Work Charting Methods

Objective

- Objectively document the work task or process for analysis
- Many methods are available
- New ones are invented regularly
- Break down the job into sub-components or tasks
- Describe the tasks in a meaningful way

Pareto Chart

- Items of interest are identified and measured on a common scale
- Then ordered in ascending order, creating a cumulative distribution

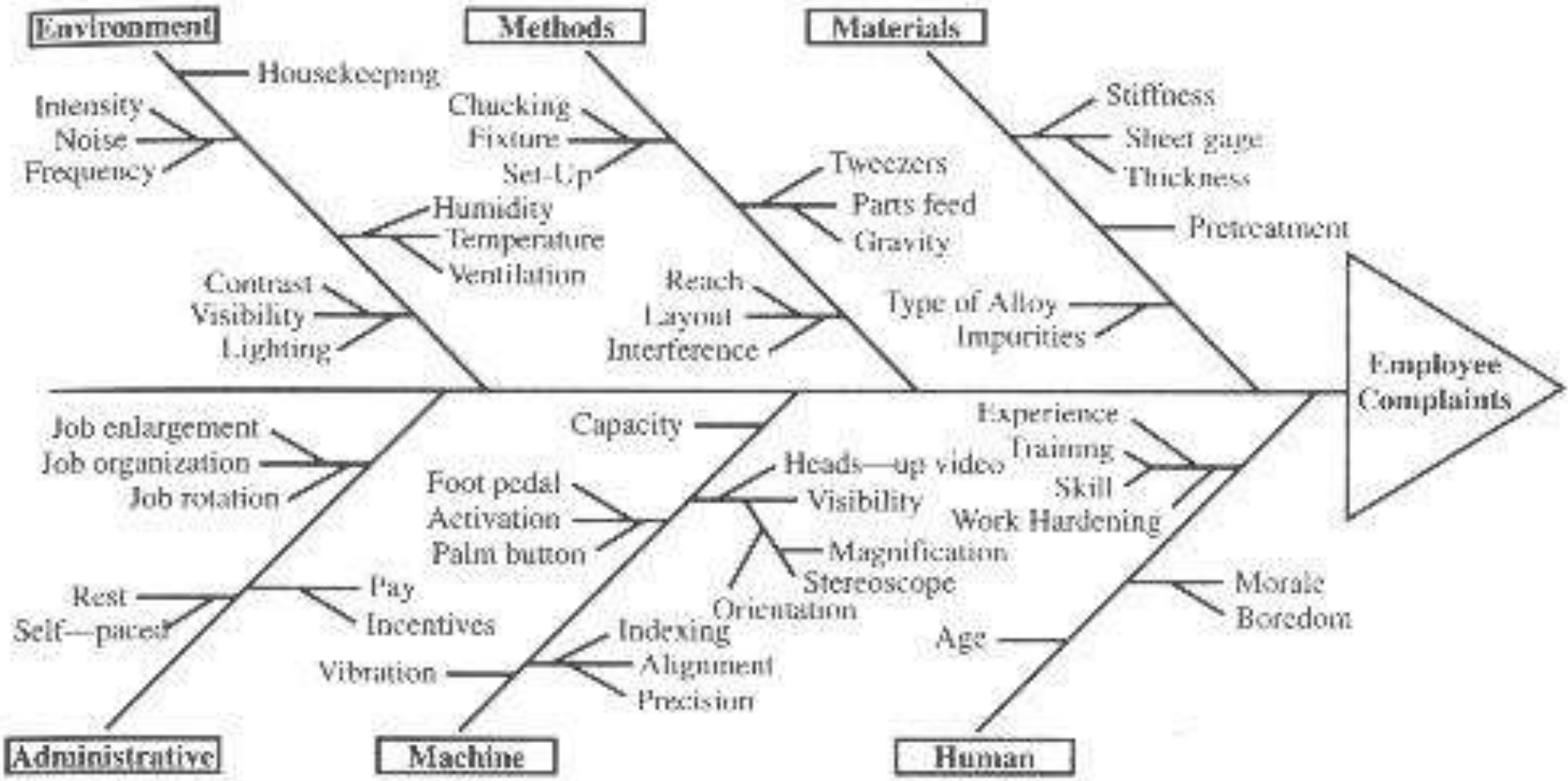
Pareto Chart

- Pareto principle: 80% of the total activity can be found in the first 20% of the items.
- Goal is to identify the appropriate 20% for analysis.
  - 80% of inventory is associated with 20% of the parts.
  - 80% of the injuries are associated with 20% of the jobs.

Fishbone Diagram (Cause-Effect)

- Identifies components lead to undesirable (desirable) event in a process
- Principle event is identified at the fish head
- Associated contributing factors are identified using a tree type structure.
- Closely related to many different charts used in safety analysis (Fault-Tree method)

FIGURE 2–2
Fish diagram for operator health complaints on cut-off operation.



Operations Process Charts

- Represents the chronological sequence of:
  - operations,
  - Inspections,
  - Time allowances, and
  - materials used in a process

- from the arrival of raw material to the packaging of the finished product.

Operations Process Charts

- Focuses on products and/or facilities
- Two symbols are used in the chart:
  - Operations are denoted using a small circle
  - Inspections are denoted using a small square

Operations Process Charts

- Vertical lines indicate general flow of the process as work is completed
- Horizontal lines feeding into vertical lines are for parts or subassemblies.
- Lines should not cross in the chart.
- Time values are assigned to operations and inspections on the chart.

FIGURE 2–6
Flowcharting conventions.

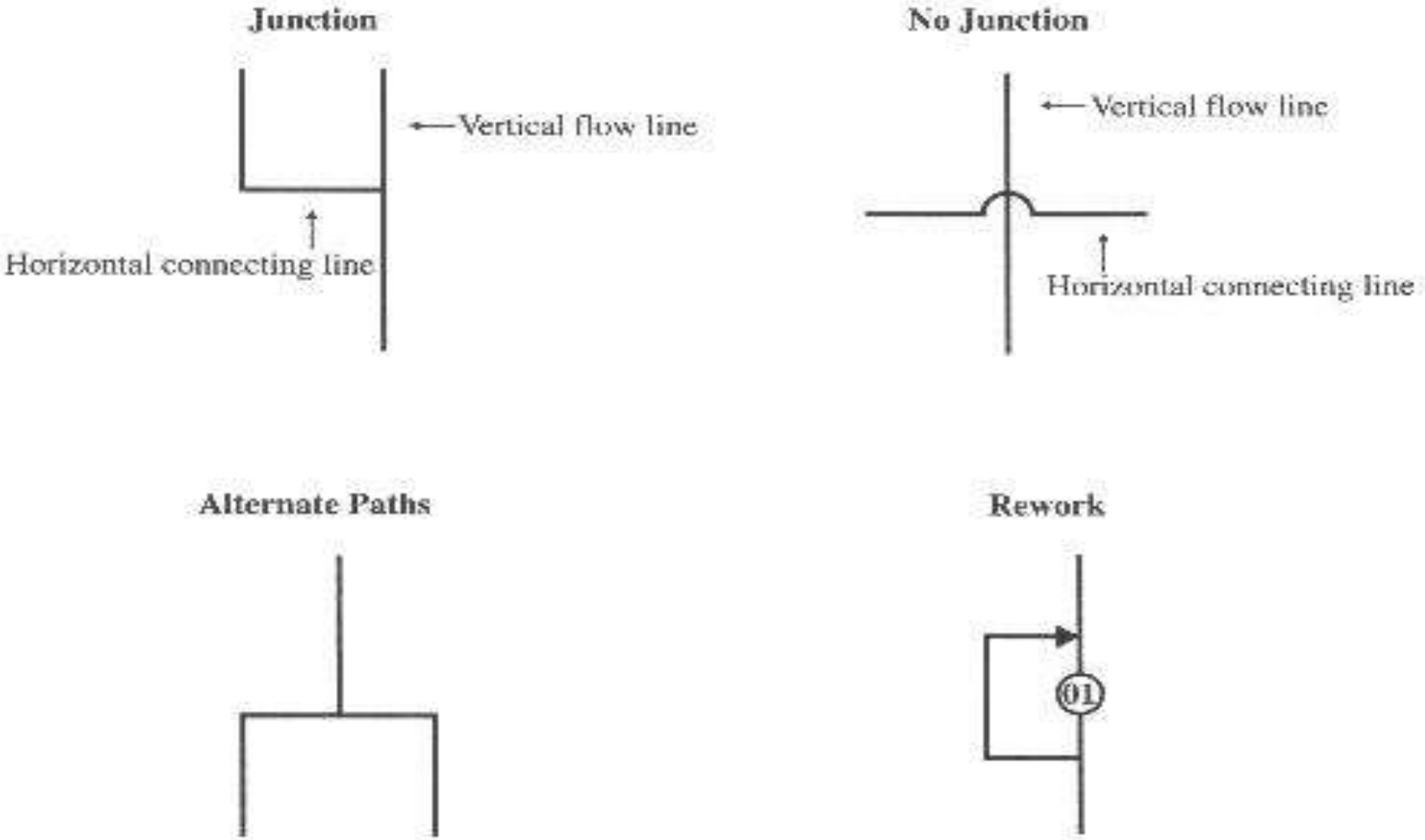
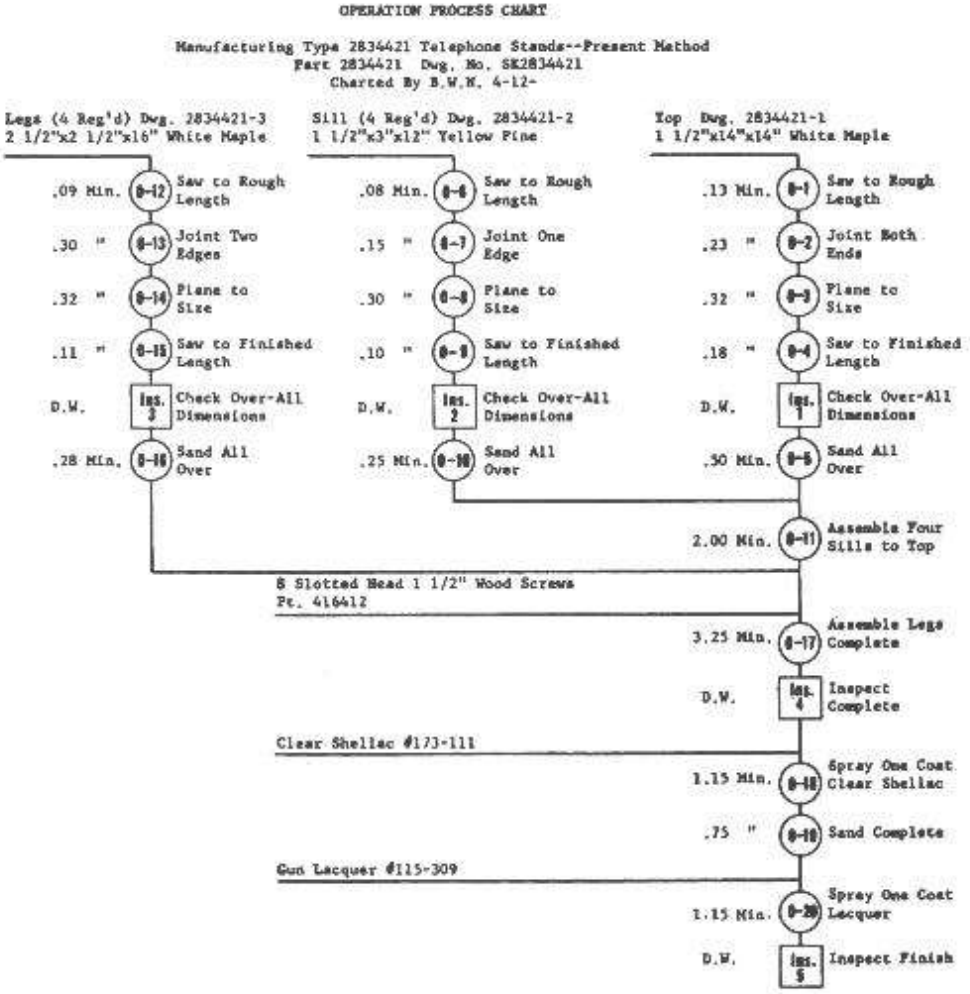


FIGURE 2–7
Operation process chart illustrating manufacture of telephone stands.



SUMMARY:

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

Flow Process Charts

- Identify operations, inspections, materials, moves, storages, and delays involved in making a part or completing a process.
- Show all events in the correct sequence.
- Show the relationship between parts and fabrication complexity.
- used for workers, components, or sub-assemblies.

Flow Process Charts

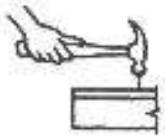
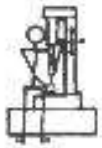
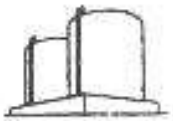
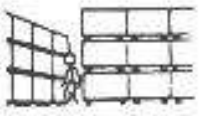
- Distinguish between produced and purchased parts.
- Provide information on the number of employees utilized and the time required to perform each operation and inspection.
- More details than operations process charts

Flow Process Charts

- Two types are commonly used:
  - Product or material
  - Operative or person

- Help identify nonproduction hidden costs such as distances traveled, delays, and temporary storage.

FIGURE 2–8
The ASME standard set of process chart symbols.

OPERATION A large circle indicates an operation, such as →	 Drive nail	 Mix	 Drill hole
TRANSPORTATION An arrow indicates a transportation, such as →	 Move material by truck	 Move material by conveyor	 Move material by carrying (messenger)
STORAGE A triangle indicates a storage, such as →	 Raw material in bulk storage	 Finished stock stacked on pallets	 Protective filing of documents
DELAY A large capital D indicates a delay, such as →	 Wait for elevator	 Material in truck or on floor at bench waiting to be processed	 Papers waiting to be filed
INSPECTION A square indicates an inspection such as →	 Examine material for quality or quantity	 Read steam gauge on boiler	 Examine printed form for information

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.

FIGURE 2–9
Nonstandard process chart symbols.

FIGURE 2–10
Flow process chart (material) for preparation of direct mail advertising.

Flow Process Chart Page 1 of 1

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	
collating rack by type	○ ○ D □ ▽			
collate 4 sheets	○ ○ D □ ▽			
stack	○ ○ D □ ▽			
to folding room	○ ○ D □ ▽		20	
jog, fold, crease	○ ○ D □ ▽			
stack	○ ○ D □ ▽			
to angle stapler	○ ○ D □ ▽		20	
staple	○ ○ D □ ▽			
stack	○ ○ D □ ▽			
to mail room	○ ○ D □ ▽		200	
addressing	○ ○ D □ ▽			
mailbag	○ ○ D □ ▽			
	○ ○ D □ ▽			
	○ ○ D □ ▽			
	○ ○ D □ ▽			
	○ ○ D □ ▽			
	○ ○ D □ ▽			

FIGURE 2–11
Flow process chart (worker) for field inspection of LUX.

Flow Process Chart Page 1 of 1

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.	○ ⇨ D □ ▽	1.00	75	Call home in advance to reduce waiting delays.
Wait, enter home.	○ ⇨ D □ ▽			
Walk to field reservoir.	○ ⇨ D □ ▽	.25	25	
Disconnect field reservoir from unit.	○ ⇨ D □ ▽	.35		
Inspect for dents, cracks in shroud, cracked glass or missing hardware.	○ ⇨ 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.	○ ⇨ 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.	○ ⇨ D □ ▽	12.00		Clean unit while being filled.
Check humidifier for proper function.	○ ⇨ D □ ▽	.5		Eliminate. No need to do this twice.
Check pressure (indicator).	○ ⇨ D □ ▽	.2		
Check reservoir contents (indicator).	○ ⇨ D □ ▽	.2		
Return to patient with filled tank.	○ ⇨ D □ ▽	1.10	100	
Hook up filled tank.	○ ⇨ D □ ▽	1.00		
Check humidifier for proper function.	○ ⇨ D □ ▽	.75		
Wait for patient to remove nasal cannula or face mask.	○ ⇨ D □ ▽	2.00		
Install new nasal cannula or face mask.	○ ⇨ D □ ▽	2.50		
Check flows with patient.	○ ⇨ D □ ▽	2.25		
Affix a dated, initialed inspection sticker.	○ ⇨ D □ ▽	1.00		Perform this while unit being filled.
Return to vehicle.	○ ⇨ D □ ▽	1.00	100	

Flow Diagrams

- Supplement to Flow process charts to indicate process flow
- Overhead pictorial plan of the facility.

FIGURE 2–13

Flow diagram of the revised layout of a group of operations on the Garand rifle.

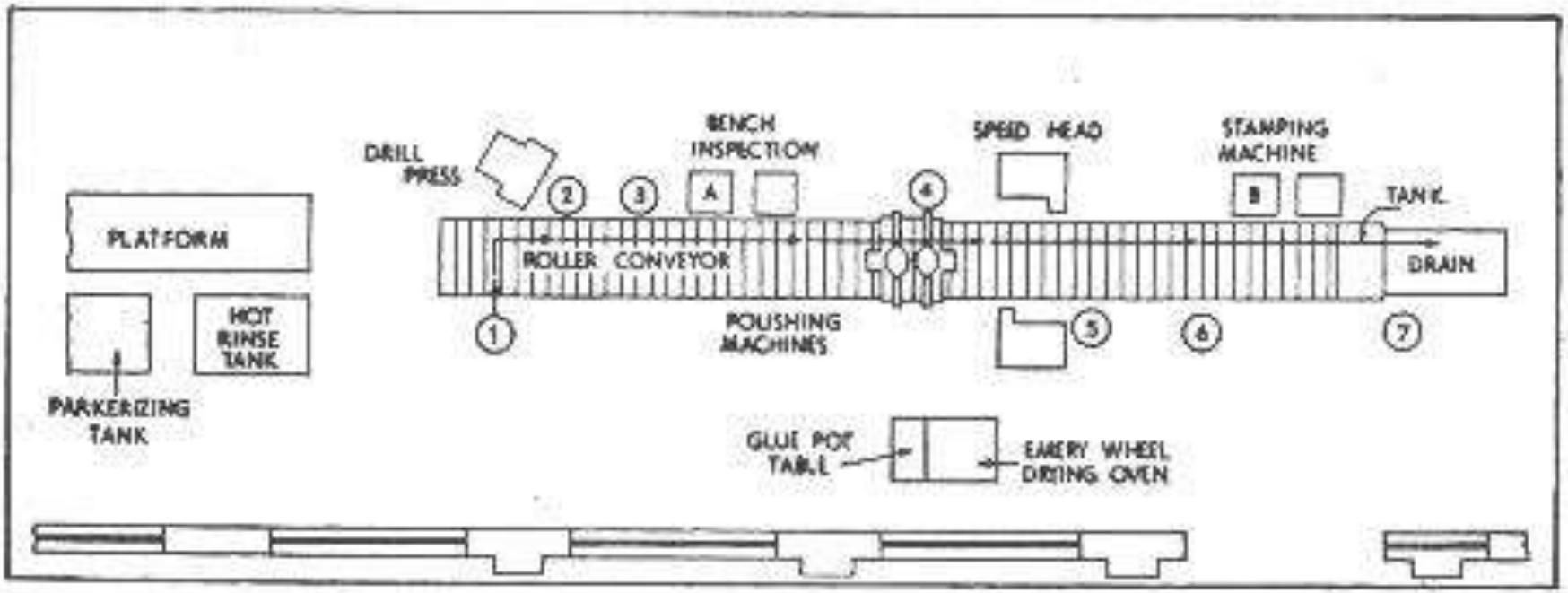
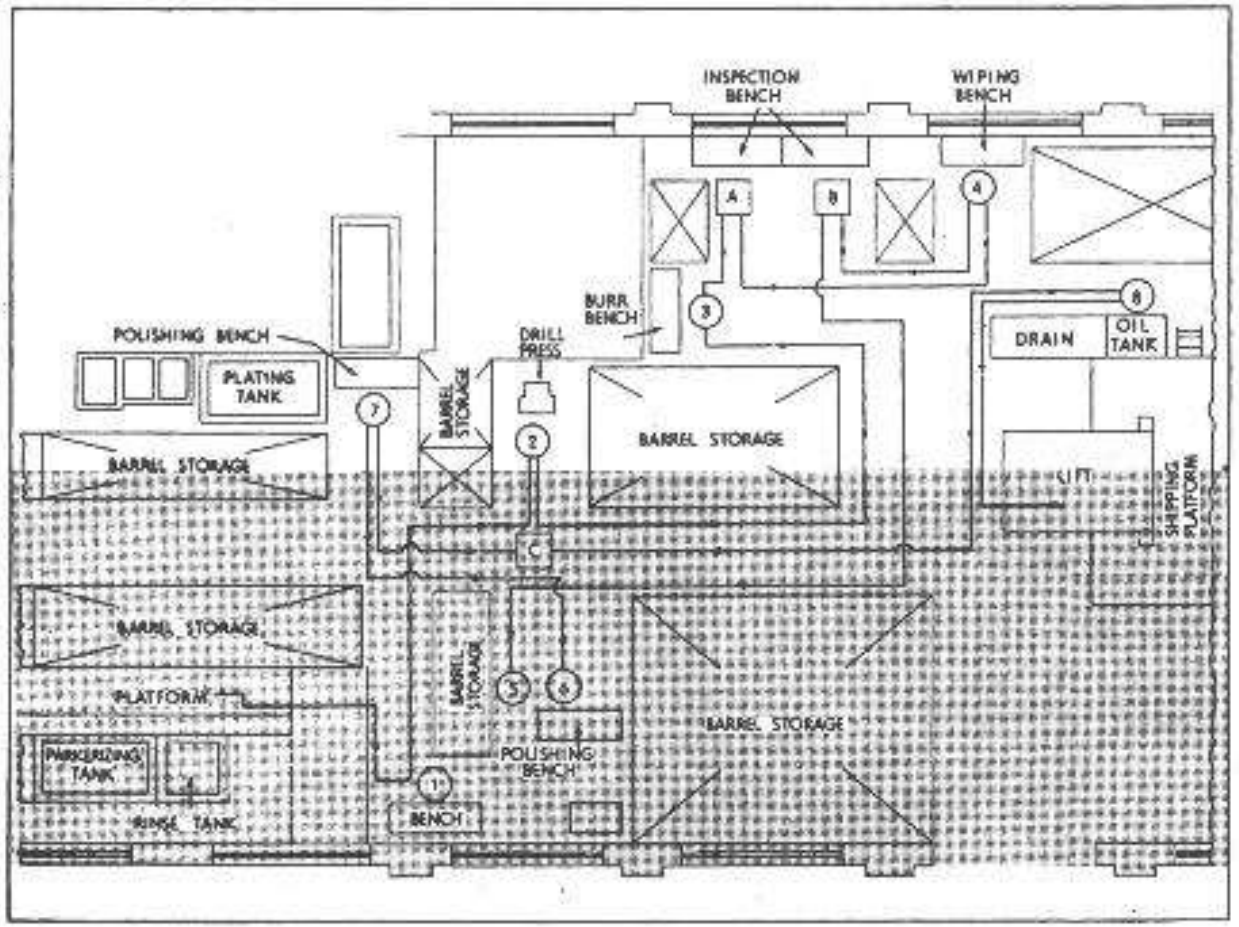


FIGURE 2–12

Flow diagram of the old layout of a group of operations on the Garand rifle. *(Shaded section of plant represents the total floor space needed for the revised layout [Figure 2–13]. This represented a 40 percent savings in floor space.)*



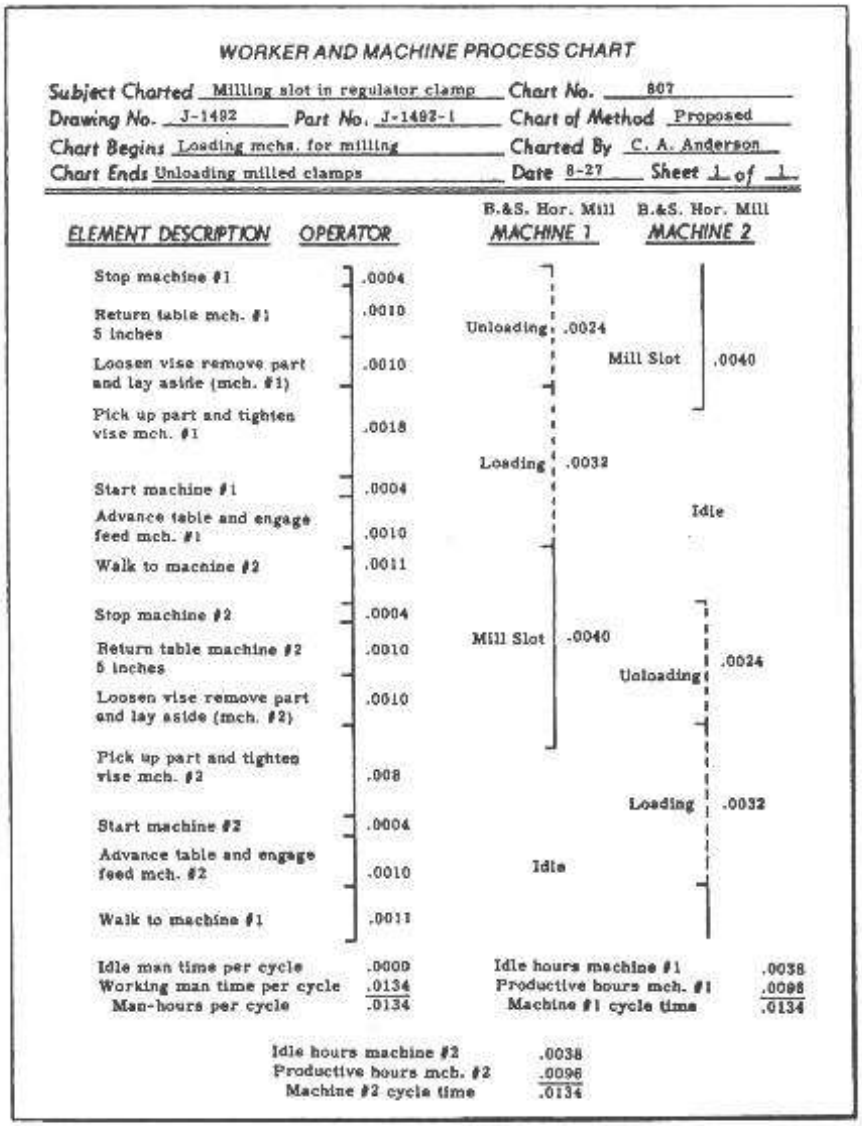
Worker and Machine Process Charts

- Show time relationship between the working cycle of a person and the operating cycle of a machine(s) at a single workstation.
- Machine times and operator times must be known for each element
- Chart drawn vertically to scale.

Worker and Machine Process Charts

- Solid lines represent productive time,
- Breaks indicate idle time,
- Dotted lines represent non-productive time.

FIGURE 2–14
Worker and machine process chart for milling machine operation.



WORKER AND MACHINE PROCESS CHART

Subject Charted: Milling slot in regulator clamp — Chart No.: 807
Drawing No.: J-1492 — Part No.: J-1492-1 — Chart of Method: Proposed
Chart Begins: Loading mchs. for milling — Charted By: C. A. Anderson
Chart Ends: Unloading milled clamps — Date: 8-27 — Sheet 1 of 1

ELEMENT DESCRIPTION	OPERATOR	B.&S. Hor. Mill MACHINE 1	B.&S. Hor. Mill MACHINE 2
Stop machine #1	.0004		
Return table mch. #1 5 inches	.0010	Unloading .0024	
Loosen vise remove part and lay aside (mch. #1)	.0010		Mill Slot .0040
Pick up part and tighten vise mch. #1	.0018		
		Loading .0032	
Start machine #1	.0004		
Advance table and engage feed mch. #1	.0010		Idle
Walk to machine #2	.0011		
Stop machine #2	.0004		
Return table machine #2 5 inches	.0010	Mill Slot .0040	
Loosen vise remove part and lay aside (mch. #2)	.0010		Unloading .0024
Pick up part and tighten vise mch. #2	.008		
			Loading .0032
Start machine #2	.0004		
Advance table and engage feed mch. #2	.0010	Idle	
Walk to machine #1	.0011		
Idle man time per cycle	.0000	Idle hours machine #1	.0038
Working man time per cycle	.0134	Productive hours mch. #1	.0096
Man-hours per cycle	.0134	Machine #1 cycle time	.0134

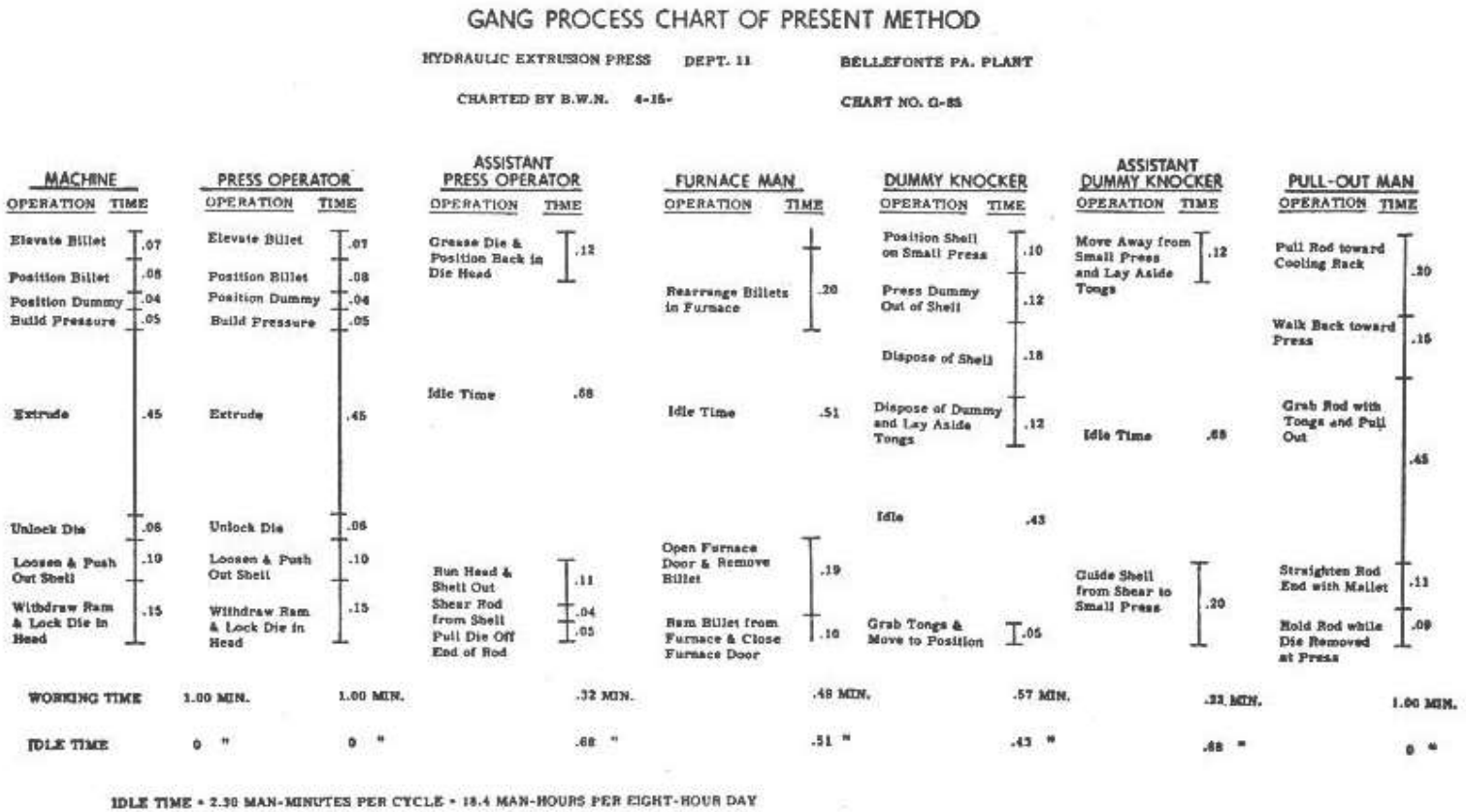
Idle hours machine #2	.0038
Productive hours mch. #2	.0096
Machine #2 cycle time	.0134

Gang Process Charts

- Worker and Machine Process charts showing many workers are called Gang Process Charts.

Gang Process Charts

FIGURE 2–15
Gang process chart of the present method of operation of a hydraulic extrusion process.



GANG PROCESS CHART OF PRESENT METHOD

HYDRAULIC EXTRUSION PRESS DEPT. 11 BELLEFONTE PA. PLANT

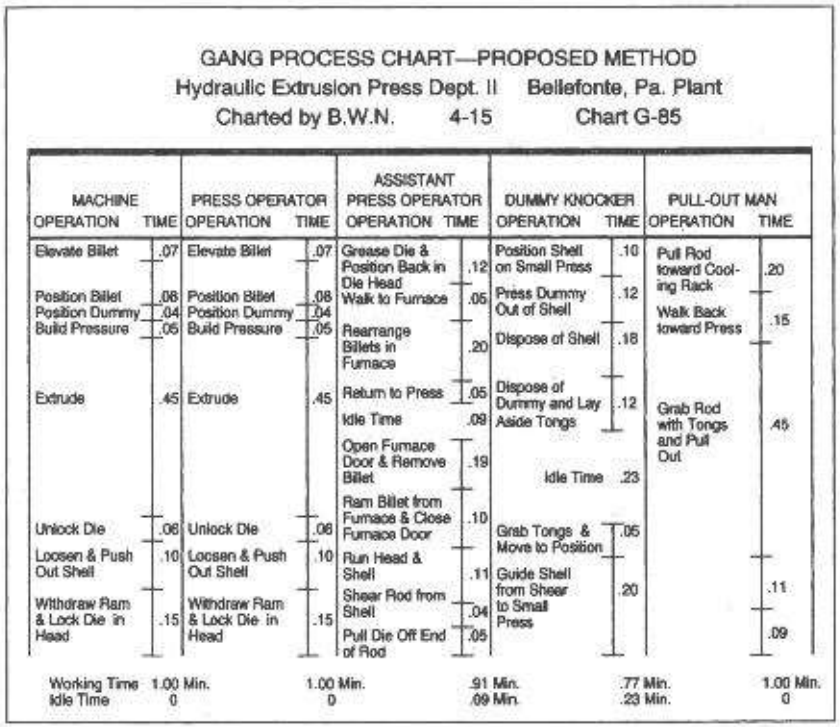
CHARTED BY B.W.N. 4-15- CHART NO. G-85

MACHINE		PRESS OPERATOR		ASSISTANT PRESS OPERATOR		FURNACE MAN		DUMMY KNOCKER		ASSISTANT DUMMY KNOCKER		PULL-OUT MAN	
OPERATION	TIME	OPERATION	TIME	OPERATION	TIME	OPERATION	TIME	OPERATION	TIME	OPERATION	TIME	OPERATION	TIME
Elevate Billet	.07	Elevate Billet	.07	Grease Die & Position Back in Die Head	.12	Rearrange Billets in Furnace	.20	Position Shell on Small Press	.10	Move Away from Small Press and Lay Aside Tongs	.12	Pull Rod toward Cooling Rack	.20
Position Billet	.08	Position Billet	.08					Press Dummy Out of Shell	.12			Walk Back toward Press	.15
Position Dummy	.04	Position Dummy	.04					Dispose of Shell	.18				
Build Pressure	.05	Build Pressure	.05	Idle Time	.68	Idle Time	.51	Dispose of Dummy and Lay Aside Tongs	.12	Idle Time	.68	Grab Rod with Tongs and Pull Out	.45
Extrude	.45	Extrude	.45					Idle	.43				
Unlock Die	.06	Unlock Die	.06			Open Furnace Door & Remove Billet	.19			Guide Shell from Shear to Small Press	.20	Straighten Rod End with Mallet	.11
Loosen & Push Out Shell	.10	Loosen & Push Out Shell	.10	Run Head & Shell Out Shear Rod from Shell Pull Die Off End of Rod	.11 / .04 / .05	Ram Billet from Furnace & Close Furnace Door	.10	Grab Tongs & Move to Position	.05			Hold Rod while Die Removed at Press	.09
Withdraw Ram & Lock Die in Head	.15	Withdraw Ram & Lock Die in Head	.15										
WORKING TIME	1.00 MIN.		1.00 MIN.		.32 MIN.		.48 MIN.		.57 MIN.		.32 MIN.		1.00 MIN.
IDLE TIME	0 "		0 "		.68 "		.51 "		.43 "		.68 "		0 "

IDLE TIME = 2.30 MAN-MINUTES PER CYCLE = 18.4 MAN-HOURS PER EIGHT-HOUR DAY

Gang Process Charts

FIGURE 2–16
Gang process chart of the proposed method of operation of a hydraulic extrusion process.



GANG PROCESS CHART—PROPOSED METHOD
Hydraulic Extrusion Press Dept. II Bellefonte, Pa. Plant
Charted by B.W.N. 4-15 Chart G-85

MACHINE OPERATION	TIME	PRESS OPERATOR OPERATION	TIME	ASSISTANT PRESS OPERATOR OPERATION	TIME	DUMMY KNOCKER OPERATION	TIME	PULL-OUT MAN OPERATION	TIME
Elevate Billet	.07	Elevate Billet	.07	Grease Die & Position Back in Die Head	.12	Position Shell on Small Press	.10	Pull Rod toward Cooling Rack	.20
Position Billet	.08	Position Billet	.08	Walk to Furnace	.05	Press Dummy Out of Shell	.12	Walk Back toward Press	.15
Position Dummy	.04	Position Dummy	.04			Dispose of Shell	.18		
Build Pressure	.05	Build Pressure	.05	Rearrange Billets in Furnace	.20				
Extrude	.45	Extrude	.45	Return to Press	.05	Dispose of Dummy and Lay Aside Tongs	.12	Grab Rod with Tongs and Pull Out	.45
				Idle Time	.09				
				Open Furnace Door & Remove Billet	.19	Idle Time	.23		
				Ram Billet from Furnace & Close Furnace Door	.10				
Unlock Die	.06	Unlock Die	.06			Grab Tongs & Move to Position	.05		
Loosen & Push Out Shell	.10	Loosen & Push Out Shell	.10	Run Head & Shell	.11	Guide Shell from Shear to Small Press	.20		.11
Withdraw Ram & Lock Die in Head	.15	Withdraw Ram & Lock Die in Head	.15	Shear Rod from Shell	.04				
				Pull Die Off End of Rod	.05				.09
Working Time	1.00 Min.		1.00 Min.		.91 Min.		.77 Min.		1.00 Min.
Idle Time	0		0		.09 Min.		.23 Min.		0

Two-Handed Process Chart

- Left-hand / right-hand chart
- Operator process chart.
- Is a flow process chart directed at an operator
- Each hand is documented separately.
- Useful when doing work methods analysis.

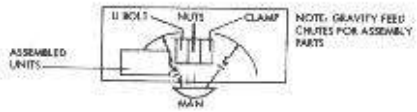
FIGURE 4–17
Two-hand process chart for assembly of cable clamps

Two-Hand Process Chart

Page 1 of 1

Operation: Assemble Cable Clamps	Part: SK-112	Summary	Left Hand / Right Hand
Operator Name and No : J.B. #1157		Effective Time:	2.7 / 11.6
Analyst: G. Thuering	Date: 6-11-98	Ineffective Time:	11.6 / 2.7
Method (circle choice): (Present) Proposed		Cycle Time =	14.30 sec.

Sketch:



Left Hand Description	Sym-bol	Time	Time	Sym-bol	Right Hand Description
Get U-Bolt (10")	REG	1.00	1.00	REG	Get Cable Clamp (10")
Place U-Bolt (10")	MP	1.20	1.20	MP RL	Place Cable Clamp (10")
			1.00	REG	Get First Nut (9")
			1.20	MP	Place First Nut (9")
			3.40	U RL	Run Down First Nut
Hold U-Bolt	H	11.00			
			1.00	REG	Get Second Nut (9")
			1.20	MP	Place Second Nut (9")
			3.40	U RL	Run Down Second Nut
Dispose of Assembly	M RL	1.10	0.90	UD	Wait