Work Charting Methods

Topics:

1. **Pareto Chart** – part 1
2. **Fishbone (Cause-Effect) Diagram** – part 1
3. **Operation Process Charts** – part 1
4. **Flow Process Charts** – part 1
5. Flow Diagrams – part 2
6. Worker and Machine Process Charts – part 2
7. Gang Process Charts – part 2
8. Two-Handed Process Charts – part 2

Objectives of Work Charting Methods

- **Objectively** document the **work task** or **process** for analysis

- Examine some of **many available methods** (new ones **invented regularly**)

- Break down job into **sub-components** (**tasks**)

- **Describe** the **tasks** in a meaningful way

1. *Pareto Chart*

1 - Pareto Chart

- **Items** of interest:
  - **identified**
  - **measured** on a common scale
  - then **ordered** in ascending order
  - used to create a **cumulative distribution**
- Pareto principle:
  - **80%** of total **activity** found in first **20%** of **items**
- Goal: **identify** appropriate **20%** for analysis
  - e.g. 80% of inventory associated 20% of parts
  - e.g. 80% of injuries associated 20% of jobs

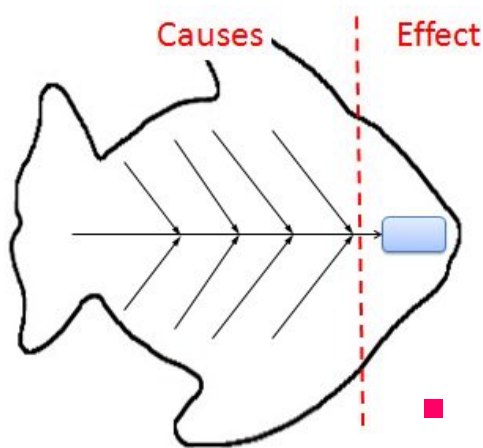Pareto Chart: Relative frequency (%) vs Product models (A, B, C, D, E, F, G, H, I, J)
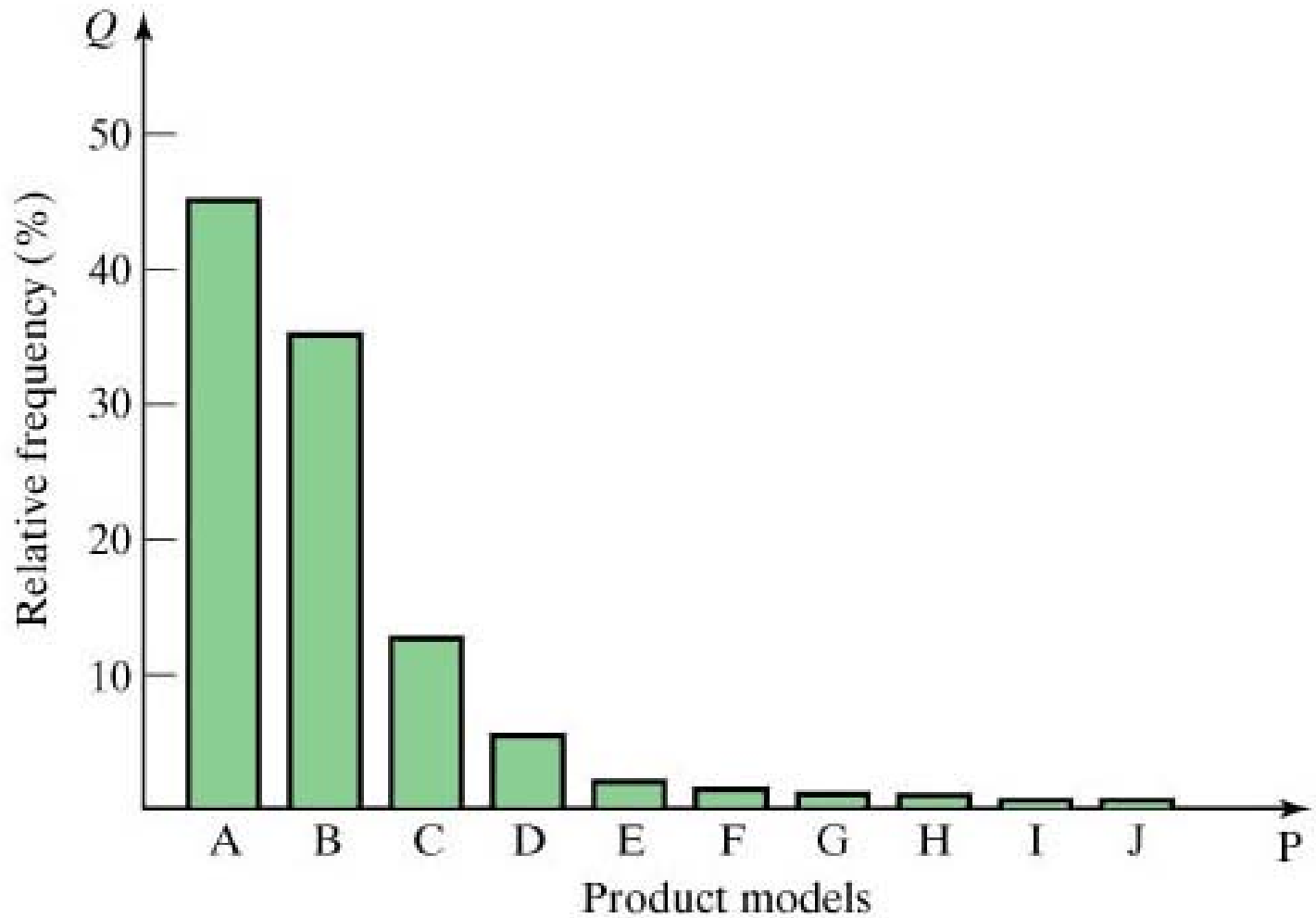
2. *Fishbone (Cause-Effect) Diagram*

2 - Fishbone (Cause-Effect) Diagram

- Identifies **components** that lead to undesirable event in a process

- **Event** / problem / effect: identified at "**fish head**"

- Associated **contributing factors:**
  - grouped into **categories** (shown in boxes)
  - **potential root causes** identified using tree type structure (using arrows)
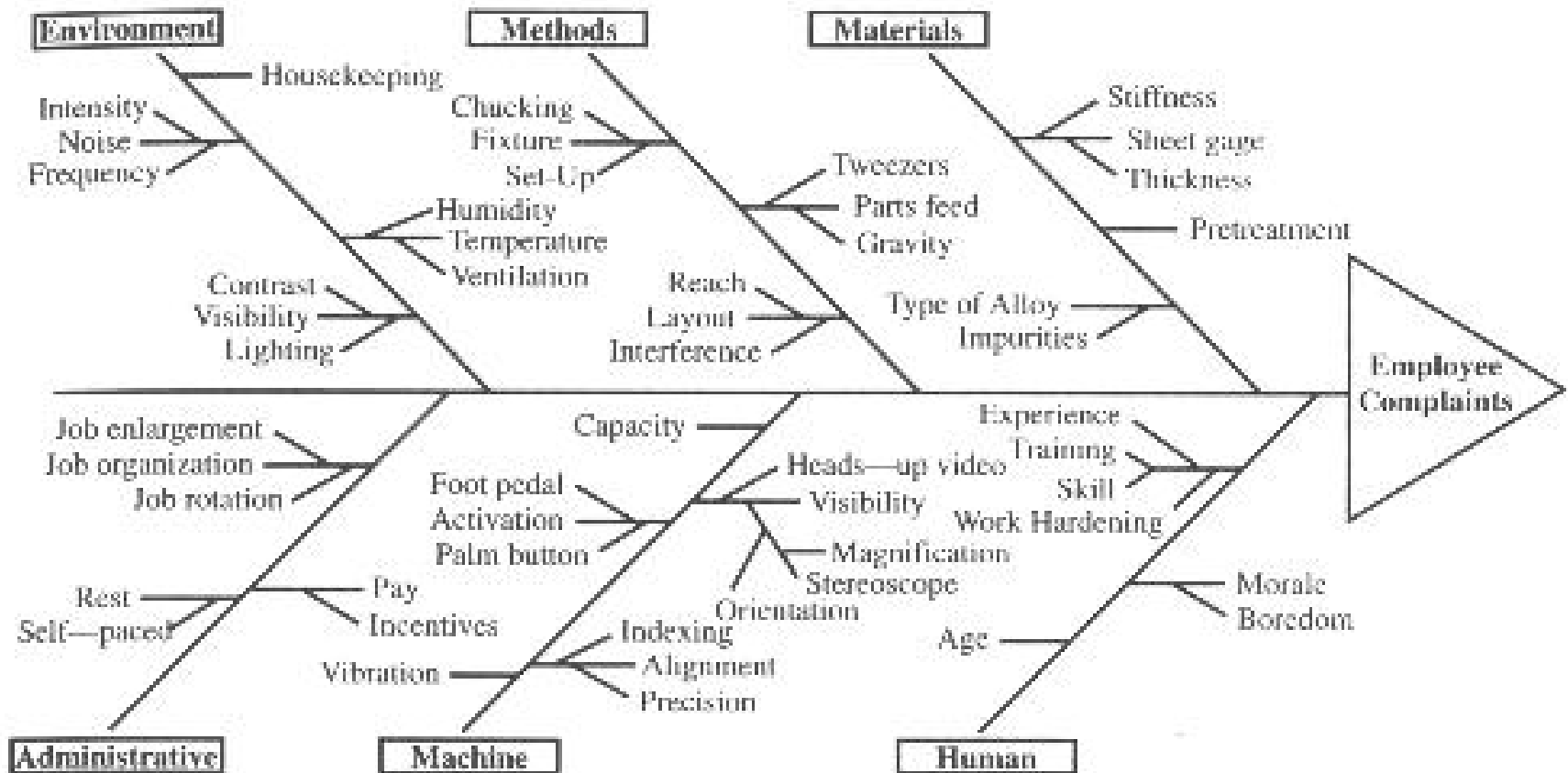
- Closely related to many different charts used in **safety analysis** (**Fault-Tree method**)
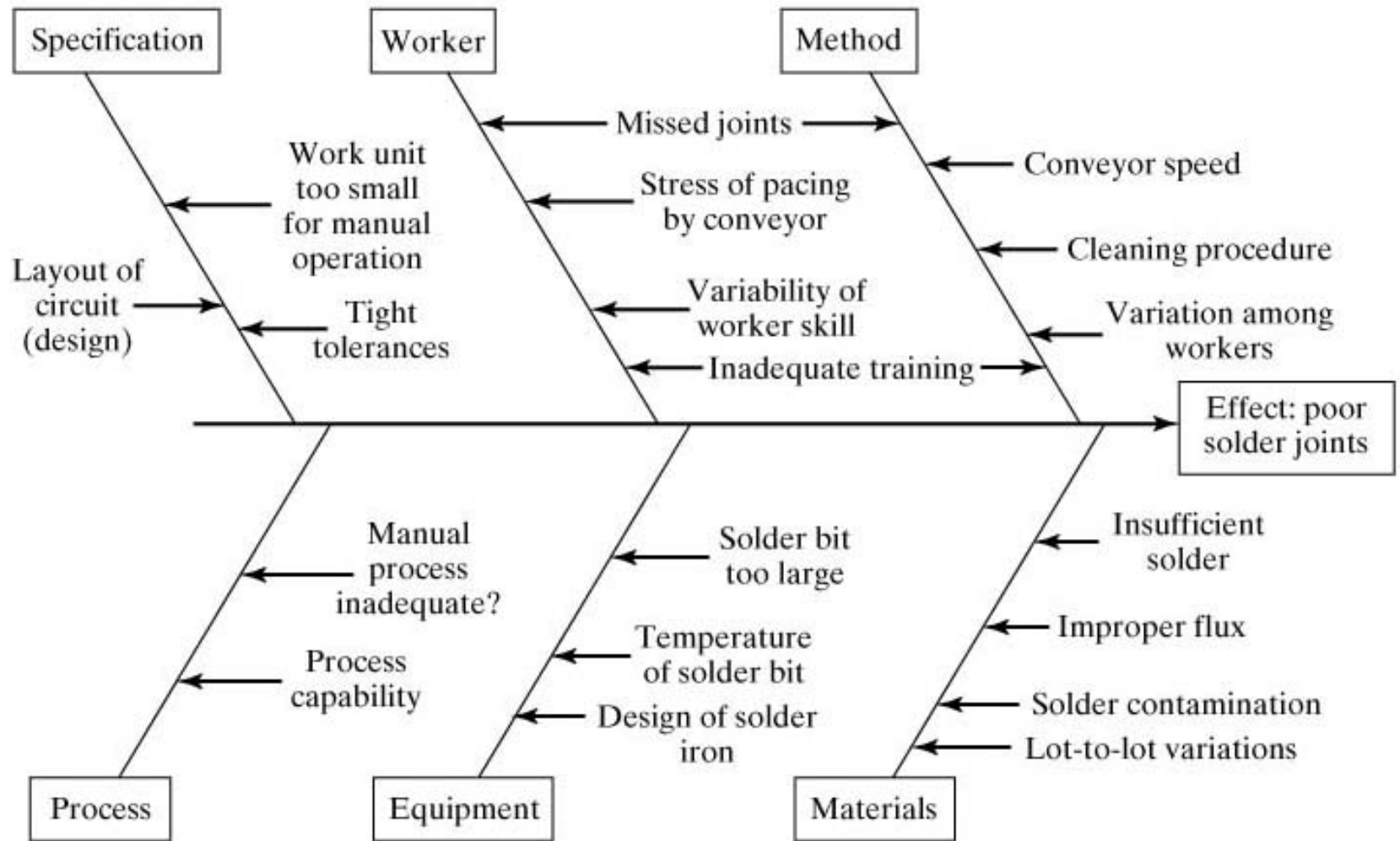
2 - Fishbone (Cause-Effect) Diagram

FIGURE 2–2

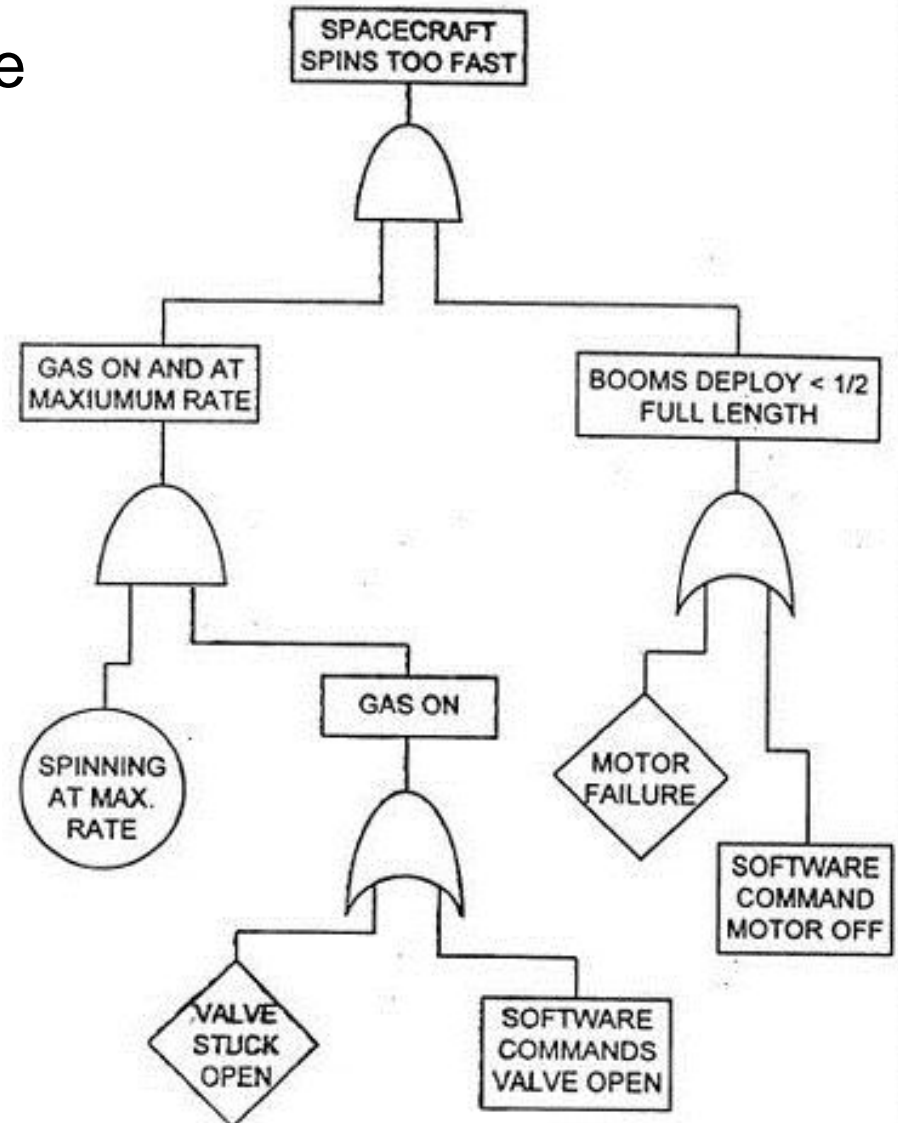Fish diagram for operator health complaints on cut-off operation.

2 - Fishbone (Cause-Effect) Diagram

2 - Fishbone (Cause-Effect) Diagram

- Simple Fault-Tree

3. *Operation Process Charts*

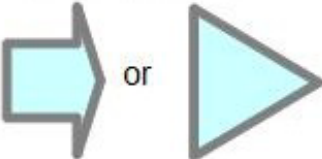# 3 - Operation Process Charts

- Represents the **chronological sequence** of:
  - **Operations**
  - **Inspections**
  - **Time allowances**, and
  - **Materials** used in a process
- Spans **time** from
  - arrival of **raw material** to
  - packaging of **finished product**
- Focuses on **products** and/or **facilities**
- Two **symbols** used in the chart (see next slide):
  - **Operations**: denoted using a small circle
  - **Inspections**: denoted using a small square

Process Flow Diagram Symbols

Chart Terminator

Transport Step [B]   or

Decision Step

Receive/Extract Step [A]

Process Flowline

Checking Step [A, B]

Document Symbol

Store/Merge Step [A, B]

Basic Process Step [A, B]

Off-Page Connector

Delay Step [B]

Storage Symbol

A. *Symbols introduced by the Gilbreths (1921)*   **B.** *Symbols published by ASME (1947)*

3 - Operation Process Charts

- **Vertical lines**:
  indicate general **flow of process** as work is completed

- **Horizontal lines feeding into vertical lines**:
  parts or subassemblies (see next slide)

- Lines should **not cross** in the chart.

- **Time* values** are assigned on the chart to:
  - **operations** and
  - **inspections**

FIGURE 2–6
Flowcharting conventions.

Junction

Vertical flow line

Horizontal connecting line

No Junction

Vertical flow line

Horizontal connecting line

Alternate Paths

Rework

01
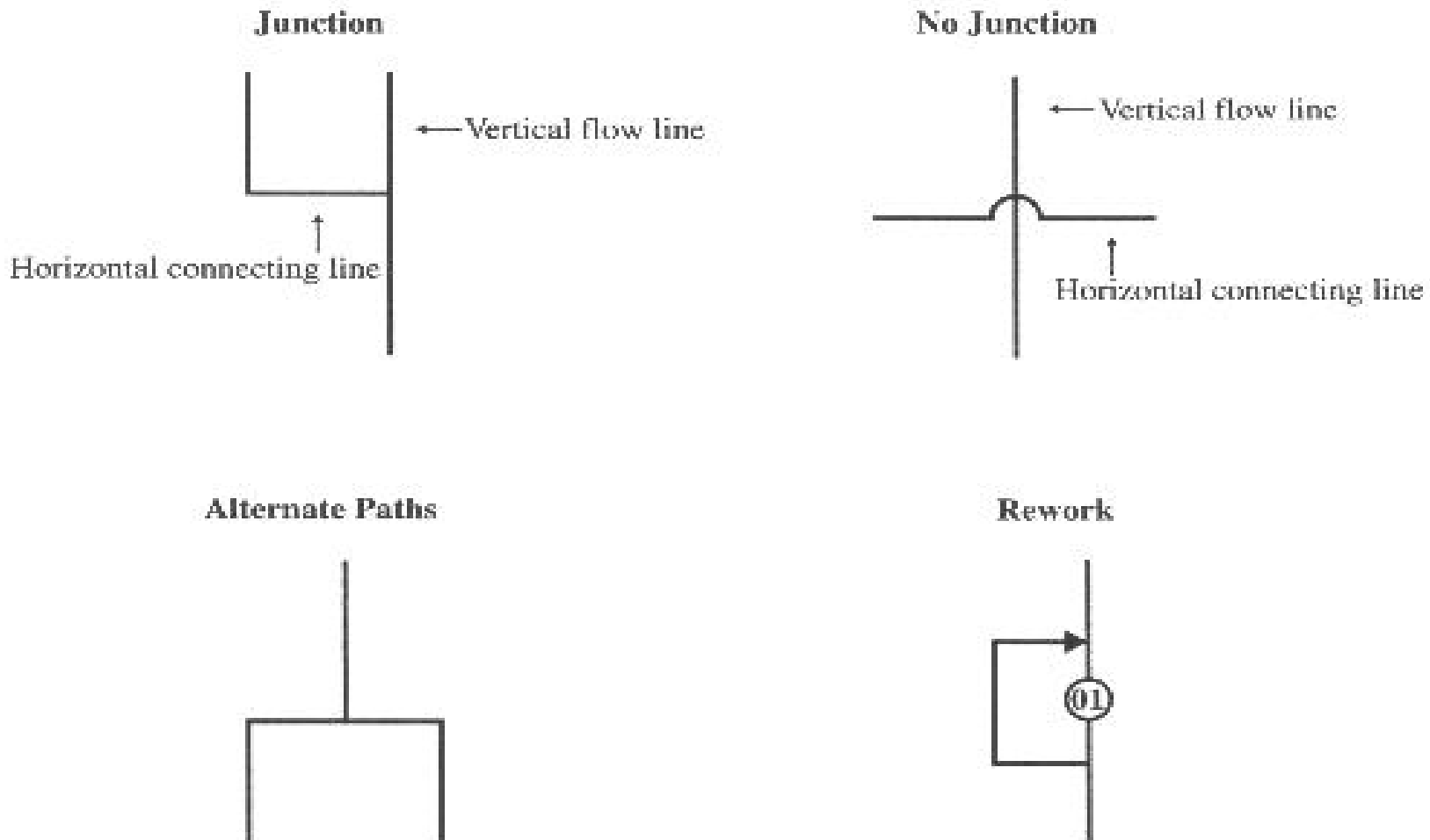
3 - Operation Process Charts

OPERATION PROCESS CHART

Part Name: Washer Assembly
Order No.: A 384/98
Drg. No.: AOC594 C

Date : Jan. 16, 2004
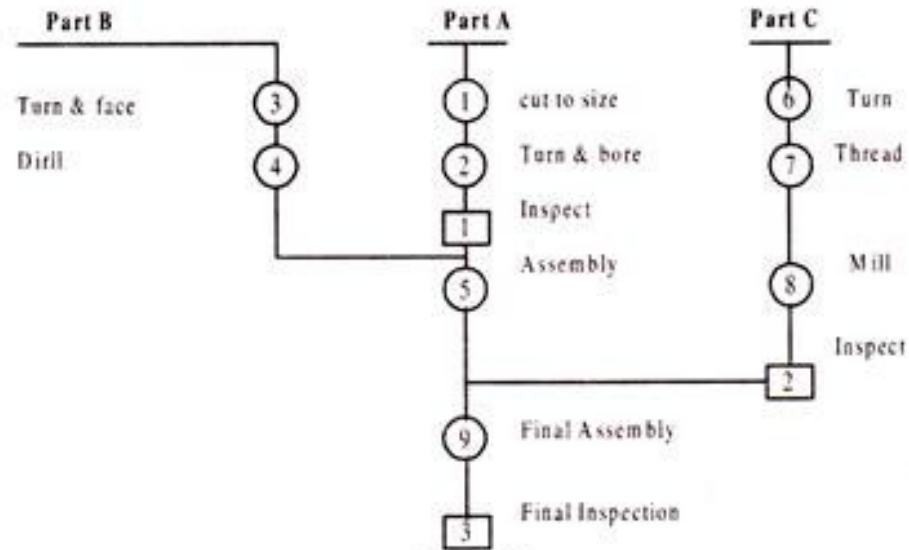
Part B		Part A		Part C	
Turn & face	③	①	cut to size	⑥	Turn
Drill	④	②	Turn & bore	⑦	Thread
		□1	Inspect		
		⑤	Assembly	⑧	Mill
				□2	Inspect
		⑨	Final Assembly		
		□3	Final Inspection		

Fig. 18.1

OPERATION PROCESS CHART

Manufacturing Type 2834421 Telephone Stands--Present Method
Part 2834421 Dwg. No. SK2834421
Charted By B.W.N. 4-12-

Legs (4 Req'd) Dwg. 2834421-3
2 1/2"x2 1/2"x16" White Maple

Sill (4 Req'd) Dwg. 2834421-2
1 1/2"x3"x12" Yellow Pine

Top Dwg. 2834421-1
1 1/2"x14"x14" White Maple

Legs
- .09 Min. (O-12) Saw to Rough Length
- .30 " (O-13) Joint Two Edges
- .32 " (O-14) Plane to Size
- .11 " (O-15) Saw to Finished Length
- D.W. (Ins. 3) Check Over-All Dimensions
- .28 Min. (O-16) Sand All Over

Sill
- .08 Min. (O-6) Saw to Rough Length
- .15 " (O-7) Joint One Edge
- .30 " (O-8) Plane to Size
- .10 " (O-9) Saw to Finished Length
- D.W. (Ins. 2) Check Over-All Dimensions
- .25 Min. (O-10) Sand All Over

Top
- .13 Min. (O-1) Saw to Rough Length
- .23 " (O-2) Joint Both Ends
- .32 " (O-3) Plane to Size
- .18 " (O-4) Saw to Finished Length
- D.W. (Ins. 1) Check Over-All Dimensions
- .50 Min. (O-5) Sand All Over

- 2.00 Min. (O-11) Assemble Four Sills to Top

8 Slotted Head 1 1/2" Wood Screws
Pt. 416412

- 3.25 Min. (O-17) Assemble Legs Complete
- D.W. (Ins. 4) Inspect Complete

Clear Shellac #173-111

- 1.15 Min. (O-18) Spray One Coat Clear Shellac
- .75 " (O-19) Sand Complete

Gun Lacquer #115-309

- 1.15 Min. (O-20) Spray One Coat Lacquer
- D.W. (Ins. 5) Inspect Finish

SUMMARY:

Event	Number	Time
Operations	20	17-58 minutes
Inspections	5	Day work

Work Charting Methods

4. Flow Process Charts

4 - Flow Process Charts

- Identify functions involved in making a **part** or completing a **process**:
    - **Operations**
    - **Inspections**
    - **Materials**
    - **Moves**
    - **Storages** and
    - **Delays**
- Show all events in the correct **sequence**
- Show the **relationship** between
    - **Parts** and
    - **Fabrication** complexity

4 - Flow Process Charts

- Used for
  - **Workers**
  - **Components**, or
  - **Sub-assemblies**
- Distinguish between
  - **Produced** and
  - **Purchased** parts.
- Provide **information** on
  - **Number of employees** utilized and
  - **Time*** required to perform each
    - **Operation** and
    - **Inspection**
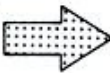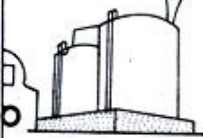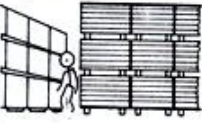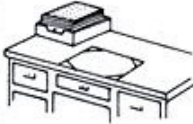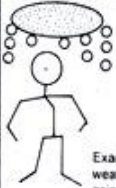
4 - Flow Process Charts

- **More details** than operations process charts
- Two types are commonly used:
  - **Product** (or **material**)
  - **Operative** (or **person**)
- Help identify **nonproduction** (hidden) **costs**:
  - **Distances** traveled
  - **Delays**, and
  - **Temporary storage**

The ASME standard set of process chart symbols

Process Chart Symbols

Sym	Name	Action		Examples
(green circle)	Operation	Adds Value	(microscope)	Saw, Cut, Paint, Solder, Package
(orange arrow)	Transport	Moves Some Distance	(hand truck)	Convey, Fork Truck, OTR Truck
(blue square)	Inspect	Check For Defects	(magnifying glass)	Visual Inspect, Dimension Inspect
(yellow D)	Delay	Temporary Delay/Hold	(STOP sign)	WIP Hold, Queue
(yellow triangle)	Storage	Formal Warehousing	(warehouse)	Warehouse or Tracked Storage Location
(orange oval)	Handle	Transfer Or Sort	(hands)	Re-Package, Transfer To Conveyor
(magenta diamond)	Decide	Make A Decision	(yellow X)	Approve/Deny Purchase

FIGURE 2–9

Nonstandard process chart symbols.

A record was created.

Information was added to a record.

A decision was made.

An inspection was performed in conjunction with an operation.

An operation and transportation took place simultaneously.
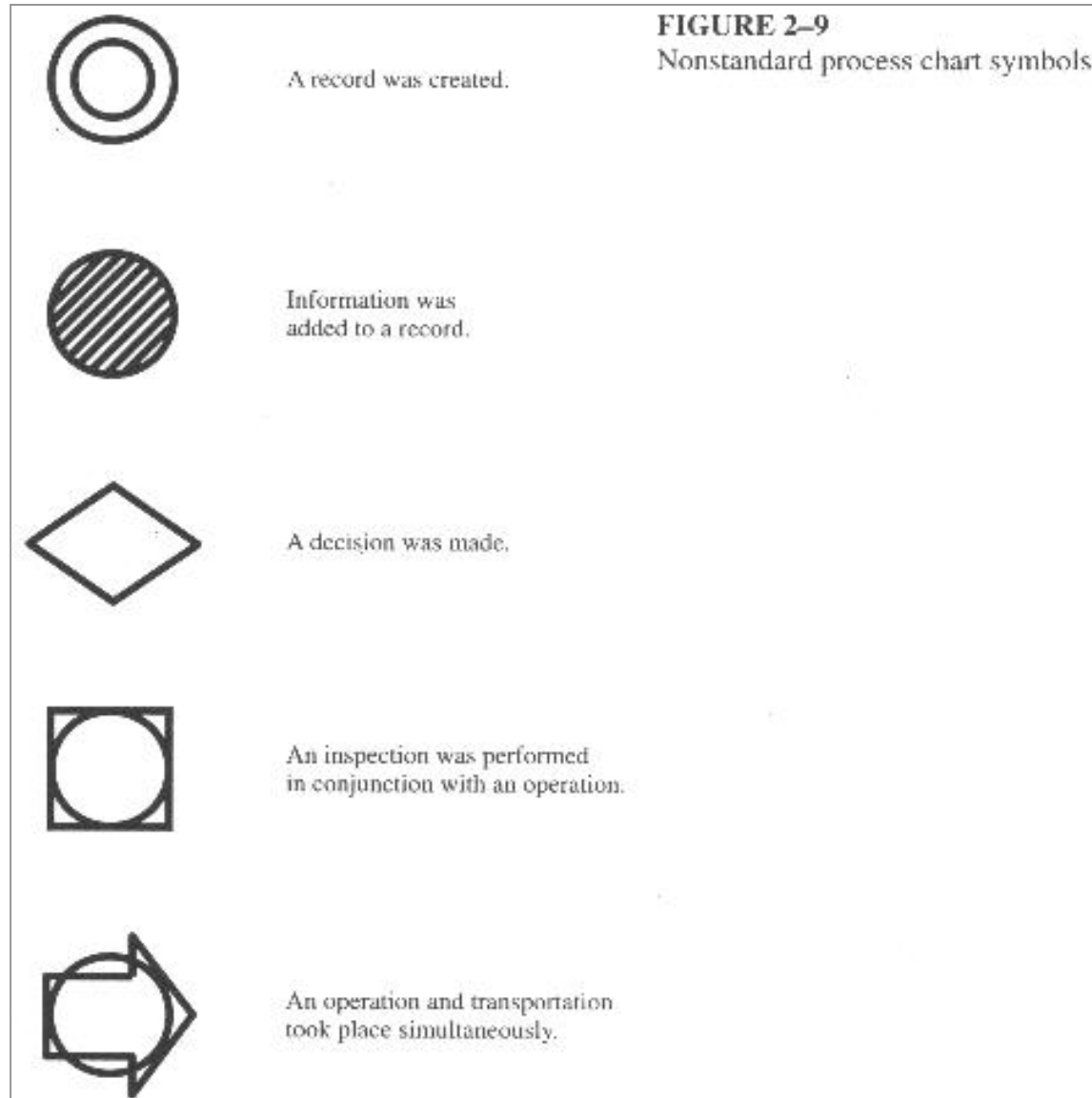
Flow Process Chart

Location: Dorben Ad Agency		Summary			
Activity: Preparing Direct Mail Ads		Event	Present	Proposed	Savings
Date: 1-26-98		Operation	4		
Operator:J.S. Analyst:A.F.		Transport	4		
Circle appropriate Method and Type:		Delay	4		
Method: (Present) Proposed		Inspection	0		
Type: Worker (Material) Machine		Storage	2		
Remarks:		Time (min)			
		Distance (ft)	340		
		Cost			

Event Description	Symbol	Time (In Minutes)	Distance (In Feet)	Method Recommendation
stock room	○ ◊ D □ ●			
to collating room	○ ● D □ ▽		100	
in collating rack by type	○ ◊ ● □ ▽			
collate 4 sheets	● ◊ D □ ▽			
in stack	○ ◊ ● □ ▽			
to folding room	○ ● D □ ▽		20	
in stack	○ ◊ ● □ ▽			
jog, fold, crease	● ◊ D □ ▽			
in stack	○ ◊ ● □ ▽			
to angle stapler	○ ● D □ ▽		20	
in stack	○ ◊ ● □ ▽			
staple	● ◊ D □ ▽			
in stack	○ ◊ ● □ ▽			
to mail room	○ ● D □ ▽		200	
in stack	○ ◊ ● □ ▽			
addressing	● ◊ D □ ▽			
in stack	○ ◊ ● □ ▽			
mailbag	○ ◊ D □ ●			
	○ ◊ D □ ▽			

Figure 2–11 | Flow process chart (material) for preparation of direct mail advertising

Flow Process Chart (Material) for Manufacture of Perforated Cup

Location : Fabrication Shop	Summary			
Activity : Manufacture of perforated cup	**Event**	**Present**	**Proposed**	**Savings**
Date: Dec. 15, 2005	Operation	9		
Operator : HSS Analyst : SK	Transport	8		
Method and Type:	Delay	10		
Method: (Present) Proposed	Inspection	1		
Type: *Worker* (Material) *Machine*	Storage	2		
Remarks:	Time (min)			
	Distance (m)	43.5		
	Cost			

Event Description	Symbol					Time (in Minutes)	Distance	Method Recommendation
In store	○	⇨	D	☐	▽			
To press #1	○	⇨	D	☐	▽		10 m	
Wait	○	⇨	D	☐	▽	2		
Blank	○	⇨	D	☐	▽	0.5		
Stack	○	⇨	D	☐	▽	3		
Blank To Press #2	○	⇨	D	☐	▽		1 m	
Wait	○	⇨	D	☐	▽	5		
Perforate	○	⇨	D	☐	▽	0.5		
Stack	○	⇨	D	☐	▽			
Blank to press #3	○	⇨	D	☐	▽	5	1 m	
Wait	○	⇨	D	☐	▽	5		
Draw	○	⇨	D	☐	▽	0.5		
Stack	○	⇨	D	☐	▽	1		
To trim machine	○	⇨	D	☐	▽			
Wait	○	⇨	D	☐	▽	1		
Trim	○	⇨	D	☐	▽	0.8		
Stack	○	⇨	D	☐	▽	20		
To buffing machine	○	⇨	D	☐	▽		**8** m	
Wait	○	⇨	D	☐	▽	2		
Buff	○	⇨	D	☐	▽	1		
To wash (on conveyer)	○	⇨	D	☐	▽		10 m	
Wash	○	⇨	D	☐	▽	0.9		
Dry and inspect	○	⇨	D	☐	▽	3		
To pack room	○	⇨	D	☐	▽		3 m	
Wait	○	⇨	D	☐	▽	30		
Place in card box	○	⇨	D	☐	▽	0.1		
Label	○	⇨	D	☐	▽	0.1		
To shelf	○	⇨	D	☐	▽		0.5 m	
At shelf	○	⇨	D	☐	▽			

FIGURE 2–11

Flow process chart (worker) for field inspection of LUX.

Flow Process Chart

Location: Dorben Co.

Activity: Field Inspection of LUX

Date: 4-17-97

Operator: T.Smith   Analyst: R. Ruhf

Circle appropriate Method and Type.

Method: (Present) Proposed

Type: (Worker) Material   Machine

Remarks:

Summary			
Event	Present	Proposed	Savings
Operation	7		
Transport	6		
Delay	2		
Inspection	6		
Storage	0		
Time (min)	32.60		
Distance (ft)	375		
Cost			

Event Description	Symbol					Time (in Minutes)	Distance (in Feet)	Method Recommendation
Leave vehicle, walk to front door, ring bell.	O	●	D	□	▽	1.00	75	Call home in advance to reduce waiting delays.
Wait, enter home.	O	●	D	□	▽			
Walk to field reservoir.	O	●	D	□	▽	.25	25	
Disconnect field reservoir from unit.	●	○	D	○	▽	.35		
Inspect for dents, cracks in shroud, cracked glass or missing hardware.	O	○	D	■	▽	1.25		This can be done while walking back to vehicle.
Clean unit with approved cleaner and disinfectant.	●	○	D	□	▽	2.25		This can be done more effectively at vehicle.
Return to vehicle with empty tank.	O	●	D	□	▽	1.00	75	
Unlock vehicle, place empty tank in fixture and connect hardware.	●	○	D	□	▽	1.75		
Open valve; begin fill.	●	○	D	□	▽	.25		
Wait for tank to fill.	O	○	■	□	▽	12.00		Clean unit while being filled.
Check humidifier for proper function.	O	○	D	■	▽	.5		Eliminate. No need to do this twice.
Check pressure (indicator).	O	○	D	■	▽	.2		
Check reservoir contents (indicator).	O	○	D	■	▽	.2		
Return to patient with filled tank.	O	●	D	□	▽	1.10	100	
Hook up filled tank.	●	○	D	□	▽	1.00		
Check humidifier for proper function.	O	○	D	■	▽	.75		
Wait for patient to remove nasal cannula or face mask.	O	○	■	□	▽	2.00		
Install new nasal cannula or face mask.	●	○	D	□	▽	2.50		
Check flows with patient.	O	○	D	■	▽	2.25		
Affix a dated, initialed inspection sticker.	●	○	D	□	▽	1.00		Perform this while unit being filled.
Return to vehicle.	O	●	D	□	▽	1.00	100	