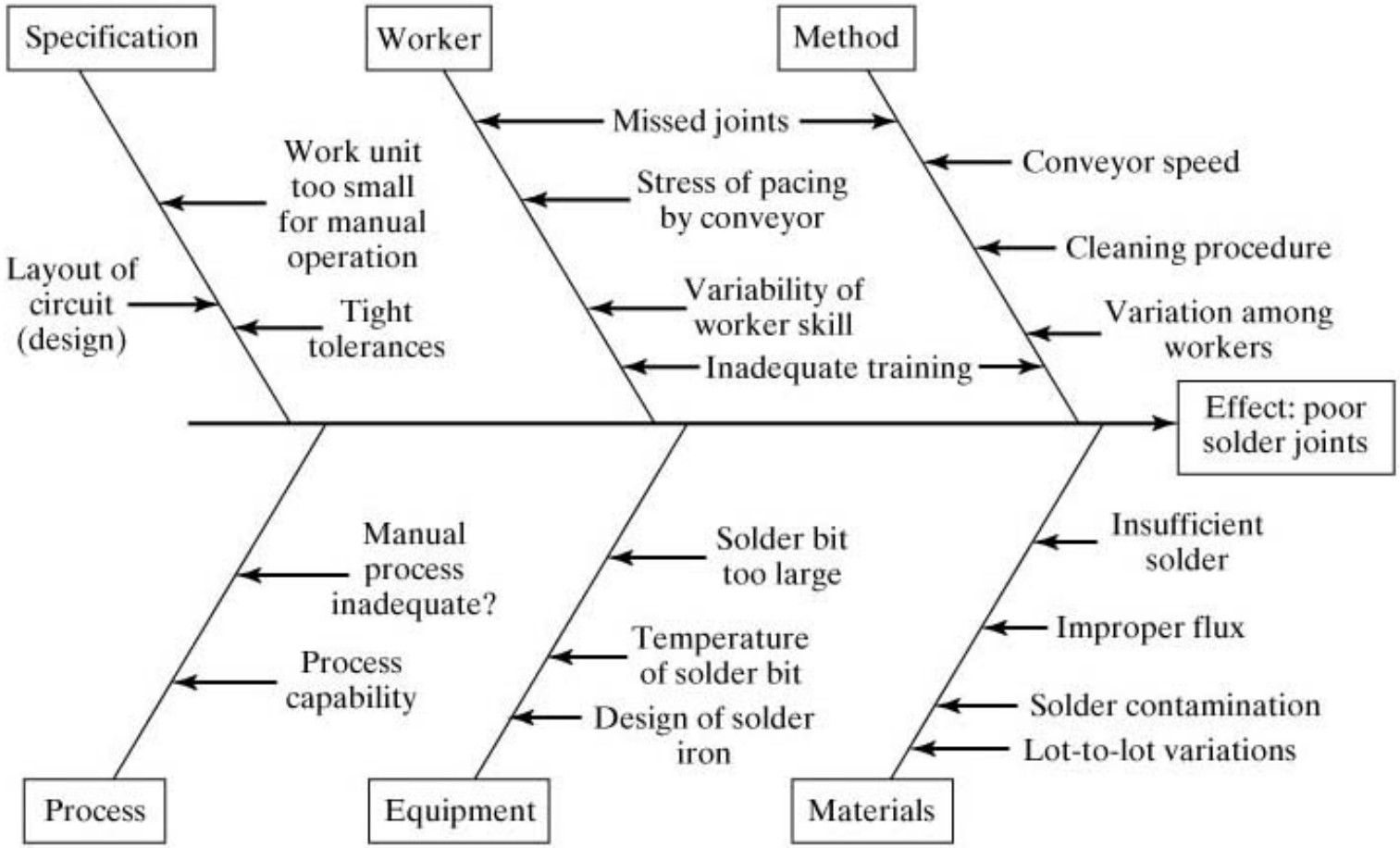


7. Cause and Effect Diagram

A **graphical-tabular chart** used to list and analyze the potential **causes of a given problem**

- Can be used to **identify** which causes are most **consequential** and how to take **corrective action** against them
- Also known as a "**fishbone diagram**" (video)

Cause and Effect Diagram



Introduction to Methods Engineering and Operations Analysis

4. Automation and Methods Engineering

Methods Engineering and Automation

- USA Principle
- Ten Strategies for Automation
- Automation Migration Strategy.

USA Principle

1. **U**nderstand the existing process
2. **S**implify the process
3. **A**utomate the process

Understand the Existing Process

- What are the **inputs**?
- What are the **outputs**?
- Number and placement of **inspections**
- Number of **moves** and **delays** experienced by the work unit
- Time spent in **storage**

Mathematical Models

- What are the **important output variables**?
- How are these output variables **affected by inputs** to the process?
- Develop **mathematical model** of the process

Simplify the Process

- What is the **purpose of** this **operation** or this transport?
- Can this step be **eliminated**?
- Is the most **appropriate technology** being used?
- How can this step be **simplified**?
- Can steps be **combined**?
- Can steps be performed **simultaneously**?
- Can steps be **integrated** into a **manually operated production line**?

Automate the Process

- If **simplification** is **successful**, **automation** may **not** be **necessary**
- Otherwise: automation is necessary
  - **Ten strategies** for automation
  - **Automation migration** strategy

Ten Strategies for Automation

1. *Specialization* of operations
2. *Combined* operations
3. *Simultaneous* operations
4. *Integration* of operations
5. Increased *flexibility*
6. Improved *material handling and storage*
7. On-line *inspection*
8. *Process control* and optimization
9. *Plant* operations *control*
10. *Computer integrated manufacturing* (**CIM**)

Automation Migration Strategy

- **Phase 1**: **Manual production** using **single station manned cells** operating **independently**
- **Phase 2**: **Automated production** using **single station automated cells** operating **independently**.
- **Phase 3**: **Automated integrated production** using a **multi-station** automated system with serial operations and **automated transfer** of work units **between stations**.

Automation Migration Strategy